Aristoteles

THE
WORKS OF ARISTOTLE

TRANSLATED INTO ENGLISH
UNDER THE EDITORSHIP

OF

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By R. P. HARDIE and R. K. GAYE

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By J. L. STOCKS

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PHYSICA

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PREFACE

The translation of the first two books of the *Physics* for this series was originally entrusted to Mr. C. D. Robertson, Fellow of Trinity College, Cambridge, and he had, before his untimely death, prepared a draft translation of these books, which was placed at the disposal of Mr. Hardie and freely used by him. The present translation of the first four books is, however, in the main by Mr. Hardie himself. He has received valuable help from Professors Joachim and J. A. Smith, and from Dr. J. C. Smith and Mr. Henry Barker. The last four books were translated by Mr. Gaye, who also died before his time, regretted by all students of Greek philosophy. Where the word 'I' occurs in notes on these books, the writer is Mr. Gaye. To me has fallen the task of securing comparative uniformity—I have not tried to produce complete uniformity—between the two halves of the translation. In this I have been much helped by Mr. George Brown, M.A., Lecturer in Logic in the University of Glasgow, who has kindly read the proofs throughout. At the same time I have on the basis of a study of the reported manuscript readings and of the Greek commentators adopted a good many changes of reading in the Greek text and altered the translation to suit them. All divergences from Bekker's text are mentioned in the notes.

Many of the technical terms in the *Physics* present considerable difficulties to the translator. The most difficult, perhaps, is κίνησις. κίνησις would often be most aptly rendered by 'change'; but often again it is distinguished from μεταβολή, and therefore narrower than 'change'. As the lesser of two evils, I have adopted the translation 'motion' or 'movement', and have very rarely departed from this; this rendering should be recognized as being to some extent conventional. The frequent combination of *φορά* with *φέρεσθαι* suggested to Mr. Hardie the translation of *φορά* by 'carry', but the associations of the noun 'carry' are rather too special for this purpose, and I have, with his forgiveness, adopted the more commonplace 'locomotion'.

W. D. ROSS.

10 *January* 1930.

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PHYSICA[1]

BOOK I

1 WHEN the objects of an inquiry, in any department, have principles, conditions, or elements,[2] it is through acquaintance with these that knowledge, that is to say scientific knowledge, is attained. For we do not think that we know a thing until we are acquainted with its primary conditions or first principles, and have carried our analysis as far as its simplest elements.[3] Plainly therefore in the science of Nature, as in other branches of study, our first task will be to try to determine what relates to its principles.[4] 184a

The natural way of doing this is to start from the things which are more knowable and obvious to us and proceed towards those which are clearer and more knowable by nature[5]; for the same things are not 'knowable relatively to

[1] The present treatise, usually called the *Physics*, deals with natural body in general: the special kinds are discussed in Aristotle's other physical works, the *De Caelo*, &c. The first book is concerned with the elements of a natural body (matter and form): the second mainly with the different types of cause studied by the physicist. Books III–VII deal with movement, and the notions implied in it. The subject of VIII is the prime mover, which, though not itself a natural body, is the cause of movement in natural bodies.

The title *φυσικὴ ἀκρόασις* (= Lectures on Physics) is as old at least as Simplicius (A.D. 530). When Aristotle uses the phrase *ἐν τοῖς φυσικοῖς* he is usually referring to the first two books of the *Physics*, but sometimes to the later books, and sometimes even to the other physical treatises. He repeatedly refers to the later books of the *Physics* as *τὰ περὶ κινήσεως*.

[2] It seems best to take (with Zabarella) the words *ὧν εἰσὶν ἀρχαὶ ἢ αἴτια ἢ στοιχεῖα* as limitative. Throughout Book I Aristotle uses the words *ἀρχή*, *αἴτιον*, and *στοιχεῖον* indiscriminately to mean the *internal* principles or factors of a natural body.

[3] Pacius takes *τὰ αἴτια τὰ πρῶτα καὶ τὰς ἀρχὰς τὰς πρώτας* to be proximate causes, as distinct from *τὰ στοιχεῖα* which are remote. But the distinction seems unnecessary: when Aristotle draws the conclusion of his syllogism, he mentions simply *ἀρχαί*.

[4] It is not clear whether this reference is to the first two books as distinct from the rest or to the *Physics* as a whole (*τὰ καθόλου περὶ φύσεως*, viii. 257a 34), as distinct from the other physical treatises.

[5] Cf. below 189a 4 where the phrase *γνωριμώτερον κατὰ τὸν λόγον* ('more knowable in the order of explanation') is used. Another

us' and 'knowable' without qualification. So in the present inquiry 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.

Now what is to us plain and obvious at first is rather confused masses, the elements and principles of which become known to us later by analysis. Thus we must advance from generalities to particulars; for it is a whole that is best known to sense-perception, and a generality is a kind of whole, comprehending many things within it,
184b like[1] parts. Much the same thing happens in the relation of the name to the formula. A name, e.g. 'round', means vaguely a sort of whole: its definition analyses this into its particular senses. Similarly a child begins by calling all men 'father', and all women 'mother', but later on distinguishes each of them.

The principles in question must be either (*a*) one or 2
(*b*) more than one.

If (*a*) one, it must be either (i) motionless, as Parmenides and Melissus assert, or (ii) in motion, as the physicists hold, some declaring air to be the first principle, others water.

If (*b*) more than one, then either (i) a finite or (ii) an infinite plurality. If (i) finite (but more than one), then either two or three or four or some other number. If (ii) infinite, then either as Democritus believed one in kind, but differing in shape or form; or different in kind and even contrary.[2]

A similar inquiry is made by those who inquire into the number of *existents*: for they inquire whether the ultimate constituents of existing things[3] are one or many, and if many,

equivalent phrase is *πρότερον τῇ φύσει*. The knowledge with which an inquiry starts is always the *causa cognoscendi* of the conclusion: it may, or may not, be knowledge of the *causa essendi*.

[1] Reading in l. 26 *ὥσπερ μέρη*, with E.

[2] 184b 21. Both Anaxagoras and the Pythagoreans recognized contraries as principles, but it is chiefly the former who is referred to here. Contraries are 'the most different of the things in the same genus' (*Met.* Δ. 1018a 27). Thus while the atoms of Democritus were the same in kind, the principles of Anaxagoras not only differed in kind, but were even contrary to each other.

[3] Reading in l. 23 *ἐστὶ πρώτων ζητοῦσι* with Bonitz.

whether a finite or an infinite plurality. So they too are inquiring whether the principle or element is one or many.[1]

Now to investigate whether Being is one and motionless is not a contribution to the science of Nature. For just as 185a
the geometer has nothing more to say to one who denies the principles of his science—this being a question for a different science[2] or for one common to all—so a man investigating *principles* cannot argue with one who denies their existence. For if Being 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.

To inquire therefore whether Being 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 Being 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 palpable and offers no difficulty at all: accept one ridiculous proposition and the rest follows—a simple enough proceeding.

We physicists, 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.[3] Moreover, no man of science 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.[4] At the same

[1] Perhaps Aristotle is thinking of Plato's account in the *Sophist* (242–6) of preceding views about the number and nature of τὰ ὄντα (a term which includes more objects than those of physics).

[2] Another special science, if there is one, to which geometry is subordinate, as optics (e.g.) is to geometry.

[3] ἐπαγωγή, the process by which a man is led on from the apprehension of particular or partial forms of a universal to the apprehension of the universal in its complete and purified form.

[4] The former method was suggested by Hippocrates of Chios, and

time the holders of the theory of which we are speaking do incidentally raise physical questions, though Nature 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.

The most pertinent question with which to begin will be this[1]: In what sense is it asserted that all things *are* one? For 'is' is used in many senses. 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.

For if *both* substance and quantity and quality are, then, whether these exist independently of each other or not, Being will be many.

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: substance alone is independent: for everything is predicated of substance as subject.[2] Now Melissus says that Being 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 through

rested on the rather obvious *geometrical* fallacy of supposing that if a particular kind of lunule can be squared, another kind can be squared also. Antiphon's method was that of exhaustion. He drew a square in the circle, and then isosceles triangles on its sides, and so on, and inferred that ultimately the inscribed polygon was equal in area to the circle. This involves a denial of the geometrical *principle* that every geometrical magnitude can be divided *ad infinitum*, and gives only an approximate result. See Heath, *Greek Mathematics*, i. 183–200, 221–3, and Diels, *Vorsokratiker*[3], i. 298 f, ii. 294 f.

[1] omitting ἰδεῖν in l. 22 with FI Simp.

[2] Aristotle is assuming the doctrine of the *Categories* which distinguishes the different types of predication, i. e. the different senses in which 'is' is used. Only things which *are* in the full sense, i. e. substances (οὐσίαι), have independent existence: other things are attributes (συμβεβηκότα) of them, and exist only when they are predicated of a subject (ὑποκείμενον) which is a substance. Thus it is self-contradictory to speak of an attribute which exists unsupported by a substance.

a concomitant attribute,[1] 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.[2] If then Being 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.[3] 185b

Again, 'one' itself, no less than 'being', is used in many senses, so we must consider in what sense the word is used when it is said that the All is one.

Now we say that (*a*) the continuous is one or that (*b*) the indivisible is one, or (*c*) things are said to be 'one', when their essence is one and the same, as 'liquor' and 'drink'.

If (*a*) their One is one in the sense of continuous, it is many, for the continuous is divisible *ad infinitum*.

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 how they can be one or many, and, if they are more than one, in what sense they are more than one.[4] (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.

But to proceed: If (*b*) their One is one as indivisible,

[1] κατὰ συμβεβηκός, of which the Latin equivalent was *per accidens*. It is usually opposed to καθ' αὑτό (*per se*) or ᾗ αὐτό (*quatenus ipsum*). Thus a triangle, through its own nature (καθ' αὑτό), or as such (ᾗ αὐτό), has its angles equal to two right angles. On the other hand, the white (object) is six feet high, not in virtue of its whiteness (καθ' αὑτό), but through an attribute which is not necessarily involved in whiteness (κατὰ συμβεβηκός). (In *Posterior Analytics*, i. 4, Aristotle draws a distinction between καθ' αὑτό and ᾗ αὐτό which may here be neglected.)

[2] See below, iii. 207a 7.

[3] The point of the paragraph is that Melissus at least is obviously committed to a dualism, since he emphasizes the infinity of the one being.

[4] Aristotle seems to have in view a possible objection to the statement that the continuous is many. It might be said that the continuous is many only potentially, not actually.

nothing will have quantity or quality,[1] and so the one will not be infinite, as Melissus says—nor, indeed, limited, as Parmenides says, for though the limit is indivisible, the limited is not.[2]

But if (*c*) 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 size'.

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,[3] 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 'being' were always used in one and the same sense. What 'is' may be many either in definition (for example 'to be white' is one thing, 'to be musical' another, yet the same thing[4] may be both, so the one is many) or by division, as the whole and its parts.
186a 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 'one' may mean either 'potentially one' or 'actually one'.[5]

[1] Indivisible unity is inconsistent with any type of predication, which always involves a subject and a predicate, and in particular with the predication of quantity.

[2] e.g. a point which terminates a line is indivisible, though the line is not.

[3] An orator and a pupil of Gorgias. For what is known of him see Zeller i^6. 1323, n. 3.

[4] Reading in l. 33 τὸ δὲ αὐτό, with E.

[5] So that there is no contradiction in supposing that a thing is (say) 'actually one', but 'potentially many', at the same time.

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 palpable and offers no difficulty at all: admit one ridiculous proposition and the rest follows—a simple enough proceeding.][1]

The fallacy of Melissus is obvious.[2] 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[3] a beginning of the *thing*—not of the time and not only in the case of coming to be in the full sense but also in the case of coming to have a quality[4]—as if change never took place suddenly. Again, does it follow that Being, 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, Being 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.

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 one is used in a single sense 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

[1] The words in brackets are probably wrongly inserted from 185a 9–12.

[2] Cf. Diels, *Vorsokratiker*³, i. 184. 29–37, 186. 3–10.

[3] Omitting οἴεσθαι in l. 13 with F Simp.

[4] See Diels, *Vorsokratiker*³, i. 187–90. Aristotle wishes to say that there is always a beginning of the time, but not always of the thing.

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.

It is necessary for him, then, to assume not only that 'being' has the same meaning, of whatever it is predicated, but further that it means (1) what *just is* [1] and (2) what is *just one*.[2]

It must be so,[3] for (1) an attribute is predicated of some subject, so that the subject to which 'being' is attributed will not be, as it is something different from 'being'.
186b Something, therefore, which is not will be. Hence 'substance'[4] will not be a predicate of anything else.[5] For the subject cannot be a *being*, unless 'being' means several things, in such a way that each *is* something. But *ex hypothesi* 'being' means only one thing.

If, then, 'substance' is not attributed to anything, but other things are attributed to it, how does 'substance' mean what is rather than what is not? For suppose that 'substance' is also 'white'. Since the definition of the latter is different (for being cannot even be attributed to white, as nothing is which is not 'substance'), it follows that 'white' is not-being—and that not in the sense of a particular not-being, but in the sense that it is not at all. Hence 'substance' is not; for it is true to say that it is white,[6] which we found to mean

[1] i. e. substance.

[2] i. e. indivisible unity.

[3] It is necessary to supply some such intermediate step as this: 'If being is not thus identified with substantial being, it is an attribute, and then the following difficulty occurs—'.

[4] Or that which *just is*.

[5] Consequently to make being = substance does not obviously involve a plurality (duality) of beings, as identifying it with an attribute does.

[6] Aristotle assumes throughout the possibility of predication.

not-being. If to avoid this[1] we say that even 'white' means substance, it follows that 'being' has more than one meaning.

In particular, then, Being will not have magnitude, if it is substance. For each of the two parts[2] must *be* in a different sense.

(2) Substance is plainly divisible into other substances, if we consider the mere nature of a definition. For instance, if 'man' is a substance, 'animal' and 'biped' must also be substances. For if not substances, they must be attributes— and if attributes, attributes either of (*a*) man or of (*b*) some other subject. But neither is possible.

(*a*) 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.[3] 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.

(*b*) 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 a substance, then 'man' too will be an attribute of something else. But we must assume that substance[4] is *not* the attribute of anything, and that the subject of which both 'biped' and 'animal' and each separately[5] are predicated is the subject also of the complex 'biped animal'.

Are we then to say that the All is composed of indivisible

[1] Sc. to avoid the self-contradiction involved in saying *τὸ ὅπερ ὂν οὐκ ὄν*.
[2] Which are, at the least, involved in its having magnitude.
[3] Omitting *ἢ ἐν . . συμβέβηκεν* in ll. 20–21, with FI Phil. Simp.
[4] Omitting *τι* in l. 34, with E[1] I Phil. Simp.
[5] Placing a comma after, not before, *καὶ ἑκάτερον* (ll. 34–5).

187a substances?[1] 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 not-being is; to that from bisection, they yielded by positing atomic magnitudes.[2] But obviously it is not true that if being means one thing, and cannot at the same time mean the contradictory of this, 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 a particular not-being. To say that all things will be one, if there is nothing besides Being itself, is absurd. For who understands 'being itself' to be anything but a particular substance? But if this is so, there is nothing to prevent there being many beings, as has been said.

It is, then, clearly impossible for Being to be one in this sense.

The physicists on the other hand have two modes of explanation. 4

The first set make the underlying body[3] one—either one of the three[4] or something else which is denser than fire and rarer than air[5]—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).

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

[1] Taking *ἐξ ἀδιαιρέτων ἄρα τὸ πᾶν* in l. 35 as a question.
[2] See Diels, *Vorsokratiker*³, i. 170 f., 181–3.
[3] 187a 13 omitting ὄν, of which there is no trace in Simplicius.
[4] Water, air, or fire. Aristotle points out elsewhere (*Met.* A. 988b 30) that no one made earth the substratum.
[5] Aristotle sometimes mentions a theory that the substratum is between water and air, and once a theory that it is between water and fire. A substance between air and fire is mentioned by Aristotle in four other passages besides the present. See Zeller i⁶. 283–91, Diels, *Vors.*³ i. 415. 32–416. 27.

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 'homœomerous'[1] substances and his contraries infinite in multitude, whereas Empedocles posits only the so-called[2] elements.

The theory of Anaxagoras that the principles are infinite in multitude was probably due to his acceptance of the common opinion of the physicists that nothing comes into being from not-being. 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.[3] Moreover, the fact that the contraries proceed 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 187b
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 the nature of the particles which are numerically predominant among the innumerable constituents of the mixture. For nothing, they say, is purely and entirely white or black or sweet, bone or flesh, but the nature of a thing is held to be that of which it contains the most.

Now (1) the infinite *qua* infinite is unknowable, so that what

[1] ὁμοιομερῆ is Aristotle's term for substances which are divisible into parts like themselves. It means primarily the 'tissues' of plants and animals, e.g. flesh, as distinguished from the ὀργανικὰ μέρη, such as the hand. It includes the metals, but not the four elements.

[2] Aristotle himself regards the four 'elements' as complex.

[3] Putting only a comma after ἀλλοιοῦσθαι in l. 30. Cf. Diels, ib. 388. 23-32.

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.

Further (2) if the parts of a whole may be of any size in the direction either of greatness or of smallness (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 be of any size. Clearly, therefore,[1] since 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.

Again (3) 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 seems obviously to follow that everything *cannot* subsist in everything else. For let flesh be extracted from water and again more flesh be produced[2] 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.[3] 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

[1] Reading in l. 16 ὅλον), εἰ δή, with Bonitz.
[2] Reading in l. 28 γενομένης, with EI.
[3] Anaxagoras would deny this.

equal[1] particles 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 188a be less than the minimum of flesh.[2]

Lastly (4) 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, and no less real than the infinite bodies, and each infinite: which is contrary to reason.

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 a 'white' or a 'healthy' which was nothing *but* white or healthy, i.e. was not the predicate of a subject. So his 'Mind' is an absurd person aiming at the impossible, if he 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,[3] and of quality, because affections are inseparable.

Nor is Anaxagoras right about the coming to be of homogeneous bodies.[4] 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[5] 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[6]; and it is better to assume a smaller and finite number of principles, as Empedocles does.[7]

[1] Aristotle supposes for simplicity that the finite amounts which are extracted are equal.

[2] For Anaxagoras there is no minimum.—It seems best to read ἐλάττων in l. 1 with Simplicius.

[3] According to Anaxagoras. [4] Reading in l. 13 ὁμοειδῶν, with EI.

[5] Omitting δέ in l. 16, perhaps with Them. and Simp.

[6] i.e. by segregation and aggregation respectively. Water comes from air by change of quality.

[7] If we accept the possibility of transmutation, it is not necessary to assume an infinite multitude of principles.

All thinkers then agree in making the contraries principles, both those who describe the All as one and unmoved (for even Parmenides treats hot and cold as principles under the names of fire and earth)[1] and those too who use the rare and the dense. The same is true of Democritus also, with his plenum[2] 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 behind; of shape, angular and angle-less, straight and round.[3] 5

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.

But we must see how this can be arrived at as a reasoned result, as well as in the way just indicated.

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 in virtue of a concomitant attribute. For how could 'white' come from 'musical', unless 'musical' happened to be an attribute of the not-white[4] or of the black? No, 'white' comes from 'not-white' —and not from *any* 'not-white', but from black or some
188b intermediate colour.[5] Similarly, 'musical' comes to be from 'not-musical', but not from *any* thing other than musical, but from 'unmusical' or any intermediate state there may be.

[1] Cf. fr. 8. 53–9.
[2] Reading in l. 22 *πλῆρες* for *στερεόν*, with E[1] I Simp. Phil. Them.
[3] Reading in l. 25 with MS. Par. 1859, Phil., and Simp., *γεγωνιωμένον ἀγώνιον, εὐθὺ περιφερές*.
[4] Reading in l. 36 *τῷ μὴ λευκῷ*, with E and Simp.
[5] According to Aristotle, the colours form a scale between black and white.

Nor again do things pass into the first chance thing; 'white' does not pass into 'musical' (except, it may be, in virtue of a concomitant attribute), but into 'not-white'—and not into any chance thing which is not white, but into black or an intermediate colour; 'musical' passes into 'not-musical'—and not into any chance thing other than musical, but into 'unmusical' or any intermediate state there may be.

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. 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[1] 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 any other complex. 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.

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.

Up to this point we have practically had most of the other writers on the subject with us, as I have said already[2]: for all of them identify their elements, and what they call their principles, with the contraries, giving no reason indeed for the theory, but constrained as it were by the truth itself. They differ, however, from one another in that some assume contraries which are more primary, others contraries which are less so: some those more knowable

[1] Reading in l. 15 διαφέρει δ' οὐθέν, with the MSS.
[2] a19–30.

in the order of explanation, others those more familiar to sense. For some make hot and cold, or again moist and dry, the conditions 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
189a think, but the same inasmuch as they are analogous; for all are taken from the same table of columns,[1] 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 more 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.

It is clear then that our principles must be contraries.

The next question is whether the principles are two or 6
three or more in number.

One they cannot be, for there cannot be one contrary. Nor can they be innumerable, because, if so, Being 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 from his principles all that Anaxagoras obtains from his innumerable principles. Lastly, some contraries are more primary than others, and some arise from others—for example sweet and bitter, white and black—whereas the principles must always remain principles.

[1] The following is the table given in *Met.* A. 986a 23:—

Limit . . .	Unlimited	Resting . . .	Moving
Odd . . .	Even	Straight . . .	Curved
One . . .	Plurality	Light . . .	Darkness
Right . . .	Left	Good . . .	Bad
Male . . .	Female	Square . . .	Oblong

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

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.

Other objections to the view that it is not necessary to assume a third principle as a substratum may be added. (1) We do not find that the contraries constitute the *substance* of any thing. But what is a first principle ought not to be the *predicate* 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 (2) 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?

If then we accept both the former argument[1] and this one,[2] we must, to preserve both, assume a third somewhat as the substratum of the contraries, such as is spoken of by 189b
those who describe the All 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[3] 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

[1] That the contraries are principles (ch. 5).
[2] That the contraries need a substratum (ll. 21–34).
[3] Reading in l. 4 πῦρ γὰρ ἤδη, with E Them. Simp.

of course be generalized, as has already been said,[1] 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.

To suppose then that the elements are three in number would seem, from these and similar considerations, a plausible view, as I said before.[2] On the other hand, the view that they are more than three in number would seem to be untenable.

For the one substratum 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[3] separately.[4] 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; in a single genus there is always a single contrariety, all the other contrarieties in it being held to be reducible to one.

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.

We will now give our own account,[5] approaching the 7
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.[6]

We say that one thing comes to be from another thing, and one sort of thing from another sort of thing, both in

[1] 187^{a}16. [2] ^{a}21.
[3] 189^{b}20 reading ἑκατέρᾳ with Philoponus and Pacius.
[4] So that one of these substrata would be superfluous.
[5] Reading in l. 30 λέγωμεν, with E. [6] Cf. 184^{a}21–^{b}14.

the case of simple and of complex things. I mean the following. We can say (1) the 'man becomes musical', (2) what is 'not-musical becomes musical',[1] or (3) the 'not-musical man becomes a musical man'. Now what becomes in (1) and (2)—'man' and 'not musical'—I call *simple*, and what each becomes—'musical'—simple also. But when (3) we say the 'not-musical man becomes a musical man', both what becomes and what it becomes are *complex*.

As regards one of these simple 'things that become' we say not only 'this becomes so-and-so',[2] but also 'from being this, comes to be so-and-so', as 'from being not-musical comes to be musical'; as regards the other we do not say this in all cases, as we do not say (1) 'from being a man he came to be musical' but only 'the man became musical'.

When a 'simple' thing is said to become something, in one case (1) it survives through the process, in the other (2) 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 continue to exist, either simply or combined with the subject.

These distinctions drawn, one can gather from surveying the various cases of becoming in the way we are describing that, as we say, 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 that I mean that it can be described in different ways.) For 'to be man' is not the same as 'to be unmusical'. One part survives, the other does not: what is not an opposite survives (for 'man' survives), but 'not-musical'[3] or 'unmusical' does not survive, nor does the compound of the two, namely 'unmusical man'.

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

[1] Omitting in l. 35 τι, with E Them. Phil. Simp.
[2] Omitting in l. 6 τι, with E[1] Them. Phil.
[3] Reading in l. 19 τὸ μὴ μουσικόν, with F.

man'—but there are exceptions, as 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 indifferently 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 man from an unmusical man', and 'an unmusical man becoming a musical man'.

But there are different senses of 'coming to be'. 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' in the unqualified sense.

Now in all cases other than substance it is plain that there must be some subject, namely, that which becomes. For we know that when a thing comes to be of such a quantity or quality or in such a relation, time, or place, a subject is always presupposed, since substance alone is not predicated of another subject, but everything else of substance.

190b But that substances too, and anything else that can be said 'to be' without qualification, come to be from some substratum, 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.

Generally things which come to be, come to be in different ways: (1) by change of shape, as a statue[1]; (2) by addition, as things which grow; (3) by taking away, as the Hermes from the stone; (4) by putting together, as a house; (5) by alteration, as things which 'turn' in respect of their material substance.[2]

[1] Sc. a bronze statue. ἐκ χαλκοῦ is probably a gloss.

[2] The first four modes of becoming are cases of artificial production. The fifth seems to include both mere change of quality (ἀλλοίωσις) and generation in the full sense (ἁπλῆ γένεσις), which presumably is always *accompanied* by ἀλλοίωσις. Milk 'turning' would be merely a case

It is plain that these are all cases of coming to be from a substratum.

Thus, clearly, from what has been said, whatever comes to be is always complex. There is, on the one hand, (*a*) something which comes into existence, and again (*b*) something which becomes that—the latter (*b*) 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'.

Plainly then, if there are conditions and principles which constitute natural objects and from which they primarily are or[1] have come to be—have come to be, I mean, what each is said to be in its essential nature, not what each is in respect of a concomitant attribute—plainly, I say, everything comes to be from both subject and form. For 'musical man' is composed (in a way)[2] of 'man' and 'musical': you can analyse it[3] into the definitions of its elements. It is clear then that what comes to be will come to be from these elements.

Now the subject is one numerically, though it is two in form. (For it is the man, the gold—the 'matter'[4] generally—that is counted, for it is more of the nature of a 'this', and what comes to be does not come from it in virtue of a concomitant attribute[5]; the privation, on the other hand, and

of change of quality (ἀλλοίωσις), not of change of substance (ἁπλῆ γένεσις): water turning into wine, or καταμήνια becoming ἄνθρωπος, would be an example of the latter. Since Aristotle is carefully working up to the conception of matter (ὕλη), the words κατὰ τὴν ὕλην are used inadvertently, or are a later addition to explain τρεπόμενα.

[1] Omitting the comma after εἰσί in l. 18.

[2] The relation of attribute to subject is only analogous to that of form to matter.

[3] Omitting the first τοὺς λόγους in l. 22, with Diels.

[4] Aristotle here introduces ὕλη as his technical term for 'matter'. Literally the word means 'wood' or 'timber', and Aristotle no doubt has in view the simplest example of a maker, the τέκτων.

[5] Every transition is of the form $XA \rightarrow XA'$, where X is substance. A' (or XA') is said to come to be from X without qualification (ἁπλῶς). On the other hand, A' comes to be from A, in virtue of an attribute (κατὰ συμβεβηκός), namely A, which X possesses. The contrast is between 'coming to be' without qualification, and 'coming to be in virtue of an attribute'. If A' is a quality, A is the contrary quality

the contrary *are* incidental[1] in the process.) And the positive form is one[2]—the order, the acquired art of music, or any similar predicate.

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 the substratum is different from the contraries, for it is 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
191a of essential nature, but three. For 'to be man' is different from 'to be unmusical',[3] 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 a substratum for 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 successive absence and presence.)

The underlying nature is an object of scientific knowledge, by an analogy. For as the bronze is to the statue, the wood to the bed, or the matter and the formless before receiving form to any thing which has form, so is the underlying nature to substance, i. e. the 'this' or existent.

This then is one principle (though not one or existent[4] in the same sense as the 'this'), and the definition was one as we agreed[5]; then further there is its contrary, the priva-

(or intermediate). But if *A′* is substance (as well as *X*), *A* is called the privation (*στέρησις*) of *A′*.

[1] Incidental = *κατὰ συμβεβηκός*.

[2] i.e. counts as principle No. 2.

[3] Reading in l. 2 *τὸ ἀνθρώπῳ καὶ τὸ ἀμούσῳ εἶναι, καὶ τὸ ἀσχηματίστῳ*, with E.

[4] Reading in l. 13 *ὂν ὡς*, with E.

[5] Altering the reading of the MSS. in l. 13 (*ἡ ὁ λόγος*) to *ἦν ὁ λόγος*. *λόγος* is used by Aristotle as equivalent to *εἶδος* of 190b 28.

tion. In what sense these are two, and in what sense more, has been stated above. Briefly, we explained first[1] that only the contraries were principles, and later[2] that a substratum was indispensable, and that the principles were three; our last statement[3] has elucidated the difference between the contraries, the mutual relation of the principles, and the nature of the substratum. Whether the form or the substratum is the essential nature of a physical object is not yet clear.[4] But that the principles are three, and in what sense, and the way in which each is a principle, is clear.

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

8 We will now proceed[5] to show that the difficulty of the early thinkers, as well as our own, is solved in this way alone.

The first of those who studied science were misled in their search for truth and the nature of things by their inexperience,[6] 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[7] be present as a substratum). 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 Being itself is. Such then was their opinion, and such the reason for its adoption.

Our explanation on the other hand is that the phrases 'something comes to be from what is or from what is not', 'what is not or what is does something or has something done to it or becomes some particular thing', are to be taken (in the first way of putting our explanation) in the

[1] Ch. 5. [2] Ch. 6. [3] Ch. 7.
[4] This is discussed below, Bk. II, Ch. 1.
[5] Reading in l. 24 λέγωμεν, with EI.
[6] Sc. of logical analysis. So Themistius and Philoponus.
[7] Reading in l. 31 δεῖν, with Bonitz.

191b same sense as 'a doctor does something or has something done to him', 'is or becomes something from being a doctor'. These expressions may be taken in two senses, and so too, clearly, may 'from being', and 'being 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 not-being' means '*qua* not-being'.

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 Being itself, thus doing away with all becoming.

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'—that is, in a qualified sense. For a thing comes to be from the privation, which in its own nature is not-being,—this not surviving as a constituent of the result. Yet this causes surprise, and it is thought[1] impossible that something should come to be in the way described from what is not.

In the same way we maintain that nothing comes to be from being, and that being does not come to be except in a qualified sense. 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 horse. The dog would then, it is true, come to be from animal[2] (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* in a qualified sense, it will not be from animal:

[1] Omitting in l. 17 the comma after δοκεῖ.
[2] ζῷον, i.e. the *genus*.

and if being, not from being—nor from not-being either, for it has been explained[1] that by 'from not-being' we mean from not-being *qua* not-being.

Note further that we do not subvert the principle that everything either is or is not.[2]

This then is one way of solving the difficulty. Another consists in pointing out that the same things can be explained in terms of potentiality and actuality. But this has been done with greater precision elsewhere.[3]

So, as we said, the difficulties which constrain people to deny the existence of some of the things we mentioned[4] 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,[5] all their ignorance would have been dispelled.

9 Others,[6] indeed, have apprehended the nature in question, but not adequately.

In the first place they allow that a thing may come to be without qualification from not-being, accepting on this point the statement[7] of Parmenides. Secondly, they think 192a that if the substratum is one numerically, it must have also only a single potentiality[8]—which is a very different thing.

Now we distinguish matter and privation, and hold that one of these, namely the matter, is not-being only in virtue of an attribute which it has, while the privation in its own nature is not-being; 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

[1] l. 9. [2] Reading in l. 26 ἢ μὴ εἶναι, with E and Simp.
[3] *Met.* Bk. Θ, and Δ. 1017a 35–b 9.
[4] e. g. becoming and plurality.
[5] The ὑποκειμένη φύσις, cf. 191a 7.
[6] The Platonists.
[7] That if a thing does not come to be from being, it must come to be from not-being.
[8] δυνάμει = εἴδει above (190b 24). In Aristotle's theory, the substratum plays a double part.

alike with not-being, 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[1] makes a dyad of it, which he calls Great and Small, the effect is the same, for he overlooked the other nature.[2] For the one which persists is a joint cause, with the form, of what comes to be—a mother, as it were.[3] But the negative part of the contrariety may often seem, if you concentrate your attention on it as an evil agent, not to exist at all.

For admitting with them 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 *per se* but *per accidens*.

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 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 special nature,[4] 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 without qualification, and which persists in the result.) 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.

[1] Plato. [2] The privation. [3] Cf. *Tim.* 50 D, 51 A.
[4] Reading αὐτῆς in l. 30 with I and Phil.

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 the primary type of science[1]; so these questions may stand over till then.[2] But of the natural, i.e. perishable,[3] forms we shall speak 192b in the expositions which follow.[4]

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.

[1] Metaphysics or 'First philosophy' (πρώτη φιλοσοφία) as it is often called. [2] *Met.* Λ. 7–9.

[3] Omitting in l. 1 τῶν after καί, with E Them. Phil.

[4] i.e. the remaining treatises of 'second philosophy' (φυσική), viz. the rest of the *Physics*, the *De Caelo*, *De Gen. et Corr.*, &c. (especially *De Gen. et Corr.* II).

192b

BOOK II

Of things that exist,[1] some exist by nature, some from other causes. 1

'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[2] exist 'by nature'.

All the things mentioned present a feature in which they differ from things which are *not* constituted by nature. Each of them has *within itself* a principle[3] 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,[4] and just to that extent—which seems to indicate that *nature is a source or cause of being moved and of being at rest in that to which it belongs primarily*, in virtue of itself and not in virtue of a concomitant attribute.

I say 'not in virtue of a concomitant attribute', because (for instance) a man who is a doctor might cure 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 source of its own production. But while in some cases (for instance houses and the other products of manual

[1] τὰ ὄντα = substances, which consist of matter and form. Such of them as exist by nature (φύσις) are the objects of Physical Science.

[2] Inorganic compounds are included (l. 20).

[3] Reading in l. 13 f. τούτων μὲν γὰρ ἕκαστον ἐν ἑαυτῷ ἀρχὴν ἔχει, with E Al. Them. Phil.

[4] A bed, e.g., tends to fall to the ground or to rest there, not *qua* bed, but *qua* made of a heavy material.

labour) that principle is in something else external to the thing, in others—those which may cause a change in themselves in virtue of a concomitant attribute—it lies in the things themselves (but not in virtue of what they are).

'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,[1] and nature always implies a subject in which it inheres.

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'.

What nature is, then, and the meaning of the terms 193a
'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 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.)

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.

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*[2]—which shows that the arrangement in accordance with the rules of the art is merely an incidental attribute, whereas the real nature is the other, which, further, persists continuously through the process of making.

But if the material of each of these objects has itself

[1] Placing a comma after τι in l. 34.
[2] Cf. Antiphon, fr. 15 Diels.

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 essence. 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.

This then is one account of 'nature', namely that it is the immediate material substratum of things which have in themselves a principle of motion or change.

Another account is that 'nature' is the shape or form which is specified in the definition of the thing.

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', 193b until it receives the form specified in the definition, which we name in defining what flesh or bone is. Thus in the second sense of 'nature' it would be the shape or form (not separable except in statement) of things which have in themselves a source of motion. (The combination of the two, e.g. man, is not 'nature' but 'by nature' or 'natural'.)

The form indeed is 'nature' rather than the matter; for a thing is more properly said to be what it is when it has attained to fulfilment than when it exists potentially. Again man is born from man, but not bed from bed. That is why people say that the figure 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 figure *is* art, then on the same principle the shape of man is his nature. For man is born from man.

We also speak of a thing's nature as being exhibited in the process of growth[1] by which its nature is attained. The 'nature' in this sense 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 (in the one sense) is related to nature (in the other). What grows *qua* growing[2] 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.

'Shape' and 'nature', it should be added, are used in two senses. For the privation too is in a way form. But whether in unqualified coming to be there is privation, i.e. a contrary to what comes to be, we must consider later.[3]

2 We have distinguished, then, the different ways in which the term 'nature' is used.

The next point to consider is how the mathematician differs from the physicist.[4] Obviously physical bodies contain surfaces and volumes, lines and points, and these are the subject-matter of mathematics.

Further, is astronomy[5] different from physics or a department of it? It seems absurd that the physicist 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 physics obviously do discuss their shape also and whether the earth and the world are spherical or not.

Now the mathematician, though he too treats of these things,[6] nevertheless does not treat of them as the limits of a physical 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

[1] Cf. *Metaphysics*, 1014b 16. '"The coming to be of growing things", as if the υ in φύσις were long' (as it is in φύομαι).

[2] Reading in l. 17 ᾗ, with E and Them.

[3] *De Gen. et Corr.* i. 3.

[4] Or student of nature (φυσικός).

[5] Reading in l. 25 ἔτι εἰ ᾗ, with Susemihl.

[6] Surfaces, &c.

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 physics, which are less separable
194a 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'.

Similar evidence is supplied by the more physical of the branches of mathematics, such as optics, harmonics, and astronomy. These are in a way the converse of geometry. While[1] geometry investigates physical lines but not *qua* physical, optics investigates mathematical lines, but *qua* physical, not *qua* mathematical.

Since 'nature' has two senses, the form and the matter, we must investigate its objects as we would the essence of snubness. That is, such things are neither independent of matter nor can be defined in terms of matter only. Here too indeed one might raise a difficulty.[2] Since there are two natures, with which is the physicist concerned? Or should he investigate the combination of the two?[3] 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?

If we look at the ancients, physics would seem to be concerned with the *matter*. (It was only very slightly that Empedocles and Democritus touched on the forms and the essence.)

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

[1] Reading in l. 9 *ἡ μὲν γὰρ γεωμετρία*, with E² F Simp.
[2] Omitting *διχῶς* in l. 15, with E¹ Them. Phil. Simp.
[3] Putting a full-stop after *φυσικοῦ* in l. 16, and a mark of interrogation after the first *ἀμφοῖν* in l. 17.

forth): if this is so, it would be the part of physics also to know nature in both its senses.

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 and there is a stage which is last, this stage is the end [1] or 'that for the sake of which'. (That is why the poet [2] was carried away into making an absurd statement when he said 'he has the end [3] 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.)

For [4] 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' has two senses: the distinction is made in our work *On Philosophy*.[5]) The arts, therefore, which govern the matter and have knowledge [6] are two, namely the art which uses the 194b
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,[7] 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.

Again, matter is a relative term: to each form there corresponds a special matter. How far then must the physicist know the form or essence? Up to a point, perhaps, as the doctor must know sinew or the smith

[1] Reading in l. 29 f. τι ἔσχατον τῆς κινήσεως, τοῦτο τέλος (Alexander's conjecture).

[2] An unidentified comic poet (Kock, *Com. Att. Fr.* iii, p. 493).

[3] i.e. death.

[4] Placing a full stop before ἐπεί in l. 33.

[5] i.e. in the dialogue *De Philosophia*.

[6] Reading in l. 1 καὶ γνωρίζουσαι, with F and Phil.

[7] Omitting ἡ ἀρχιτεκτονική in l. 4, with Prantl[1].

bronze (i. e. until he understands the purpose of each): and[1] the physicist 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 the primary type of philosophy[2] to define.

Now that we have established these distinctions, we 3
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).[3] So clearly we[4] too must do this as regards both coming to be and passing away and every kind of physical change, in order that, knowing their principles, we may try to refer to these principles each of our problems.

In[5] one sense, then, (1) that out of which a thing comes to be and which persists, is called '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.

In another sense (2) the form or the archetype, i. e. the statement of the essence, and its genera, are called 'causes' (e. g. of the octave the relation of 2 : 1, and generally number),[6] and the parts in the definition.

Again (3) the primary source of the change or coming to rest; e. g. the man who gave advice is a cause, the father is cause of the child, and generally what makes of what is made and what causes change of what is changed.

Again (4) 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.[7] 'To be healthy', and, having said that, we think we have assigned

[1] Reading in l. 11 f. τοῦ—τίνος . . . ἕκαστον—καί, with Jaeger.
[2] i. e. not of natural philosophy, but of metaphysics. Cf. *Met.* Z. 6–8.
[3] The proximate cause, which is primarily responsible for an event.
[4] i. e. natural philosophers.
[5] $194^b 23$–$195^b 21$ is repeated almost *verbatim* in *Met.* Δ. 2.
[6] Treating οἷον . . . ἀριθμός in ll. 27–8 as parenthetical.
[7] Placing a full stop after φαμέν in l. 34.

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.

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

As the word has several senses, it follows that there are several causes of the same thing (not merely in virtue of a concomitant attribute), e.g. both the art of the sculptor 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 origin of change. 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.

All the causes now mentioned fall into four familiar divisions.[1] The letters are the causes of syllables, the material of artificial products, fire, &c., 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 substratum, 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 adviser, and generally the maker, are all sources whence the change or stationariness originates,[2] while the others are causes in the sense of the end or the good of the rest; for 'that for the sake of which' means what is best and

[1] Reading in l. 15 τρόπους. Bekker's τόπους is a misprint.
[2] Omitting in l. 23 ἢ κινήσεως, with E and *Met.* 1013^{b} 25.

the end of the things that lead up to it. (Whether we say the 'good itself' or the 'apparent good' makes no difference.)

Such then is the number and nature of the kinds of cause.

Now the modes of causation are many, though when brought under heads they too can be reduced in number. For 'cause' is used in many senses 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 incidental and its genera, e.g. in one way 'Polyclitus', in another 'sculptor' is the cause of a statue, because 'being Polyclitus' and 'sculptor' are incidentally conjoined. Also the classes in which the incidental attribute is included; thus 'a man' could be said to be the cause of a statue or, generally, 'a living creature'. An incidental 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.

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

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

All these various uses, however, come to six in number, under each of which again the usage is twofold. Cause means either what is particular or a genus, or an incidental attribute or a genus of that, and these either as a complex or each by itself; and all six 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 housebuilding 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.

In investigating the cause of each thing it is always necessary to seek what is most precise (as also in other things): thus 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.

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.

This must suffice for our account of the number of causes and the modes of causation.

4 But chance also and spontaneity are 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.

Some people[1] even question whether they are real 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 cases of chance[2] 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;

[1] Apparently Democritus is meant. Cf. Diels, *Vors.*[3] ii. 29. 3–11.
[2] Omitting λεγομένων in l. 6 with E[1].

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[1] said which denied chance), nevertheless they speak of some of these things as happening by chance and others not. For this reason also they ought to have at least referred to the matter in some way or other.

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.'[2] He tells us also that most of the parts of animals came to be by chance.

There are some[3] too who ascribe this heavenly sphere and all the worlds[4] to spontaneity. They say that the vortex arose spontaneously, i. e. the motion that separated and arranged in its present order all that exists. 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
196b might well have been said about it. For besides the other absurdities of the statement, it is the more absurd that

[1] Cf. ll. 1–7.
[2] Fr. 53.
[3] Apparently Democritus is meant. Cf. Simplicius 331. 16.
[4] Reading in l. 25 κόσμων, with E Phil. Simp.

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.

Others[1] there are who, indeed, believe that chance is a cause, but that it is inscrutable to human intelligence, as being a divine thing and full of mystery.

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.

5 First then we observe that some things always come to pass in the same way, and others for the most part.[2] It is clearly of neither of these that chance is said to be the cause,[3] nor can the 'effect of chance' be identified with any of the things that come to pass by necessity and always, or for the most part.[2] 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.

But, secondly, some events are for the sake of something, others not. Again, some of the former class are in accordance with deliberate 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 the necessary and the normal,[2] there are some in connexion with which the phrase 'for the sake of something' is applicable. (Events[4] 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 incidentally are said to be 'by chance'. For just as a thing is something either in virtue of itself or incidentally,[5]

[1] Democritus, cf. Diels, *Vors.*[3] ii. 29. 21–6.
[2] Reading in ll. 11, 13, 20 ὡς ἐπὶ τὸ πολύ, with I.
[3] Putting a comma after λέγεται, not after τύχης, in l. 12.
[4] With ll. 21–5 cf. *Met.* 1065a 26–30.
[5] *A* may 'be' *B*, either because it is *A* or because *A* is casually conjoined with some other attribute of the subject which is *B*.

so may it be a cause. For instance, the housebuilding faculty is in virtue of itself the cause of a house, whereas the pale or the musical[1] is the incidental cause. That which is *per se* cause of the effect is determinate, but the incidental cause is indeterminable, for the possible attributes of an individual are innumerable. To resume 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[2]—for the present it is sufficient if it is plain that both are in the sphere of things done for the sake of something.)

Example: A man is engaged in collecting[3] 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 incidentally that he got his money by going there[4]; and this was not due to the fact that he went there as a rule or
197a necessarily, nor is the end effected (getting the money) a cause present in himself—it belongs to the class of things that are intentional and the result of intelligent deliberation. It is when these conditions are satisfied that the man is said to have gone 'by chance'. If he had gone of deliberate purpose and 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'.

It[5] is clear then that chance is an incidental cause in the sphere of those actions for the sake of something which involve purpose. Intelligent reflection, then, and chance are in the same sphere, for purpose implies intelligent reflection.

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

[1] Incidental attributes of the housebuilder. [2] In ch. 6.
[3] Reading in l. 34 κομιζόμενος, with E[1].
[4] Omitting in l. 35 τοῦ κομίσασθαι ἕνεκα, with Bonitz.
[5] With ll. 5–14 cf. *Met.* 1065a 30–5.

are correct, because they are well grounded. Things *do*, in a way, occur by chance, for they occur incidentally and chance is an *incidental cause*. But strictly it is not the *cause*—without qualification—of anything; for instance, a housebuilder is the cause of a house; incidentally, a flute-player may be so.

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.[1] Thus to say that chance is a thing contrary to rule is correct. For 'rule' applies to what is always true or true for the most part, whereas chance belongs to a third type of event. Hence, to conclude, since causes of this kind[2] are indefinite, chance too is indefinite. (Yet in some cases one might raise the question whether *any* incidental fact might be the cause of the chance occurrence, e. g. of health the fresh air or the sun's heat[3] may be the cause, but having had one's hair cut *cannot*; for some incidental causes are more relevant to the effect than others.)

Chance[4] or fortune 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.[5] 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 be invariable or normal.

Both are then, as I have said, incidental causes—both chance and spontaneity—in the sphere of things which are capable of coming to pass not necessarily, nor normally,

[1] Reading in l. 17 *φεύγων καὶ θεασόμενος*, with Simp.
[2] i. e. incidental causes.
[3] Reading in l. 23 *εἵλησις*, with Simp.
[4] With ll. 25–7 cf. *Met.* 1065a 35–b1.
[5] Reading in l. 28 *ἢ εὐτυχεῖν ἢ ἀτυχεῖν*, with E and Simp.

and with reference to such of these as might come to pass for the sake of something.

They differ in that 'spontaneity' is the wider term. 6
Every result of chance is from what is spontaneous, but not everything that is from what is spontaneous is from chance.

197b Chance and what results from chance are appropriate to agents that are capable of good fortune and of moral action generally. Therefore necessarily chance is in the sphere of moral 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 moral action, since it is well-doing. Hence what is not capable of moral action cannot do anything by chance. Thus an inanimate thing or a lower animal or a child cannot do anything by chance, because it is incapable of deliberate intention; nor can 'good fortune' or 'ill fortune' be ascribed to them, except metaphorically, as Protarchus,[1] 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 lower animals 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[2] 'of itself', because, though when it fell it stood on its feet so as to serve for a seat, it did not fall for the sake of that.

Hence it is clear that events which (1) belong to the general class of things that may come to pass for the sake of something, (2) do not come to pass for the sake of what actually results, and (3) 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 deliberate

[1] Probably the reference is to the Protarchus described as a pupil of Gorgias in Plat. *Phil.* 58 A. Cf. Zeller, *Phil. d. Gr.*, i.^{5} 1323, n. 4.

[2] i. e. on its feet.

intention and due to agents capable of that mode of action. This is indicated by the phrase 'in vain', which is used when *A*, which is for the sake of *B*, does not result in *B*. 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 the means to an end is 'in vain', when it does not effect the end towards which it was the natural means—for it would be absurd for a man to say that he had bathed in vain because the sun was not eclipsed, since the one was not done with a view to the other. Thus the spontaneous is even according to its derivation the case in which the thing itself happens in vain.[1] The stone that struck the man did not fall for the purpose of striking him; therefore it fell spontaneously, because it might have fallen by the action of an agent and for the purpose of striking. The difference between spontaneity and what results by chance[2] 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.

We have now explained what chance is and what spon- 198^a
taneity is, and in what they differ from each other. Both belong to the mode of causation[3] '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.

Spontaneity[4] and chance are causes of effects which, though they might result from intelligence or nature, have in fact been caused by something *incidentally*. Now since nothing which is incidental is prior to what is *per se*, it is clear that no incidental cause can be prior to a cause *per se*. Spontaneity and chance, therefore, are posterior to

[1] There is no parallel in English for this false derivation.
[2] Reading in l. 33 τοῦ, with E and Phil.
[3] Reading in l. 2 τῆς δ' αἰτίας τῶν τρόπων, with E.
[4] With ll. 5–13 cf. *Met.* 1065^b 2–4.

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[1] of this All[2] and of many things in it besides.

It is clear then that there are causes, and that the 7
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 (1), in things which do not involve motion, e.g. in mathematics, to the 'what' (to the definition of 'straight line' or 'commensurable', &c.), or (2) to what initiated a motion, e.g. 'why did they go to war?—because there had been a raid'; or (3) we are inquiring 'for the sake of what?'—'that they may rule'; or (4), 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.

Now, the causes being four, it is the business of the physicist 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[3]; 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[4] (for man generates man), and so too, in general, are all things which cause movement by being themselves moved; and such as are not of this kind are no longer inside the province of physics, 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,[5] the second of things in motion, but indestructible,[6] the third of destructible things.[7]

[1] Reading in l. 12 *νοῦν αἴτιον καὶ φύσιν εἶναι* with FI Simp.
[2] Reading in l. 13 *τοῦ παντός*, with FI Them. Phil. Simp.
[3] Reading in l. 25 *εἰς ἕν*, with Them. and Simp.
[4] They are different *individuals*.
[5] Reading in l. 30 *ἀκινήτων*, with E and Phil.
[6] Reading in l. 30 f. *κινουμένων μὲν ἀφθάρτων*, with E[1] and Phil.
[7] (2) and (3) belong to physics, (1) to physics only in so far as such things are the cause of motion.

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.

Now the principles which cause motion in a physical way are two, of which one is not physical, as it has no principle of motion[1] in itself. Of this kind is whatever 198b
causes movement, not being itself moved, such as (1) that 7
which is completely unchangeable, the primary reality, and (2) the essence of that which is coming to be, 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, (1) that from this that will necessarily result ('from this' either without qualification or in most cases); (2) that 'this must be so if that is to be so' (as the conclusion presupposes the premisses)[2]; (3) that this was the essence of the thing; and (4) because it is better thus (not without qualification, but with reference to the essential nature in each case).

8 We must explain then (1) that Nature belongs to the class of causes which act for the sake of something; (2) about the necessary and its place in physical problems, for all writers ascribe things to this cause, arguing that since the hot and the cold, &c., are of such and such a kind, therefore certain things *necessarily* are and come to be—and if they mention any other cause (one[3] his 'friendship and strife', another[4] his 'mind'), it is only to touch on it, and then good-bye to it.

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

[1] i. e. no capacity of being itself moved.

[2] i. e. the material cause or the *condicio sine qua non*; cf. 195a 16–19.

[3] Empedocles.

[4] Anaxagoras.

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 ox-progeny' did.[1]

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 normally 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
199a mere coincidence the frequency of rain in winter, but frequent rain in summer we do; nor heat in the dog-days, but only if we have it in winter. If then, it is agreed that things are either the result of coincidence or for an end, and these cannot be the result of coincidence or spontaneity, it follows that they must be for an end; 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.

Further, where a series has a completion, all the preceding steps are for the sake of that. Now surely as in intelligent action, so in nature; and as in nature, so it is in each action, if nothing interferes.[2] Now intelligent action

[1] Fr. 61. 2.
[2] Reading in ll. 9–11 οὐκοῦν . . . ἐμποδίζῃ; with Susemihl.

is for the sake of an end; therefore the nature of things also is so.[1] 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 also by art, they would come to be in the same way as by nature. Each step then in the series is for the sake of the next; and generally art partly completes what nature cannot bring to a finish, and partly imitates her. 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 terms of the series is the same in both.

This is most obvious in the animals other than man: they make things neither by art nor after inquiry or deliberation. Wherefore people discuss 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' means two things, 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'.

Now mistakes come to pass even in the operations of art: the grammarian 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 199b
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[2] the 'ox-progeny' if they failed to reach a deter-

[1] Reading in l. 11 ἄρα ἕνεκά του, with Phil. Simp. [2] Cf. 198^b 32.

minate end must have arisen through the corruption of some principle corresponding to what is now the seed.

Further, seed must have come into being first, and not straightway the animals: the words 'whole-natured first . . .'[1] must have meant seed.

Again, in plants too we find the relation of means to end, 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 been, if there were such things among animals.

Moreover, among the seeds anything must have 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 completion: the same completion is not reached from every principle; nor any chance completion, but always the tendency in each is towards the same end, if there is no impediment.

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,[2] 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 incidental, for chance is an incidental cause, as I remarked before.[3] But when an event takes place always or for the most part, it is not incidental or by chance. In natural products the sequence is invariable, if there is no impediment.

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

[1] Empedocles, Fr. 62. 4.

[2] Reading in l. 20 λυσάμενος (γρ. I, γρ. Phil.). There is probably a reference to Plato's imprisonment in Aegina and to his being ransomed by Anniceris, who had accidentally arrived there (*D. L.* iii. 20; Lucian, *Dem. Enc.* 23; Aelian, *Var. Hist.* ii. 27).

[3] 196^b 23–7.

nature. The best illustration is a doctor doctoring himself: nature is like that. ?

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

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, wherefore the stones and foundations take the lowest place, with earth[1] 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 production for an end; 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*; it is not a result necessarily determined by antecedents. Necessity is in the matter, while 'that for the sake of which' is in the definition.

Necessity in mathematics is in a way similar to necessity in things which come to be through the operation of nature. Since a straight line is what it is,[2] 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

[1] i. e. baked earth, bricks.
[2] i. e. since it is such that one line standing on another makes with it angles = 2 right angles.

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 premiss will not be true, so here the end or 'that for the sake of which' will not exist. For this too is itself a starting-point, but of the reasoning, not of the action; while in mathematics the starting-point is the starting-point 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 premisses will not be true, if the angles of the triangle are not equal to two right angles.

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 physicist, but especially the end;[1] for that is the cause of the matter, not *vice versa*; and the end is 'that for the sake of which', and the beginning starts from the definition or essence; as in artificial products, since a house 200b 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. Similarly if man is this, then these; if these, then those.[2] 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 are, as it were, its matter.

[1] Reading in l. 33 *τίνος*, with Them. Phil. Simp.
[2] i. e. what 'these' presuppose.

BOOK III

1 NATURE has been defined as a 'principle of motion and change', and it is the subject of our inquiry. We must therefore see that we understand the meaning of 'motion'; for if it were unknown, the meaning of 'nature' too would be unknown.

When we have determined the nature of motion, our next task will be to attack in the same way the terms which are involved in it. 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 'infinite' is often used in definitions of the continuous ('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 common to, and coextensive with, all the objects of our science, 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.[1]

To begin then, as we said, with motion.

We[2] may start by distinguishing[3] (1) what exists in a state of fulfilment only, (2) what exists as potential, (3) what exists as potential[4] and also in fulfilment—one being a 'this', another 'so much', a third 'such', and similarly in each of the other modes of the predication of being.

Further, the word 'relative' is used with reference to (1) excess and defect, (2) agent and patient and generally

[1] The subject of Physics (φυσική) is natural bodies and their properties. Their common properties are the subject of the present treatise.

[2] With ll. 26–8 cf. *Met.* 1065b 5–7.

[3] Omiting τι in l. 26, with Phil. and *Met.*

[4] Reading in l. 26 τὸ δὲ δυνάμει, τὸ δὲ δυνάμει, with *Met.* 1065b 5 (EJ).

what can move and what can be moved.[1] For 'what can cause movement' is relative to 'what can be moved', and *vice versa*.

Again,[2] there is no such thing as motion *over and above* the things. It is always with 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 *quantum*
201a nor *quale* 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 (1) substance—the one is positive form, the other privation; (2) in quality, white and black; (3) in quantity, complete and incomplete; (4) in respect of locomotion,[3] upwards and downwards or light and heavy. Hence there are as many types of motion or change as there are meanings of the word 'is'.[4]

We have now before us the distinctions in the various classes of being between what is fully real and what is potential.

Def. *The fulfilment of what exists potentially, in so far as it exists potentially, is motion*—namely, of what is alterable *qua* alterable, *alteration*: of what can be increased and its opposite what can be decreased (there is no common name), *increase* and *decrease*: of what can come to be and can pass away, *coming to be* and *passing away*: of what can be carried along, *locomotion*.

Examples will elucidate this definition of motion. When the buildable, in so far as it is just *that*, is fully real, it is *being built*, and this is build*ing*. Similarly, learning, doctoring, rolling, leaping, ripening, ageing.

[1] The former pair denote a special kind of the latter, namely change of *quality* ('such-ness') or alteration.

[2] With l. 32–201a 19 cf. *Met.* 1065a 7–20.

[3] = φορά, 'being carried', *translatio*. In the *Categories* (c. 14) this kind of 'motion' is simply called μεταβολὴ κατὰ τόπον.

[4] While the wider term μεταβολή (change) is used in all the categories, κίνησις (motion) holds only in Quality, Quantity, and Place.

The same thing, if it is of a certain kind, can be both potential and fully real, not indeed at the same time or not in the same respect, but e. g. potentially hot and actually cold. Hence at once 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 causing alteration and of being altered. Hence, too, what effects motion as a physical 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.[1] It *is* possible for a thing to cause motion, though it is itself incapable of being moved.

It[2] is the fulfilment of what is potential when it is already fully real and operates not as *itself* but as *movable*,[3] 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'[4] are not the same. If they were identical without qualification, i. e. in *definition*,[5] the fulfilment of bronze as bronze *would* have been 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 201b
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.)

We can distinguish, then, between the two—just as, to give another example, 'colour' and 'visible' are different—and clearly it is the fulfilment of what is potential *as* potential that is motion. So this, precisely, is motion.

Further[6] it is evident that motion is an attribute of

[1] viii. 5. [2] With l. 27–202a 3 cf. *Met.* 1065b 21–1066a 26.

[3] Reading in l. 28 ἐνεργῇ οὐχ ᾗ αὐτὸ ἀλλ' ᾗ κινητόν, with γρ. I Asp. Them.

[4] Omitting κινητῷ in l. 32, with Simp. and *Met.* 1065b 26.

[5] When *A* and *B* are identical in definition (or intension), it is also true that whatever is *A* is also *B*. But even when they are different in definition, we can still say that '*A* is *B*', if a *subject* which has the attribute *A* has also the attribute *B*.

[6] With ll. 6–7 cf. *Met.* 1065b 20–1.

a thing just *when* it is fully real in this way, and neither before nor after. For each thing of this kind[1] is capable of being at one time actual, at another not. Take for instance the buildable as buildable.[2] The actuality of the buildable as buildable is the process of building. For the actuality of the buildable must be either this or the house. But when there is a house, the buildable is no longer buildable. On the other hand, it *is* the buildable which is *being* built. The process then of being built must be the kind of actuality required. But building is a kind of motion, and the same account will apply to the other kinds also.

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. 2

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'[3] 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.

The reason why they put motion into these genera is that it is thought to be something indefinite,[4] and the principles in the second column are indefinite because they are privative: none of them is either 'this' or 'such' or[5] comes under any of the other modes of predication. The reason in turn why motion is thought to be indefinite is that it cannot be classed simply as a potentiality or as an actuality—a thing that is merely *capable* of having a certain size is not undergoing change, nor yet a thing that is

[1] i. e. all things which are φυσικὰ σώματα.

[2] Reading in l. 8 τὸ οἰκοδομητὸν ᾗ οἰκοδομητόν with *Met.* 1066a 2, Simp., Them., and inserting a comma thereafter.

[3] Plato in the *Timaeus* (52 E, 57 E, 58 A) makes motion depend on inequality.

[4] In the Pythagorean columns of opposites (e.g. Arist. *Met.* 986a 25), ἠρεμοῦν and κινούμενον are placed under πέρας and ἄπειρον respectively.

[5] Omitting ὅτι in l. 27, with *Met.* 1066a 16, Them., and Bonitz.

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 sheer 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 202a kind described, hard to grasp, but not incapable of existing.

The mover too is moved, as has been said—every mover, that is, which is capable of motion, and whose immobility is rest—when a thing is subject to motion its immobility is rest.[1] 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 we can define motion as *the fulfilment of the movable* qua *movable*, *the cause of the attribute being contact with what can move*,[2] so that the mover is also acted on. The mover or agent will always be the vehicle of a form, either a 'this' or a 'such',[3] which, when it acts, will be the source and cause of the change, e.g. the full-formed man begets man from what is potentially man.

3 The[4] solution of the difficulty that is raised about the motion—whether it is in the *movable*—is plain. It is the fulfilment of this potentiality, and by the action of that which has the power of causing 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

[1] ἠρεμία is the *privatio*, not the contradictory (ἀκινησία), of κίνησις, i.e. it can be predicated only of a thing which is capable of motion.

[2] 'move' in the sense of *cause* motion. This seems to be intended to be the complete or *real* definition of the attribute 'motion', i.e. the definition which embodies the *cause* of the attribute. Cf. *Post. An.* 93b 39.

[3] All the manuscripts except E add in l. 10 ἢ τοσόνδε. It seems better to omit these words, as Aristotle is thinking mainly of the generation of substance, and of alteration of quality—the cases in which form is most obviously *transferred*.

[4] With ll. 13–21 cf. *Met.* 1066a 26–34.

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 they can be described in different ways. So it is with the mover and the moved.

This view has a dialectical difficulty. Perhaps it is necessary that the actuality of the agent and that of the patient should not be the same. The one is 'agency' and the other 'patiency'; and the outcome and completion of the one is an 'action', that of the other a 'passion'.[1] Since then they are both motions, we may ask: *in* what are they, if they are different? Either (*a*) bot.. are in what is acted on and moved, or (*b*) the agency is in the agent and the patiency in the patient.[2] (If we ought to call the latter also 'agency', the word would be used in two senses.)

Now, in alternative (*b*), the motion will be in the mover, for the same statement will hold of 'mover' and 'moved'.[3] Hence either *every* mover will be moved, or, though having motion, it will not be moved.

If on the other hand (*a*) 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[4] in *one* subject towards *one* definite quality? The thing is impossible: the actualization will be one.

202b But (some one 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

[1] πάθος = affection, modification, change caused in a thing *ab extra*.
[2] Aristotle omits the two other possibilities as they *obviously* lead to absurdity.
[3] i.e. we can substitute 'mover' and 'moved' for 'agent' and 'patient' in the formulation of the hypothesis.
[4] Alterations of quality = ἀλλοιώσεις. Aristotle sometimes tends to think of κίνησις as primarily change of quality, rather than as change of position.

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.

One may reply:

(1) 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 *on* some patient—it is not cut adrift from a subject, but is of *A* on *B*.

(2) There is nothing to prevent two things having one and the same actualization,[1] provided the actualizations are not *described* in the same way, but are related as what can act to what is acting.[2]

(3) 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 *definition* (as 'raiment' and 'dress'), but are the same merely 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.[3] For it is not things which are in a way the same that have all their attributes the same, but only such as have the same definition. 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 the two *vectors* *AB* and *BA* 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 *X* in *Y*' and the 'actualization of *Y* through the action of *X*' differ in *definition*.

What then Motion is, has been stated both generally and particularly. It is not difficult to see how each of

[1] Reading in l. 8 with FI and Simp. *κωλύει οὐθὲν τὴν αὐτὴν εἶναι* for *αὐτὴν εἶναι κωλύει*.

[2] What can act and what is acting are *idem subjecto*, but not *idem definitione*. Read *δυνάμενον* in l. 10, with E.

[3] Cf. a18–20.

its types will be defined—alteration is the fulfilment of the alterable *qua* 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, &c. A similar definition will apply to each of the other kinds of motion.

The science of nature is concerned with spatial magni- 4
tudes and motion and time, and each of these at least is necessarily infinite or finite, even if some things dealt with by the science 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 specializes in physics to discuss the infinite and to inquire whether there *is* such a thing or not, and, if there is, *what* it is.

The appropriateness to the science of this problem is
203a clearly indicated. 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.

(1) Some, as the Pythagoreans and Plato, make the infinite a principle in the sense of a self-subsistent substance, and not as a mere attribute 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.

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,[1]

[1] περιτιθεμένων γὰρ τῶν γνωμόνων περὶ τὸ ἓν καὶ χωρίς. No thoroughly satisfactory explanation of καὶ χωρίς has been given. But Aristotle's general meaning is fairly plain. He is describing *two* constructions: in the one *odd* gnomons are placed round the *one*, in the other *even*

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

The physicists, on the other hand, all of them, always regard the infinite as an attribute of a substance which is different from it and belongs to the class of the so-called elements [1]—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 seed-mass of the atomic shapes according to the other.

Further, Anaxagoras held that any part is a mixture in the same way as the All, 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 beginning 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 an origin of coming to be. One such source there is which he calls Mind, and Mind begins its work of thinking from some starting-point. So necessarily all things must have been together at a certain time, and must have begun to be moved at a certain time.

Democritus, for his part, asserts the contrary, namely that no element arises from another element. Nevertheless for him [2] the common body is a source of all things, differ- 203b
ing from part to part in size and in shape.

It is clear then from these considerations that the inquiry concerns the physicist. Nor is it without reason that they

gnomons are placed round the *two*. The translation follows Milhaud (*Philosophes-géomètres*, p. 115). See also Burnet, *Early Greek Philosophy*², p. 103, n. 2.

[1] Aristotle does not regard them as elements.

[2] Reading in l. 34 αὐτῷ, with Phil. and Bonitz.

all make it a principle or source. We cannot say that the infinite has no effect, and the only effectiveness which we can ascribe to it is that of a principle. Everything is either a source or derived from a source. But there cannot be a source of the infinite or limitless, for that would be a limit of it. Further, as it is a beginning, it is both uncreatable and indestructible. For there must be a point at which what has come to be reaches completion, 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.

Belief in the existence of the infinite comes mainly from five considerations:

(1) From the nature of time—for it is infinite.

(2) From the division of magnitudes—for the mathematicians also use the notion of the infinite.

(3) If coming to be and passing away do not give out, it is only because that from which things come to be is infinite.

(4) 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.

(5) 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*.

The last fact (that what is outside is infinite) leads people to suppose 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 must be.

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?

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

We must begin by distinguishing the various senses in which the term 'infinite' is used.

(1) [1] What is incapable of being gone through, because it is not its nature to be gone through (the sense in which the voice is 'invisible').

(2) What admits of being gone through, the process however having no termination, or (3) what scarcely admits of being gone through.

(4) What naturally admits of being gone through, but is not actually gone through or does not actually reach an end.

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

5 Now it is impossible that the infinite should be a thing which is itself infinite, separable from sensible objects. If the infinite is neither a magnitude nor an aggregate, but is itself a substance and not an attribute, it will be indivisible; for the divisible must be either a magnitude or an aggregate. But if indivisible, then not infinite, except in the sense (1) in which the voice is 'invisible'. But this is not the sense in which it is used by those who say that the infinite exists, nor that in which we are investigating it, namely as (2), 'that which cannot be gone through'. But [2] if the infinite exists as an attribute, it would not be, *qua* infinite, an element in substances, any more than the invisible would be an element of speech, though the voice is invisible.

[1] With ll. 3-14 cf. *Met.* $1066^a 35-{}^b7$..

[2] With ll. 14-17 cf. *Met.* $1066^b 8-11$.

Further,[1] how can the infinite be itself any thing, unless both number and magnitude, of which it is an essential attribute, exist in that way? If *they* are not substances, *a fortiori* the infinite is not.

It[2] 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 full completion: for it must be a definite quantity.

Suppose then that infinity belongs to substance as an attribute. But, if so, it cannot, as we have said, be described as a principle, but rather that of which it is an attribute—the air or the even number.

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.

This[3] discussion, however, involves the more general question whether the infinite can be present in mathematical objects and things which are intelligible and do not
204b have extension, as well as among sensible objects. Our inquiry (as physicists) is limited to its 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[4] increase.

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

If 'bounded by a surface' is the definition of body there cannot be an infinite body either intelligible or sensible.

[1] With ll. 17–19 cf. *Met.* 1066b 7–8.
[2] With ll. 20–32 cf. *Met.* 1066b 11–21.
[3] With ll. 34–b8 cf. *Met.* 1066b 21–6.
[4] Reading in l. 4 ἐπί. Bekker's περί is a misprint.

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.

If,[1] 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.

The infinite body must be either (1) compound, or (2) simple; yet neither alternative is possible.

(1) Compound the infinite body will not be, 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*.[2]

Nor (2) can the infinite body be one and simple, whether it is, as some[3] hold, a thing over and above the elements (from which they generate the elements) or is not thus qualified.

(*a*) We must consider the former alternative; for there *are* some people who make this the infinite, and not air or water, in order that[4] 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.

It is impossible, however, that there should be such a body; not because it is infinite—on that point a general

[1] With ll. 10–24 cf. *Met.* 1066^b 26–36.
[2] There could not be *two* such bodies.
[3] The reference is probably to Anaximander.
[4] Reading in l. 25 ὅπως, with I Phil.

proof can be given which applies equally to all, air, water, or anything else—but[1] simply because there is, as a matter of fact, 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.

(*b*) Nor can fire or any other of the elements be infinite.
205a For generally, and apart from the question how any of them could be infinite, the All, 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).

The preceding consideration of the various cases serves to show us whether it is or is not possible that there should be an infinite sensible body. The following arguments give a general demonstration that it is not possible.

It[2] 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.

Suppose (*a*) that the infinite sensible body is homogeneous. Then each part 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 *ex hypothesi* 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 home everywhere—then it will not

[1] With l. 32–205a 7 cf. *Met.* 1066b 36–1067a 7.
[2] With ll. 10–25 cf. *Met.* 1067a 7–20.

be moved; or it will be moved everywhere—then it will not come to rest.[1]

But if (*b*) the All has dissimilar parts, the proper places of the parts will be dissimilar also, and the body of the All will have no unity except that of contact. Then, further, the parts will be either finite or infinite in variety of kind. (i) *Finite* they cannot be, for if the All is to be infinite, some of them would have to be infinite, while the others were not, e.g. fire or water will be infinite. But, as we have seen before, such an element would destroy what is contrary to it. (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.)[2]

But[3] (ii) 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[4] (and then the body would no longer[5] 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.

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.

[1] Reading in ll. 18–19 *ἢ πάνταχοῦ μενεῖ—οὐ κινηθήσεται ἄρα· ἢ πανταχοῦ κινηθήσεται—οὐκ ἄρα στήσεται.*

[2] This sentence should probably come, as Pacius suggests, after *εἶναι* in $^{b}1$.

[3] With ll. 29–32 cf. *Met.* 1067^{a} 20–3.

[4] Omitting the first *ἅμα* in l. 34, with E Them. Phil.

[5] Reading in l. 35 *σῶμα ἔτι· οὔτε*, with E and Phil.

Even if it is true as true can 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. Anything else might be in a state of rest, but 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[1] the centre. But it would not be because there was no other region in which it could be carried along that it would remain at the centre, but because this is its nature.[2] 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 because it is infinite, 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.

Another difficulty emerges at the same time. Any 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.

In[3] general, the view that there is an infinite body is plainly incompatible with the doctrine that there is necessarily 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

[1] Reading in l. 11 ὑπό, with Simp. Phil. and Bonitz.
[2] Omitting οὐ in l. 13 with E and Them.
[3] With l. 24–206a 7 cf. *Met.* 1067a 23–33.

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 [1] 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 arbitrary agreement, 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. 206a

Surely what is in a special place is in place, and what is in place is in a special place. Just, then, as the infinite cannot be quantity—that would imply that it has a particular quantity,[2] e.g. two or three cubits; quantity just means these—so a thing's being in 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.

It is plain from these arguments that there is no body which is *actually* infinite.

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.

We must keep in mind that the word 'is' means either what *potentially* is or what *fully* is.

Further, a thing is infinite either by addition or by division.[3]

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.[4]) The alternative then remains that the infinite has a potential existence.

[1] Reading in l. 31 ἔσχατον καὶ μέσον, with Simp. and *Met.* 1067^a 28.
[2] Reading in l. 3 ποσόν γάρ τι, with Bonitz.
[3] Reading in l. 15 διαιρέσει, with F Them. Phil. Simp.
[4] Cf. Bk. vi and *De Lineis Insecabilibus*.

But the phrase 'potential existence' is ambiguous. When we speak of the potential existence of a statue we mean that there will be an actual statue. It is not so with the infinite. There will not be an actual infinite. The word 'is' has many senses, 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.

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' has more than one sense,[1] so that we must not regard the infinite as a 'this',[2] 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; definite if you like at each stage, yet always different.

206b But when this takes place 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.

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 in proportion as we see division going on, in the same proportion we see addition being made 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),[3]

[1] Inserting in l. 29 ἔτι (ὅτι E) τὸ εἶναι πλεοναχῶς λέγεται, with E Phil. Simp.
[2] A fully existent individual.
[3] Reading in l. 8 τι τοῦ ὅλου μέγεθος, with F and Simp.

and so on, 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[1] finite magnitude is exhausted by means of any determinate quantity however small.

The infinite, then, exists in no other way, but in this way it does exist, potentially and by reduction. It exists fully 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.

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 in smallness and there will be a smaller part.

But in respect of addition there cannot be an infinite which even potentially exceeds every assignable magnitude, unless it has the attribute of being actually infinite, as the physicists hold to be true of the body which is outside the world, whose essential nature is air or something of the kind. But if there cannot be in this way a sensible body which is infinite in the full sense, evidently there can no more be a body which is potentially infinite in respect of addition, except as the inverse of the infinite by 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 the parts number only up to the decad.

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, 207a
but what always has something outside it. This is indicated

[1] Omitting the second τό in l. 11, with E F.

by the fact that rings also that have no bezel are described as 'endless',[1] 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 next part which is taken should never be the same. In the circle, the latter condition is not satisfied: it is only the adjacent part from which the new part is different.

Our definition then is as follows:

A quantity is infinite if it is such that we can always take a part outside what has been already taken. 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 a whole box. What is true of each particular is true of the whole as such—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 (τέλειον) which has no end (τέλος); and the end is a limit.

Hence Parmenides must be thought to have spoken better than Melissus. The latter says that the whole is infinite,[2] but the former describes it as limited, 'equally balanced from the middle'.[3] For to connect the infinite with the all and the whole is not like joining two pieces of string;[4] for it is from this they get the dignity they ascribe to the infinite—its containing[5] all things and holding[6] the all 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 the full sense. It is divisible both in the direction of reduction and of the inverse addition. It is a whole and limited; not,

[1] ἄπειροι.
[2] Reading in l. 16 ἄπειρον τὸ ὅλον, with Bonitz.
[3] Fr. 8. 44.
[4] A proverbial example of combining things which are homogeneous.
[5] Reading in l. 19 περιέχειν, with E and Them.
[6] Reading in l. 20 ἔχειν, with Them. and Bonitz.

however, in virtue of its own nature, but in virtue of what is other than it. 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 statue.) If it contains in the case of sensible things,[1] 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.

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[2] and the infinite are contained inside what contains them, while it is the form which contains. It is natural too to suppose that 207b
in number there is a limit in the direction of the minimum, and that in the other direction every assigned number is surpassed. In magnitude, on the contrary, every assigned 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 merely derivative terms, and so with each of the other numbers. But in the direction of largeness it is always possible to think of a larger 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 assigned number. But this number is not separable from the process of bisection, and its infinity is not a permanent actuality but consists in a process of coming to be, like time and the number of time.

[1] Putting the comma before *καί* in l. 29, not before *ἔδει* in l. 30.
[2] Omitting *ὡς* in l. 35, with E and Simp.

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 also actually be.[1] Hence since no sensible magnitude is infinite, it is impossible to exceed every assigned magnitude; for if it were possible there would be something bigger than the heavens.

The infinite[2] is not the same in magnitude and movement and time, in the sense of a single nature, but its secondary sense depends on its primary sense, i. e. 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.)

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 the finite straight line may be produced as far as they wish. It is possible to have divided in 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 to have such an infinite instead, while its existence will be in the sphere of real 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
208a 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.

It remains to dispose of the arguments[3] which are sup- 8
posed to support the view that the infinite exists not only

[1] Otherwise the potentiality would be unintelligible.
[2] With ll. 21–5 cf. *Met.* 1067^a 33–7.
[3] Cf. 203^b 15–30.

potentially but as a separate thing. Some have no cogency; others can be met by fresh objections that are valid.

(1) 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 All being limited.

(2) 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 necessarily possible between any two things taken at random.

(3) To rely on mere 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 [1] 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.

(*a*) Time indeed and movement are infinite, and also thinking, in the sense that each part that is taken passes in succession out of existence.

(*b*) Magnitude is not infinite either in the way of reduction or of magnification in thought.

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.

[1] Omitting τοῦ ἄστεος and ἢ in l. 18, with γρ. Phil. and Diels.

BOOK IV

The physicist must have a knowledge of Place, too, as 1
well as of the infinite—namely, whether there is such a thing or not, and the manner of its existence and what it is—both because all suppose that things which exist are *somewhere* (the non-existent is nowhere—where is the goat-stag or the sphinx?), and because 'motion' in its most general and primary sense is change of place, which we call 'locomotion'.

The question, what is place? presents many difficulties. An examination of all the relevant facts seems to lead to divergent conclusions. Moreover, we have inherited nothing from previous thinkers, whether in the way of a statement of difficulties or of a solution.

208b The existence of place is held to be obvious from the fact of mutual replacement. Where water now is, there in turn, when the water has gone out as from a vessel, air is present. When therefore another body occupies this same place, the place is thought to be different from all the bodies which come to be in it and replace one another. What now contains air formerly contained water, so that clearly the place or space into which and out of which they passed was something different from both.

Further, the typical locomotions of the elementary natural bodies—namely, fire, earth, and the like—show not only that place is something, but also that it exerts a certain influence. Each is carried to its own place, if it is not hindered, the one up, the other down. Now these are regions or kinds of place—up and down and the rest of the six directions. Nor do such distinctions (up and down and right and left, &c.) hold only in relation to us. To *us* they are not always the same but change with the direction in which we are turned: that is why the same thing may be both right *and* left, up *and* down, before *and* behind. But in *nature* each is ~~distinct, taken apart by~~ itself. It is not every chance direction which is 'up', but where fire and what is light are carried; similarly, too, 'down' is not any chance direction but where what has weight and what is made of earth are carried—the implication being that these places do not differ merely in relative position, but also as possessing distinct potencies. This is made plain also by the objects studied by mathematics. Though they have no real place, they nevertheless, in respect of their position relatively to us, have a right and left as attributes ascribed to them only in consequence of their relative position, not having by nature these various characteristics[1]. Again, the theory that the void exists involves the existence of place: for one would define void as place bereft of body.

These considerations then would lead us to suppose that place is something distinct from bodies, and that every sensible body is in place. Hesiod too might be held to have given a correct account of it when he made chaos first. At least he says:

> First of all things came chaos to being, then broad-
> breasted earth,[2]

implying that things need to have space first, because he thought, with most people, that everything is somewhere and in place. If this is its nature, the potency of place must be a marvellous thing, and take precedence of all other things. For that without which nothing else can exist, while it can exist without the others, must needs be first; for place does not pass out of existence when the 209a
things in it are annihilated.

True, but even if we suppose its existence settled, the question of its *nature* presents difficulty—whether it is some sort of 'bulk' of body or some entity other than that, for we must first determine its genus.

(1) Now it has three dimensions, length, breadth, depth, the dimensions by which all body also is bounded. But

[1] Reading in l. 24 ὡς μόνον λεγόμενα διὰ θέσιν, οὐκ ἔχοντα φύσει, with Laas (ὡς τὰ μόνον κτλ. Simp.). The readings of the MSS. are due to a conjecture by Alexander.

[2] *Theog.* 116 f.

the place cannot *be* body; for if it were there would be two bodies in the same place.

(2) Further, if body has a place and space, clearly so too have surface and the other limits of body; for the same statement will apply to them: where the bounding planes of the water were, there in turn will be those of the air. But when we come to a point we cannot make a distinction between it and its place. Hence if the place of a point is not different from the point, no more will that of any of the others be different, and place will not be something different from each of them.

(3) What in the world then are we to suppose place to be? If it has the sort of nature described, it cannot be an element or composed of elements, whether these be corporeal or incorporeal: for while it has size, it has not body. But the elements of sensible bodies are bodies, while nothing that has size results from a combination of intelligible elements.

(4) Also we may ask: of what in things is space the cause? None of the four modes of causation can be ascribed to it. It is neither cause in the sense of the matter of existents (for nothing is composed of it), nor as the form and definition of things, nor as end, nor does it move existents.

(5) Further, too, if it is itself an existent, *where* will it be? Zeno's difficulty[1] demands an explanation: for if everything that exists has a place, place too will have a place, and so on *ad infinitum*.

(6) Again, just as every body is in place, so, too, every place has a body in it. What then shall we say about *growing* things? It follows from these premisses that their place must grow with them, if their place is neither less nor greater than they are.

By asking these questions, then, we must raise the whole problem about place—not only as to what it is, but even whether there is such a thing.

We may distinguish generally between predicating B of 2
A because it (A) is itself, and because it is something else;

[1] Cf. Diels, *Vors.*[3] i. 171. 15-26.

and particularly between place which is common and in which all bodies are, and the special place occupied primarily by each. I mean, for instance, that you are now in the heavens because you are in the air and it is in the heavens; and you are in the air because you are on the earth; and similarly on the earth because you are in this place which contains no more than you.

Now [1] if place is what *primarily* contains each body, it would be a limit, so that the place would be the form or shape of each body by which the magnitude or the matter of the magnitude is defined: for this is the limit of each body. 209b

If, then, we look at the question in this way the place of a thing is its form. But, if we regard the place as the *extension* of the magnitude, it is the matter. For this is different from the magnitude: it is what is contained and defined by the form, as by a bounding plane. Matter or the indeterminate is of this nature; when the boundary and attributes of a sphere are taken away, nothing but the matter is left.

This is why Plato in the *Timaeus* [2] says that matter and space are the same; for the 'participant' and space are identical. (It is true, indeed, that the account he gives there of the 'participant' is different from what he says in his so-called 'unwritten teaching'.[3] Nevertheless, he did identify place and space.) I mention Plato because, while all hold place to be something, he alone tried to say *what* it is.

In view of these facts we should naturally expect to find difficulty in determining what place is, if indeed it *is* one of these two things, matter or form. They demand a very close scrutiny, especially as it is not easy to recognize them apart.

But it is at any rate not difficult to see that place cannot be either of them. The form and the matter are not

[1] λέγω . . . σέ ^{a}33–^{b}1 is parenthetical, and there should be a comma before εἰ in ^{b}1 (so Bonitz).

[2] 52.

[3] Where he apparently identified 'the participant' with 'the great and the small'; cf. l. 35.

separate from the thing, whereas the place can be separated. As we pointed out,[1] where air was, water in turn comes to be, the one replacing the other; and similarly with other bodies. Hence the place of a thing is neither a part nor a state of it, but is separable from it. For place is supposed to be something like a vessel—the vessel being a transportable place. But the vessel is no part of the thing.

In so far then as it is separable from the thing, it is not the form: *qua* containing, it is different from the matter.

Also it is held that what is anywhere is both itself something and that there is a different thing outside it.[2] (Plato of course, if we may digress, ought to tell us why the form and the numbers are not in place, if 'what participates' is place—whether what participates is the Great and the Small
210a or the matter, as he called it in writing in the *Timaeus*.)[3]

Further, how could a body be carried to its own place, if place was the matter or the form? It is impossible that what has no reference to motion or the distinction of up and down can be place. So place must be looked for among things which have these characteristics.

If the place is in the thing[4] (it must be if it is either shape or matter) place will have a place: for both the form and the indeterminate undergo change and motion along with the thing, and are not always in the same place, but are where the thing is. Hence the place will have a place.

Further, when water is produced from air, the place has been destroyed, for the resulting body is not in the same place.[5] What sort of destruction then is that?

(1) This concludes my statement of the reasons why space must be something, and again of the difficulties that may be raised about its essential nature.

(2) The next step we must take is to see in how many senses one thing is said to be 'in' another. 3

[1] 208^b 2.
[2] Cf. 212^b 14–16.
[3] 52.
[4] Reading αὐτῷ in l. 5, with the MSS.
[5] The place of the air is part of the substance air.

(1) As the finger is 'in' the hand and generally the part 'in' the whole.

(2) As the whole is 'in' the parts: for there is no whole over and above the parts.

(3) As man is 'in' animal and generally species 'in' genus.

(4) As the genus is 'in' the species and generally the part of the specific form 'in' the definition of the specific form.

(5) As health is 'in' the hot and the cold and generally the form 'in' the matter.

(6) As the affairs of Greece centre 'in' the king, and generally events centre 'in' their primary motive agent.

(7) As the existence of a thing centres 'in' its good and generally 'in' its end, i.e. in 'that for the sake of which' it exists.

(8) In the strictest sense of all, as a thing is 'in' a vessel, and generally 'in' place.

One might raise the question whether a thing can be in itself, or whether nothing can be in itself—everything being either *no*where or in something *else*.

The question is ambiguous; we may mean the thing *qua* itself or *qua* something else.

When there are parts of a whole—the one that in which a thing is, the other the thing which is in it—the whole will be described as being in itself. For a thing is described in terms of its parts, as well as in terms of the thing as a whole, e.g. a man is said to be white because the visible surface of him is white, or to be scientific because his thinking faculty has been trained. The jar then will not be in itself and the wine will not be in itself. But the jar of wine will: for the contents and the container are both parts of the same whole.

In this sense then, but not primarily, a thing can be in itself, namely, as 'white' is in body (for the visible surface is in body), and science is in the mind.[1]

[1] Because the faculty of reasoning is in the mind. ἡ ἐπιφάνεια ... σώματι ($^{a}34$–$^{b}1$) is parenthetical.

It is from these, which are 'parts' (in the sense at least of being 'in' the man), that the man is called white, &c. But the jar and the wine in separation are not parts of a whole, though together they are. So when there are parts, a thing will be in itself, as 'white' is in man because it is in body, and in body because it resides in the visible surface. We cannot go further and say that it is in surface in virtue of something other than itself. (Yet it is not in itself: though these are in a way the same thing,) they differ in essence, each having a special nature and capacity, 'surface' and 'white'.

Thus if we look at the matter inductively we do not find anything to be 'in' itself in any of the senses that have been distinguished; and it can be seen by argument that it is impossible. For each of two things will have to be both, e.g. the jar will have to be both vessel and wine, and the wine both wine and jar, if it is possible for a thing to be in itself; so that, however true it might be that they were in each other, the jar will receive the wine in virtue not of *its* being wine but of the wine's being wine, and the wine will be in the jar in virtue not of *its* being a jar but of the jar's being a jar. Now that they are different in respect of their essence is evident; for 'that in which something is' and 'that which is in it' would be differently defined.

Nor is it possible for a thing to be in itself even incidentally: for two things would be at the same time in the same thing. The jar would be in itself—if a thing whose nature it is to receive can be in itself;[1] and that which it receives, namely (if wine) wine, will be in it.

Obviously then a thing cannot be in itself *primarily*.

Zeno's problem[2]—that if Place is something it must be in something[3]—is not difficult to solve. There is nothing to prevent the first place from being 'in' something else—not indeed in that as 'in' place, but as health is 'in' the

[1] Reading a comma after εἶναι in l. 20.
[2] Cf. Diels, *Vors.*^{3} i. 171. 15-26.
[3] Reading ἔν τινι in l. 23, with Them. Phil. Simp.

hot as a positive determination of it or as the hot is 'in' body as an affection. So we escape the infinite regress.

Another thing is plain: since the vessel is no part of what is in it[1] (what contains in the *strict* sense is different from what is contained), place could not be either the matter or the form of the thing contained, but must be different—for the latter, both the matter and the shape, are parts of what is contained.

This then may serve as a critical statement of the difficulties involved.

4 What then after all is place? The answer to this question may be elucidated as follows.

Let us take for granted about it the various characteristics which are supposed correctly to belong to it essentially.[2] We assume then—

(1) Place is what contains that of which it is the place.

(2) Place is no part of the thing. 211a

(3) The immediate place of a thing is neither less nor greater than the thing.

(4) Place can be left behind by the thing and is separable.

In addition:

(5) All place admits of the distinction of up and down, and each of the bodies is naturally carried to its appropriate place and rests there, and this makes the place either up or down.

Having laid these foundations, we must complete the theory. We ought to try to make our investigation such as will render an account of place, and will not only solve the difficulties connected with it, but will also show that the attributes supposed to belong to it do really belong to it, and further will make clear the cause of the trouble and of the difficulties about it. Such is the most satisfactory kind of exposition.

First then we must understand that place would not

[1] Reading αὐτῷ in l. 28, with Simp. and Bonitz.
[2] Reading αὐτόν in l. 33, with G.

have been thought of, if there had not been a special kind of motion, namely that with respect to place. It is chiefly for this reason that we suppose the heaven also to be in place, because it is in constant movement. Of this kind of change there are two species—locomotion on the one hand and, on the other, increase and diminution. For these too involve variation of place: what was then in this place has now in turn changed to what is larger or smaller.

Again, when we say a thing is 'moved', the predicate either (1) belongs to it actually, in virtue of its own nature, or (2) in virtue of something conjoined with it. In the latter case it may be either (*a*) something which by its own nature is capable of being moved, e.g. the parts of the body or the nail in the ship, or (*b*) something which is not in itself capable of being moved, but is *always* moved through its conjunction with something else, as 'whiteness' or 'science'. These have changed their place only because the subjects to which they belong do so.

We say that a thing is in the world, in the sense of in place, because it is in the air, and the air is in the world; and when we say it is in the air, we do not mean it is in every part of the air, but that it is in the air because of the outer surface of the air which surrounds it; for if all the air were its place, the place of a thing would not be equal to the thing—which it is supposed to be, and which the primary place in which a thing is actually is.[1]

When what surrounds, then, is not separate from the thing, but is in continuity with it, the thing is said to be in what surrounds it, not in the sense of in place, but as a part in a whole. But when the thing is separate and in contact, it is immediately 'in' the inner surface of the surrounding body, and this surface is neither a part of what is in it nor yet greater than its extension, but equal to it; for the extremities of things which touch are coincident.

Further, if one body is in continuity with another, it is not moved *in* that but *with* that. On the other hand it is

[1] As Bonitz pointed out, εἰ . . . ἐστίν (ll. 27–9) is parenthetical, and there should be a comma after εἶναι (l. 28), and a colon after the parenthesis.

moved *in* that if it is separate. It makes no difference whether what contains is moved or not.

Again, when it is not separate it is described as a part in 211b
a whole, as the pupil in the eye or the hand in the body: when it is separate, as the water in the cask or the wine in the jar. For the hand is moved *with*[1] the body and the water *in* the cask.

It will now be plain from these considerations what place is. There are just four things of which place must be one —the shape, or the matter, or some sort of extension between the bounding surfaces of the containing body, or this boundary itself if it contains no extension over and above the bulk of the body which comes to be in it.

Three of these it obviously cannot be:

(1) The shape is supposed to be place because it surrounds, for the extremities of what contains and of what is contained are coincident. Both the shape and the place, it is true, are boundaries. But not of the same thing: the form is the boundary of the thing, the place is the boundary of the body which contains it.

(2) The extension between the extremities is thought to be something, because what is contained and separate may often be changed while the container remains the same (as water may be poured from a vessel)—the assumption being that the extension is something over and above the body displaced. But there is no such extension. One of the bodies which change places and are naturally capable of being in contact with the container falls in—whichever it may chance to be.

If there were an extension which were such as to exist independently and be permanent, there would be an infinity of places in the same thing.[2] For when the water and the air change places, all the portions of the two together will play the same part in the whole which was previously played by all the water in the vessel; at the same time

[1] Reading μετά in l. 4; Bekker's κατά is a misprint.

[2] Reading in l. 19 τι διάστημα (Phil. Simp.) ⟨καθ'⟩ αὐτὸ πεφυκὸς ⟨εἶναι⟩ (Laas) καὶ μένον, ἐν τῷ αὐτῷ ἄπειροι κτλ. (F Phil. Simp., except that Simp. has the comma after αὐτῷ).

the place too will be undergoing change; so that there will be another place which is the place of the place, and many places will be coincident. There is not a different place of the part, in which it is moved, when the whole vessel changes its place: it is always the same: for it is in the (proximate) place where they are that the air and the water (or the parts of the water) succeed each other, not in that place in which they come to be, which is part of the place which is the place of the whole world.

(3) The matter, too, might seem to be place, at least if we consider it in what is at rest and is thus separate but in continuity. For just as in change of quality there is something which was formerly black and is now white, or formerly soft and now hard—this is just why we say that the matter exists—so place, because it presents a similar phenomenon, is thought to exist—only in the one case we say so because *what* was air is now water, in the other because *where* air formerly was there is now water. But 212a the matter, as we said before,[1] is neither separable from the thing nor contains it, whereas place has both characteristics.

Well, then, if place is none of the three—neither the form nor the matter nor an extension which is always there, different from, and over and above, the extension of the thing which is displaced—place necessarily is the one of the four which is left, namely, the boundary of the containing body at which it is in contact with the contained body.[2] (By the contained body is meant what can be moved by way of locomotion.)

Place is thought to be something important and hard to grasp, both because the matter and the shape present themselves along with it, and because the displacement of the body that is moved takes place in a stationary container, for it seems possible that there should be an interval which is other than the bodies which are moved. The air, too, which is thought to be incorporeal, contributes something to

[1] 209b 22–32.

[2] Reading in l. 6 σώματος καθ' ὃ συνάπτει τῷ περιεχομένῳ, with Them. Phil. Simp.

the belief: it is not only the boundaries of the vessel which seem to be place, but also what is between them, regarded as empty. Just, in fact, as the vessel is transportable place, so place is a non-portable vessel. So when what is within a thing which is moved, is moved[1] and changes its place, as a boat on a river, what contains plays the part of a vessel rather than that of place. Place on the other hand is rather what is motionless: so it is rather the whole river that is place, because as a whole it is motionless.

Hence we conclude that *the innermost motionless boundary of what contains is place.*

This explains why the middle of the heaven and the surface which faces us of the rotating system are held to be 'up' and 'down' in the strict and fullest sense for all men: for the one is always at rest, while the inner side of the rotating body[2] remains always coincident with itself. Hence since the light is what is naturally carried up, and the heavy what is carried down, the boundary which contains in the direction of the middle of the universe, and the middle itself, are down, and that which contains in the direction of the outermost part of the universe, and the outermost part itself, are up.

For this reason, too, place is thought to be a kind of surface, and as it were a vessel, i.e. a container of the thing.

Further, place is coincident with the thing, for boundaries are coincident with the bounded.

5 If then a body has another body outside it and containing it, it is in place, and if not, not. That is why, even if there were to be water which had not a container, the parts of it, on the one hand, will be moved (for one part is contained in another), while, on the other hand, the whole will be moved in one sense, but not in another. For as a whole it does not simultaneously change its place, though it will be moved in a circle: for this place is the place of its 212b
parts. (Some things are moved, not up and down, but in

[1] Omitting τι in l. 16 with EFG.
[2] Reading in l. 24 κύκλῳ, with FGI.

a circle; others up and down, such things namely as admit of condensation and rarefaction.)

As was explained,[1] some things are potentially in place, others actually. So, when you have a homogeneous substance which is continuous, the parts are potentially in place: when the parts are separated, but in contact, like a heap, they are actually in place.

Again, (1) some things are *per se* in place, namely every body which is movable either by way of locomotion or by way of increase is *per se* somewhere, but the heaven, as has been said,[2] is not anywhere as a whole, nor in any place, if at least, as we must suppose, no body contains it. On the line on which it is moved, its parts have place[3]: for each is contiguous to the next.

But (2) other things are in place indirectly, through something conjoined with them, as the soul and the heaven. The latter is, in a way, in place, for all its parts are: for on the orb one part contains another. That is why the upper part is moved in a circle, while the All is not anywhere. For what is somewhere is itself something, and there must be alongside it some other thing wherein it is and which contains it. But alongside the All or the Whole there is nothing outside the All, and for this reason all things are in the heaven; for the heaven, we may say, is the All. Yet their place is not the same as the heaven. It is part of it, the innermost part of it, which is in contact with the movable body;[4] and for this reason the earth is in water, and this in the air, and the air in the aether, and the aether in heaven, but we cannot go on and say that the heaven is in anything else.

It is clear, too, from these considerations that all the problems which were raised[5] about place will be solved when it is explained in this way:

(1) There is no necessity that the place should grow with the body in it,

[1] 211a 17–b5. [2] a32.
[3] It is only in reference to its parts that it can be said to be moved.
[4] Omitting πέρας ἠρεμοῦν in l. 19, with E Them. Simp.
[5] 209a 2–30.

(2) Nor that a point should have a place,

(3) Nor that two bodies should be in the same place,

(4) Nor that place should be a corporeal interval: for what is between the boundaries of the place is any body which may chance to be there, not an interval in body.

Further, (5) place is also somewhere, not in the sense of being in a place, but as the limit is in the limited; (for not everything that is is in place, but only movable body.)

Also (6) it is reasonable that each kind of body should be carried to its own place. For a body which is next in the series and in contact (not by compulsion) is akin, and bodies which are united do not affect each other, while those which are in contact interact on each other.[1]

Nor (7) is it without reason that each[2] should remain naturally in its proper place. For this part has the same relation to its place,[3] as a separable part to its whole, as when one moves a part of water or air: so, too, air is 213a related to water, for the one is like matter, the other form—water is the matter of air, air as it were the actuality of water, for water is potentially air, while air is potentially water, though in another way.

These distinctions will be drawn more carefully later.[4] On the present occasion it was necessary to refer to them: what has now been stated obscurely will then be made more clear. If the matter and the fulfilment are the same thing (for water is both, the one potentially, the other completely), water will be related to air in a way as part

[1] The scheme suggested is

Fire { Dry, Hot
Air { Hot, Wet
Water { Wet, Cold
Earth { Cold, Dry

[2] Omitting in l. 33 ἕκαστον, with FG.

[3] Omitting in l. 34 ὅλῳ, with E and Phil.

[4] *De Gen. et Corr.* i. 3.

to whole. That is why these have *contact*: it is *organic union* when both become actually one.

This concludes my account of place—both of its existence and of its nature.

The investigation of similar questions about the void, 6
also, must be held to belong to the physicist—namely whether it exists or not, and how it exists or what it is—just as about place. The views taken of it involve arguments both for and against, in much the same sort of way. For those who hold that the void exists regard it as a sort of place or vessel which is supposed to be 'full' when it holds the bulk which it is capable of containing, 'void' when it is deprived of that—as if 'void' and 'full' and 'place' denoted the same thing, though the essence of the three is different.

We must begin the inquiry by putting down the account given by those who say that it exists, then the account of those who say that it does not exist, and third the current view on these questions.

Those who try to show that the void does not exist do not disprove what people really mean by it, but only their erroneous way of speaking;[1] this is true of Anaxagoras and of those who refute the existence of the void in this way. They merely give an ingenious demonstration that air is something—by straining wine-skins and showing the resistance of the air, and by cutting it off in clepsydras. But people really mean that there is an empty interval in which there is *no* sensible body. They hold that everything which is is body and say that what has nothing in it at all is void (so what is full of air is void). It is not then the existence of air that needs to be proved, but the non-existence of an interval, different from the bodies, either separable or actual—an interval which divides the whole body so as to break its continuity, as Democritus and Leucippus
213b hold, and many other physicists—or even perhaps as some-

[1] Reading in l. 24 ἀλλ' ὃ ἁμαρτάνοντες, with Them. Phil. Simp. and Pacius.

thing which is outside the whole body, which remains continuous.

These people, then, have not reached even the threshold of the problem, but rather those who say that the void exists.

(1) They argue, for one thing, that change in place (i. e. locomotion and increase) would not be. For it is maintained that motion would seem not to exist, if there were no void, since what is full cannot contain anything more. If it could, and there were two bodies in the same place, it would also be true that any number of bodies could be together; for it is impossible to draw a line of division beyond which the statement would become untrue. If this were possible, it would follow also that the smallest body would contain the greatest; for 'many a little makes a mickle': thus if many equal bodies can be together, so also can many unequal bodies.

Melissus,[1] indeed, infers from these considerations that the All is immovable; for if it were moved there must, he says, be void, but void is not among the things that exist.

This argument, then, is one way in which they show that there is a void.

(2) They reason from the fact that some things are observed to contract and be compressed, as people say that a cask will hold the wine which formerly filled it, along with the skins into which the wine has been decanted,[2] which implies that the compressed body contracts into the voids present in it.

Again (3) increase, too, is thought to take place always by means of void, for nutriment is body, and it is impossible for two bodies to be together. A proof of this they find also in what happens to ashes, which absorb as much water as the empty vessel.

The Pythagoreans,[3] too, (4) held that void exists and that it enters the heaven itself,[4] which as it were inhales it, from the infinite air. Further it is the void which distin-

[1] Cf. *De Gen. et Corr.* 325a 2–16.
[2] Cf. *Probl.* xxv. 8.
[3] Cf. Diels, *Vors.*[3] i. 354. 20–28.
[4] Reading in l. 23 αὐτῷ, with G.

guishes the natures of things, as if it were like what separates and distinguishes[1] the terms of a series. This holds primarily in the numbers, for the void distinguishes their nature.

These, then, and so many, are the main grounds on which people have argued for and against the existence of the void.

As a step towards settling which view is true, we must determine the meaning of the name. 7

The void is thought to be place with nothing in it. The reason for this is that people take what exists to be body, and hold that while every body is in place, void is place in which there is no body, so that where there is no body, there must be void.

214a Every body, again, they suppose to be tangible; and of this nature is whatever has weight or lightness.

Hence, by a syllogism, what has nothing heavy or light in it, is void.

This result, then, as I have said, is reached by syllogism. It would be absurd to suppose that the point is void; for the void must be *place* which has in it an interval in tangible body.

But at all events we observe then that in one way the void is described as what is not full of body perceptible to touch; and what has heaviness and lightness is perceptible to touch. So we would raise the question: what would they say of an interval that has colour or sound—is it void or not? Clearly they would reply that if it *could* receive what is tangible it was void, and if not, not.

In another way void is that in which there is no 'this' or corporeal substance. So some say that the void is the matter of the body (they identify the place, too, with this), and in this[2] they speak incorrectly; for the matter is not separable from the things, but they are inquiring about the void as about something separable.

Since we have determined the nature of place,[3] and void

[1] Omitting τῆς in l. 26, with Bonitz.
[2] Placing the comma after τὸ αὐτό in l. 14.
[3] ch. 4.

must, if it exists,[1] be place deprived of body, and we have stated both in what sense plaçe exists and in what sense it does not, it is plain that on this showing void does not exist, either unseparated or separated; for the void is meant to be, not body but rather an interval in body. This is why the void is thought to be something, viz. because place is, and for the same reasons. For the fact of motion in respect of place comes to the aid both of those who maintain that place is something over and above the bodies that come to occupy it, and of those who maintain that the void is something. They state that the void is the condition of movement in the sense of that in which movement takes place; and this would be the kind of thing that some say place is.

But there is no necessity for there being a void if there is movement. It is not in the least needed as a condition of movement in general, for a reason which,[2] incidentally, escaped Melissus; viz. that the full can suffer *qualitative* change.

But not even movement in respect of place involves a void; for bodies may simultaneously make room for one another, though there is no interval separate and apart from the bodies that are in movement. And this is plain even in the rotation of continuous things, as in that of liquids.

And things can also be compressed not into a void but because they squeeze out what is contained in them (as, for instance, when water is compressed the air within it is squeezed out); and things can increase in size not only by 214b
the entrance of something but also by qualitative change; e.g. if water were to be transformed into air.

In general, both the argument about increase of size[3] and that about the water poured on to the ashes[4] get in their own way. For either not any and every part of the body is increased, or bodies may be increased otherwise than by the addition of body, or there may be two bodies in the same place (in which case they are claiming to solve a quite

[1] Reading commas before and after εἰ ἔστιν in l. 17.
[2] Reading δι' ὅ in l. 27.
[3] 213b 18–20 [4] ib. 21 f.

general difficulty, but are not proving the existence of void), or the *whole* body must be void, if it is increased in every part and is increased by means of void. The same argument applies to the ashes.

It is evident, then, that it is easy to refute the arguments by which they prove the existence of the void.

Let us explain again that there is no void existing 8
separately, as some maintain. If each of the simple bodies has a natural locomotion, e. g. fire upward and earth downward and towards the middle of the universe, it is clear that it cannot be the void that is the condition of locomotion. What, then, *will* the void be the condition of? It is thought to be the condition of movement in respect of place, and it is not the condition of this.

Again, if void is a sort of place deprived of body, when there is a void where will a body placed in it move to? It certainly cannot move into the whole of the void. The same argument applies as against those who think that place is something separate, into which things are carried; viz. how will what is placed in it move, or rest? Much the same argument will apply to the void as to the 'up' and 'down' in place, as is natural enough since those who maintain the existence of the void make it a place.

And in what way will things be present either in place or in the void? For the expected[1] result does not take place when a body[2] is placed as a whole in a place conceived of as separate and permanent; for a part of it, unless it be placed apart, will not be in a place but in the whole. Further, if separate place does not exist, neither will void.

If people say that the void must exist, as being necessary if there is to be movement, what rather turns out to be the case, if one studies the matter, is the opposite, that not a single thing can be moved if there *is* a void; for as with those who for a like reason say the earth is at rest, so, too,

[1] Expected by those who believe in a separately existing place or void.

[2] Reading in l. 26 σῶμά τι, with Phil.'s and Simp.'s paraphrase.

in the void things must be at rest; for there is no place to which things can move more or less than to another; since the void in so far as it is void admits no difference.

The second reason is this[1]: all movement is either com- 215a pulsory or according to nature, and if there is compulsory movement there must also be natural (for compulsory movement is contrary to nature, and movement contrary to nature is posterior to that according to nature, so that if each of the natural bodies has not a natural movement, none of the other movements can exist); but how can there be natural movement if there is no difference throughout the void or the infinite? For in so far as it is infinite, there will be no up or down or middle, and in so far as it is a void, up differs no whit from down; for as there is no difference in what is nothing, there is none in the void (for the void[2] seems to be a non-existent and a privation of being), but natural locomotion seems to be differentiated, so that the things that exist by nature must be differentiated. Either, then, nothing has a natural locomotion, or else there is no void.

Further, in point of fact things that are thrown move though that which gave them their impulse is not touching them, either by reason of mutual replacement, as some maintain, or because the air that has been pushed pushes them with a movement quicker than the natural locomotion of the projectile wherewith it moves to its proper place.[3] But in a void none of these things can take place, nor can anything be moved save as that which is carried is moved.

Further, no one could say why a thing once set in motion should stop anywhere; for why should it stop *here* rather than *here*? So that a thing will either be at rest or must be moved *ad infinitum*, unless something more powerful get in its way.

Further, things are now thought to move into the void because it yields; but in a void this quality is present equally everywhere, so that things should move in all directions.

[1] Reading in l. 1 ἔπειθ' ὅτι, with I Them. Simp.
[2] Reading in l. 10 καὶ τοῦ κενοῦ· τὸ γὰρ κενόν, with H Them. Simp.
[3] i. e. downwards.

Further, the truth of what we assert is plain from the following considerations. We see the same weight or body moving faster than another for two reasons, either because there is a difference in what it moves through, as between water, air, and earth, or because, other things being equal, the moving body differs from the other owing to excess of weight or of lightness.

Now the medium causes a difference because it impedes the moving thing, most of all if it is moving in the opposite direction, but in a secondary degree even if it is at rest; and especially a medium that is not easily divided, i.e. a medium that is somewhat dense.

215b A, then, will move through B in time Γ, and through Δ, which is thinner,[1] in time E (if the length of B is equal to Δ), in proportion to the density of the hindering body. For let B be water and Δ air; then by so much as air is thinner and more incorporeal than water, A will move through Δ faster than through B. Let the speed have the same ratio to the speed, then, that air has to water. Then if air is twice as thin, the body will traverse B in twice the time that it does Δ, and the time Γ will be twice the time E. And always, by so much as the medium is more incorporeal and less resistant and more easily divided, the faster will be the movement.

Now there is no ratio in which the void is exceeded by body, as there is no ratio of 0 to a number. For if 4 exceeds 3 by 1, and 2 by more than 1, and 1 by still more than it exceeds 2, still there is no ratio by which it exceeds 0; for that which exceeds must be divisible into the excess + that which is exceeded, so that 4 will be what it exceeds 0 by + 0. For this reason, too, a line does not exceed a point—unless it is composed of points! Similarly the void can bear no ratio to the full, and therefore neither can movement through the one to movement through the other, but if a thing moves through the thickest medium such and such a distance in such and such a time, it moves through the void with a speed beyond any ratio.[2] For let

[1] Reading in l. 2 λεπτοτέρου, with E G Them. Simp.
[2] Placing the comma in l. 22 before διὰ τοῦ κενοῦ.

Z be void, equal in magnitude to B and to Δ. Then if A is to traverse and move through it in a certain time, H, a time less than E, however, the void will bear this ratio to the full. But in a time equal to H, A will traverse the part Θ of Δ. And it will surely also traverse in that time any substance Z which exceeds air in thickness in the ratio which the time E bears to the time H. For if the body Z be as much thinner than Δ as E exceeds H, A, if it moves through Z, will traverse it in a time inverse to the speed of the movement, i.e. in a time equal to H. If, then, there is 216a *no* body in Z, A will traverse Z still more quickly. But we supposed that its traverse of Z when Z was void occupied the time H. So that it will traverse Z in an equal time whether Z be full or void. But this is impossible. It is plain, then, that if there is a time in which it will move through any part of the void, this impossible result will follow: it will be found to traverse a certain distance, whether this be full or void, in an equal time; for there will be some *body* which is in the same ratio to the other body as the time is to the time.

To sum the matter up, the cause of this result is obvious, viz. that between any two movements there is a ratio (for they occupy time, and there is a ratio between any two times, so long as both are finite), but there is no ratio of void to full.

These are the consequences that result from a difference in the media; the following depend upon an excess of one moving body over another. We see that bodies which have a greater impulse either of weight or of lightness, if they are alike in other respects,[1] move faster over an equal space, and in the ratio which their magnitudes bear to each other. Therefore they will also move through the void with this ratio of speed. But that is impossible; for why should one move faster? (In moving through *plena* it must be so; for the greater divides them faster by its force. For a moving thing cleaves the medium either by its shape, or by the impulse which the body that is carried along or is projected possesses.) Therefore all will possess equal velocity. But this is impossible.

[1] Omitting τοῖς σχήμασι in l. 14, as Simplicius may have done.

It is evident from what has been said, then, that, if there is a void, a result follows which is the very opposite of the reason for which those who believe in a void set it up. They think that if movement in respect of place is to exist, the void cannot exist, separated all[1] by itself; but this is the same as to say that place is a separate cavity; and this has already been stated to be impossible.[2]

But even if we consider it on its own merits the so-called vacuum will be found to be really vacuous. For as, if one puts a cube in water, an amount of water equal to the cube will be displaced; so too in air; but the effect is imperceptible to sense. And indeed always, in the case of any body that can be displaced, it must, if it is not compressed, be displaced in the direction in which it is its nature to be displaced—always either down, if its locomotion is downwards as in the case of earth, or up, if it is fire, or in both directions—whatever[3] be the nature of the inserted body. Now in the void this is impossible; for it is not body; the void must have penetrated[4] the cube to a distance equal to that which this portion of void formerly occupied in the
216b void, just as if the water or air had not been displaced by the wooden cube, but had penetrated right[5] through it.

But the cube also has a magnitude equal to that occupied by the void; a magnitude which, if it is also hot or cold, or heavy or light, is none the less different in essence from all its attributes, even if it is not separable from them; I mean the *volume* of the wooden cube. So that even if it were separated from everything else and were neither heavy nor light, it will occupy an equal amount of void, and fill the same place, as the part of place or of the void equal to itself. How then will the body of the cube differ from the void or place that is equal to it? And if there can be two such things, why cannot there be any number coinciding?

This, then, is one absurd and impossible implication of the

[1] Reading in l. 24 ἀποκεκριμένον. ἀποκρινόμενον is a misprint.
[2] 211^b 19 sqq., 213^a 31.
[3] Omitting the second ἢ in l. 33, with Prantl, and apparently with Simp.
[4] Omitting δόξειεν in l. 35, with E.
[5] Reading πάντῃ in l. 2, with EHI Them.

theory. It is also evident that the cube will have this same volume even if it is displaced, which is an attribute possessed by all other bodies also. Therefore if this differs in no respect from its place,[1] why need we assume a place for bodies over and above the volume of each, if their volume be conceived of as free from attributes? It contributes nothing to the situation if there is an equal interval attached to it as well. [Further, it ought to be clear by the study of moving things what sort of thing void is. But in fact it is found nowhere in the world. For air is something, though it does not *seem* to be so—nor, for that matter, would water, if fishes were made of iron; for the discrimination of the tangible is by touch.[2]]

It is clear, then, from these considerations that there is no separate void.

9 There are some who think that the existence of rarity and density shows that there is a void. If rarity and density do not exist, they say, neither can things contract and be compressed. But if this were not to take place, either there would be no movement at all, or the universe would bulge, as Xuthus[3] said, or air and water must[4] always change into equal amounts (e. g. if air has been made out of a cupful of water, at the same time out of an equal amount of air a cupful of water must have been made), or void must necessarily exist; for compression and expansion[5] cannot take place otherwise.

Now, if they mean by the rare that which has many voids existing separately, it is plain that if void cannot exist separate any more than a place can exist with an extension all to itself, neither can the rare exist in this sense. But if they mean that there is void, not separately existent, but still present in the rare, this is less impossible, yet, first, the void turns out not to be a condition of *all*

[1] Reading *τοῦ τόπου* in l. 14; Bekker's *τοῦτό που* is a misprint.
[2] The words in brackets are unknown to the Greek commentators and probably spurious.
[3] A Pythagorean of Croton; cf. Diels, *Vors.*³ i. 284. 22–5.
[4] Inserting *δεῖ* after *ἀεί* in l. 26, with Bonitz.
[5] Reading in l. 29 *ἐπεκτείνεσθαι*, with E and apparently Simp.

movement, but only of movement upwards (for the rare is
217a light, which is the reason why they say fire is rare); second, the void turns out to be a condition of movement not as that in which it takes place, but in that the void carries things up as skins by being carried up themselves carry up what is continuous with them. Yet how can void have a local movement or a place? For thus that into which void moves is till then void of a void.

Again, how will they explain, in the case of what is heavy, its movement downwards? And it is plain that if the rarer and more void a thing is the quicker it will move upwards, if it were completely void it would move with a maximum speed! But perhaps even this is impossible, that it should move at all[1]; the same reason which showed that in the void all things are incapable of moving shows that the void cannot move, viz., the fact that the speeds are incomparable.

Since we deny that a void exists, but for the rest the problem has been truly stated,[2] that *either* there will be no movement, if there is not to be condensation and rarefaction, *or* the universe will bulge, *or* a transformation of water into air will always be balanced by an equal transformation of air into water (for it is clear that the air produced from water is bulkier than the water)[3]: it is necessary therefore, if compression does not exist, *either* that the next portion will be pushed outwards and make the outermost part bulge, *or* that somewhere else there must be an equal amount of water produced out of air, so that the entire bulk of the whole may be equal, *or* that nothing moves. For when anything is displaced this will always happen, unless it comes round in a circle; but locomotion is not always circular, but sometimes in a straight line.

These then are the reasons for which they might say that there is a void; *our* statement is based on the assumption that there is a single matter for contraries, hot and cold and the other natural contrarieties, and that what exists actually is produced from a potential existent, and

[1] Reading a comma after ἀδύνατον in l. 8.
[2] 216b 24-6.
[3] Putting a colon before ἀνάγκη in l. 15, with Bonitz.

that matter is not separable from the contraries but its being[1] is different, and that a single matter may serve for colour and heat and cold.

The same matter also serves for both a large and a small body. This is evident; for when air is produced from water, the same matter has become something different, not by acquiring an addition to it, but has become actually what it was potentially, and, again, water is produced from air in the same way, the change being sometimes from smallness to greatness, and sometimes from greatness to smallness. Similarly, therefore, if air which is large in extent comes to have a smaller volume, or becomes greater from being smaller, it is the matter which is potentially both that comes to be[2] each of the two.

For as the same matter becomes hot from being cold, and cold from being hot, because it was potentially both, so too from hot it can become more hot, though nothing in 217b
the matter has become hot that was not hot when the thing was less hot; just as, if the arc or curve of a greater circle becomes that of a smaller, whether it remains the same or becomes a different curve, convexity has not come to exist in anything that was not convex but straight (for differences of degree do not depend on an intermission of the quality); nor can we get any portion of a flame, in which both heat and whiteness are not present. So too, then, is the earlier heat related to the later.[3] So that the greatness and smallness, also, of the sensible volume are extended, not by the matter's acquiring anything new, but because the matter is potentially matter[4] for both states; so that the same thing is dense and rare, and the two qualities have one matter.

The dense is heavy, and the rare is light. [Again, as the arc of a circle when contracted into a smaller space does not acquire a new part which is convex, but what was there has been contracted; and as any part of fire that one takes will be hot; so, too, it is all a question of contraction and

[1] Reading in l. 24 τὸ δ' εἶναι, with EFG Them.
[2] Reading in ll. 32–3 ὕλη γίνεται, with E.
[3] Reading in l. 8 πρὸς τὴν ὕστερον (so perhaps Simp.).
[4] Omitting ἡ in l. 10, with E.

expansion[1] of the same matter.[2]] There are two types in each case, both in the dense and in the rare; for both the heavy and the hard are thought to be dense, and contrariwise both the light and the soft are rare; and weight and hardness fail to coincide in the case of lead and iron.

From what has been said it is evident, then, that void does not exist either separate (either absolutely separate or as a separate element in the rare) or potentially, unless one is willing to call the condition of movement void, whatever it may be. At that rate the matter of the heavy and the light, *qua* matter of them, would be the void; for the dense and the rare are productive of locomotion in virtue of *this* contrariety, and in virtue of their hardness and softness productive of passivity and impassivity, i. e. not of locomotion but rather of qualitative change.

So much, then, for the discussion of the void, and of the sense in which it exists and the sense in which it does not exist.

Next for discussion after the subjects mentioned is Time. 10
The best plan will be to begin by working out the difficulties connected with it, making use of the current arguments. First, does it belong to the class of things that exist or to that of things that do not exist? Then secondly, what is its nature? To start, then: the following considerations would make one suspect that it either does not exist at all or barely, and in an obscure way. One part of it has been and is not, while the other is going to be and
218a is not yet. Yet time—both infinite time and any time you like to take—is made up of these. One would naturally suppose that what is made up of things which do not exist could have no share in reality.

Further, if a divisible thing is to exist, it is necessary that, when it exists, all or some of its parts must exist. But of time some parts have been, while others have to be, and no part of it *is*, though it is divisible. For what is

[1] Reading συναγωγὴ καὶ διαστολὴ in l. 15, with Simp. and Diels.
[2] The words in brackets appear to be an alternative version of ll. 2–11; they are not in place here.

'now' is not a part: a part is a measure of the whole, which must be made up of parts. Time, on the other hand, is not held to be made up of 'nows'.

Again, the 'now' which seems to bound the past and the future—does it always remain one and the same or is it always other and other? It is hard to say.

(1) If it is always different and different, and if none of the *parts* in time which are other and other are simultaneous (unless the one contains and the other is contained, as the shorter time is by the longer), and if the 'now' which is not, but formerly was, must have ceased-to-be at some time, the '*nows*' too cannot be simultaneous with one another, but the prior 'now' must always have ceased-to-be. But the prior 'now' cannot have ceased-to-be in[1] itself (since it then existed); yet it cannot have ceased-to-be in another 'now'. For we may lay it down that one 'now' cannot be next to another, any more than point to point.[2] If then it did not cease-to-be in the next 'now' but in another, it would exist simultaneously with the innumerable 'nows' between the two[3]—which is impossible.

Yes, but (2) neither is it possible for the 'now' to remain always the same. No determinate divisible thing has a single termination, whether it is continuously extended in one or in more than one dimension: but the 'now' is a termination, and it is possible to cut off a determinate time. Further, if coincidence in time (i.e. being neither prior nor posterior) means to be 'in one and the same "now"',[4] then, if both what is before and what is after are in this same 'now', things which happened ten thousand years ago would be simultaneous with what has happened to-day, and nothing would be before or after anything else.

This may serve as a statement of the difficulties about the attributes of time.

[1] The argument would be clearer if we could say 'during' itself. If the existent perished 'in' itself, it would never exist without perishing.

[2] Reading στιγμὴν στιγμῆς in l. 19, with E Phil. Simp.

[3] Omitting τοῖς νῦν in l. 21, as Phil. apparently does.

[4] Reading in l. 26 f. καὶ ἐνὶ νῦν, with Diels.

As to what time is or what is its nature, the traditional accounts give us as little light as the preliminary problems which we have worked through.

Some assert that it is (1) the movement of the whole,
218b others that it is (2) the sphere itself.[1]

(1) Yet part, too, of the revolution is a time, but it certainly is not a revolution: for what is taken is part of a revolution, not a revolution. Besides, if there were more heavens than one, the movement of any of them equally would be time, so that there would be many times at the same time.

(2) Those who said that time is the sphere of the whole thought so, no doubt, on the ground that all things are in time and all things are in the sphere of the whole. The view is too naive for it to be worth while to consider the impossibilities implied in it.

But as time is most usually supposed to be (3) motion and a kind of change, we must consider this view.

Now (*a*) the change or movement of each thing is only *in* the thing which changes or *where* the thing itself which moves or changes may chance to be. But time is present equally everywhere and with all things.

Again, (*b*) change is always faster or slower, whereas time is not: for 'fast' and 'slow' are defined by time—'fast' is what moves much in a short time, 'slow' what moves little in a long time; but time is not defined by time, by being either a certain amount or a certain kind of it.

Clearly then it is not movement. (We need not distinguish at present between 'movement' and 'change'.)

But neither does time exist without change; for when III
the state of our own minds does not change at all, or we have not noticed its changing, we do not realize that time has elapsed, any more than those who are fabled to sleep among the heroes in Sardinia[2] do when they are awakened; for they connect the earlier 'now' with the later and make

[1] Aristotle is probably referring to Plato and the Pythagoreans respectively. Cf. Diels, *Vors.*[3] i. 355. 6.
[2] For the fable cf. Rohde, *Rhein. Mus.* xxxv. 157 ff.

them one, cutting out the interval because of their failure to notice it. So, just as, if the 'now' were not different but one and the same, there would not have been time, so too when its difference escapes our notice the interval does not seem to be time. If, then, the non-realization of the existence of time happens to us when we do not distinguish any change, but the soul seems to stay in one indivisible state, and when we perceive and distinguish we say time has elapsed, evidently time is not independent of movement and change. It is evident, then, that time is neither 219a movement nor independent of movement.

We must take this as our starting-point and try to discover—since we wish to know what time is—what exactly it has to do with movement.

Now we perceive movement and time together: for even when it is dark and we are not being affected through the body, if any movement takes place in the mind we at once suppose that some time also has elapsed; and not only that but also, when some time is thought to have passed, some movement also along with it seems to have taken place. Hence time is either movement or something that belongs to movement. Since then it is not movement, it must be the other.

But what is moved[1] is moved from something to something, and all magnitude is continuous. Therefore the movement goes with the magnitude. Because the magnitude is continuous, the movement too must be continuous, and if the movement, then the time; for the time that has passed is always thought to be in proportion to the movement.

The distinction of 'before' and 'after' holds primarily, then,[2] in place; and there in virtue of relative position. Since then 'before' and 'after' hold in magnitude, they must hold also in movement, these corresponding to those. But also in time the distinction of 'before' and 'after' must hold, for time and movement always correspond with each other. The 'before' and 'after'[3] in motion identical in

[1] κίνησις here must be restricted to that κατὰ τὸν τόπον.
[2] Omitting δὲ in l. 14, with EH Them. Al.
[3] Omitting αὐτῶν in l. 20, with H Them. Phil. Simp.

substratum with motion yet differs from it in definition, and is not identical with motion.

But we apprehend time only when we have marked motion, marking it by[1] 'before' and 'after'; and it is only when we have perceived 'before' and 'after' in motion that we say that time has elapsed. Now we mark them by judging that *A* and *B* are different, and that some third thing is intermediate to them. When we think of the extremes as different from the middle and the mind pronounces that the 'nows' are two, one before and one after, it is then that we say that there is time, and this that we say is time. For what is bounded by the 'now' is thought to be time—we may assume this.

When, therefore, we perceive the 'now' as one, and neither as before and after in a motion nor as an identity but in relation to a 'before' and an 'after', no time is thought to have elapsed, because there has been no motion either. On the other hand, when we do perceive a 'before'
219b and an 'after', then we say that there is time. For time is just this—number of motion in respect of 'before' and 'after'.

Hence time is not movement, but only movement in so far as it admits of enumeration. A proof of this: we discriminate the more or the less by number, but more or less movement by time. Time then is a kind of number. (Number, we must note, is used in two senses—both of what is counted or the countable and also of that with which we count. Time obviously[2] is what is counted, not that with which we count: these are different kinds of thing.)

Just as motion is a perpetual succession, so also is time. But every simultaneous time is self-identical; for the 'now' as a subject is an identity, but it accepts different attributes.[3]

[1] Reading τῷ in l. 23, with EFG.
[2] Reading δή in l. 7, with FG.
[3] E.g. if you come in when I go out, the time of your coming in is in fact the time of my going out, though for it to be the one and to be the other are different things.

The 'now' measures time, in so far as time involves the 'before and after'.

The 'now' in one sense is the same, in another it is not the same. In so far as it is in succession, it is different (which is just what its being now[1] was supposed to mean), but its substratum[2] is an identity: for motion, as was said,[3] goes with magnitude,[4] and time, as we maintain, with motion. Similarly, then, there corresponds to the point[5] the body which is carried along, and by which we are aware of the motion and of the 'before and after' involved in it. This is an identical *substratum* (whether a point or a stone or something else of the kind), but it has different *attributes*—as the sophists assume that Coriscus' being in the Lyceum is a different thing from Coriscus' being in the market-place.[6] And the body which is carried along is different, in so far as it is at one time here and at another there. But the 'now' corresponds to the body that is carried along, as time corresponds to the motion. For it is by means of the body that is carried along that we become aware of the 'before and after' in the motion, and if we regard these as countable we get the 'now'. Hence in these also the 'now' as substratum[7] remains the same (for it is what is before[8] and after in movement), but what is predicated of it is different; for it is in so far as the 'before and after' is numerable that we get the 'now'. This is what is most knowable: for, similarly, motion is known because of that which is moved, locomotion because of that which is carried. For what is carried is a real thing, the movement is not. Thus what is called 'now' in one sense is always the same; in another it is not the same: for this is true also of what is carried.

Clearly, too, if there were no time, there would be no 'now', and vice versa. Just as the moving body and its loco- 220a

[1] Reading in l. 14 τὸ νῦν εἶναι, with Phil. and Bonitz.
[2] Reading ὃ δέ ποτε, with H and Simp. [3] a11.
[4] i.e. with the path traversed. [5] i. e. in the path.
[6] sc. to prove that Coriscus is different from himself. I.e., they assume that a difference in the attribute means a difference in the substratum.
[7] Reading in l. 26 νῦν ἐστι, τό (cf. ll. 14 f.).
[8] Reading τὸ πρότερον in l. 26, with EHI Phil.

motion involve each other mutually, so too do the number of the moving body and the number of its locomotion. For the number of the locomotion is time, while the 'now' corresponds to the moving body, and is like the unit of number.

Time, then, also is both made continuous by the 'now' and divided at it. For here too there is a correspondence with the locomotion and the moving body. For the motion or locomotion is made one by the thing which is moved, because *it* is one—not because it is one in its own nature (for there might be pauses in the movement of such a thing)—but because it is one in definition[1]: for this determines the movement as 'before' and 'after'. Here, too, there is a correspondence with the point; for the point also both connects and terminates the length—it is the beginning of one and the end of another. But when you take it in this way, using the one point as two, a pause is necessary, if the same point is to be the beginning and the end. The 'now' on the other hand, since the body carried is moving, is always different.

Hence time is not number in the sense in which there is 'number' of the same point because it is beginning and end, but rather as the extremities of a line[2] form a number, and not as the parts of the line do so, both for the reason given (for we can use the middle point as two, so that on that analogy time might stand still), and further because obviously the 'now' is no[3] *part* of time nor the section any part of the movement, any more than the points are parts of the line—for it is two *lines* that are *parts* of one line.

In so far then as the 'now' is a boundary, it is not time, but an attribute of it; in so far as it numbers, it is number; for boundaries belong only to that which they bound, but number (e.g. ten) is the number of these[4] horses, and belongs also elsewhere.

It is clear, then, that time is 'number of movement in respect of the before and after', and is continuous since it is an attribute of what is continuous.

[1] i.e. as *moved*.
[2] Reading in l. 16 *τῆς γραμμῆς μᾶλλον*, with Phil. Simp.
[3] Reading *οὐδέν* in l. 19, with EG Al. Asp. Simp.
[4] Reading *ἀριθμὸς τῶνδε* in l. 23, with E Phil. Simp.

12 The smallest number, in the strict sense of the word 'number', is two.[1] But of number as concrete, sometimes there is a minimum, sometimes not: e.g. of a 'line', the smallest in respect of *multiplicity* is two (or, if you like, one), but in respect of *size* there is no minimum; for every line is divided *ad infinitum*. Hence it is so with time. In respect of number the minimum is one (or two); in point of extent there is no minimum.

It is clear, too, that time is not described as fast or slow, but as many or few[2] and as long or short. For as continuous it is long or short and as a number many or few, but it is not fast or slow—any more than any number with which we number is fast or slow.

Further, there is the same time everywhere at once, but not the same time before and after, for while the present change is one, the change which has happened and that which will happen are different. Time is not number with which we count, but the number of things which are counted, and this according as it occurs before or after is always different, for the 'nows' are different. And the number of a hundred horses and a hundred men is the same, but the things numbered are different—the horses from the men. Further, as a movement can be one and the same again and again, so too can time, e.g. a year or a spring or an autumn.

Not only do we measure the movement by the time, but also the time by the movement, because they define each other. The time marks the movement, since it is its number, and the movement the time. We describe the time as much or little, measuring it by the movement, just as we know the number by what is numbered, e.g. the number of the horses by one horse as the unit. For we know how many horses there are by the use of the number; and again by using the one horse as unit we know the number of the horses itself. So it is with the time and the movement; for we measure the movement by the time and vice versa. It is natural that this should happen;

[1] Reading in l. 27 ἐστὶν ἡ δυάς.

[2] e.g. 'many years'.

for the movement goes with the distance and the time with the movement, because they are quanta and continuous and divisible. The movement has these attributes because the distance is of this nature, and the time has them because of the movement. And we measure both the distance by the movement and the movement by the distance; for we say that the road is long, if the journey is long, and that this is long, if the road is long—the time, too, if the movement, and the movement, if the time.

221a Time is a measure of motion and of being moved, and it measures the motion by determining a motion which will measure exactly the whole motion, as the cubit does the length by determining [1] an amount which will measure out the whole. Further 'to be in time' means, for movement, that both it and its essence are measured by time (for simultaneously it measures both the movement and its essence, and this is what being in time means for it, that its essence should be measured).

Clearly then [2] 'to be in time' has the same meaning for other things also, namely, that their being should be measured by time. 'To be in time' is one of two things: (1) to exist when time exists, (2) as we say of some things that they are 'in number'. The latter means either what is a part or mode of number—in general, something which belongs to number—or that things have a number.

Now, since time is number, the 'now' and the 'before' and the like are in time, just as 'unit' and 'odd' and 'even' are in number, i. e. in the sense that the one set belongs to number, the other to time. But things are in time as they are in number. If this is so, they are contained by time as things in place are contained by place.

Plainly, too, to be in time does not mean to coexist with time, any more than to be in motion or in place means to coexist with motion or place. For if 'to be in something' is to mean this, then all things will be in anything, and the heaven will be in a grain; for when the grain is, then also is the heaven. But this is a merely incidental conjunction,

[1] Reading ὁρίσαι in l. 3, with EG Them. Simp.

[2] Reading in ll. 5–7 (ἅμα . . . εἶναι), δῆλον ὅτι, with Al. Simp.

whereas the other is necessarily involved: that which is in time necessarily involves that there is time when *it* is, and that which is in motion that there is motion when *it* is.

Since what is 'in time' is so in the same sense as what is in number is so, a time greater than everything in time can be found. So it is necessary that all the things in time should be contained by time, just like other things also which are 'in anything', e.g. the things 'in place' by place.

A thing, then, will be affected by time, just as we are accustomed to say that time wastes things away, and that all things grow old through time, and that there is oblivion owing to the lapse of time, but we do not say the same of getting to know or of becoming young or fair. For time 221b
is by its nature the cause rather of decay, since it is the number of change, and change removes what is.

Hence, plainly, things which are always are not, as such, in time, for they are not contained by time, nor is their being measured by time. A proof of this is that none of them is *affected* by time, which indicates that they are not in time.

Since time is the measure of motion, it will be the measure of rest too—indirectly. For all rest is in time. For it does not follow that what is in time is moved, though what is in motion is necessarily moved. For time is not motion, but 'number of motion': and what is at rest, also, can be in the number of motion. Not everything that is not in motion can be said to be 'at rest'—but only that which can be moved, though it actually is not moved, as was said above.[1]

'To be in number' means that there is a number of the thing, and that its being is measured by the number in which it is. Hence if a thing is 'in time' it will be measured by time. But time will measure what is moved and what is at rest, the one *qua* moved, the other *qua* at rest; for it will measure their motion and rest respectively.

Hence what is moved will not be measurable by the time simply in so far as it has quantity, but in so far as

[1] 202a 4.

its *motion* has quantity. Thus none of the things which are neither moved nor at rest are in time: for 'to be in time' is 'to be measured by time', while time is the measure of motion and rest.

Plainly, then, neither will everything that does not exist be in time, i. e. those non-existent things that cannot exist, as the diagonal cannot be commensurate with the side.

Generally, if time is directly the measure of motion and indirectly of other things, it is clear that a thing whose existence is measured by it will have its existence in rest or motion. Those things therefore which are subject to perishing and becoming—generally, those which at one time exist, at another do not—are necessarily in time: for there is a greater time which will extend both beyond their existence and beyond the time which measures their existence. Of things which do not exist but are contained by time
222a some were, e. g. Homer once was, some will be, e. g. a future event; this depends on the direction in which time contains them; if on both, they have both modes of existence.[1] As to such things as it does not contain in any way, they neither were nor are nor will be. These are those non-existents whose opposites always are, as the incommensurability of the diagonal always is—and this will not be in time. Nor will the commensurability, therefore; hence this eternally is not, because it is contrary to what eternally is. A thing whose contrary is not eternal can be and not be, and it is of such things that there is coming to be and passing away.

The 'now' is the link of time, as has been said[2] (for it 13
connects past and future time), and it is a limit[3] of time (for it is the beginning of the one and the end of the other). But this is not obvious as it is with the point, which is fixed. It divides potentially, and in so far as it is dividing the 'now' is always different, but in so far as it connects it is always the same, as it is with mathematical lines.

[1] Putting a comma after ἀμφότερα in l. 2.
[2] 220a 5.
[3] Omitting ὅλως in l. 11, with E and Simp.

For the intellect it is not always one and the same point, since it is other and other[1] when one divides the line; but in so far as it is one, it is the same in every respect.

So the 'now' also is in one way a potential dividing of time, in another the termination of both parts, and their unity. And the dividing and the uniting are the same thing and in the same reference, but in essence they are not the same.

So[2] one kind of 'now' is described in this way: another is when the time is *near* this kind of 'now'. 'He will come now' because he will come to-day; 'he has come now' because he came to-day. But the things in the *Iliad* have not happened 'now', nor is[3] the flood 'now'—not that the time[4] from now to them is not continuous, but because they are not near.

'At some time' means a time determined in relation to the first of the two types of 'now',[5] e.g. 'at some time' Troy was taken, and 'at some time' there will be a flood; for it must be determined with reference to the 'now'. There *will* thus be a determinate time from this 'now' to that,[6] and there *was* such in reference to the past event. But if there be no time which is not 'sometime', every time will be determined.

Will time then fail? Surely not, if motion always exists. Is time then always different or does the same time recur? Clearly time is, in the same way as motion is. For if one and the same motion sometimes recurs, it will be one and the same time, and if not, not.

Since the 'now' is an end and a beginning of time, not 222b of the same time however, but the end of that which is past and the beginning of that which is to come, it follows that, as the circle has its convexity and its concavity, in a sense, in the same thing, so time is always at a beginning and at an end. And for this reason it seems to be always different; for the 'now' is not the beginning and the end of the same thing; if it were, it would be at the same time

[1] Reading in l. 17 *ἄλλη καὶ ἄλλη*, with F Them. Phil.
[2] Reading in l. 20 *μὲν οὖν οὕτω*, with GHI Them. Simp.
[3] Omitting *γέγονε* in l. 23, with Them.
[4] Reading in l. 24 *συνεχὴς ὁ χρόνος* with E Them. Phil. Simp.
[5] Cf. ll. 20 f.
[6] Omitting *καί* before *εἰς* in l. 28, with GH Phil.

and in the same respect two opposites.[1] And time will not fail; for it is always at a beginning.

'Presently' or 'just' refers to the part of future time which is near the indivisible present 'now' ('When do you walk?' 'Presently', because the time in which he is going to do so is near), and to the part of past time which is not far from the 'now' ('When do you walk?' 'I have just been walking'). But to say that Troy has just been taken—we do not say that, because it is too far from the 'now'. 'Lately', too, refers to the part of past time which is near[2] the present 'now'. 'When did you go?' 'Lately', if the time is near the existing now. 'Long ago' refers to the distant past.

'Suddenly' refers to what has departed from its former condition in a time imperceptible because of its smallness; but it is the nature of *all* change to alter things from their former condition. In time all things come into being and pass away; for which reason some called it the wisest of all things, but the Pythagorean Paron[3] called it the most stupid, because in it we also forget; and his was the truer view. It is clear then that it must be in itself, as we said before,[4] the condition of destruction rather than of coming into being (for change, in itself, makes things depart from their former condition), and only incidentally of coming into being, and of being. A sufficient evidence of this is that nothing comes into being without itself moving somehow and acting, but a thing can be destroyed even if it does not move at all. And this is what, as a rule, we chiefly mean by a thing's being destroyed by time. Still, time does not work even this change; even this sort of change takes place *incidentally* in time.

We have stated, then, that time exists and what it is, and in how many senses we speak of the 'now', and what 'at some time', 'lately', 'presently' or 'just', 'long ago', and 'suddenly' mean.

[1] Putting a full stop after εἴη in l. 6, with Bonitz.
[2] Reading in l. 13 νῦν [τὸ] μόριον, with Them. Simp. Bonitz.
[3] Nothing further is known of Paron. [4] 221b 1.

14 These distinctions having been drawn,[1] it is evident that every change and everything that moves is in time; for the distinction of faster and slower exists in reference to all change, since it is found in every instance. In the phrase 'moving faster' I refer to that which changes before another into the condition in question, when it moves over the same interval and with a regular movement; e.g. in the case of locomotion, if both things move along the circumference of a circle, or both along a straight line; and similarly in all other cases. But what is *before* is in time; for we say 'before' and 'after' with reference to the distance from the 'now', and the 'now' is the boundary of the past and the future; so that since 'nows' are in time, the before and the after will be in time too; for in that in which the 'now' is, the distance from the 'now' will also be. But 'before' is used contrariwise with reference to past and to future time; for in the past we call 'before' what is farther from the 'now', and 'after' what is nearer, but in the future we call the nearer 'before' and the farther 'after'. So that since the 'before' is in time, and every movement involves a 'before', evidently every change and every movement is in time.

It is also worth considering how time can be related to the soul; and why time is thought to be in everything, both in earth and in sea and in heaven. Is it because it is an attribute, or state, of movement (since it is the number of movement)[2] and all these things are movable (for they are all in place), and time and movement are together, both in respect of potentiality and in respect of actuality?

Whether if soul did not exist time would exist or not, is a question that may fairly be asked; for if there cannot be some one to count there cannot be anything that can be counted, so that evidently there cannot be number; for number is either what has been, or what can be, counted. But if nothing but soul, or in soul reason, is qualified to count, there would not be time unless there were soul, but

[1] Reading in l. 30 διωρισμένων, with H Them. Phil.
[2] Treating ἐν . . . πάντα in l. 19 f. as parenthetical.

only that of which time is an attribute, i. e. if *movement* can exist without soul, and the before and after are attributes of movement, and time is these *qua* numerable.

One might also raise the question what sort of movement time is the number of. Must we not say 'of *any* kind'? For things both come into being in time and pass away, and grow, and are altered in time, and are moved locally; thus it is of each movement *qua* movement that time is the number. And so it is simply the number of continuous movement, not of any particular kind of it.

223b But other things as well may have been moved now, and there would be a number of each of the two movements. Is there another time, then, and will there be two equal times at once? Surely not. For a time that is both equal and simultaneous is one and the same time,[1] and even those that are not simultaneous are one in kind; for if there were dogs, and horses, and seven of each, it would be the same number. So, too, movements that have simultaneous limits have the same time, yet the one may in fact be fast and the other not, and one may be locomotion and the other alteration; still the time of the two changes is the same if their number also is equal and simultaneous; and for this reason, while the movements are different and separate, the time is everywhere the same, because the number of equal and simultaneous movements is everywhere one and the same.

Now there is such a thing as locomotion, and in locomotion there is included circular movement, and everything is measured by some one thing homogeneous with it, units by a unit, horses by a horse, and similarly times by some definite time, and, as we said,[2] time is measured by motion as well as motion by time (this being so because by a motion definite in time the quantity both of the motion and of the time is measured): [3] if, then, what

[1] Reading in l. 3 ὁ αὐτὸς γὰρ χρόνος καὶ εἷς ὁ ἴσος καὶ ἅμα.
[2] 220^b 28.
[3] Placing a comma after ὡρισμένῳ in l. 15 and a semicolon before εἰ in l. 18, and treating τοῦτο . . . χρόνου in ll. 16–18 as parenthetical, with Bonitz.

is first is the measure of everything homogeneous with it, regular circular motion is above all else the measure, because the number of this is the best known. Now neither alteration nor increase nor coming into being can be regular, but locomotion can be. This also is why time is thought to be the movement of the sphere, viz. because the other movements are measured by this, and time by this movement.

This also explains the common saying that human affairs form a circle, and that there is a circle in all other things that have a natural movement and coming into being and passing away. This is because all other things are discriminated by time, and end and begin as though conforming to a cycle; for even time itself is thought to be a circle. And this opinion again is held because time is the measure of this kind of locomotion and is itself measured by such. So that to say that the things that come into being form a circle is to say that there is a circle of time; and this is to say that it is measured by the circular movement; for apart from the measure nothing else to be measured is observed; the whole is just a plurality of 224a
measures.

It is said rightly, too, that the number of the sheep and of the dogs is the same *number* if the two numbers are equal, but not the same *decad* or the same *ten*; just as the equilateral and the scalene are not the same *triangle*, yet they are the same *figure*, because they are both triangles. For things are called the same so-and-so if they do not differ by a differentia of that thing, but not if they do; e.g. triangle differs from triangle by a differentia of triangle,[1] therefore they are different triangles; but they do not differ by a differentia of figure, but are in one and the same division of it. For a figure of one kind is a circle and a figure of another kind a triangle, and a triangle of one kind is equilateral and a triangle of another kind scalene. They are the same figure, then, and that, triangle,

[1] Reading in l. 7 τρίγωνον τριγώνου τριγώνου, with Torstrik and perhaps with Simplicius.

but not the same triangle.[1] Therefore the number of two groups also is the same number[2] (for their number does not differ by a differentia of number), but it is not the same decad; for the things of which it is asserted differ; one group are dogs, and the other horses.

We have now discussed time—both time itself and the matters appropriate to the consideration of it.

[1] Reading in l. 12 τοῦτο τρίγωνον, τρίγωνον δ' οὔ.
[2] Omitting ὁ in l. 13, with F and Phil.

BOOK V

1 Everything[1] which changes does so in one of three senses. It may change (1) *accidentally*, as for instance when we say that something musical walks, that which walks being something in which aptitude for music is an *accident*. Again (2) a thing is said without qualification to change because *something belonging to it* changes, i.e. in statements which refer to part of the thing in question: thus the body is restored to health because the eye or the chest, that is to say a *part* of the whole body, is restored to health. And above all there is (3) the case of a thing which is in motion neither accidentally nor in respect of something else belonging to it, but in virtue of being *itself* directly in motion. Here we have a thing which is *essentially* movable: and that which is so is a different thing according to the particular variety of motion: for instance it may be a thing capable of alteration: and within the sphere of alteration it is again a different thing according as it is capable of being restored to health or capable of being heated. And there are the same distinctions in the case of the mover: (1) one thing causes motion accidentally, (2) another partially (because something belonging to it causes motion), (3) another of itself directly, as, for instance, the physician heals, the hand strikes. We have, then,[2] the following factors: (*a*) on the one hand that which directly causes motion, and (*b*) on the other hand that which is in motion: further, we have (*c*) that in which motion takes place, namely time, and (distinct from these three) (*d*) that from which and (*e*) that to which it proceeds: for every motion proceeds from something and to something, that which is directly in motion being distinct from that to which it is in motion and that from which it is in motion: for instance,

224^a … 224^b

[1] With l. 21–^{b}1 cf. *Met.* 1067^b 1–9.

[2] The apodosis to ἐπεὶ δ' ἔστι κτλ. begins at ἡ δὴ κίνησις κτλ. (224^b 4).

we may take the three things 'wood', 'hot', and 'cold', of which the first is that which is in motion, the second is that to which the motion proceeds, and the third is that from which it proceeds. This being so, it is clear that the motion is in the wood, not in its form: for the motion is neither caused nor experienced by the form or the place or the quantity. So we are left with a mover, a moved, and a goal of motion. I do not include the starting-point of motion: for it is the goal rather than the starting-point of motion that gives its name to a particular process of change. Thus 'perishing' is change *to not-being*, though it is also true that that which perishes changes *from being*: and 'becoming' is change *to being*, though it is also change *from not-being*.

Now a definition of motion has been given above,[1] from[2] which it will be seen that every goal of motion, whether it be a form, an affection, or a place, is immovable, as, for instance, knowledge and heat. Here, however, a difficulty may be raised. Affections, it may be said, are motions, and whiteness is an affection: thus there may be change *to* a motion.[3] To this we may reply that it is not whiteness but whitening that is a motion. Here also the same distinctions are to be observed: a goal of motion may be so accidentally, or partially and with reference to something other than itself, or directly and with no reference to anything else:[4] for instance, a thing which is becoming white changes accidentally to an object of thought, the *colour* being only accidentally the object of thought; it changes to colour,[5] because white is a part of colour, or to Europe, because Athens is a part of Europe; but it changes essentially to white colour. It is now clear in what sense a thing is in motion essentially, accidentally, or in respect of something other than itself, and in what sense the phrase

[1] 201a 10.
[2] With ll. 11–16 cf. *Met.* 1067b 9–12.
[3] i.e. there may be motion not only in τὸ κινούμενον but also in τὸ εἰς ὃ κινεῖται.
[4] Omitting in l. 17 τὸ before both κατ' ἄλλο and μὴ κατ' ἄλλο, which are intended merely to amplify κατὰ μέρος and πρώτως respectively: there are only *three* distinct senses, as may be seen from the opening words of the book.
[5] Here κατὰ μέρος must be supplied in sense, if not in the text.

'itself directly' is used [1] in the case both of the mover and of the moved: and it is also clear that the motion is not in the form but in that which is in motion, that is to say 'the movable in activity'. Now accidental change we may leave out of account: for it is to be found in everything, at any time, and in any respect. Change [2] which is not accidental on the other hand is not to be found in everything, but only in contraries, in things intermediate between contraries, and in contradictories, as may be proved by induction. An intermediate may be a starting-point of change, since for the purposes of the change it serves as contrary to either of two contraries: for the intermediate is in a sense the extremes. Hence we speak of the intermediate as in a sense a contrary relatively to the extremes and of either extreme as a contrary relatively to the intermediate: for instance, the central note is low relatively to the highest and high relatively to the lowest, and grey is light relatively to black and dark relatively to white.[3]

And since every change is *from* something *to* something—as the word itself (μεταβολή) indicates, implying something 'after' (μετά) something else, that is to say something earlier and something later—that which changes must change in one of four ways: from [4] subject to subject, from subject to non-subject, from non-subject to subject, or from non-subject to non-subject, where by 'subject' I mean what is affirmatively expressed. So it follows necessarily from what has been said above [5] that there are

[1] It seems possible to keep (with Bekker) the words καὶ πῶς τὸ αὐτὸ πρῶτον, regarding αὐτὸ πρῶτον as a phrase quoted from above. Argyropylus, however, renders 'et quomodo idem primum sit', which seems pointless. Others regard the words as a mere repetition of the preceding πῶς καθ' αὐτὸ κινεῖται—though in order to do so they have to emend τὸ to τῷ—and therefore bracket them as an interpolation.

[2] With ll. 28–30, cf. *Met.* 1067b 12–14.

[3] It seems necessary to use four terms in English, though two are sufficient in Greek, since both μέλαν and λευκόν are more elastic in meaning than the English 'black' and 'white', which, however, must be used here to translate τὸ μέλαν and τὸ λευκόν, the two extremes.

[4] With l. 3–226a 16 cf. *Met.* 1067b 14–1068b 15.

[5] 224b 28, 29. Or ἐκ τῶν εἰρημένον might mean 'of the four conceivable kinds of change just mentioned': but Aristotelian usage seems in favour of the rendering adopted in the text, which gives just as good sense.

only three kinds of change, that from subject to subject, that from subject to non-subject, and that from non-subject to subject: for the fourth conceivable kind, that from non-subject to non-subject, is not change, as in that case there is no opposition either of contraries or of contradictories.

Now change from non-subject to subject, the relation being that of contradiction, is 'coming to be'—'unqualified coming to be' when the change takes place in an unqualified way, 'particular coming to be' when the change is change in a particular character: for instance, a change from not-white to white is a coming to be of the particular thing, white, while change from unqualified not-being to being is coming to be in an unqualified way, in respect of which we say that a thing 'comes to be' without qualification, not that it 'comes to be' some particular thing. Change from subject to non-subject is 'perishing'—'unqualified perishing' when the change is from being to not-being, 'particular perishing' when the change is to the opposite negation, the distinction being the same as that made in the case of coming to be.

Now [1] the expression 'not-being' is used in several senses: and there can be motion neither of that which 'is not' in respect of the affirmation or negation of a predicate,[2] nor of that which 'is not' in the sense that it only *potentially* 'is', that is to say the opposite of that which *actually* 'is' in an unqualified sense: for although that which is 'not-white' or 'not-good' may nevertheless be in motion *accidentally* (for example that which is 'not-white' might be a man), yet that which is without qualification 'not-so-and-so' cannot in any sense be in motion: therefore it is impossible for that which *is not* to be in motion. This being so, it follows that 'becoming' cannot be a motion: for it is that which 'is not' that 'becomes'. For however true it may be that it *accidentally*

[1] The following sentences are very loosely joined together, but the sequence of thought is fairly clear. The apodosis to the εἰ-clause must be found in the words ἀδύνατον τὸ μὴ ὂν κινεῖσθαι, l. 25, where γὰρ must be omitted, with Themistius and with some MSS. in *Met.* 1067b 30.

[2] Lit. 'in respect of conjunction or separation': i. e. in *false* judgements, which 'join together' things which ought not to be joined together, e. g. 'man has wings', or 'separate' things which ought not to be separated, e. g. 'man has not arms'.

'becomes',[1] it is nevertheless correct to say that it is that which 'is not' that in an unqualified sense 'becomes'. And similarly it is impossible for that which 'is not' to be at rest.

There are these difficulties, then, in the way of the assumption that that which 'is not' can be in motion: and it may be further objected that, whereas everything which is in motion is in space, that which 'is not' is not in space: for then it would be *somewhere*.

So, too, 'perishing' is not a motion: for a motion has for its contrary either another motion or rest, whereas 'perishing' is the contrary of 'becoming'.

Since, then, every motion is a kind of change, and there are only the three kinds of change mentioned above;[2] and since of these three those which take the form of 'becoming' and 'perishing', that is to say those which imply a 225b
relation of contradiction, are not motions: it necessarily follows that only change from subject to subject is motion. And every such subject is either a contrary or an intermediate (for[3] a privation may be allowed to rank as a contrary) and can be affirmatively expressed, as naked, toothless,[4] or black. If, then, the categories are severally distinguished as Being, Quality, Place, Time, Relation, Quantity, and Activity or Passivity, it necessarily follows that there are three kinds of motion—qualitative, quantitative, and local.

2 In respect of Substance there is no motion, because Substance has no contrary among things that are. Nor is there motion in respect of Relation:[5] for it may happen that when one correlative changes, the other, although this does not itself change, is no longer[6] applicable, so that in these cases the motion is accidental. Nor is there motion

[1] i.e. 'that it is something in which τὸ μὴ ὂν is an accident that becomes, and not τὸ μὴ ὂν itself'.

[2] l. 7.

[3] The connexion of thought is: 'the fact that there are motions ἐκ στερήσεως or εἰς στέρησιν does not affect the validity of the assertion that the ὑποκείμενα of motion are ἢ ἐναντία ἢ μεταξύ: for a στέρησις which is a ὑποκείμενον of motion (sc. of κίνησις as distinct from γένεσις) is after all in a sense ἐναντίον and (like other ἐναντία) δηλοῦται καταφάσει.'

[4] l. 5, read νωδόν for λευκόν, with *Met.* 1068a 7.

[5] Reading in l. 11 τοῦ πρός τι, with the MS. A[b] in *Met.* 1068a 11.

[6] Reading in l. 12 ⟨μὴ⟩ ἀληθεύεσθαι, with Schwegler.

in respect of Agent and Patient—in fact there can never be motion of mover and moved, because there cannot be motion of motion or becoming of becoming or in general change of change.

For in the first place there are two senses in which motion of motion is conceivable. (1) The motion of which there is motion might be conceived as subject; e. g. a man is in motion because he changes from fair to dark. Can it be that in this sense motion grows hot or cold, or changes place, or increases or decreases? Impossible: for change is not a subject. Or (2) can there be motion of motion in the sense that some other subject changes from a change to another mode of being, as e. g. a man changes from falling ill to getting well? Even this is possible only in an accidental sense. For, whatever the subject may be,[1] movement is change from one form to another. (And the same holds good of becoming and perishing, except that in these processes we have a change to a particular[2] kind of opposite, while the other, motion, is a change to a different[3] kind.)[4] So, if there is to be motion of motion, that which is changing from health to sickness must simultaneously be changing from this very change to another. It is clear, then,[5] that by the time that it has become sick, it must also have changed to whatever may be the other change concerned (for that it should be at rest, though logically possible, is excluded by the theory). Moreover this other can never be any casual change, but must be a change from something definite to some other definite thing. So in this case it must be the opposite change, viz. convalescence. It is only accidentally that there can be change of change, e. g. there is a change from remembering to forgetting only because the subject of this change changes at one time to knowledge, at another to ignorance.[6]

[1] Reading in l. 23 *ἅπασι* for *αὐτῃ*, with MS. A^b in *Met.* 1068^a 23.
[2] sc. a contradictory. [3] sc. a contrary.
[4] 225^b 25–6 reading *εἰς ἀντικείμενα ὡδί, ἡ δ' ὡδί, ἡ κίνησις*, with Simplicius and with the MS. A^b in *Met.* 1068^a 25.
[5] Reading in l. 28 *δή*, with E H I.
[6] Reading in l. 33 *ἄγνοιαν*, with (apparently) Philoponus and Simplicius.

In the second place, if there is to be change of change and becoming of becoming, we shall have an infinite regress. Thus if one of a series of changes is to be a change of change, the preceding change must also be so: e.g. if 226a
simple becoming was ever in process of becoming, then that which was becoming simple becoming was also in process of becoming, so that we should not yet have arrived at what was in process of simple becoming but only at what was already in process of becoming in process of becoming.[1] And this again was sometime in process of becoming, so that even then we should not have arrived at what was in process of simple becoming. And since in an infinite series there is no first term, here there will be no first stage and therefore no following stage either. On this hypothesis, then, nothing can become or be moved or change.

Thirdly, if a thing is capable of any particular motion, it is also capable of the corresponding contrary motion or the corresponding coming to rest, and a thing that is capable of becoming is also capable of perishing: consequently, if there be becoming of becoming, that which is in process of becoming is in process of perishing at the very moment when it has[2] reached the stage of becoming: since it cannot be in process of perishing when it is just beginning to become or after it has ceased to become: for that which is in process of perishing must be in existence.

Fourthly, there must be a substrate underlying all processes of becoming and changing. What can this be in the present case? It is either the body or the soul that undergoes alteration: what[3] is it that correspondingly becomes motion or becoming? And again what[4] is the goal of their motion? It must be the motion or becoming of something from something to something else.[5] But in what sense can this be so? For the becoming of learning cannot be learning: so neither can the becoming of becoming be

[1] Reading in l. 2 *ἀλλὰ γινόμενον γινόμενον ἤδη*, with Bonitz.
[2] Reading in l. 8 *γένηται*, with EF.
[3] Reading in l. 12 *οὕτω τί τὸ γινόμενον*, with F Simp. and some MSS. in *Met.* 1068b 12.
[4] Reading in l. 13 *τί*, with *Met.* 1068b 12.
[5] Reading in l. 13 *εἶναι τὴν . . . εἰς τόδε κίνησιν ἢ γένεσιν*, with Simp.

becoming, nor can the becoming of any process be that process.

Finally, since there are three kinds of motion, the substratum and the goal of motion must be one or other of these, e.g. locomotion will have to be altered or to be locally moved.

To sum up, then, since everything that is moved is moved in one of three ways, either accidentally, or partially, or essentially, change can change only accidentally, as e.g. when a man who is being restored to health runs or learns: and accidental change we have long ago[1] decided to leave out of account.

Since,[2] then, motion can belong neither to Being nor to Relation nor to Agent and Patient, it remains that there can be motion only in respect of Quality, Quantity, and Place: for with each of these we have a pair of contraries. Motion in respect of Quality let us call alteration, a general designation that is used to include both contraries: and by Quality I do not here mean a property of substance (in that sense that which constitutes a specific distinction is a quality) but a passive quality in virtue of which a thing is said to be acted on or to be incapable of being acted on. Motion in respect of Quantity has no name that includes both contraries, but it is called increase or decrease according as one or the other is designated: that is to say motion in the direction of complete magnitude is increase, motion in the contrary direction is decrease. Motion in respect of Place has no name either general or particular: but we may designate it by the general name of locomotion, though strictly the term 'locomotion' is applicable to things that change their place only when they have not the power to come to a stand, and to things that do not move *themselves* locally.

226b Change within the same kind from a lesser to a greater or from a greater to a lesser degree is alteration: for it is motion either from a contrary or to a contrary,[3] whether in an unqualified or in a qualified sense: for change to a lesser

[1] 224^b 26. [2] With ll. 23–9 cf. *Met.* 1068^b 15–20.
[3] Reading in l. 2 ἢ γὰρ ἐξ ἐναντίου ἢ (MS. E) εἰς ἐναντίον.

degree of a quality will be called change to the contrary of that quality, and change to a greater degree of a quality will be regarded as change from the contrary of that quality to the quality itself.[1] It makes no difference whether the change be qualified or unqualified, except that in the former case the contraries will have to be contrary to one another only in a qualified sense: and a thing's possessing a quality in a greater or in a lesser degree means the presence[2] or absence in it of more or less of the opposite quality. It is now clear, then, that there are only these three kinds of motion.

The[3] term 'immovable' we apply in the first place to that which is absolutely incapable of being moved (just as we correspondingly apply the term invisible to sound); in the second place to that which is moved with difficulty after a long time or whose movement is slow at the start—in fact, what we describe as hard to move; and in the third place to that which is naturally designed for and capable of motion, but is not in motion when, where, and as it naturally would be so. This last is the only kind of immovable thing of which I use the term 'being at rest': for rest is contrary to motion, so that rest will be negation of motion in that which is capable of admitting motion.

The foregoing remarks are sufficient to explain the essential nature of motion and rest, the number of kinds of change, and the different varieties of motion.

3 Let us now proceed to define the terms 'together' and 'apart', 'in contact', 'between', 'in succession', 'contiguous', and 'continuous', and to show in what circumstances each of these terms is naturally applicable.

Things[4] are said to be together in place when they are in one place (in the strictest sense of the word 'place') and to be apart when they are in different places.

Things are said to be in contact when their extremities are together.

[1] Reading in l. 5 εἰς αὐτό, with F.
[2] Reading in l. 8 τὸ πλέον, with E.
[3] With ll. 10–16 cf. *Met.* 1068b 20–5.
[4] With ll. 21–5 cf. *Met.* 1068b 26–30.

That which a changing thing, if it changes continuously in a natural manner, naturally reaches[1] before it reaches that to which it changes last, is between. Thus 'between' implies the presence of at least three things: for in a process of change it is the contrary that is 'last': and a thing is moved continuously if it leaves no gap or only the smallest possible[2] gap in the material—not in the time (for a gap in the time does not prevent things having a 'between', while, on the other hand, there is nothing to prevent the highest note sounding immediately after the lowest) but in the material in which the motion takes place. This is manifestly true not only in local changes but in every other kind

227a 7 as well. ⟨Now[3] every change implies a pair of opposites, and opposites may be either contraries or contradictories; since then contradiction admits of no mean term, it is obvious that 'between' must imply a pair of contraries.⟩

226b 32 That[4] is locally contrary which is most distant in a straight line: for the shortest line is definitely limited, and that which is definitely limited constitutes a measure.[5]

A thing is 'in succession' when it is after the beginning[6] in position or in form[7] or in some other respect in which it

227a is definitely so regarded, and when further there is nothing of the *same* kind as itself between it and that to which it is in succession, e.g. a line or lines if it is a line, a unit or units if it is a unit, a house if it is a house (there is nothing to prevent something of a *different* kind being between). For that which is in succession is in succession to a particular thing, and is something posterior: for one is not 'in succession' to two, nor is the first day of the month to the second: in each case the latter is 'in succession' to the former.

A thing that is in succession and touches is 'contiguous'. The 'continuous' is a subdivision of the contiguous:

[1] Reading in l. 24 πρότερον, with *Met.* 1068b 28.

[2] Reading in l. 28 ἢ ὅτι ὀλίγιστον, with E.

[3] Sense seems to require this transposition: v. Prantl, *ad loc.*, and cf. Themistius.

[4] With l. 32–227a 31 cf. *Met.* 1068b 30–1069a 14.

[5] sc. for τὸ πλεῖστον.

[6] Omitting in l. 35 μόνον, with E.

[7] Reading in l. 35 εἴδει for φύσει, with EH.

things are called continuous when the touching limits of each become one and the same and are, as the word implies, contained in each other: continuity is impossible if these extremities are two. This definition makes it plain that continuity belongs to things that naturally in virtue of their mutual contact form a unity. And in whatever way that which holds them together is one, so too will the whole be one, e. g. by a rivet or glue or contact or organic union.

It is obvious that of these terms 'in succession' is first in order of analysis: for that which touches is necessarily in succession, but not everything that is in succession touches: and so succession is a property of things prior in definition, e. g. numbers, while contact is not. And if there is continuity there is necessarily contact, but if there is contact, that alone does not imply continuity: for the extremities of things may be '*together*' without necessarily being *one*: but they cannot be one without being necessarily together. So natural junction is last in coming to be: for the extremities must necessarily come into contact if they are to be naturally joined: but things that are in contact are not all naturally joined, while where there is no contact clearly there is no natural junction either. Hence, if as some say 'point' and 'unit' have an independent existence of their own, it is impossible for the two to be identical: for points can touch while units can only be in succession. Moreover, there can always be something between points (for all lines are intermediate between points[1]), whereas it is not necessary that there should possibly be anything between units: for there can be nothing between the numbers one and two.

We have now defined what is meant by 'together' and 'apart', 'contact', 'between' and 'in succession', 'con- 227b
tiguous' and 'continuous': and we have shown in what circumstances each of these terms is applicable.

4 There are many senses in which motion is said to be 'one': for we use the term 'one' in many senses.

Motion is one *generically* according to the different cate-

[1] Cf. $231^{b}9$.

gories to which it may be assigned: thus any locomotion is one generically with any other locomotion, whereas alteration is different generically from locomotion.

Motion is one specifically when besides being one generically it also takes place in a species incapable of subdivision: e. g. colour has specific differences: therefore blackening and whitening differ specifically; but at all events[1] every whitening will be specifically the same with every other whitening and every blackening with every other blackening. But whiteness is not further subdivided by specific differences: hence any whitening is specifically one with any other whitening. Where it happens that the genus is at the same time a species, it is clear that the motion will then in a sense[2] be one specifically though not in an unqualified sense: learning is an example of this, knowledge being on the one hand a species of apprehension and on the other hand a genus including the various knowledges. A difficulty, however, may be raised as to whether a motion is specifically one when the same thing changes from the same to the same, e. g. when one point changes again and again from a particular place to a particular place: if this motion is specifically one, circular motion will be the same as rectilinear motion, and rolling the same as walking. But is not this difficulty removed by the principle already laid down that if that in which the motion takes place is specifically different (as in the present instance the circular path is specifically different from the straight) the motion itself is also different? We have explained, then, what is meant by saying that motion is one generically or one specifically.

Motion is one in an unqualified sense when it is one essentially or numerically: and the following distinctions will make clear what this kind of motion is. There are three classes of things in connexion with which we speak of motion, the 'that which', the 'that in which', and the 'that during which'. I mean that[3] there must *be* some-

[1] Reading in l. 9 δ' οὖν, with EH.
[2] Reading in l. 12 δῆλον ὡς ἔστιν ὡς, with E^2.
[3] Omitting in l. 24 ὅ, with EF.

thing that is in motion, e.g. a man or gold, and it must be in motion *in* something, e.g. a place or an affection, and *during* something, for all motion takes place during a time. Of these three it is the thing in which the motion takes place that makes it one generically or specifically,[1] it is the thing moved that makes the motion one in subject, and it is the time that makes it consecutive: but it is the three together that make it one without qualification: to effect this, that in which the motion takes place (the species) must be one and incapable of subdivision, that during which it takes place (the time) must be one and unintermittent, and that which is in motion must be one—not in an accidental sense (i.e. it must be one as the white that blackens is one or Coriscus who walks is one, not in the accidental sense in which Coriscus and white may be one), nor merely in virtue of community of nature (for there might be a case of two men being restored to health at the same time in the same way, e.g. from inflammation of the eye, yet this motion is not really one, but only specifically one).

Suppose, however, that Socrates undergoes an alteration specifically the same but at one time and again at another: in this case if it is possible for that which ceased to be again to come into being and remain numerically the same, then this motion too will be one: otherwise it will be the same but not one. And akin to this difficulty there is another; viz. is health one? and generally are the states and affections in bodies severally one in essence although (as is clear) the things that contain them are obviously in motion and in flux? Thus if a person's health at daybreak and at the present moment is one and the same, why should not this health be numerically one with that which he recovers after an interval? The same argument applies in each case.[2] There is, however, we may answer, this difference: that if

[1] The text seems faulty, though Simplicius read the same. The translation follows the suggestion of Bonitz in inserting, after κινεῖται in l. 28, τὸ δὲ τῷ ὑποκειμένῳ μίαν ἐν τῷ πράγματι ὃ κινεῖται. But the next clause is, in view of 228a 26–31, best emended by reading τὸ δ' ἐχομένῳ ἐν τῷ χρόνῳ.

[2] sc. the case of ἕξεις and the case of κινήσεις.

the states are two then it follows simply from this fact[1] that the activities must also in point of number be two (for only that which is numerically one can give rise to an activity that is numerically one), but if the state is one, this is not in itself enough to make us regard the activity also as one: for when a man ceases walking, the walking no longer is, but it will again be if he begins to walk again. But, be this as it may, if in the above instance the health is one and the same, then it must be possible for that which is one and the same to come to be and to cease to be many times. However,[2] these difficulties lie outside our present inquiry.

Since every motion is continuous, a motion that is one in an unqualified sense must (since every motion is divisible) be continuous, and a continuous motion[3] must be one. There will not be continuity between any motion and any other indiscriminately any more than there is between any two things chosen at random in any other sphere: there can be continuity only when the extremities of the two things are one. Now some[4] things have no extremities at all: and the extremities of others differ specifically although we give them the same name of 'end': how should e.g. the 'end' of a line and the 'end' of walking touch or come to be one? Motions that are not the same either specifically or generically may, it is true, be *consecutive* (e.g. a man may run and then at once fall ill of a fever), and again, in the torch-race we have consecutive but not continuous locomotion: for according to our definition there can be continuity only when the ends of the two things are one. Hence motions may be consecutive[5] or successive in virtue of the time being continuous, but there can be continuity only in virtue of the motions themselves being continuous, that is when the end of each is one with the end of the
228b other. Motion, therefore, that is in an unqualified sense continuous and one must be specifically the same, of one

[1] Reading in l. 13 *δι' αὐτὸ τοῦτο ὡς τῷ ἀριθμῷ καὶ τὰς ἐνεργείας ἀνάγκη*.
[2] Reading in l. 19 *μὲν οὖν*, with FHI.
[3] Reading in l. 22 *μίαν*, with Them. and Bonitz.
[4] sc. indivisibles.
[5] Reading in l. 30 *ἐχόμεναι*, with EH.

thing, and in one time. Unity is required in respect of time in order that there may be no interval of immobility, for where there is intermission of motion there must be rest, and a motion that includes intervals of rest will be not one but many, so that a motion that is interrupted by stationariness is not one or continuous, and it is so interrupted if there is an interval of time. And though of a motion that is not specifically one (even if the time is unintermittent) the time[1] is one, the motion is specifically different, and so cannot really be one, for motion that is one must be specifically one, though motion that is specifically one is not necessarily one in an unqualified sense. We have now explained what we mean when we call a motion one without qualification.

Further, a motion is also said to be one generically, specifically, or essentially when it is complete, just as in other cases completeness and wholeness are characteristics of what is one: and sometimes a motion even if incomplete is said to be one, provided only that it is continuous.

And besides the cases already mentioned there is another in which a motion is said to be one, viz. when it is regular: for in a sense a motion that is irregular is not regarded as one, that title belonging rather to that which is regular, as a straight line is regular,[2] the irregular being as such[3] divisible. But the difference would seem to be one of degree.[4] In every kind of motion we may have regularity or irregularity: thus there may be regular alteration, and locomotion in a regular path, e.g. in a circle or on a straight line, and it is the same with regard to increase and decrease. The difference that makes a motion irregular[5] is sometimes to be found in its path: thus a motion cannot be regular if its path is an irregular magnitude, e. g. a broken

[1] Omitting in l. 8 *οὔ*, with E, and reading *ὁ χρόνος, ὁ μὲν χρόνος*, with Bonitz.

[2] *ὁμαλής* (= *ὁμοιομερής* of mathematical writers), regular in the sense that any part applied to any other part can coincide with it.

[3] e.g. a line partly straight and partly curved (and the motion along it) may be divided accordingly.

[4] i. e. regularity and irregularity do not constitute distinct species of motion: they occur in every kind of motion, making it more or less what it is.

[5] Reading in l. 21 *ἀνωμαλία*, with E Them.

line,[1] a spiral,[2] or any other magnitude that is not such that any part of it taken at random fits on to any other that may be chosen. Sometimes it is found neither in the place nor in the time nor in the goal but in the manner of the motion: for in some cases the motion is differentiated by quickness and slowness: thus if its velocity is uniform a motion is regular, if not it is irregular. So quickness and slowness are not species of motion nor do they constitute specific differences of motion, because this distinction occurs in connexion with all the distinct species of motion. The same is true of heaviness and lightness[3] when they refer to the same thing: e. g. they do not specifically distinguish earth from itself or fire from itself.
229a Irregular motion, therefore, while in virtue of being continuous it is one, is so in a lesser degree, as is the case with locomotion in a broken line: and a lesser degree of something always means an admixture of its contrary. And since every motion that is one can be both regular and irregular, motions that are consecutive but not specifically the same cannot be one[4] and continuous: for how should a motion composed of alteration and locomotion be regular? If a motion is to be regular its parts ought to fit one another.

We have further to determine what motions are contrary 5
to each other, and to determine similarly how it is with rest. And we have first to decide whether contrary motions are motions respectively from and to the same thing, e. g. a motion from health and a motion to health (where the opposition, it would seem, is of the same kind as that between coming to be and ceasing to be); or motions respectively from contraries, e. g. a motion from health and a motion from disease; or motions respectively to contraries, e. g. a motion to health and a motion to disease; or motions respectively from a contrary and to the opposite contrary, e. g. a motion from health and a motion to disease;

[1] i. e. as we should say, *two* lines meeting in an angular point.
[2] One spiral—the cylindrical helix—is regular: but this property was first proved for it by Apollonius.
[3] Which cause quick and slow motion.
[4] Reading in l. 4 εἶδος αἱ αὐταὶ ἐχόμεναι μία.

or motions respectively from a contrary to the opposite contrary and from the latter to the former, e. g. a motion from health to disease and a motion from disease to health: for motions must be contrary to one another in one or more of these ways, as there is no other way in which they can be opposed.

Now motions respectively from a contrary and to the opposite contrary, e. g. a motion from health and a motion to disease, are not contrary motions: for they are one and the same. (Yet their essence is not the same, just as changing from health is different from changing to disease.) Nor are motions respectively from a contrary and from the opposite contrary contrary motions, for a motion from a contrary is at the same time a motion to a contrary or to an intermediate (of this, however, we shall speak later),[1] but changing to a contrary rather than changing from a contrary would seem to be the cause of the contrariety of motions, the latter being the loss, the former the gain, of contrariness. Moreover, each several motion takes its name rather from the goal than from the starting-point of change, e. g. motion to health we call convalescence, motion to disease sickening. Thus we are left with motions respectively to contraries, and motions respectively to contraries from the opposite contraries. Now it would seem that motions to contraries are at the same time motions from contraries (though their essence may not be the same; 'to health' is distinct, I mean, from 'from disease', and 'from health' from 'to disease').

Since then change differs from motion (motion being change from a particular subject to a particular subject), it follows that contrary motions are motions respectively from a contrary to the opposite contrary and from the latter to the former, e. g. a motion from health to disease 229b
and a motion from disease to health. Moreover, the consideration of particular examples will also show what kinds of processes are generally recognized as contrary: thus falling ill is regarded as contrary to recovering one's health, these processes having contrary goals, and being taught as

[1] l. 28 sqq.

contrary to being led into error by another, it being possible to acquire error, like knowledge, either by one's own agency or by that of another. Similarly we have upward locomotion and downward locomotion, which are contrary lengthwise,[1] locomotion to the right and locomotion to the left, which are contrary breadthwise, and forward locomotion and backward locomotion, which too are contraries. On the other hand, a process simply to a contrary, e.g. that denoted by the expression 'becoming white', where no starting-point is specified, is a change but not a motion. And in all cases of a thing that has no contrary we have as contraries change from and change to the same thing. Thus coming to be is contrary to ceasing to be, and losing to gaining. But these are changes and not motions. And wherever a pair of contraries admit of an intermediate, motions to that intermediate must be held to be in a sense motions to one or other of the contraries: for the intermediate serves as a contrary for the purposes of the motion, in whichever direction the change may be, e.g. grey in a motion from grey to white takes the place of black as starting-point, in a motion from white to grey it takes the place of black as goal, and in a motion from black to grey it takes the place of white as goal: for the middle is opposed in a sense to either of the extremes, as has been said above.[2] Thus we see that two motions are contrary to each other only when one is a motion from a contrary to the opposite contrary and the other is a motion from the latter to the former.

But since a motion appears to have contrary to it not 6
only another motion but also a state of rest, we must determine how this is so. A motion has for its contrary in the strict sense of the term another motion, but it also has for an opposite a state of rest (for rest is the privation of motion and the privation of anything may be called its

[1] Cf. *de Caelo* 284b 24 *ἔστι δὲ τὸ μὲν ἄνω τοῦ μήκους ἀρχή, τὸ δὲ δεξιὸν τοῦ πλάτους, τὸ δὲ πρόσθεν τοῦ βάθους.*

[2] 224b 32 sqq. There is no need to insert *ἐναντίον* (with Prantl) after *μέσον* in l. 19.

contrary), and motion of one kind[1] has for its opposite rest of that kind, e. g. local motion has local rest. This statement, however, needs further qualification: there remains the question, is the opposite of remaining at a particular place motion from or motion to that place? It is surely clear that since there are two subjects between which motion takes place, motion from one of these (*A*) to its contrary (*B*) has for its opposite remaining in *A*, while the reverse motion has for its opposite remaining in *B*. At the same time these two are also contrary to each other: for it would be absurd to suppose that there are contrary motions and not opposite states of rest. States of rest in contraries *are* 230a
opposed. To take an example, a state of rest in health is (1) contrary to a state of rest in disease, and (2) the motion to which it is contrary is that from health to disease. For (2) it would be absurd that its contrary motion should be that from disease to health, since motion to that in which a thing is at rest is rather a coming to rest, the coming to rest being found to come into being simultaneously with the motion; and one of these two motions it must be. And (1) rest in *whiteness* is of course not contrary to rest in health.

Of all things that have no contraries there are opposite *changes* (viz. change from the thing and change to the thing, e. g. change from being and change to being), but no *motion*. So, too, of such things there is no remaining though there is absence of change. Should there be a particular subject, absence of change in its being will be contrary to absence of change in its not-being. And here a difficulty may be raised: if not-being is not a particular something, what is it, it may be asked, that is contrary to absence of change in a thing's being? and is this absence of change a state of rest? If it is, then either it is not true that every state of rest is contrary to a motion or else coming to be and ceasing to be are motion. It is clear then that, since we exclude these from among motions, we must not say that this absence of change is a state of rest: we must say that it is similar to a state of rest and call it absence of change.

[1] Reading in l. 26 ποιᾷ δὲ ποιά, with Phil.

And it will have for its contrary[1] either nothing or absence of change in the thing's not-being, or the ceasing to be of the thing: for such ceasing to be is change from it and the thing's coming to be is change to it.

Again, a further difficulty may be raised. How is it, it may be asked, that whereas in local change both remaining and moving may be natural or unnatural, in the other changes this is not so? e.g. alteration is not now natural and now unnatural, for convalescence is no more natural or unnatural than falling ill, whitening no more natural or unnatural than blackening; so, too, with increase and decrease: these are not contrary to each other in the sense that either of them is natural while the other is unnatural, nor is one increase contrary to another in this sense; and the same account may be given of becoming and perishing: it is not true that becoming is natural and perishing unnatural (for growing old[2] is natural), nor do we observe one becoming to be natural and another unnatural. We answer that if what happens under violence is unnatural, then violent perishing is unnatural and as such contrary to natural perishing. Are there then also some becomings that are violent and not the result of natural necessity, and are therefore contrary to natural becomings, and violent in-
230b creases and decreases, e.g. the rapid growth to maturity of profligates and the rapid ripening of seeds even when not packed close in the earth? And how is it with alterations? Surely just the same: we may say that some alterations are violent while others are natural, e.g. patients alter naturally or unnaturally according as they throw off fevers on the critical days or not. But, it may be objected, then we shall have perishings contrary to one another, not to becoming.[3] Certainly: and why should not this in a sense be so?[4] Thus it is so if one perishing is pleasant and another painful: and so one perishing will be contrary to another not in an

[1] If there is no *μὴ ὄν* to be contrary to the *ὄν*, then *ἀμεταβλησία* in the *ὄν* will have no contrary: if there is, it will have for contraries (*a*) the *ἀμεταβλησία* in the *μὴ ὄν* and (*b*) the *φθορά* which = *μεταβολὴ ἐξ ἀμεταβλησίας τοῦ ὄντος* (*εἰς ἀμεταβλησίαν τοῦ μὴ ὄντος*).

[2] Reading in l. 28 *ἡ γὰρ γήρανσις*, with EH.

[3] Reading in l. 7 *γενέσει* (Bekker's *γενέσεις* is a misprint).

[4] Reading in l. 7 *κωλύει ἔστιν ὡς*; with E Phil. Simp.

unqualified sense, but in so far as one has this quality and the other that.

Now motions and states of rest universally[1] exhibit contrariety in the manner described above,[2] e.g. upward motion and rest above are respectively contrary to downward motion and rest below, these being instances of local contrariety; and upward locomotion belongs naturally to fire and downward to earth, i.e. the locomotions of the two are contrary to each other. And again, fire moves up naturally and down unnaturally: and its natural motion is certainly contrary to its unnatural motion. Similarly with remaining: remaining above is contrary to motion from above downwards, and to earth this remaining comes unnaturally, this motion naturally. So the unnatural remaining of a thing is contrary to its natural motion, just as we find a similar contrariety in the motion of the same thing: one of its motions, the upward or the downward, will be natural, the other unnatural.

Here, however, the question arises, has every state of rest that is not permanent a becoming, and is this becoming a coming to a standstill? If so, there must be a becoming of that which is at rest unnaturally, e.g. of earth at rest above: and therefore this earth during the time that it was being carried violently upward was coming to a standstill. But whereas the velocity of that which comes to a standstill seems always to increase, the velocity of that which is carried violently seems always to decrease: so it will *be* in a state of rest without having *become* so. Moreover 'coming to a standstill' is generally recognized to be identical or at least concomitant with the locomotion of a thing to its proper place.[3]

There is also another difficulty involved in the view that remaining in a particular place is contrary to motion from that place. For when a thing is moving from or discarding something, it still appears to have that which is being discarded, so that if a state of rest is itself contrary to the

[1] i.e. the contrariety of natural)(violent is no exception.

[2] In chapter 5.

[3] ∴ we must not use the term ἵστασθαι to describe the process that ends in unnatural rest.

motion from the state of rest to its contrary, the contraries rest and motion will be simultaneously predicable of the same thing. May we not say, however, that in so far as the thing is still stationary it is in a state of rest in a qualified sense? For,[1] in fact, whenever a thing is in motion, part of it is at the starting-point while part is at the goal
231a to which it is changing: and consequently a motion finds its true contrary rather in another motion than in a state[2] of rest.

With regard to motion and rest, then, we have now explained in what sense each of them is one and under what conditions they exhibit contrariety.

[3][With regard to coming to a standstill the question may be raised whether there is an opposite state of rest to unnatural as well as to natural motions. It would be absurd if this were not the case: for a thing may remain still merely under violence: thus we shall have a thing being in a non-permanent state of rest without having become so. But it is clear that it must be the case: for just as there is unnatural motion, so, too, a thing may be in an unnatural state of rest. Further, some things have a natural and an unnatural motion, e.g. fire has a natural upward motion and an unnatural downward motion: is it, then, this unnatural downward motion or is it the natural downward motion of earth that is contrary to the natural upward motion? Surely it is clear that both are contrary to it though not in the same sense: the natural motion of earth is contrary inasmuch as the motion of fire is also natural, whereas the upward[4] motion of fire as being natural is contrary to the downward motion of fire as being unnatural. The same is true of the corresponding cases of remaining. But there would seem to be a sense in which a state of rest and a motion are opposites.]

[1] Cf. vi. 5.
[2] ἠρέμησις seems to be used for ἠρεμία. Cf. 251a 26.
[3] This confused paragraph following what should be the final sentence of the book is omitted by six MSS., ignored by Themistius, and considered superfluous by Simplicius.
[4] Reading in l. 14 τῆς αὐτοῦ· ἡ δ' ἄνω.

BOOK VI

1 Now if the terms 'continuous', 'in contact', and 'in succession' are understood as defined above[1]—things being 'continuous' if their extremities are one, 'in contact' if their extremities are together, and 'in succession' if there is nothing of their own kind intermediate between them—nothing that is continuous can be composed of indivisibles: e.g. a line cannot be composed of points, the line being continuous and the point indivisible. For the extremities of two points can neither be *one* (since of an indivisible there can be no extremity as distinct from some other part) nor *together* (since that which has no parts can have no extremity, the extremity and the thing of which it is the extremity being distinct).

Moreover, if that which is continuous is composed of points, these points must be either *continuous* or *in contact* with one another: and the same reasoning applies in the case of all indivisibles. Now for the reason given above 231b
they cannot be continuous: and one thing can be in contact with another only if whole is in contact with whole or part with part or part with whole. But since indivisibles have no parts, they must be in contact with one another as whole with whole. And if they are in contact with one another as whole with whole, they will not be continuous: for that which is continuous has distinct parts: and these parts into which it is divisible are different in this way, i.e. spatially separate.

Nor, again, can a point be *in succession* to a point or a moment to a moment in such a way that length can be composed of points or time of moments: for things are in succession if there is nothing of their own kind intermediate between them, whereas that which is intermediate between points is always a[2] line and that which is intermediate between moments is always a period of time.

Again, if length and time could thus be composed of

[1] v. 3.

[2] i.e. if we take any two points (moments) A and B, since they cannot touch there is a line (time) between them: and on this line (in

indivisibles, they could be divided into indivisibles, since each is divisible into the parts of which it is composed. But, as we saw, no continuous thing is divisible into things without parts. Nor can there be anything of any other kind intermediate between the parts or between the moments: for if there could be any such thing it is clear that it must be either indivisible or divisible, and if it is divisible, it must be divisible either into indivisibles or into divisibles that are infinitely divisible, in which case it is continuous.

Moreover, it is plain that everything continuous is divisible into divisibles that are infinitely divisible: for if it were divisible into indivisibles, we should have an indivisible in contact with an indivisible, since the extremities of things that are continuous with one another are one and[1] are in contact.

The same reasoning applies equally to magnitude, to time, and to motion: either all of these are composed of indivisibles and are divisible into indivisibles, or none. This may be made clear as follows. If a magnitude is composed of indivisibles, the motion over that magnitude must be composed of corresponding indivisible motions: e.g. if the magnitude ΑΒΓ is composed of the indivisibles Α, Β, Γ, each corresponding part of the motion ΔΕΖ of Ω over ΑΒΓ is indivisible. Therefore,[2] since where there is motion there must be something that is in motion, and where there is something in motion there must be motion, therefore the being-moved will also be composed of indivisibles. So Ω traversed Α when its motion was Δ, Β when its motion was Ε, and Γ similarly when its motion was Ζ. Now[3] a thing that is in motion from one place to another cannot at the moment when it was in motion both be in motion and at the same time have completed its motion at the place to which it was in motion: e.g. if a man is walking to Thebes, he cannot be walking to Thebes and at

this time) we can always take another point (moment) Γ. ∴ A and B have between them another thing of the same kind, and so are not ἐφεξῆς.

[1] Omitting the comma in l. 18. [2] l. 25 reading δή, with EHIK.

[3] There is a slight anacoluthon, the virtual apodosis being introduced by ὥστ' (232a 2).

the same time have completed his walk to Thebes: and, as we saw, Ω traverses the partless section A in virtue of the presence of the motion Δ. Consequently, if Ω actually passed through A *after* being in process of passing through, the motion must be divisible: for at the time when Ω was passing through, it neither was at rest nor had completed its passage but was in an intermediate state: while if it is passing through and has completed its passage *at the same moment*, then that which is walking[1] will at the moment when it is walking have completed its walk and will be in the place to which it is walking; that is to say, it will have completed its motion at the place to which it is in motion.[2] And if a thing is in motion over the whole ΑΒΓ and its motion is the three Δ, E, and Z, and if it is not in motion at all over the partless section A but has completed its motion over it, then the motion will consist not of motions but of starts, and will take place by[3] a thing's having completed a motion without being in motion: for on this assumption it has completed its passage through A without passing through it. So it will be possible for a thing to have completed a walk without ever walking: for on this assumption it has completed a walk over a particular distance without walking over that distance. Since, then, everything must be either at rest or in motion, and Ω is therefore at rest in each of the sections A, B, and Γ, it follows that a thing can be continuously at rest and at the same time in motion: for, as we saw, Ω is in motion over the whole ΑΒΓ and at rest in any part (and consequently in the whole) of it. Moreover, if the indivisibles composing ΔEZ are motions, it would be possible for a thing in spite of the presence in it of motion to be not in motion but at rest, while if they are not motions, it would be possible for motion to be composed of something other than motions.

And if length and motion are thus indivisible, it is neither more nor less necessary that time also be similarly indivisible, that is to say be composed of indivisible moments:

[1] Reading commas before and after τὸ βαδίζον in l. 4.
[2] Which is *ex hypothesi* impossible (231^b 28–30).
[3] Reading in l. 9 καὶ τῷ.

for if the whole distance is divisible and an equal velocity will cause a thing to pass through less of it in less time, the time must also be divisible, and conversely, if the time in which a thing is carried over the section A is divisible, this section A must also be divisible.

And since every magnitude is divisible into magnitudes— 2
for we have shown that it is impossible for anything continuous to be composed of indivisible parts, and every magnitude is continuous—it necessarily follows that the quicker of two things traverses a greater magnitude in an equal time, an equal magnitude in less time, and a greater magnitude in less time, in conformity with the definition sometimes given of 'the quicker'. Suppose that A is quicker than B. Now since of two things that which changes sooner is quicker, in the time ZH, in which A has changed from Γ to Δ, B will not yet have arrived at Δ but will be short of it: so that in an equal time the quicker will pass over a greater magnitude. More than this, it will pass over a greater magnitude in less time: for in the time in which A has arrived at Δ, B being the slower has arrived, let us say, at E. Then since A has occupied the whole
232b time ZH in arriving at Δ, it will have arrived at Θ in less time than this, say ZK. Now the magnitude ΓΘ[1] that A has passed over is greater than the magnitude ΓE, and the time ZK is less than the whole time ZH: so that the quicker will pass over a greater magnitude in less time. And from this it is also clear that the quicker will pass over an equal magnitude in less time than the slower. For since it passes over the greater magnitude in less time than the slower, and (regarded by itself) passes over ΛM the greater in more time than ΛΞ the lesser, the time ΠP in which it passes over ΛM will be more than the time ΠΣ in which it passes over ΛΞ: so that, the time ΠP being less than the time ΠX in which the slower passes over ΛΞ, the time ΠΣ will also be less than the time ΠX: for it is less than the time ΠP, and that which is less than some-

[1] Γ E Θ Δ. Bekker's ΓΔ in l. 3 is a misprint.

thing else that is less than a thing is also itself less than that thing. Hence it follows that the quicker will traverse an equal magnitude in less time than the slower. Again, since the motion of anything must always occupy either an equal time or less or more time in comparison with that of another thing, and since, whereas a thing is slower if its motion occupies more time and of equal velocity if its motion occupies an equal time, the quicker is neither of equal velocity nor slower, it follows that the motion of the quicker can occupy neither an equal time nor more time. It can only be, then, that it occupies less time, and thus we get the necessary consequence that the quicker will pass over an equal magnitude (as well as a greater) in less time than the slower.

And since every motion is in time and a motion may occupy any time, and the motion of everything that is in motion may be either quicker or slower, both quicker motion and slower motion may occupy any time: and this being so, it necessarily follows that time also is continuous. By continuous I mean that which is divisible into divisibles that are infinitely divisible: and if we take this as the definition of continuous, it follows necessarily that time is continuous. For since it has been shown that the quicker will pass over an equal magnitude in less time than the slower, suppose that A is quicker and B slower, and that the slower has traversed the magnitude ΓΔ in the time ZH. Now it is clear that the quicker will traverse the same magnitude in less time than this: let us say in the time ZΘ. Again, since the quicker has passed over the whole ΓΔ in the time ZΘ, the slower will in the same time pass over ΓK, say,[1]
which is less than ΓΔ. And since B, the slower, has passed 233a
over ΓK in the time ZΘ, the quicker will pass over it in less time: so that the time ZΘ will again be divided. And if this is divided the magnitude ΓK will also be divided just as ΓΔ was: and again, if the magnitude is divided, the time will also be divided. And we can carry on this process for ever, taking the slower after the quicker and the quicker after the slower alternately, and using what has been

[1] l. 33 reading ἔστω, with E Them. Simp.

demonstrated at each stage as a new point of departure: for the quicker will divide the time and the slower will divide the length. If, then, this alternation always holds good, and at every turn involves a division, it is evident that all time must be continuous. And at the same time it is clear that all magnitude is also continuous; for the divisions of which time and magnitude respectively are susceptible are the same and equal.

Moreover, the current popular arguments make it plain that, if time is continuous, magnitude is continuous also, inasmuch as a thing passes over half a given magnitude in half the time taken to cover the whole: in fact without qualification it passes over a less magnitude in less time; for the divisions of time and of magnitude will be the same. And if either is infinite, so is the other, and the one is so in the same way as the other; i.e. if time is infinite in respect of its extremities,[1] length is also infinite in respect of its extremities: if time is infinite in respect of divisibility, length is also infinite in respect of divisibility: and if time is infinite in both respects, magnitude is also infinite in both respects.

Hence Zeno's argument[2] makes a false assumption in asserting that it is impossible for a thing to pass over or severally to come in contact with infinite things in a finite time. For there are two senses in which length and time and generally anything continuous are called 'infinite': they are called so either in respect of divisibility or in respect of their extremities. So while a thing in a finite time cannot come in contact with things quantitatively infinite, it can come in contact with things infinite in respect of divisibility: for in this sense the time itself is also infinite: and so we find that the time occupied by the passage over the infinite is not a finite but an infinite time, and the contact with the infinites is made by means of moments not finite but infinite in number.

[1] i.e. extends infinitely in both directions.

[2] i.e. one of his arguments for the impossibility of motion, which ran as follows: if motion is possible, a thing can in a finite time pass over infinite things touching each of them; but this is impossible: therefore motion is impossible. Cf. 239b 9–14, *Top.* 160b 7.

The passage over the infinite,[1] then, cannot occupy a finite time, and the passage over the finite cannot occupy an infinite time: if the time is infinite the magnitude must be infinite also, and if the magnitude is infinite, so also is the time. This may be shown as follows. Let AB be a finite magnitude, and let us suppose that it is traversed in infinite time Γ, and let a finite period ΓΔ of the time be taken. Now in this period the thing in motion will pass 233b
over a certain segment of the magnitude: let BE be the segment that it has thus passed over. (This will be either an exact measure of AB or less[2] or greater than an exact measure: it makes no difference which it is.) Then, since a magnitude equal to BE will always be passed over in an equal time, and BE measures the whole magnitude, the whole time occupied in passing over AB will be finite: for it will be divisible into periods equal in number to the segments into which[3] the magnitude is divisible. Moreover, if it is the case that infinite time is not occupied in passing over every magnitude, but it is possible to pass over some magnitude, say BE, in a finite time, and if this BE measures the whole of which it is a part, and if an equal magnitude is passed over in an equal time, then it follows that the time like the magnitude is finite. That infinite time will not be occupied in passing over BE is evident if the time be taken as limited in one direction[4]: for as the part will be passed over in less time than the whole, the time occupied in traversing this part must be finite, the limit in one direction being given. The same reasoning will also show the falsity of the assumption that infinite length can be traversed in a finite time. It is evident, then, from what

[1] i.e. in the strict sense, viz. extending infinitely in both directions.

[2] i.e. the nearest multiple of BE to AB will be less or greater than AB: e.g. 4 feet καταμετρεῖ 16 feet (16 being an exact multiple of 4), 3 feet ἐλλείπει (the nearest multiple being 15, i.e. *less* than 16), 6 feet ὑπερβάλλει (the nearest multiple being 18, i.e. *greater* than 16). Obviously, since the amount by which BE ἐλλείπει or ὑπερβάλλει is always less than BE, it makes no difference to the argument whether BE is an exact measure or not.

[3] l. 7 omit ὡς, with E, and the comma.

[4] i.e. the point B at which the motion begins is fixed, and the moment at which the motion begins must similarly be regarded as fixed.

has been said that neither a line nor a surface nor in fact anything continuous can be indivisible.

This conclusion follows not only from the present argument but from the consideration that the opposite assumption implies the divisibility of the indivisible. For since the distinction of quicker and slower may apply to motions occupying any period of time and in an equal time the quicker passes over a greater length, it may happen that it will pass over a length twice, or one and a half times, as great as that passed over by the slower: for their respective velocities may stand to one another in this proportion. Suppose, then, that the quicker has in the same time been carried over a length one and a half times as great as that traversed by the slower, and that the respective magnitudes are divided, that[1] of the quicker, the magnitude ΑΒΓΔ,[2] into three indivisibles, and that[3] of the slower into the two indivisibles EZ, ZH. Then the time may also be divided into three indivisibles, for an equal magnitude will be passed over in an equal time. Suppose then that it is thus divided into KΛ, ΛM, MN. Again, since in the same time the slower has been carried over EZ, ZH, the time may also be similarly divided into two. Thus the indivisible will be divisible, and that which has no parts will be passed over not in an indivisible but in a greater time.[4] It is evident, therefore, that nothing continuous is without parts.

The present also is necessarily indivisible—the present, 3
that is, not in the sense in which the word is applied to one thing in virtue of another,[5] but in its proper and primary sense; in which sense it is inherent in all time. For the
234a present is something that is an extremity of the past (no part of the future being on this side of it) and also of the future (no part of the past being on the other side of it): it is, as we have said,[6] a limit of both. And if it is once shown

[1] Reading in ll. 23–4 τὸ μέν, with Simp.
[2] Reading in l. 24 ΑΒΓΔ, with EIK.
[3] Reading in l. 25 τὸ δέ, with E Simp.
[4] The slower will traverse EZ in a greater time than the indivisible time in which the quicker traverses KΛ.
[5] i. e. in which it means a period of time including the present proper.
[6] 222a 12.

that it is essentially of this character and one and the same, it will at once be evident also that it is indivisible.

Now the present that is the extremity of both times must be one and the same: for if each extremity were different, the one could not be in succession to the other, because nothing continuous can be composed of things having no parts: and if the one is apart from the other, there will be time intermediate between them, because everything continuous is such that that there is something intermediate between its limits and described by the same name as itself. But if the intermediate thing is time, it will be divisible: for all time has been shown[1] to be divisible. Thus on this assumption the present is divisible. But if the present is divisible, there will be part of the past in the future and part of the future in the past: for past time will be marked off from future time at the actual point of division. Also the present will be a present not in the proper sense but in virtue of something else: for the division which yields it will not be a division proper.[2] Furthermore, there will be a part of the present that is past and a part that is future, and it will not always be the same part that is past or future: in fact one and the same present will not be simultaneous[3]: for the time may be divided at many points.[4] If, therefore, the present cannot possibly have these characteristics, it follows that it must be the same present that belongs to each of the two times.[5] But if this is so it is evident that the present is also indivisible: for if it is divisible it will be involved in the same implications as before. It is clear, then, from what has been said that time contains something indivisible, and this is what we call a present.

We will now show that nothing can be in motion in a present. For if this is possible,[6] there can be both quicker and slower motion in the present. Suppose then that in

[1] Chapter 2.
[2] i.e. it will not be a *point* of division but merely something intermediate between past and future.
[3] 234a 18 reading τὸ αὐτὸ ἅμα, with E.
[4] i.e. the present, being a period of time, can itself be divided into a number of presents.
[5] i.e. that *ends* one period of time and *begins* the next.
[6] Omitting ἐστιν after γάρ in l. 25, with E.

the present N the quicker has traversed the distance AB. That being so, the slower will in the same present traverse a distance less than AB, say AΓ. But since the slower will have occupied the whole present in traversing AΓ, the quicker will occupy less than this in traversing it. Thus we shall have a division of the present, whereas we found it to be indivisible. It is impossible, therefore, for anything to be in motion in a present.

Nor can anything be at rest in a present: for, as we were saying,[1] that only can be at rest which is naturally designed to be in motion but is not in motion when, where, or as it would naturally be so: since, therefore, nothing is naturally designed to be in motion in a present, it is clear that nothing can be at rest in a present either.

Moreover, inasmuch as it is the same present that belongs to both the times,[2] and it is possible for a thing to be in motion throughout one time and to be at rest throughout
234b the other, and that which is in motion or at rest for the whole of a time will be in motion or at rest as the case may be in any part of it in which it is naturally designed to be in motion or at rest: this being so, the assumption that there can be motion or rest in a present will carry with it the implication that the same thing can at the same time be at rest and in motion: for both the times have the same extremity, viz. the present.

Again, when we say that a thing is at rest, we imply that its condition in whole and in part is at the time of speaking uniform with what it was previously: but the present contains no 'previously': consequently, there can be no rest in it.

It follows then that the motion of that which is in motion and the rest of that which is at rest must occupy time.

Further, everything that changes must be divisible. For 4
since every change is from something to something, and when a thing is at the goal of its change it is no longer changing, and when both it itself and all its parts are at the starting-point of its change[3] it is not changing (for that

[1] 226b 12 sqq. [2] viz. past and future.
[3] Reading in l. 12 f. εἰς ὃ μετέβαλλεν . . . ἐξ οὗ μετέβαλλεν (so EK), καὶ αὐτὸ . . . πάντα, οὐ μεταβάλλει.

which is in whole and in part in an unvarying condition is not in a state of change); it follows, therefore,[1] that part of that which is changing must be at the starting-point and part at the goal: for as a whole it cannot be in both or in neither. (Here by 'goal of change' I mean that which comes first in the process of change: e.g. in a process of change from white the goal in question will be grey, not black: for it is not necessary that that which is changing should be at either of the extremes.) It is evident, therefore, that everything that changes must be divisible.

Now motion is divisible in two senses. In the first place it is divisible in virtue of the time that it occupies. In the second place it is divisible according to the motions of the several parts of that which is in motion: e.g. if the whole ΑΓ is in motion, there will be a motion of ΑΒ and a motion of ΒΓ. That being so, let ΔΕ be the motion of the part ΑΒ and ΕΖ the motion of the part ΒΓ. Then the whole ΔΖ[2] must be the motion of ΑΓ: for ΔΖ must constitute the motion of ΑΓ inasmuch as ΔΕ and ΕΖ severally constitute the motions of each of its parts. But the motion of a thing can never be constituted by the motion of something else: consequently the whole motion is the motion of the whole magnitude.

Again, since every motion is a motion of something, and the whole motion ΔΖ is not the motion of either of the parts (for each of the parts ΔΕ, ΕΖ is the motion of one of the parts ΑΒ, ΒΓ) or of anything else (for, the whole motion being the motion of a whole, the parts of the motion are the motions of the parts of that whole: and the parts of ΔΖ are the motions of ΑΒ, ΒΓ[3] and of nothing else: for, as we saw,[4] a motion that is one cannot be the motion of more things than one): since this is so, the whole motion will be the motion of the magnitude ΑΒΓ.

Again, if there is a motion of the whole other than ΔΖ, say ΘΙ, the motion of each of the parts may be subtracted from it: and these motions will be equal to ΔΕ, ΕΖ respectively: for the motion of that which is one must be 235a

[1] Placing a colon before ἀνάγκῃ in l. 15.
[2] Omitting ἡ in l. 25, with E.
[3] Reading in l. 32 ΑΒ ΒΓ with Them. Simp.
[4] 223b 1 sqq.

one. So if the whole motion ΘI may be divided into the motions of the parts, ΘI will be equal to ΔZ: if on the other hand there is any remainder, say KI, this will be a motion of nothing: for it can be the motion neither of the whole nor of the parts (as the motion of that which is one must be one) nor of anything else: for a motion that is continuous must be the motion of things that are continuous. And the same result follows if the division of ΘI reveals a surplus on the side of the motions of the parts.[1] Consequently, if this is impossible, the whole motion must be the same as and equal to ΔZ.

This then is what is meant by the division of motion according to the motions of the parts: and it must be applicable to everything that is divisible into parts.

Motion is also susceptible of another kind of division, that according to time. For since all motion is in time and all time is divisible, and in less time the motion is less, it follows that every motion must be divisible according to time. And since everything that is in motion is in motion in a certain sphere and for a certain time and has a motion belonging to it, it follows that the time, the motion, the being-in-motion, the thing that is in motion, and the sphere of the motion must all be susceptible of the same divisions (though spheres of motion are not all divisible in a like manner: thus quantity is essentially, quality accidentally divisible). For suppose that A is the time occupied by the motion B. Then if all the time has been occupied by the whole motion, it will take less of the motion to occupy half the time, less again to occupy a further subdivision of the time, and so on to infinity. Again, the time will be divisible similarly to the motion: for if the whole motion occupies all the time half the motion will occupy half the time,[2] and less of the motion again will occupy less of the time.

In the same way the being-in-motion will also be divisible. For let Γ be the whole being-in-motion. Then the being-in-

[1] i. e. of what can this surplus motion be the motion?
[2] i. e. if the motion is regular.

motion that corresponds to half the motion[1] will be less than the whole being-in-motion, that which corresponds to a quarter of the motion will be less again, and so on to infinity. Moreover by setting out successively the being-in-motion corresponding to each of the two motions ΔΓ (say) and ΓΕ, we may argue that the whole being-in-motion will correspond to the whole motion (for if it were some other being-in-motion that corresponded to the whole motion, there would be more than one being-in-motion corresponding to the same motion), the argument being the same as that whereby we showed[2] that the motion of a thing is divisible into the motions of the parts of the thing: for if we take separately the being-in-motion corresponding to each of the two motions, we shall see that the whole being-in-motion is continuous.[3]

The same reasoning will show the divisibility of the length, and in fact of everything that forms a sphere of change (though[4] some of these are only accidentally divisible because that which changes is so): for the division of one term will involve the division of all. So, too, in the matter of their being finite or infinite, they will all alike be either the one or the other. And we now see that in most 235b
cases[5] the fact that all the terms are divisible or infinite is a direct consequence of the fact that the thing that changes is divisible or infinite: for the attributes 'divisible' and 'infinite' belong in the first instance to the thing that changes. That divisibility does so we have already[6] shown; that infinity does so will be made clear in what follows.[7]

5 Since everything that changes changes from something to something, that which has changed must at the moment

[1] i.e. in which half the motion is realized, τὸ κινεῖσθαι being the state of the κινούμενον in so far as it actually exhibits κίνησις.

[2] 234^b 24 sqq., especially 234^b 34 sqq.

[3] Cf. 235^a 6: κίνησις being continuous, κινεῖσθαι is so also.

[4] The accepted punctuation seems wrong: the sentence ἑνὸς γὰρ . . . διαιρεθήσεται serves to justify not the reservation introduced by πλὴν but the general conclusion as to the divisibility of the terms involved in motion.

[5] An exception would be χρόνος, the divisibility of which would follow from that of κίνησις rather than from that of κινούμενον.

[6] 234^b 10–20.

[7] Chapter 7.

when it has first changed be in that to which it has changed. For that which changes retires from or leaves that from which it changes; and leaving, if not identical with changing, is at any rate a consequence of it. And if leaving is a consequence of changing, having left is a consequence of having changed: for there is a like relation between the two in each case.

One kind of change, then, being change in a relation of contradiction, where a thing has changed from not-being to being it has left not-being. Therefore it will be in being: for everything must either be or not be. It is evident, then, that in contradictory change that which has changed must be in that to which it has changed. And if this is true in this kind of change, it will be true in all other kinds as well: for in this matter what holds good in the case of one will hold good likewise in the case of the rest.

Moreover, if we take each kind of change separately, the truth of our conclusion will be equally evident, on the ground that that which has changed must be somewhere or in something. For, since it has left that from which it has changed and must be somewhere, it must be either in that to which it has changed or in something else. If, then, that which has changed to B is in something other than B, say Γ, it must again be changing from Γ to B: for it cannot be assumed that there is no interval[1] between Γ and B, since change is continuous. Thus we have the result that the thing that has changed, at the moment when it has changed, is changing to that to which it has changed, which is impossible: that which has changed, therefore, must be in that to which it has changed. So it is evident likewise that that which has come to be, at the moment when it has come to be, will *be*, and that which

[1] Cf. the definition of *ἐχόμενον* as *ὃ ἂν ἐφεξῆς ὂν ἅπτηται* (227a 6). The exact connexion of thought is a little obscure: but the argument seems to be this: since the change is continuous, the changing thing, if it has not yet reached the state B, must be in *process* of reaching it, for there must be a gap between B and any intermediate state Γ which is different from B, and this gap can be bridged only by a process of change: ∴ the change being continuous, the changing thing when it reaches Γ must be in process of change towards B. Read *τὸ* B in l. 24, with Hayduck.

has ceased to be will *not-be*: for what we have said applies universally to every kind of change, and its truth is most obvious in the case of contradictory change. It is clear, then, that that which has changed, at the moment when it has first changed, is in that to which it has changed.

We will now show that the 'primary when' in which that which has changed effected the completion of its change must be indivisible, where by 'primary' I mean possessing the characteristics in question of itself and not in virtue of the possession of them by something else belonging to it. For let AΓ be divisible, and let it be divided at B. If then the completion of change has been effected in AB or again in BΓ, AΓ cannot be the primary thing in which the completion of change has been effected. If, on the other hand, it has been changing in both AB and BΓ (for it must either have changed or be changing in each of them), it must have been changing in the whole AΓ: 236a
but our assumption was that AΓ contains only the *completion* of the change. It is equally impossible to suppose that one part of AΓ contains the process and the other the completion of the change: for then we shall have something prior to what is primary.[1] So that in which the completion of change has been effected must be indivisible. It is also evident, therefore, that that in which that which has ceased to be has ceased to be and that in which that which has come to be has come to be are indivisible.

But there are two senses of the expression 'the primary when in which something has changed'. On the one hand it may mean the primary when containing the *completion* of the process of change—the moment when it is correct to say 'it has changed': on the other hand it may mean the primary when containing the *beginning* of the process of change. Now the primary when that has reference to the *end* of the change is something really existent: for a change may really be completed, and there is such a thing as an end of change, which we have in fact shown to be indivisible because it is a limit. But that which has

[1] sc. BΓ will have more right than AΓ to be regarded as that in which the change has been completed.

reference to the beginning is not existent at all: for there is no such thing as a beginning of a process of change,[1] and the time occupied by the change does not contain any primary when in which the change began. For suppose that AΔ is such a primary when. Then it cannot be indivisible: for, if it were, the moment immediately preceding the change and the moment in which the change begins would be consecutive (and moments cannot be consecutive). Again, if the changing thing is at rest in the whole preceding time ΓA[2] (for we may suppose that it is at rest), it is at rest in A also[3]: so if AΔ is without parts, it will simultaneously be at rest and have changed: for it is at rest in A and has changed in Δ.[4] Since then AΔ is not without parts, it must be divisible, and the changing thing must have changed in every part of it (for if it has changed in neither of the two parts into which AΔ is divided, it has not changed in the whole either: if, on the other hand, it is in process of change in both parts, it is likewise in process of change in the whole: and if, again, it has changed in one of the two parts, the whole is not the primary when in which it has changed: it must therefore have changed in every part). It is evident, then, that with reference to the beginning of change there is no primary when in which change has been effected: for the divisions are infinite.

So, too, of that which has changed there is no primary part that has changed. For suppose that of ΔE the primary part that has changed is ΔZ (everything that changes having been shown[5] to be divisible): and let ΘI

[1] i. e. no *part* of the process can be called absolutely first, because that part may be divided again, thus reaching a prior 'first', and so on to infinity. Similarly of course no *part* of the process can strictly be called the end: but the *limit* (πέρας) exists as such, because it is *not* a part of the process but an indivisible something marking the fact that the process is concluded. In the same sense there is an ἀρχή, but it is not strictly speaking an ἀρχὴ μεταβολῆς, because as yet the process has not begun; so it remains true that there is no such thing as τὸ ἐν ᾧ πρώτῳ ἤρξατο μεταβάλλειν.

[2] i. e. if the two moments mentioned above are assumed to be really only one (A).

[3] It would be more correct to say 'is not in motion in A', for in a moment nothing can be either at rest or in motion (234^a 24 sqq.).

[4] sc. because AΔ being indivisible is the same as A.

[5] 234^b 10 sqq.

be the time in which ΔZ has changed. If, then, in the whole time ΔZ has changed, in half the time there will be a part[1] that has changed, less than and therefore prior to ΔZ: and again there will be another part prior to this, and yet another, and so on to infinity. Thus of that which changes there cannot be any primary part that has changed. It is evident, then, from what has been said, that neither of that which changes nor of the time in which it changes is there any primary part.

With regard, however, to the actual subject of change[2]— 236b
that is to say that in respect of which a thing changes—there is a difference to be observed. For in a process of change we may distinguish three terms—that which changes, that in which it changes, and the actual subject of change,[3] e. g. the man, the time, and the fair complexion. Of these the man and the time are divisible: but with the fair complexion it is otherwise (though they are all divisible accidentally, for that in which the fair complexion or any other quality is an accident is divisible). For[4] of actual subjects of change it will be seen that those which are classed as essentially, not accidentally, divisible have no primary part. Take the case of magnitudes: let AB be a magnitude, and suppose that it has moved from B to a primary 'where' Γ. Then if BΓ is taken to be indivisible, two things without parts will have to be contiguous (which is impossible): if on the other hand it is taken to be divisible, there will be something prior to Γ to which the magnitude has changed, and something else again prior to that, and so on to infinity, because the process of division may be continued without end. Thus there can be no

[1] l. 32 reading *ἔσται τι*, with Simp.

[2] Keeping in l. 1 the reading of all the MSS.—*αὐτὸ δὲ ὃ μεταβάλλει* ('the actual thing that changes' in the particular *μεταβάλλον*, e. g. its place, its quantity, its quality), explained immediately as *καθ' ὃ μεταβάλλει*.

[3] Reading in l. 3 with four MSS. *καὶ ὃ μεταβάλλει*, to be explained as above.

[4] The generally accepted punctuation can hardly be right, as the *ἐπεί* clause contains no sort of justification of the immediately preceding statement: it connects rather with the sentence ending *οὐκέθ' ὁμοίως ἕξει* (236b 1), the intervening sentence being of a parenthetical character.

primary 'where' to which a thing has changed. And if we take the case of quantitative change, we shall get a like result, for here too the change is in something continuous. It is evident, then, that only in qualitative motion can there be anything essentially indivisible.

Now everything that changes changes in time, and that 6
in two senses: for the time in which a thing is said to change may be the primary time, or on the other hand it may have an extended reference, as e.g. when we say that a thing changes in a particular year because it changes in a particular day. That being so, that which changes must be changing in any part of the primary time in which it changes. This is clear from our definition of 'primary',[1] in which the word is said to express just this: it may also, however, be made evident by the following argument. Let XP be the primary time in which that which is in motion is in motion: and (as all time is divisible) let it be divided at K. Now in the time XK it either is in motion or is not in motion, and the same is likewise true of the time KP. Then if it is in motion in neither of the two parts, it will be at rest in the whole: for it is impossible that it should be in motion in a time in no part of which it is in motion. If on the other hand it is in motion in only one of the two parts of the time, XP cannot be the primary time in which it is in motion: for its motion will have reference to a time other than XP. It must, then, have been in motion in any part of XP.

And now that this has been proved, it is evident that everything that is in motion must have been in motion before. For if that which is in motion has traversed the distance KA in the primary time XP, in half the time a thing that is in motion with equal velocity and began its motion at the same time will have traversed half the distance. But if this second thing whose velocity is equal
237a has traversed a certain distance in a certain time, the

[1] 235b 33. The 'primary time' is the irreducible minimum: thus the very terms of the definition make it clear that a thing must be changing in the *whole* of the 'primary time' in which it changes.

original thing that is in motion must have traversed the same distance in the same time. Hence that which is in motion must have been in motion before.

Again, if by taking the extreme moment of the time—for it is the moment that defines the time, and time is that which is intermediate between moments—we are enabled to say that motion has taken place in the whole time XP or in fact in any period[1] of it, motion may likewise be said to have taken place in every other such period. But half the time finds an extreme in the point of division. Therefore motion will have taken place in half the time and in fact in any part of it: for as soon as any division is made there is always a time defined by moments. If, then, all time is divisible, and that which is intermediate between moments is time, everything that is changing must have completed an infinite number of changes.

Again, since a thing that changes continuously and has not perished or ceased from its change must either be changing or have changed in any part of the time of its change, and since it cannot be changing in a moment, it follows that it must have changed at every moment in the time: consequently, since the moments are infinite in number, everything that is changing must have completed an infinite number of changes.

And not only must that which is changing have changed, but that which has changed must also previously have been changing, since everything that has changed from something to something has changed in a period of time. For suppose that a thing has changed from A to B in a moment. Now the moment in which it has changed cannot be the same as that in which it is at A (since in that case it would be in A and B at once): for we have shown above[2] that that which has changed, when it has changed, is not in

[1] Reading in l. 4 *ἢ ὅλως ἐν ὁτῳοῦν χρόνῳ*. The insertion of a second *ἢ* after *ὅλως* seems to make *ὅλως* pointless, *ἐν τῷ παντὶ χρόνῳ* having preceded: and cf. below *ὅλως ἐν ὁτῳοῦν τῶν μερῶν* (237a 8). If the text is otherwise right, *χρόνῳ* here must mean 'period of the whole time': otherwise no sense can be given to *τοῖς ἄλλοις*: but one would like to read something like *ἐν ὁτῳοῦν χρόνῳ* ⟨*τῶν τούτου*⟩, *τῷ λαβεῖν κτλ.*

[2] 235b 6 sqq.

that from which it has changed. If, on the other hand, it is a different moment, there will be a period of time intermediate between the two: for, as we saw,[1] moments are not consecutive. Since, then, it has changed in a period of time, and all time is divisible, in half the time it will have completed another[2] change, in a quarter another, and so on to infinity: consequently when it has changed, it must have previously been changing.

Moreover, the truth of what has been said is more evident in the case of magnitude, because the magnitude over which what is changing changes is continuous. For suppose that a thing[3] has changed from Γ to Δ. Then if ΓΔ is indivisible, two things without parts will be consecutive. But since this is impossible, that which is intermediate between them must be a magnitude and divisible into an infinite number of segments: consequently, before the change is completed, the thing changes to those segments. Everything that has changed, therefore, must previously have been changing: for the same proof also holds good
237b of change with respect to what is not continuous, changes, that is to say, between contraries and between contradictories. In such cases we have only to take the time in which a thing has changed and again apply the same reasoning. So that which has changed must have been changing and that which is changing must have changed, and a process of change is preceded by a completion of change and a completion by a process: and we can never take any stage and say that it is absolutely the first. The reason of this is that no two things without parts can be contiguous, and therefore in change the process of division is infinite,[4] just as lines may be infinitely divided so that one part is continually increasing and the other continually decreasing.[5]

[1] 231b 6 sqq.: where it is shown that moments cannot be ἐφεξῆς, of which ἐχόμενον is a subdivision (V. 3. 227a 6).

[2] i. e. different from the whole change.

[3] l. 30 reading γάρ τι, with F.

[4] l. 8 reading ἄπειρος, with E.

[5] i. e. you may begin by cutting off half the line, then half of what remains, and so on, the part cut off thus continuously increasing and the part remaining continually decreasing.

So it is evident also that that which has become must previously have been in process of becoming, and that which is in process of becoming must previously have become everything (that is) that is divisible and continuous: though it is not always the actual thing that is in process of becoming of which this is true: sometimes it is something else, that is to say, some part of the thing in question, e. g. the foundation-stone of a house.[1] So, too, in the case of that which is perishing and that which has perished: for that which becomes and that which perishes must contain an element of infiniteness as an immediate consequence of the fact that they are continuous things[2]: and so a thing cannot be in process of becoming without having become or have become without having been in process of becoming. So, too, in the case of perishing and having perished: perishing must be preceded by having perished, and having perished must be preceded by perishing. It is evident, then, that that which has become must previously have been in process of becoming, and that which is in process of becoming must previously have become: for all magnitudes and all periods of time are infinitely divisible.

Consequently no absolutely first stage of change can be represented by any particular part of space or time which the changing thing may occupy.

7 Now since the motion of everything that is in motion occupies a period of time, and a greater magnitude is traversed in a longer time, it is impossible that a thing should undergo a finite motion in an infinite time, if this is understood to mean not that the same motion or a part of it is continually repeated,[3] but that the whole infinite time is occupied by the whole finite motion. In all cases where a thing is in motion with uniform velocity it is clear that the finite magnitude is traversed in a finite time. For if

[1] i. e. the 'having become' (completion) of a house must be preceded by its 'becoming': for when a foundation-stone is being laid, the process is to be regarded not merely as the laying of the foundation-stone but also as the building of the house, of which it is a part.

[2] i. e. they are σώματα, which being συνεχῆ are therefore εἰς ἄπειρον διαιρετά.

[3] as e. g. in the case of rotation or the swing of a pendulum.

we take a part of the motion which shall be a measure of the whole, the whole motion is completed in as many equal[1] periods of the time as there are parts of the motion. Consequently, since these parts are finite, both in size individually and in number collectively, the whole time must also be finite: for it will be a multiple of the portion, equal to the time occupied in completing the aforesaid part multiplied by the number of the parts.

But it makes no difference even if the velocity is not uniform. For let us suppose that the line AB[2] represents a finite stretch over which a thing has been moved in the given time, and let ΓΔ be the infinite time.
238a Now if one part of the stretch must have been traversed before another part (this is clear, that in the earlier and in the later part of the time a different part of the stretch has been traversed: for as the time lengthens a different part of the motion will always be completed in it, whether the thing in motion changes with uniform velocity or not: and whether the rate of motion increases or diminishes or remains stationary this is none the less so),[3] let us then take AE a part of the whole stretch of motion AB which shall be a measure of AB. Now this part of the motion occupies a certain period of the infinite time: it cannot itself occupy an infinite time, for we are assuming that that is occupied by the whole AB. And if again I take another part equal to AE, that also must occupy a finite time in consequence of the same assumption. And if I go on taking parts in this way, on the one hand there is no part which will be a measure of the infinite time (for the infinite cannot be composed of finite parts whether equal or unequal, because there must be some unity which will be a measure of things finite in multitude or in magnitude, which, whether they are equal or unequal, are none the less limited in magnitude); while on the other hand the finite stretch of motion AB is a certain multiple of AE: consequently the motion AB must be accomplished in a finite time. More-

[1] l. 29 omitting τοῖς, with E.
[2] Reading in l. 35 τὸ AB, with Simp. and Bonitz.
[3] Reading a comma after ἧττον in l. 6, with Bonitz.

over it is the same with coming to rest as with motion.[1] And so it is impossible for one and the same thing to be infinitely in process of becoming or of perishing.[2]

The same reasoning will prove that in a finite time there cannot be an infinite extent of motion or of coming to rest, whether the motion is regular or irregular. For if we take a part which shall be a measure of the whole time, in this part a certain fraction, not the whole, of the magnitude will be traversed, because we assume that the traversing of the whole occupies all the time. Again, in another equal part of the time another part of the magnitude will be traversed: and similarly in each part of the time that we take, whether equal or unequal to the part originally taken. It makes no difference whether the parts are equal or not, if only each is finite: for it is clear that while the time is exhausted by the subtraction of its parts, the infinite magnitude will not be thus exhausted, since the process of subtraction is finite both in respect of the quantity subtracted and of the number of times a subtraction is made. Consequently the infinite magnitude will not be traversed in a finite time: and it makes no difference whether the magnitude is infinite in only one direction or in both: for the same reasoning will hold good.

This having been proved, it is evident that neither can a finite magnitude traverse an infinite magnitude in a finite time, the reason being the same as that given above: in part of the time it will traverse a finite magnitude and in each several part likewise, so that in the whole time it will traverse a finite magnitude.

And since a finite magnitude will not traverse an infinite
in a finite time, it is clear that neither will an infinite 238b
traverse a finite in a finite time. For if the infinite could traverse the finite, the finite could traverse the infinite; for it makes no difference which of the two is the thing in motion: either case involves the traversing of the infinite

[1] viz. a finite process of coming to rest (completion of motion) cannot occupy an infinite time.

[2] A thing that is *τὸ αὐτὸ καὶ ἕν* is *πεπερασμένον*: its *γένεσις* or *φθορά* is therefore also *πεπερασμένη* and cannot be *ἐν ἀπείρῳ χρόνῳ* (to which *ἀεί* is here equivalent).

by the finite. For when the infinite magnitude A is in motion a part of it, say ΓΔ, will occupy the finite B,[1] and then another, and then another, and so on to infinity. Thus the two results will coincide: the infinite will have completed a motion over the finite and the finite will have traversed the infinite: for it would seem to be impossible for the motion of the infinite over the finite to occur in any way other than by the finite traversing the infinite either by locomotion over it or by measuring it.[2] Therefore, since this is impossible, the infinite cannot traverse the finite.

Nor again will the infinite traverse the infinite in a finite time. Otherwise it would also traverse the finite, for the infinite includes the finite. We can further prove this in the same way by taking the time as our starting-point.[3]

Since, then, it is established that in a finite time neither will the finite traverse the infinite, nor the infinite the finite, nor the infinite the infinite,[4] it is evident also that in a finite time there cannot be infinite motion: for what difference does it make whether we take the motion or the magnitude to be infinite? If either of the two is infinite, the other must be so likewise: for all locomotion is in space.[5]

Since everything to which motion or rest is natural is in motion or at rest in the natural time, place, and manner, that which is coming to a stand, when it is coming to a stand, must be in motion: for if it is not in motion it must be at rest: but that which is at rest cannot be coming to rest.[6] From this it evidently follows that coming to a stand must occupy a period of time: for the motion of that which is in motion occupies a period of time, and that 8

[1] Reading in l. 6 τὸ B τὸ πεπερασμένον, with E.

[2] i.e. the finite must either travel from end to end of the infinite (if the infinite could have ends) or be itself traversed by the infinite, thus 'measuring up' the infinite with itself as the measure.

[3] viz. by dividing up the πεπερασμένος χρόνος in the way described above (238a 22 sqq.) instead of the πεπερασμένον μέγεθος.

[4] Reading in l. 18 τὸ ἄπειρον τὸ ἄπειρον, with FHI²K.

[5] And therefore infinity in any of the terms must imply spatial infinity of some sort.

[6] In this connexion ἠρεμίζεσθαι is identical in meaning with ἵστασθαι.

which is coming to a stand has been shown to be in motion: consequently coming to a stand must occupy a period of time.

Again, since the terms 'quicker' and 'slower' are used only of that which occupies a period of time, and the process of coming to a stand may be quicker or slower, the same conclusion follows.

And[1] that which is coming to a stand must be coming to a stand in any part of the primary time in which it is coming to a stand. For if it is coming to a stand in neither of two parts into which the time may be divided, it cannot be coming to a stand in the whole time, with the result that that which is coming to a stand will not be coming to a stand. If on the other hand it is coming to a stand in only one of the two parts of the time, the whole cannot be the primary time in which it is coming to a stand: for it is coming to a stand in the whole time not primarily but in virtue of something distinct from itself,[2] the argument being the same as that which we used above about things in motion.[3]

And just as there is no primary time in which that which
is in motion is in motion, so too there is no primary time 239a
in which that which is coming to a stand is coming to a stand, there being no primary stage either of being in motion or of coming to a stand. For let AB be the primary time in which a thing is coming to a stand. Now AB cannot be without parts: for there cannot be motion in that which is without parts, because the moving thing would necessarily have been already moved for part of the time of its movement:[4] and that which is coming to a stand has been shown to be in motion. But since AB is therefore divisible, the thing is coming to a stand in every one of the parts of AB: for we have shown above[5] that it

[1] A new point is here introduced. It is not the apodosis to the previous sentence ἔτι δ' εἰ κτλ., which serves only to substantiate the conclusion already reached: the apodosis is not expressed, but is easily supplied.

[2] Reading in l. 35 καθ' ἕτερον, with EF.

[3] Ch. 6.

[4] Reading in l. 5 τι ἂν αὐτοῦ, with E.

[5] 238b 31 sqq.

is coming to a stand in every one of the parts in which it is primarily coming to a stand. Since, then, that in which primarily a thing is coming to a stand must be a period of time and not something indivisible, and since all time is infinitely divisible, there cannot be anything in which primarily it is coming to a stand.

Nor again can there be a primary time at which the being at rest of that which is at rest occurred: for it cannot have occurred in that which has no parts, because there cannot be motion in that which is indivisible, and that in which rest takes place is the same as that in which motion takes place: for we defined [1] a state of rest to be the state of a thing to which motion is natural but which is not in motion when (that is to say in that [2] in which) motion would be natural to it. Again, our use of the phrase 'being at rest' also implies that the previous state of a thing is still unaltered, not one point only but two at least being thus needed to determine its presence: consequently that in which a thing is at rest cannot be without parts. Since, then, it is divisible, it must be a period of time, and the thing must be at rest in every one of its parts, as may be shown by the same method as that used above in similar demonstrations.

So there can be no primary part of the time: and the reason is that rest and motion are always in a period of time, and a period of time has no primary part any more than a magnitude or in fact anything continuous: for everything continuous is divisible into an infinite number of parts.

And since everything that is in motion is in motion in a period of time and changes from something to something, when its motion is comprised within a particular period of time essentially—that is to say when it fills the whole and not merely a part of the time in question [3]—it is impossible

[1] 226b 12 sqq.

[2] sc. time. *καὶ ἐν ᾧ* (which is here equivalent to *ὅτε*) is added simply for the sake of introducing the exact expression used immediately before.

[3] l. 24. It is hard to get any sense out of Bekker's reading—*τῶν ἐν ἐκείνου τινί*. The reading of EHI Simp. *τῷ ἐν ἐκείνου τινί* will give the

that in that time that which is in motion should be over against some particular thing primarily.[1] For if a thing—itself and each of its parts—occupies the same space for a definite period of time, it is at rest: for it is in just these circumstances that we use the term 'being at rest'—when at one moment after another it can be said with truth that a thing, itself and its parts, occupies the same space. So if this is being at rest it is impossible for that which is changing to be as a whole, at the time when it is primarily changing, over against any particular thing (for the whole period of time is divisible), so that in one part of it after another it will be true to say that the thing, itself and its parts, occupies the same space. If this is not so and the aforesaid proposition is true only at a single moment, then the thing will be over against a particular thing not for any period of time but only at a moment that limits the time. It is true that at any moment it is always over against something stationary: but it is not at rest: for at a moment 239b
it is not possible for anything to be either in motion or at rest. So while it is true to say that that which is in motion is at a moment not in motion and is opposite some particular thing, it cannot in a period of time be over against that which is at rest: for that would involve the conclusion that that which is in locomotion is at rest.

9 Zeno's reasoning, however, is fallacious, when he says that if everything when it occupies an equal space is at rest, and if that which is in locomotion is always occupying such a space at any moment, the flying arrow is therefore motionless.[2] This is false, for time is not composed of

required sense, as also would τῷ ἐν τῶν ἐκείνου τινί, which I would suggest as best accounting for the variants.

[1] i.e. a space only just large enough to contain it, not a larger space of which only part is occupied.

[2] Zeno's argument apparently does not prove that the arrow is at rest because it is not in motion. ἀεὶ ἠρεμεῖ πᾶν ἢ κινεῖται is therefore not used as a premise, and the best way of emending the passage is (with Zeller) to treat ἢ κινεῖται as a gloss introduced through the influence of such passages as 238^{b} 23. ἔστι l. 6 can in the context stand for ἔστι κατὰ τὸ ἴσον, but possibly we should insert κατὰ τὸ ἴσον after νῦν l. 7, with Zeller and some MS. support.

indivisible moments any more than any other magnitude is composed of indivisibles.

Zeno's arguments[1] about motion, which cause so much disquietude to those who try to solve the problems that they present, are four in number. The first asserts the non-existence of motion on the ground that that which is in locomotion must arrive at the half-way stage before it arrives at the goal.[2] This we have discussed above.[3]

The second is the so-called 'Achilles', and it amounts to this, that in a race the quickest runner can never overtake the slowest[4], since the pursuer must first reach the point whence the pursued started, so that the slower must always hold a lead. This argument is the same in principle as that which depends on bisection,[5] though it differs from it in that the spaces with which we successively have to deal are not divided into halves. The result of the argument is that the slower is not overtaken: but it proceeds along the same lines as the bisection-argument (for in both a division of the space in a certain way leads to the result that the goal is not reached, though the 'Achilles' goes further in that it affirms that even the quickest runner[6] in legendary tradition must fail in his pursuit of the slowest[7]), so that the solution must be the same. And the axiom that that which holds a lead is never overtaken is false: it is not overtaken, it is true, while it holds a lead: but it is overtaken nevertheless if it is granted that it traverses the finite distance prescribed. These then are two of his arguments.

The third is that already given above, to the effect that

[1] On the arguments generally see Noël in the *Revue de Métaphysique et de Morale*, vol. i, pp. 107 sqq., and Russell, *Principles of Mathematics*, vol. i, chs. 42, 43. Further references to the literature of the subject are given in Zeller, i.[6] 755 n., and in Heath, *Gk. Mathematics*, i. 279, 280 n. 1, 283 n. 2. The first two arguments are addressed to those who assert, the second two to those who deny the infinite divisibility of space and time.

[2] The remaining half being again divisible into two, and so on to infinity.

[3] 233a 13 sqq.

[4] Reading in l. 15 *βραδύτατον*, with E, Themistius, and Simplicius.

[5] viz. the first argument given above, ll. 11–14.

[6] sc. Achilles as described by Homer—*πόδας ὠκὺς Ἀχιλλεύς*.

[7] sc. the tortoise, proverbial for slowness: cf. Plut. *Mor.* 1082 E.

the flying arrow is at rest, which result follows from the assumption that time is composed of moments: if this assumption is not granted, the conclusion will not follow. The fourth argument[1] is that concerning the two rows of

[1] Zeno's fourth argument may be represented thus:—

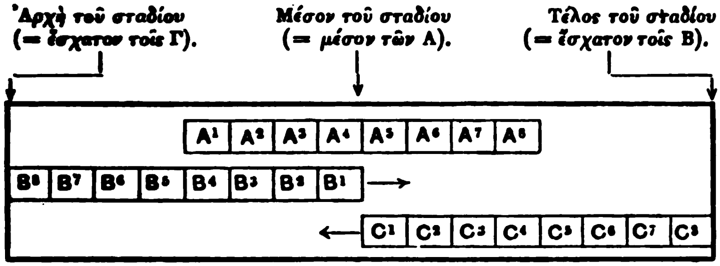


Fig. 1 (240a 4).

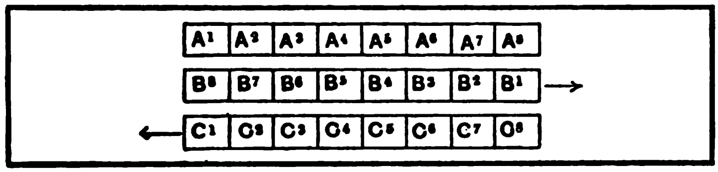


Fig. 2 (240a 9).

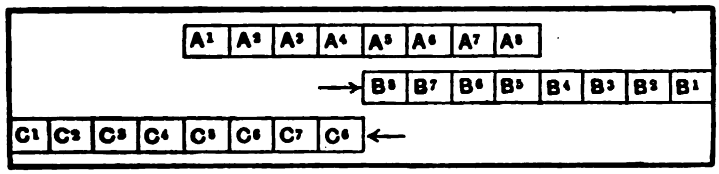


Fig. 3 (240a 13).

Let C^1 have reached B^8 at the moment M in the time T.

Then at the same moment M—

(1) Since B^1 and C^1 are travelling with equal velocity, B^1 must have reached C^8 (= A^8) and must have occupied the same time as C^1. Therefore B^1's time = T.

(2) C^1 must have travelled a distance equal to A^1–A^8, since (α) it has passed all the B's, (β) each B = each A, (γ) spaces of equal size must be traversed in equal times if the speed be equal. B^1, however, has only travelled the distance A^5–A^8. Therefore B^1, having travelled only half the distance, can have occupied only half the time that has been occupied by C^1. Therefore B^1's time = $\frac{T}{2}$.

(3) C^1 must have completed the course, since having started at the middle point of the course it has travelled a distance equal to A^1–A^8 (= half the course). Therefore B^1 must also have completed the course. But for this to have happened (that is to say, for all the B's to have passed all the C's) twice as much time must have elapsed as

bodies, each row being composed of an equal number of bodies of equal size, passing each other on a race-course as they proceed with equal velocity in opposite directions, the one row originally occupying the space between the goal and the middle point of the course and the other that between the middle point and the starting-post. This, he thinks, involves the conclusion that half a given time is 240a equal to double that time.[a] The fallacy of the reasoning lies in the assumption that a body occupies an equal time in passing with equal velocity a body that is in motion and a body of equal size that is at rest; which is false. For instance (so runs the argument), let A, A . . . be the stationary bodies of equal size, B, B . . . the bodies, equal in number and in size to A, A . . ., originally occupying the half of the course from the starting-post to the middle of the A's, and Γ, Γ . . . those originally occupying the other half from the goal to the middle of the A's, equal in number, size, and velocity to B, B . . . . Then three consequences follow:

First, as the B's and the Γ's pass one another, the first B reaches the last Γ at the same moment as the first Γ reaches the last B. Secondly,[1] at this moment the first Γ has passed all the A's,[2] whereas the first B[3] has passed

was necessary to enable C^1 to reach B^8. But the time occupied by C^1 in reaching $B^8 = T$. Therefore B^1's time $= 2T$.

Thus at the same moment M the time occupied since the start by B^1 is both $\frac{T}{2}$ and $2T$. Consequently, if motion is possible, half a given time is equal to double that time, which is absurd. Therefore motion is impossible. Q.E.D.

As the argument is intended for those who attempt to evade the first two by denying the infinite divisibility of space and time, and to refute scientific theories as to the structure of matter that involve the view that matter is divisible ultimately into units (ὄγκοι) occupying a certain amount of space and yet not themselves divisible, the assumption that Aristotle stigmatizes as false is not an arbitrary assumption of Zeno's own but a deduction from the view criticized.

For a further discussion of the passage and justification of the rendering given above, see an article by R. K. Gaye in the *Journal of Philology*, xxxi. 95 sqq.

[1] Reading συμβαίνει δέ, with E[1]FHK, Alex.

[2] Reading πάντα τὰ A, with FKE[2] and Simplicius.

[3] Reading τὰ δὲ B, with E and Simplicius.

only half the A's, and has consequently occupied only half the time occupied by the first Γ, since each of the two occupies an equal time in passing each A. Thirdly, at the same moment all the B's have passed all the Γ's: for the first Γ and the first B will simultaneously reach the opposite ends of the course, since (so says Zeno) the time occupied by the first Γ in passing each of the B's is equal to that occupied by it in passing each of the A's, because an equal time is occupied by both the first B and the first Γ in passing all the A's. This is the argument, but it presupposed the aforesaid fallacious assumption.

Nor in reference to contradictory change shall we find anything unanswerable in the argument that if a thing is changing from not-white, say, to white, and is in neither condition, then it will be neither white nor not-white: for the fact that it is not *wholly* in either condition will not preclude us from calling it white or not-white. We call a thing white or not-white not necessarily because it is wholly either one or the other, but because most of its parts or the most essential parts[1] of it are so: not being in a certain condition is different from not being wholly in that condition. So, too, in the case of being and not-being and all other conditions which stand in a contradictory relation: while the changing thing must of necessity be in one of the two opposites, it is never wholly in either.

Again, in the case of circles and spheres and everything whose motion is confined within the space that it occupies, it is not true to say that the motion can be nothing but rest, on the ground that such things in motion, themselves and their parts, will occupy the same position for a period of time, and that therefore they will be at once at rest and in motion. For in the first place the parts do not occupy the same position for any period of time: and in the second place the whole also is always changing to a different position: for if we take the orbit as described from a point A on a 240b

[1] i. e. the parts (not necessarily a majority of the whole) the whiteness of which more especially justifies us in calling the whole thing white: e. g. we may speak of the sea being white if the crests of the waves are white.

circumference, it will not be the same as the orbit as described from B or Γ or any other point on the same circumference except in an accidental sense, the sense that is to say in which a musical man is the same as a man.[1] Thus one orbit is always changing into another, and the thing will never be at rest. And it is the same with the sphere and everything else whose motion is confined within the space that it occupies.

Our next point is that that which is without parts cannot be in motion except accidentally: i. e. it can be in motion only in so far as the body or the magnitude is in motion and the partless is in motion by inclusion therein,[2] just as that which is in a boat may be in motion in consequence of the locomotion of the boat, or a part may be in motion in virtue of the motion of the whole. (It must be remembered, however, that by 'that which is without parts' I mean that which is quantitatively indivisible (and that the case of the motion of a part is not exactly parallel)[3]: for parts have motions belonging essentially and severally to themselves distinct from the motion of the whole. The distinction may be seen most clearly in the case of a revolving sphere, in which the velocities of the parts near the centre and of those on the surface are[4] different from one another and from that of the whole; this implies that there is not one motion but many.) As we have said, then, that which is without parts can be in motion in the sense in which a man sitting in a boat is in motion when the boat is travelling, but it cannot be in motion of itself. For suppose that it is 10

[1] i. e. the one orbit is the same as the other only in the sense that they both belong to or are 'accidents' of (*συμβέβηκε*) the same portion of space, just as the attributes *μουσικός* and *ἄνθρωπος* may belong to the same individual.

[2] Reading in l. 10 *τῷ ἐνυπάρχειν*, with Simplicius (*τῶν ἐνυπάρχειν* E).

[3] The point is that *τὸ ἀμερές* can have no motion of its own just because it is *ἀμερές*, whereas *μέρη*, not being *ἀμερῆ*, may have motions of their own as well as accidental motions. It is only in so far as the *μέρος* is in motion merely in virtue of the motion of the *ὅλον* that its motion is comparable with that of the *ἀμερές*.

[4] Reading in l. 16 *ἐστὶ*, with E.

changing from AB to BΓ—either from one magnitude to another,[1] or from one form to another,[2] or from some state to its contradictory—and let Δ be the primary time in which it undergoes the change. Then in the time in which it is changing it must be either in AB or in BΓ or partly in one and partly in the other: for this, as we saw,[3] is true of everything that is changing. Now it cannot be partly in each of the two: for then it would be divisible into parts. Nor again can it be in BΓ: for then it will have completed the change, whereas the assumption is that the change is in process. It remains, then, that in the time in which it is changing, it is in AB. That being so, it will be at rest: for, as we saw,[4] to be in the same condition for a period of time is to be at rest. So it is not possible for that which has no parts to be in motion or to change in any way: for only one condition could have made it possible for it to have motion, viz. that time should be composed of moments, in which case at any moment it would have completed a motion or a change, so that it would never be 241a
in motion, but would always have been in motion. But this we have already shown above[5] to be impossible: time is not composed of moments, just as a line is not composed of points, and motion is not composed of starts: for this theory simply makes motion consist of indivisibles in exactly the same way as time is made to consist of moments or a length[6] of points.

Again, it may be shown in the following way that there can be no motion of a point or of any other indivisible. That which is in motion can never traverse a space greater than itself without first traversing a space equal to or less than itself. That being so, it is evident that the point also must first traverse a space equal to or less than itself. But since it is indivisible, there can be no space less than itself

[1] sc. either κατὰ τόπον or κατὰ ποσόν.

[2] sc. κατὰ ποιόν.

[3] 234b 10 sqq., where, however, it is pointed out that only the third alternative here mentioned is really possible (234b 15): the other two are included here only for the sake of completeness.

[4] 239a 27.

[5] 231b 18 sqq.

[6] Reading in l. 6 μῆκος, with E and Simp.

for it to traverse first: so it will have to traverse a distance equal to itself. Thus the line will be composed of points, for the point, as it continually traverses a distance equal to itself, will be a measure of the whole line. But since this is impossible, it is likewise impossible for the indivisible to be in motion.

Again, since motion is always in a period of time and never in a moment, and all time is divisible, for everything that is in motion there must be a time less than that[1] in which it traverses a distance as great as itself. For that in which it is in motion will be a time, because all motion is in a period of time; and all time has been shown above[2] to be divisible. Therefore,[3] if a point is in motion, there must be a time less than that[4] in which it has itself traversed any distance.[5] But this is impossible, for in less time it must traverse less distance, and thus the indivisible will be divisible into something less than itself, just as the time is so divisible: the fact being that the only condition under which that which is without parts and indivisible could be in motion would have been the possibility of the infinitely small being in motion in a moment: for in the two questions—that of motion in a moment and that of motion of something indivisible—the same principle is involved.

Our next point is that no process of change is infinite: for every change, whether between contradictories or between contraries, is a change from something to something. Thus in contradictory changes the positive or the negative, as the case may be, is the limit, e. g. being is the limit of coming to be and not-being is the limit of ceasing to be: and in contrary changes the particular contraries are the limits, since these are the extreme points of any such process of change, and consequently of every process

[1] Reading in l. 17 (with E and apparently Simplicius) ἢ ἐν ᾧ.
[2] 232^b 23 sqq.
[3] Omitting δ' in l. 19, with FHK.
[4] Reading (with E Them. Phil.) ἢ ἐν ᾧ.
[5] sc. a distance equal to itself, which is the least it can travel (241^a 11). It would be easier if we could read ὅσον αὐτή or ἴσον αὐτῇ for αὐτή with (apparently) Philoponus and Themistius.

of alteration: for alteration is always dependent upon[1] some contraries. Similarly contraries are the extreme points of processes of increase and decrease: the limit of increase is to be found in the complete magnitude proper to the peculiar nature of the thing that is increasing, while 241b
the limit of decrease is the complete loss of such magnitude. Locomotion, it is true, we cannot show to be finite in this way, since it is not always between contraries. But since that which cannot be cut (in the sense that it is inconceivable that it should be cut, the term 'cannot' being used in several senses[2])—since it is inconceivable that that which in this sense cannot be cut should be in process of being cut, and generally that that which cannot come to be should be in process of coming to be, it follows that it is inconceivable that that which cannot complete a change[3] should be in process of changing to that to which it cannot complete a change.[3] If, then, it is to be assumed that that which is in locomotion is in process of changing, it must be capable of completing the change.[3] Consequently its motion is not infinite, and it will not be in locomotion over an infinite distance, for it cannot traverse such a distance.

It is evident, then, that a process of change cannot be infinite in the sense that it is not defined by limits. But it remains to be considered whether it is possible in the sense that one and the same process of change may be infinite in respect of the time which it occupies. If it is not one process, it would seem that there is nothing to prevent its being infinite in this sense; e.g. if a process of locomotion be succeeded by a process of alteration and that by a process of increase and that again by a process

[1] That this is the meaning of ἐξ here seems clear. It is unlikely that the starting-point of the change should be insisted upon rather than the final limit: cf. 241a 29, 30 above. Aristotle means that the existence of ἀλλοίωσις always implies the existence of a pair of contraries.

[2] For the different senses of ἀδύνατον see *Metaph.* Δ. 1019b 19 sqq.

[3] Reading in ll. 7 (after τὸ), 8, and 9 (with one MS.) μεταβαλεῖν, the aorist being necessary to denote the act as opposed to the process of change: cf. τμηθῆναι)(τέμνεσθαι above. Simplicius apparently had μεταβαλεῖν.

of coming to be: in this way there may be motion for ever so far as the time is concerned, but it will not be one motion, because all these motions do not compose one. If it is to be one process, no motion can be infinite in respect of the time that it occupies, with the single exception of rotatory locomotion.

BOOK VII[1]

1 EVERYTHING that is in motion must be moved by something. For if it has not the source of its motion in itself it is evident that it is moved by something other than itself, for there must be something else that moves it. If on the other hand it has the source of its motion in itself, let AB be taken to represent that which is in motion essentially of itself and not in virtue of the fact that something belonging to it is in motion. Now in the first place to assume that AB, because it is in motion as a whole and is not moved by anything external to itself, is therefore moved by itself—this is just as if, supposing that KΛ is moving ΛM and is also itself in motion, we were to deny[2] that KM is moved by anything on the ground that it is not evident which is the part that is moving it and which the part that is moved. In the second place that which is in motion without being moved by anything does not necessarily cease from its motion because something else is at rest, but a thing must 242a be moved by something if the fact of something else having ceased from its motion causes it to be at rest. Thus,[3] if this is accepted, everything that is in motion must be moved by something. For AB, which has been taken to represent that which is in motion, must be divisible, since everything that is in motion is divisible. Let it be divided, then, at Γ. Now if ΓB is not in motion, then AB will not be in motion: for if it is, it is clear that AΓ would be in motion while BΓ is at rest, and thus AB cannot be in

[1] On the text of this book, see Shute, *Anecdota Oxoniensia*, Classical Series, vol. i, part 3. For the purposes of this translation the Teubner text of Prantl has been taken as the standard for chapters 1 to 3.

[2] It will make no difference to the translation whether εἰ is repeated before μὴ φάσκοι or not. In view of the intervening clause the repetition does not seem impossible.

[3] The use of γάρ implies a slight ellipse: '⟨I make this point⟩ for...'

motion essentially and primarily. But *ex hypothesi* AB is in motion essentially and primarily. Therefore if ΓB is not in motion AB will be at rest. But we have agreed that that which is at rest if something else is not in motion must be moved by something. Consequently, everything that is in motion must be moved by something: for that which is in motion will always be divisible, and if a part of it is not in motion the whole must be at rest.

Since everything that is in motion must be moved by something, let us take the case in which a thing is in locomotion and is moved by something that is itself in motion, and that again is moved[1] by something else that is in motion, and that by something else, and so on continually: then the series cannot go on to infinity, but there must be some first movent. For let us suppose that this is not so and take the series to be infinite. Let A then be moved by B, B by Γ, Γ by Δ, and so on, each member of the series being moved by that which comes next to it. Then since *ex hypothesi* the movent while causing motion is also itself in motion, and the motion of the moved and the motion of the movent must proceed simultaneously (for the movent is causing motion[2] and the moved is being moved simultaneously) it is evident that the respective motions of A, B, Γ, and each of the other moved movents are simultaneous. Let us take the motion of each separately and let E be the motion of A, Z of B, and H and Θ respectively the motions of Γ and Δ: for though they are all moved severally one by another, yet we may still take the motion of each as numerically one, since every motion is from something to something and is not infinite in respect of its extreme points. By a motion that is numerically one I mean a motion that proceeds from something numerically one and the same to something numerically one and the same in a period of time numerically one and the same: for a motion may be the same generically, specifically, or numerically: it is

[1] Reading in l. 19 κινῆται, with Par. 1859.
[2] Reading in l. 24 (with the MSS.) γὰρ κινεῖ.

generically the same if it belongs to the same category, e.g. substance or quality: it is specifically the same if it proceeds from something specifically the same to something specifically the same, e.g. from white to black or from good to bad, which is not of a kind specifically distinct:[1]
it is numerically the same if it proceeds from something 242b
numerically one to something numerically one in the same period of time, e.g. from a particular white to a particular black, or from a particular place to a particular place, in a particular period of time: for if the period of time were not one and the same, the motion would no longer be numerically one though it would still be specifically one. We have dealt with this question above.[2] Now let us further take the time in which A has completed its motion, and let it be represented by K. Then since the motion of A[3] is finite the time will also be finite. But since the movents and the things moved are infinite, the motion ΕΖΗΘ, i.e. the motion that is composed of all the individual motions, must be infinite. For the motions of A, B, and the others may be equal, or the motions of the others may be greater: but assuming what is conceivable,[4] we find that whether they are equal[5] or some are greater, in both cases the whole motion is infinite. And since the motion of A and that of each of the others are simultaneous, the whole motion must occupy the same time as the motion of A: but the time occupied by the motion of A is finite: consequently the motion will be infinite in a finite time, which is impossible.[6]

It might be thought that what we set out to prove[7] has

[1] i.e. ἀγαθά and κακά themselves admit of further differences κατ' εἶδος. Read in l. 37 εἰς κακὸν ἀδιάφορον, with the MSS.

[2] v. 4. 227b 3 sqq.

[3] Reading in l. 10 τῆς τοῦ A, with the MSS.

[4] i.e. certain conceivable cases: it will not do to assume the other possible case, viz. that in which, as we proceed backwards along the series of motions, they become less: for if Z were less than E, H than Z, and so on to infinity, ἡ ὅλη κίνησις would not be ἄπειρος.

[5] Reading in l. 17 εἴ τε ἴσαι, with Simp.

[6] i.e. it is impossible in such cases as we are considering, though the present case has not as yet been shown to be one of such cases: cf. the immediate sequel.

[7] sc. that there is a πρῶτον κινοῦν.

thus been shown, but our argument so far does not prove it, because it does not yet prove that anything impossible results from the contrary supposition: for in a finite time there may be an infinite motion, though not of one thing, but of many: and in the case that we are considering this is so: for each thing accomplishes its own motion, and there is no impossibility in many things being in motion simultaneously. But if (as we see to be universally the case) that which primarily is moved locally and corporeally[1] must be either in contact with or continuous with that which moves it, the things moved and the movents must be continuous or in contact with one another, so that together they all form a single unity: whether this unity is finite or infinite makes no difference to our present argument; for in any case since the things in motion are infinite in number the whole motion will be infinite, if, as is theoretically possible, each motion is either equal to or greater than that which follows it in the series: for we shall take as actual that which is theoretically possible. If, then, A, B, Γ, Δ form an infinite magnitude[2] that passes through the motion EZHΘ in the finite time K, this involves the conclusion that an infinite motion is passed through in a finite time: and whether the magnitude in question is finite or infinite this is in either case impossible. Therefore the series must come to an end, and there must be a first movent and a first moved:[3] for the
243a fact that this impossibility results only from the assumption of a particular case[4] is immaterial, since the case assumed is theoretically possible, and the assumption of a theoretically possible case ought not to give rise to any impossible result.

[1] Locomotion caused by something acting on the body is here opposed to locomotion caused by something acting on the mind, e. g. τὸ ἐρωστόν.

[2] Reading in l. 31 (with the MSS.) ἀπειρόν τι. There is no need to alter (with Prantl) ἄπειρον to τῶν ἀπείρων, as it is easy to take the words ἢ τὸ πεπερασμένον ἢ τὸ ἄπειρον at the end of the sentence as an afterthought added for the sake of completeness.

[3] For καὶ κινούμενον we should rather expect μὴ κινούμενον (not moved by anything else), and this is what Simplicius seems to have read.

[4] sc. the case in which each motion is either equal to or greater than the motion that follows it in the series.

2 That which is the first movent of a thing—in the sense that it supplies not 'that for the sake of which' but the source of the motion—is always together with that which is moved by it (by 'together' I mean that there is nothing intermediate between them). This is universally true wherever one thing is moved by another. And since there are three kinds of motion, local, qualitative, and quantitative, there must also be three kinds of movent, that which causes locomotion, that which causes alteration, and that which causes increase or decrease.

Let us begin with locomotion, for this is the primary motion. Everything that is in locomotion is moved either by itself or by something else. In the case of things that are moved by themselves it is evident that the moved and the movent are together: for they contain within themselves their first movent, so that there is nothing in between. The motion of things that are moved by something else must proceed in one of four ways: for there are four kinds of locomotion caused by something other than that which is in motion, viz. pulling, pushing, carrying, and twirling. All forms of locomotion are reducible to these. Thus pushing on is a form of pushing in which that which is causing motion away from itself[1] follows up that which it pushes and continues to push it: pushing off occurs when the movent does not follow up the thing that it has moved: throwing when the movent causes a motion away from itself[1] more violent than the natural locomotion 243b
of the thing moved, which continues its course so long as it is controlled by the motion imparted to it. Again, pushing apart and pushing together are forms respectively of pushing off and pulling: pushing apart is pushing off, which may be a motion either away from the pusher or away from something else, while pushing together is pulling, which may be a motion towards something else as well as towards the puller. We may similarly classify all the varieties of these last two, e.g. packing and combing: the former is a form of pushing together, the latter a form of pushing apart. The same is true of the other processes

[1] Reading in a 19, b 1, ἀφ' αὑτοῦ.

of combination and separation (they will all be found to be forms of pushing apart or of pushing together),[1] except such as are involved in the processes of becoming and perishing. (At the same time it is evident that there is no other kind of motion but[2] combination and separation: for they may all be apportioned to one or other of those already mentioned.) Again, inhaling is a form of pulling, exhaling a form of pushing: and the same is true of spitting and of all other motions that proceed through the body, whether secretive or assimilative, the assimilative being forms of pulling, the secretive of pushing off. All other kinds of locomotion must be similarly reduced, for they all fall under one or other of our four heads. And again, of these four, carrying and twirling are reducible to pulling and pushing. For carrying always follows one of the other three methods, for that which is carried is in motion accidentally, because it is in or upon something that is in motion, and that which carries it is in doing so being either
244a pulled or pushed or twirled;[3] thus carrying belongs to all the other three kinds of motion in common. And twirling is a compound of pulling and pushing, for that which is twirling a thing must be pulling one part of the thing and pushing another part, since it impels one part away from itself and another part towards itself. If, therefore, it can be shown that that which is pushing and that which is pulling are adjacent respectively to that which is being pushed and that which is being pulled, it will be evident that in all locomotion there is nothing intermediate between

[1] ll. 8–9 *ἅπασαι . . . συνώσεις* is parenthetical.

[2] Reading in l. 11 (with the MSS. and Bekker) *ἢ σύγκρισις*. Prantl alters *ἢ* to *ἡ*: the meaning would then be 'combination and separation do not constitute a kind of motion distinct from those enumerated'. But this would be in part a repetition, and in part (so far as *γένεσις* and *φθορά* are concerned) a contradiction, of the preceding sentence. The reading of the MSS. is defensible if we regard *ἅμα δὲ . . . εἰρημένων* as a parenthesis, the sense being that from another point of view we may reduce all kinds of motion to *σύγκρισις* and *διάκρισις*, which are coextensive with *ὦσις* and *ἕλξις*.

[3] i.e. unless *τὸ ὀχοῦν* happens to be a living being, but that case need not be considered, as Aristotle's object is to prove that *τὸ πρῶτον κινοῦν ἅμα τῷ κινουμένῳ ἐστί*, which has already been proved in the case of things that *αὐτὰ ὑφ' αὑτῶν κινεῖται*, among which *ἔμψυχα* are of course included. Cf. 243a 13 above.

moved and movent. But the former fact is clear even from the definitions of pushing and pulling, for pushing is motion to something else from oneself or from something else, and pulling is motion from something else to oneself or to something else, when the motion of that which is pulling is quicker[1] than the motion that would separate[2] from one another the two things that are continuous:[3] for it is this that causes one thing to be pulled on along with the other. (It might indeed be thought that there is a form of pulling that arises in another way: that wood, e.g. pulls fire in a manner different from that described above. But it makes no difference whether that which pulls is in motion or is stationary when it is pulling: in the latter case it pulls to the place where it is, while in the former it pulls to the place where it was.) Now it is impossible to move anything either from oneself to something else or from something else to oneself without being in contact with it: it is evident, therefore, that in all locomotion there 244b
is nothing intermediate between moved and movent.

Nor again is there anything intermediate between that which undergoes and that which causes alteration: this can be proved by induction: for in every case we find that the respective extremities of that which causes and that which undergoes alteration are adjacent. For[4] our assumption is that things that are undergoing alteration are altered in virtue of their being affected in respect of their so-called

[1] Reading in l. 9 θᾶττον, with Simp.

[2] Reading in l. 10 ἕλκοντος τῆς χωριζούσης, with Par. 1859 and Simp.

[3] i.e. the thing pulling and the thing pulled. The second motion is the natural resistance of the thing pulled, which seeks to disconnect itself from that which is pulling it.

[4] Reading in l. 4 τὸ πρῶτον ἀλλοιούμενον. ὑπόκειται γὰρ ἡμῖν τὸ τὰ ἀλλοιούμενα κατὰ τὰς παθητικὰς λεγομένας ποιότητας πάσχοντα ἀλλοιοῦσθαι· τὸ γὰρ ποιὸν ἀλλοιοῦται τῷ αἰσθητὸν εἶναι· αἰσθητὰ δ' ἐστίν, οἷς διαφέρουσι τὰ σώματα ἀλλήλων· ἅπαν γὰρ σῶμα σώματος διαφέρει τοῖς αἰσθητοῖς ἢ πλείοσιν ἢ ἐλάττοσιν ἢ τῷ μᾶλλον καὶ ἧττον τοῖς αὐτοῖς· ἀλλὰ μὴν καὶ ἀλλοιοῦται τὸ ἀλλοιούμενον ὑπὸ τῶν εἰρημένων. It seems clear that in the text as given by Bekker something must have dropped out between ἀλλοιούμενον and ὑπὸ τῶν εἰρημένων: and Prantl would restore it as above, partly from Simplicius and partly from the second text as given in six MSS. Even so the connexion of thought is not quite clear. For the term παθητικαὶ ποιότητες cf. *Cat.* viii. 9a 28 sqq.

affective qualities, since that which is of a certain quality is altered in so far as it is sensible, and the characteristics in which bodies differ from one another are sensible characteristics: for every body differs from another in possessing a greater or lesser number of sensible characteristics or in possessing the same sensible characteristics in a greater or lesser degree. But the alteration of that which undergoes alteration is also caused by the above-mentioned characteristics, which are affections of some particular underlying quality.[1] Thus we say that a thing is altered by becoming hot or sweet or thick or dry or white: and we make these assertions alike of what is inanimate and of what is animate, and further, where animate things are in question, we make them both of the parts that have no power of sense-perception and of the senses themselves. For in a way even the senses undergo alteration, since the active sense is a motion through the body in the course of which the sense[2] is affected in a certain way. We see, then, that the animate is capable of every kind of alteration of which the inanimate is capable: but the inanimate is not capable of every kind of alteration of which the animate is capable, since it is not capable of alteration in respect of the senses: moreover the inanimate is unconscious of being affected by
245a alteration, whereas the animate is conscious of it, though there is nothing to prevent the animate also being unconscious of it when the process of the alteration does not concern the senses. Since, then, the alteration of that which undergoes alteration is caused by sensible things, in every case of such alteration it is evident that the respective extremities of that which causes and that which undergoes alteration are adjacent. Thus the air is continuous with that which causes the alteration,[3] and the body that undergoes alteration is continuous with the air. Again, the colour is continuous with the light and the light

[1] Reading in l. 6 (with the MSS. and Bekker) τῆς ὑποκειμένης ποιότητος.

[2] αἴσθησις in this passage is used in such a way as to include the meanings of 'sense-perception' and of 'sense-organ'.

[3] i. e. in cases of ἁφή such as θέρμανσις.

with the sight.[1] And the same is true of hearing and smelling: for the primary movent in respect to the moved is the air. Similarly, in the case of tasting, the flavour is adjacent to the sense of taste. And it is just the same in the case of things that are inanimate and incapable of sense-perception. Thus there can be nothing intermediate between that which undergoes and that which causes alteration.

Nor, again, can there be anything intermediate between that which suffers and that which causes increase: for the part of the latter that starts the increase does so by becoming attached in such a way to the former that the whole becomes one. Again, the decrease of that which suffers decrease is caused by a part of the thing becoming detached. So that which causes increase and that which causes decrease must be continuous with that which suffers increase and that which suffers decrease respectively: and if two things are continuous with one another there can be nothing intermediate between them.

It is evident, therefore, that between the extremities of the moved and the movent that are respectively first and last 245b
in reference to the moved there is nothing intermediate.

3 Everything, we say, that undergoes alteration is altered by sensible causes, and there is alteration only in things that are said to be essentially affected by sensible things. The truth of this is to be seen from the following considerations. Of all other things it would be most natural to suppose that there is alteration in figures and shapes, and in acquired states and in the processes of acquiring and losing these: but as a matter of fact in neither of these two classes[2] of things is there alteration.

In the first place, when a particular formation[3] of a thing is completed, we do not call it by the name of its material: e.g. we do not call the statue 'bronze' or the

[1] Terms are used somewhat loosely all through this passage, cf. αἴσθησις above. Here χρῶμα is the coloured surface, φῶς the illuminated air, and ὄψις the organ of sight.

[2] σχήματα and μορφαί make up one class as against ἕξεις: hence οὐδετέροις.

[3] Omitting καὶ ῥυθμιζόμενον in l. 9, with Par. 1859 and Simp.

pyramid[1] 'wax' or the bed 'wood', but we use a derived expression and call them 'of bronze', 'waxen,' and 'wooden' respectively. But when a thing has been affected and altered in any way we still call it by the original name: thus we speak of the bronze or the wax being dry or fluid or hard or hot.[2]

And not only so: we also speak of the particular fluid or hot substance as being bronze, giving the material the same name as that which we use to describe the affection.[3]

246a Since, therefore, having regard to the figure or shape of a thing we no longer call that which has become of a certain figure by the name of the material that exhibits the figure, whereas having regard to a thing's affections or alterations we still call it by the name of its material, it is evident that becomings of the former kind cannot be alterations.

Moreover it would seem absurd even to speak in *this* way, to speak, that is to say, of a man or house or anything else that has come into existence as having been altered. Though it may be true that every such becoming is necessarily the result of something's being altered, the result, e.g. of the material's being condensed or rarefied or heated or cooled, nevertheless it is not the things that are coming into existence that are altered, and their becoming is not an alteration.

Again, acquired states, whether of the body or of the soul, are not alterations. For some are excellences and others are defects, and neither excellence nor defect is an alteration: excellence is a perfection (for when anything acquires its proper excellence we call it perfect, since it is then if ever that we have a thing in its natural state: e.g. we have a perfect circle when we have one as good as possible),[4] while defect is a perishing of or departure from this condition. So just as when speaking of a house we do not call its arrival at perfection an alteration (for it would be absurd to suppose that the coping or the tiling is an alteration or

[1] sc. candle.

[2] Reading in l. 13 (with four MSS.) *ξηρὸν γὰρ καὶ ὑγρὸν καὶ σκληρὸν καὶ θερμόν*.

[3] i. e. that which is *ὑγρόν* or *θερμόν* (has the *πάθος* of *ὑγρότης* or *θερμότης*) we may denote by the expression *τὸ θερμόν* or *τὸ ὑγρόν*.

[4] Omitting in l. 16 *καὶ ὅταν*, with Par. 1859.

that in receiving its coping or its tiling a house is altered and not perfected), the same also holds good in the case of excellences and defects and of the persons or things that possess or acquire them: for excellences are perfections 246b
of a thing's nature and defects are departures from it: consequently they are not alterations.

Further, we say that all excellences depend upon particular relations. Thus bodily excellences such as health and a good state of body we regard as consisting in a blending of hot and cold elements within the body in due proportion, in relation either to one another or to the surrounding atmosphere: and in like manner we regard beauty, strength, and all the other bodily excellences and defects. Each of them exists in virtue of a particular relation and puts that which possesses it in a good or bad condition with regard to its proper affections, where by 'proper' affections I mean those influences that from the natural constitution of a thing tend to promote or destroy its existence. Since, then, relatives are neither themselves alterations nor the subjects of alteration or of becoming or in fact of any change whatever, it is evident that neither states nor the processes of losing and acquiring states are alterations, though it may be true that their becoming or perishing is necessarily, like the becoming or perishing of a specific character or form, the result of the alteration of certain other things, e. g. hot and cold or dry and wet elements or the elements, whatever they may be, on which the states primarily depend. For each several bodily defect or excellence involves a relation with those things from which the possessor of the defect or excellence is naturally subject to alteration: thus excellence disposes its possessor to be unaffected by these influences or to be affected by those of them that ought to be admitted,[1] while defect disposes its possessor to be affected by them or to be unaffected by those of them that ought to be admitted.

And the case is similar in regard to the states of the soul, all of which (like those of body) exist in virtue of 247a

[1] The alternative is added because, while some would use πάθη only in a bad sense, others would recognize both good and bad πάθη.

particular relations, the excellences being perfections of nature and the defects departures from it: moreover, excellence puts its possessor in good condition, while defect puts its possessor in a bad condition, to meet his proper affections. Consequently these cannot any more than the bodily states be alterations, nor can the processes of losing and acquiring them be so, though their becoming is necessarily the result of an alteration of the sensitive part of the soul, and this is altered by sensible objects: for all moral excellence is concerned with bodily pleasures and pains, which again depend either upon acting or upon remembering or upon anticipating. Now those that depend upon action are determined by sense-perception, i.e. they are stimulated by something sensible: and those that depend upon memory or anticipation are likewise to be traced to sense-perception, for in these cases pleasure is felt either in remembering what one has experienced or in anticipating what one is going to experience. Thus all pleasure of this kind[1] must be produced by sensible things: and since the presence[2] in any one of moral defect or excellence involves the presence[2] in him of pleasure or pain (with which moral excellence and defect are always concerned), and these pleasures and pains are alterations of the sensitive part,[3] it is evident that the loss and acquisition of these states no less than the loss and acquisition of the states of the body must be the result of the alteration of something else. Consequently, though their becoming is accompanied by an alteration, they are not themselves alterations.

247b Again, the states of the intellectual part of the soul are not alterations, nor is there any becoming of them. In the first place it is much more[4] true of the possession of knowledge that it depends upon a particular relation. And further, it is evident that there is no becoming of these states. For that which is potentially possessed of know-

[1] sc. of the sensitive part of the soul.

[2] It is hardly possible without awkwardness to give the full force of ἐγγίνεσθαι here in English. It means strictly 'to come to be present in'.

[3] Aristotle really means 'arise from the alteration of the sensitive part': but his mode of expression is as often somewhat loose.

[4] Reading in l. 2 μᾶλλον, with (apparently) Simp.

ledge becomes actually possessed of it not by being set in motion at all itself but by reason of the presence[1] of something else: i.e. it is when it meets with the particular object that it knows in a manner[2] the particular through its knowledge of the universal. (Again, there is no becoming of the actual use and activity of these states, unless it is thought that there is a becoming of vision and touching and that the activity in question is similar to these.) And the original acquisition of knowledge is not a becoming or an alteration[3]: for the terms 'knowing' and 'understanding' imply that the intellect has reached a state of rest and come to a standstill,[4] and there is no becoming that leads to a state of rest, since, as we have said above,[5] no change at all can have a becoming. Moreover, just as to say, when any one has passed from a state of intoxication or sleep or disease to the contrary state, that he has become possessed of knowledge again is incorrect in spite of the fact that he was previously incapable of using his knowledge, so, too, when any one originally acquires the state, it is incorrect to say that he becomes possessed of knowledge: for the possession of understanding and knowledge is produced by the soul's settling down[6] out of the restlessness natural to it. Hence, too, in learning and in forming judgements on matters relating to their sense-perceptions children are inferior to adults owing to the great amount 248a
of restlessness and motion in their souls. Nature itself causes the soul to settle down and come to a state of rest for the performance of some of its functions, while for the

[1] No one English word will quite give the force of ὑπάρξαι here: it implies that something objective 'appears on the scene', 'comes into existence in relation to τὸ ἐπιστῆμον'.

[2] The qualification is added because knowledge (ἐπιστήμη) in the strict sense is concerned not with the particular but with the universal. The point here is that knowledge of the universal includes a sort of knowledge of the particular, out of which it was originally built up.

[3] Reading in l. 10 ἔστιν οὐδ' ἀλλοίωσις, with Par. 1859 and Simp.

[4] The etymological connexion between ἐπιστήμη and στῆναι can hardly be adequately given in translation. Read λεγόμεθα in l. 11, with Par. 1859.

[5] v. 2. 225b 15 sqq.

[6] The same etymological connexion is here present to Aristotle's mind as that noted above.

performance of others other things[1] do so: but in either case the result is brought about through the alteration of something in the body, as we see in the case of the use[2] and activity of the intellect arising from a man's becoming sober or being awakened. It is evident, then, from the preceding argument that alteration and being altered occur in sensible things and in the sensitive part of the soul and, except accidentally, in nothing else.

A difficulty may be raised as to whether every motion 4
is commensurable with every other or not. Now if they are all commensurable and if two things to have the same velocity must accomplish an equal motion in an equal time, then we may have a circumference equal to a straight line, or, of course, the one may be greater or less than the other. Further, if one thing alters and another accomplishes a locomotion in an equal time, we may have an alteration and a locomotion equal to one another: thus an affection will be equal to a length, which is impossible. But is it not[3] only when an equal motion is accomplished by two things in an equal time that the velocities of the two are equal? Now an affection cannot be equal to a length. Therefore there cannot be an alteration equal to or less than a locomotion: and consequently it is not the case that every motion is commensurable with every other.

But how will our conclusion work out in the case of the circle and the straight line? It would be absurd to suppose that the motion of one thing in a circle and of another in a straight line cannot be similar, but that the one must inevitably move more quickly or more slowly than the other, just as if the course of one were downhill and of the other uphill. Moreover it does not as a matter of fact make any difference to the argument to say that the one motion must inevitably be quicker or slower than the other:

[1] e. g. education, experience, etc.

[2] Reading in l. 5 *χρήσεως* with several MSS. This gives a much better balance to the sentence than *ἐγέρσεως* which Bekker and Prantl adopt: *becoming sober* and *being awakened* lead to the recovery of the *use* and the *activity* of the intellect.

[3] Reading in l. 16 *ἆρα . . . ἰσοταχὲς*; with Bonitz.

for then the circumference can be greater or less than the straight line; and if so it is possible for the two to be equal. For if in the time A the quicker (B) passes over the distance B′ and the slower (Γ) passes over the distance Γ′, B′ will be greater than Γ′: for this is what we[1] took 248b 'quicker' to mean: and so quicker motion also implies that one thing traverses an equal distance in less time than another: consequently there will be a part of A in which B will pass over a part of the circle equal to Γ′, while Γ will occupy the whole of A in passing over Γ′. None the less, if the two motions[2] are commensurable, we are confronted with the consequence stated above, viz. that there may be a straight line equal to a circle. But these are not commensurable: and so the corresponding motions are not commensurable either.

But may we say that things are always commensurable if the same terms are applied to them without equivocation? e.g. a pen, a wine, and the highest note in a scale are not commensurable: we cannot say whether any one of them is sharper than any other: and why is this? they are incommensurable because it is only equivocally that the same term 'sharp' is applied to them: whereas the highest note in a scale is commensurable with the leading-note, because the term 'sharp' has the same meaning as applied to both. Can it be, then, that the term 'quick' has not the same meaning as applied to straight motion and to circular motion respectively? If so, far less will it have the same meaning as applied to alteration and to locomotion.

Or shall we in the first place deny that things are always commensurable if the same terms are applied to them without equivocation? For the term 'much' has the same meaning whether applied to water or to air, yet water and air are not commensurable in respect of it:[3] or, if this

[1] vi. 2. 232a 25 sqq.

[2] The sense is improved by taking the first συμβλητά to refer to the motions and the second to the straight line and the circle. The awkwardness of expression is not un-Aristotelian. The objector is supposed to maintain (248a 19) that the two *motions* must surely be commensurable. Nevertheless, says A., this would imply etc. . . .

[3] i.e. a body of water will have more δύναμις though it may have the same ὄγκος as a body of air.

illustration is not considered satisfactory, 'double' at any rate would seem to have the same meaning as applied to each (denoting in each case the proportion of two to one), yet water and air are not commensurable in respect of it.[1] But here again may we not take up the same position and say that the term 'much' is equivocal? In fact there are some terms of which even the definitions are equivocal; e.g. if 'much' were defined as 'so much and more', 'so much' would mean something different in different cases:[2] 'equal' is similarly equivocal; and 'one' again is perhaps inevitably an equivocal term; and if 'one' is equivocal, so is 'two'. Otherwise why is it that some things[3] are commensurable while others[4] are not, if the nature of the attribute in the two cases is really one and the same?

Can it be that the incommensurability of two things in respect of any attribute is due to a difference in that which is primarily capable of carrying the attribute? Thus horse and dog are so commensurable that we may say which is the whiter, since that which primarily contains the whiteness is the same in both, viz. the surface: and similarly they are commensurable in respect of size. But water and speech are not commensurable in respect of clearness,[5] since that which primarily contains the attribute is different in the two cases. It would seem, however, that we must reject this solution, since clearly we could thus make all equivocal attributes univocal and say merely that that which contains each of them is different in different cases:
249a thus 'equality', 'sweetness,' and 'whiteness' will severally always be the same, though that which contains them is different in different cases. Moreover, it is not any casual thing that is capable of carrying any attribute: each single

[1] e.g. two cubic feet of air will have twice the δύναμις of one cubic foot of air but not twice the δύναμις of one cubic foot of water.

[2] Reading in l. 18 a comma after ἔτι (cf. *Met.* 1021a 6).

[3] e.g. two cubic feet of air and one cubic foot of air.

[4] e.g. two cubic feet of air and one cubic foot of water: the doubleness in the two cases is not identical. Cf. above.

[5] The attribute in question is still λευκότης, which can be applied in Greek not only to ἵππος and κύων but also to ὕδωρ and φωνή: but a change of word is necessary in English.

attribute can be carried primarily only by one single thing.

Must we then say that, if two things are to be commensurable in respect of any attribute, not only must the attribute in question be applicable to both without equivocation, but there must also be no specific differences either in the attribute itself or in that which contains the attribute—that these, I mean, must not be divisible in the way in which colour is divided into kinds? Thus in this respect one thing will not be commensurable with another, i.e. we cannot say that one is more coloured than the other where only colour in general and not any particular colour is meant; but they are commensurable in respect of whiteness.

Similarly in the case of motion: two things are of the same velocity if they occupy an equal time in accomplishing a certain equal amount of motion. Suppose, then, that in a certain time an alteration is undergone by one half[1] of a body's length and a locomotion is accomplished by the other half: can we say that in this case the alteration is equal to the locomotion and of the same velocity? That would be absurd, and the reason is that there are different species of motion. And if in consequence of this we must say that two things are of equal velocity if they accomplish locomotion over an equal distance in an equal time, we have to admit the equality of a straight line and a circumference.[2] What, then, is the reason of this? Is it that locomotion is a genus or that line is a genus? (We may leave the time out of account, since that is one and the same.) If the lines are specifically different, the locomotions also differ specifically from one another:[3] for locomotion is specifically differentiated according to the

[1] The argument clearly requires that the two parts represented by τὸ μὲν and τὸ δὲ should be *equal*: cf. ἴσον τοσονδί above.

[2] This seems to be the general sense of the sentence ὥστ' εἰ . . . περιφερής. But the connexion of thought is so obscure that I am inclined to suspect a lacuna, e.g. ὥστε τὸ αὐτὸ εἶδος κινήσεως δεῖ εἶναι ἑκατέρῳ, εἰ ἰσοταχῆ ἔσται. ἀλλ' εἰ κτλ.

[3] Reading in l. 15 (with Simplicius) χρόνος ὁ αὐτός· ἂν δὲ τῷ εἴδει ᾖ ἄλλα, καὶ ἐκεῖνα εἴδει διαφέρει. The ordinary reading of the MSS. and of Bekker is said by Simplicius to have been introduced from the second text.

specific differentiation of that over which it takes place. (It is also similarly differentiated, it would seem, accordingly as the instrument of the locomotion is different: thus if feet are the instrument, it is walking, if wings it is flying; but perhaps we should rather say that this is not so, and that in this case the differences in the locomotion are merely differences of posture in that which is in motion.[1]) We may say, therefore, that things are of equal velocity if in an equal time they traverse the same magnitude: and when I call it 'the same' I mean that it contains no specific difference and therefore no difference in the motion that takes place over it. So we have now to consider how motion is differentiated: and this discussion serves to show that the genus is not a unity but contains a plurality latent in it and distinct from it, and that in the case of equivocal terms sometimes the different senses in which they are used are far removed from one another, while sometimes there is a certain likeness between them, and sometimes again they are nearly related either generically or analogically, with the result that they seem not to be equivocal though they really are.

When, then, is there a difference of species? Is an attribute specifically different if the subject is different while the attribute is the same, or must the attribute itself be different as well? And how are we to define the limits of a species? What will enable us to decide that particular instances of whiteness or sweetness are the same or different? Is it enough that it appears different in one subject from what it appears in another? Or must there be no sameness at all? And further, where alteration is in question, how is one alteration to be of equal velocity with another? One person may be cured quickly and another slowly, and cures may also be simultaneous: so that, recovery of health being an alteration, we have here alterations of equal
249b velocity, since each alteration occupies an equal time. But what[2] alteration? We cannot here speak of an 'equal'

[1] Reading ἔτι l. 17 . . . ἄλλη l. 19 as parenthetical.

[2] i. e. what qualification are we to introduce into our definition of τὸ ἰσοταχές in ἀλλοίωσις corresponding to ἴσον or ταὐτὸν μέγεθος (249a 19) in the case of φορά? Thus τί will be accusative.

alteration: what corresponds in the category of quality to equality in the category of quantity is 'likeness'. However, let us say that there is equal velocity where *the same* change is accomplished in an equal time. Are we, then, to find the commensurability in the subject of the affection or in the affection itself? In the case that we have just been considering it is the fact that health is one and the same that enables us to arrive at the conclusion that the one alteration is neither more nor less than the other, but that both are alike. If on the other hand the affection is different in the two cases, e. g. when the alterations take the form of becoming white and becoming healthy respectively, here there is no sameness or equality or likeness inasmuch as the difference in the affections[1] at once makes the alterations specifically different, and there is no unity of alteration any more than there would be unity of locomotion under like conditions.[2] So we must find out how many species there are of alteration and of locomotion respectively. Now if the things that are in motion—that is to say, the things to which the motions belong essentially and not accidentally—differ specifically, then their respective motions will also differ specifically: if on the other hand they differ generically or numerically, the motions also will differ generically or numerically as the case may be. But there still remains the question whether, supposing that two alterations are of equal velocity, we ought to look for this equality in the sameness (or likeness) of the affections, or in the things altered, to see e. g. whether a certain quantity of each has become white. Or ought we not rather to look for it in both? That is to say, the alterations are the same or different according as the affections are the same or different,[3] while they are equal or unequal according as the things altered are equal or unequal.[3]

And now we must consider the same question in the case of becoming and perishing: how is one becoming of equal velocity with another? They are of equal velocity

[1] *ταῦτα*: sc. *τὸ λευκαινόμενον* and *τὸ ὑγιαζόμενον*.

[2] sc. if there are two locomotions of different species.

[3] Reading in l. 18 *τὸ αὐτὸ ἢ μὴ τὸ αὐτό* (*τὸ αὐτὸ αὐτό* E), and in l. 19 *(ἴσον ἢ) ἄνισον*.

if in an equal time there are produced two things that are the same[1] and specifically inseparable, e.g. two men (not merely generically inseparable as e.g. two animals). Similarly one is quicker than the other if in an equal time the product is different in the two cases. I state it thus[2] because we have no pair of terms that will convey this 'difference' in the way in which unlikeness is conveyed.[3] If we adopt the theory that it is number that constitutes being, we may indeed speak of a 'greater number' and a 'lesser number'[4] within the same species, but there is no common term that will include both relations,[5] nor are there terms to express each of them separately in the same way as we indicate a higher degree or preponderance of an affection by 'more', of a quantity by 'greater'.

Now since wherever there is a movent, its motion always acts upon something, is always in something, and always extends to something (by 'is always in something' I mean that it occupies a time: and by 'extends to something' I mean that it involves the traversing of a certain amount of distance: for at any moment when a thing is causing motion, it also has caused motion, so that there must always be a certain amount of distance that has been traversed and a certain amount of time that has been occupied).[6] If, then, A the movent have moved B a distance Γ in a time Δ, then in the same time the same force A will move ½B twice the distance Γ, and in ½Δ it will move ½B the whole distance Γ: for thus the rules of proportion will be observed. Again if a given force move a given weight a certain distance in a certain time and 5

[1] i.e. in the matter of completeness of development: there is no sufficiently specialized term for Aristotle to use. Cf. the sequel.

[2] sc. use these general terms τὸ αὐτό and ἕτερον.

[3] i.e. ἀλλοιώσεις are συμβληταί in respect of ὁμοιότης and ἀνομοιότης: and the relation of ἀνομοιότης is indicated by the use of the two terms μᾶλλον and ἧττον.

[4] i.e. instead of merely using the single term ἕτερον.

[5] Aristotle has as a matter of fact just used ἑτερότης for this, but he feels that this is really too wide a term.

[6] Reading λέγω l. 28 . . . ποσῷ l. 30 as a parenthesis, followed by a comma (so Bonitz).

half the distance in half the time,[1] half the motive power will move half the weight the same distance in the same time. Let E represent half the motive power A and Z half the weight B: then the ratio between the motive power and the weight in the one case is similar and proportionate to the ratio in the other, so that each force will cause the same distance to be traversed in the same time.

But if E move Z a distance Γ in a time Δ, it does not necessarily follow that E can move twice Z half the distance Γ in the same time. If, then, A move B a distance Γ in a time Δ, it does not follow that E, being half of A, will in the time Δ or in any fraction of it cause B[2] to traverse a part of Γ the ratio between which and the whole of Γ is proportionate to that between A and E (whatever fraction of A E may be):[3] in fact it might well be that it will cause no motion at all; for it does not follow that, if a given motive power causes a certain amount of motion, half that power will cause motion either of any particular amount or in any length of time: otherwise one man might move a ship, since both the motive power of the ship-haulers and the distance that they all cause the ship to traverse are divisible into as many parts as there are men. Hence Zeno's reasoning is false when he argues that there is no part of the millet that does not make a sound: for there is no reason why any such part should not in any length of time fail to move the air that the whole bushel moves in falling.[4] In fact it does not of itself move even such a quantity of the air as it would move if this part were by itself: for no part even exists otherwise than potentially.

If on the other hand we have two forces each of which separately moves one of two weights a given distance in a given time, then the forces in combination will move the combined weights an equal distance in an equal time: for in this case the rules of proportion apply.

[1] Reading in l. 5 a comma after ἡμίσει and not after κινεῖ (so Bonitz).

[2] Omitting τὴν in ll. 12, 13, with Simp., and reading in l. 12 ὅση, with EHK.

[3] Both the text and the exact sense of this sentence are somewhat doubtful. In l. 14 I read ⟨τι⟩ τῆς, with Prantl, and omit ἥ, with EFK.

[4] Reading in l. 22 πεσών. with Hbc.

Then does this hold good of alteration and of increase also? Surely it does, for in any given case we have a definite thing that causes increase and a definite thing that suffers increase, and the one causes and the other suffers a certain amount of increase in a certain amount of time. Similarly we have a definite thing that causes alteration and a definite thing that undergoes alteration, and a certain amount, or rather degree,[1] of alteration is completed in
250b a certain amount of time: thus in twice as much time twice as much alteration will be completed and conversely twice as much alteration will occupy twice as much time: and the alteration of half of its object will occupy half as much time and in half as much time half of the object will be altered: or again, in the same amount of time it will be altered twice as much.

On the other hand if that which causes alteration or increase causes a certain amount of increase or alteration respectively in a certain amount of time, it does not necessarily follow that half the force will occupy twice the time in altering or increasing the object, or that in twice the time the alteration or increase will be completed by it:[2] it may happen that there will be no alteration or increase at all, the case being the same as with the weight.

[1] *lit.* 'a certain amount in respect of more or less': the qualification is added because *ἀλλοίωσις* is not measured by *quantity* in the strict sense like *φορά* but by degree: in this case we say *μᾶλλον* or *ἧττον* where in the other case we say *μεῖζον* or *ἔλαττον*. Cf. above 249b 26.

[2] It seems necessary to read in l. 5 *τὸ ἥμισυ ἐν διπλασίῳ καὶ ἐν διπλασίῳ ἥμισυ*. Only so will the point made correspond to that made about weight in a12–19.

BOOK VIII

1 It remains to consider the following question. Was there ever a becoming of motion before which it had no being, and is it perishing again so as to leave nothing in motion? Or are we to say that it never had any becoming and is not perishing, but always was and always will be? Is it in fact an immortal never-failing property of things that are, a sort of life as it were to all naturally constituted things?

Now the *existence* of motion is asserted by all who have anything to say about nature, because they all[1] concern themselves with the construction of the world and study the question of becoming and perishing, which processes could not come about without the existence of motion. But those who say that there is an infinite number of worlds, some of which are in process of becoming while others are in process of perishing, assert that there is always motion (for these processes of becoming and perishing of the worlds necessarily involve motion), whereas those who hold that there is only one world, whether everlasting or not,[2] make corresponding assumptions in regard to motion. If then it is possible that at any time nothing should be in motion, this must come about in one of two ways: either in the manner described by Anaxagoras, who says that all things were together and at rest for an infinite period of time, and that then Mind introduced motion and separated them; or in the manner described by Empedocles, according to whom the universe is alternately in motion and at rest—in motion, when Love is making the one out of many, or Strife is making many out of one, and at rest

[1] Reading in l. 17 πᾶσιν. Bekker's πᾶσαν is a misprint.

[2] ἕνα ἢ μὴ ἀεί in l. 22 is difficult. As Simplicius says, the words really stand for ἕνα καὶ ἀεὶ τὸν αὐτὸν ἢ ἕνα μέν, οὐκ ἀεὶ δέ. We should probably read ἕνα ⟨ἢ ἀεὶ⟩ ἢ μὴ ἀεί, with (apparently) Themistius.

in the intermediate periods of time—his account being as follows:

'Since[1] One hath learned to spring from Manifold,
And One disjoined makes Manifold arise,
251a Thus they Become, nor stable is their life:
But since their motion must alternate be,
Thus have they ever Rest upon their round':

for we must suppose that he means by this that they alternate from the one motion to the other.[2] We must consider, then, how this matter stands, for the discovery of the truth about it is of importance, not only for the study of nature, but also for the investigation of the First Principle.

Let us take our start from what we have already[3] laid down in our course on Physics.[4] Motion, we say, is the fulfilment of the movable in so far as it is movable. Each kind of motion, therefore, necessarily involves the presence of the things that are capable of that motion. In fact, even apart from the definition of motion, every one would admit that in each kind of motion it is that which is capable of that motion that is in motion: thus it is that which is capable of alteration that is altered, and that which is capable of local change that is in locomotion: and so there must be something capable of being burned before there can be a process of being burned, and something capable of burning before there can be a process of burning. Moreover, these things also must either have a beginning before

[1] Reading in l. 29 *λέγων 'οὕτως ᾗ μὲν . . .'*, with Diels (fr. 17. 9–13 = 26. 8–12).

[2] i. e. from motion towards *ἕν* to motion towards *πολλά* and vice versa. But the last two lines quoted from Empedocles do not naturally bear this meaning: he seems to be insisting first on the *rotation* and then on the *permanence* of the rotation: he does not here say anything about the *μεταξὺ χρόνοι* in which occurs that *ἠρεμία* which as Aristotle says makes *κίνησις* to cease altogether.—Reading in l. 4 *τὸ γὰρ ᾗ δὲ τάδ' ἀλλάσσοντα ἐνθένδε ἐκεῖσε λέγειν αὐτὸν ὑποληπτέον*, with FHI.

[3] iii. 1.

[4] The title of the whole eight books of this treatise (or, rather, course of lectures) is *Φυσικὴ Ἀκρόασις*. When Aristotle refers to *τὰ φυσικά* or *τὰ περὶ φύσεως* he usually means the first four books only: books V, VI, and VIII are referred to as *τὰ περὶ κινήσεως*. Cf. 267b 21.

which they had no being, or they must be eternal. Now if there was a becoming of every movable thing, it follows that before the motion in question another change or motion must have taken place in which that which was capable of being moved or of causing motion had its becoming. To suppose, on the other hand, that these things were in being throughout all previous time without there being any motion appears unreasonable on a moment's thought, and still more unreasonable, we shall find, on further consideration. For if we are to say that, while there are on the one hand things that are movable, and on the other hand things that are motive, there is a time when there is a first movent and a first moved, and another time when there is no such thing but only something that is at rest, then this thing that is at rest must previously have been in process of change: for there must have been some cause of its rest, rest[1] being the privation of motion. Therefore, before this first change there will be a previous change. For some things cause motion in only one way, while others can produce either of two contrary motions: thus fire causes heating but not cooling, whereas it would seem that knowledge may be directed to two contrary ends while remaining one and the same. Even in the former class, however, there seems to be something similar, for a cold thing in a sense causes heating by turning away and retiring, just as one possessed of knowledge voluntarily makes an error when he uses his knowledge in the reverse way.[2] But at any rate all things that are 251b
capable respectively of affecting and being affected, or of causing motion and being moved, are capable of it not under all conditions, but only when they are in a particular condition and approach one another: so it is on the approach of one thing to another that the one causes

[1] Simplicius in his commentary has ἠρεμία here though we cannot be sure that he is quoting verbally from Aristotle. But A. uses ἠρέμησις to mean not only 'coming to rest' but also 'being at rest', which must be the meaning here as we are professedly only dealing with a state of rest. Cf. v. 6. 231a 2.

[2] i.e. by means of his knowledge he can be sure of giving a wrong opinion and thus deceiving some one.

motion and the other is moved, and when they are present under such conditions as rendered the one motive and the other movable. So if the motion was not always in process, it is clear that they must have been in a condition not such as to render them capable[1] respectively of being moved and of causing motion, and one or other of them must have been in process of change: for in what is relative this is a necessary consequence: e. g. if one thing is double another when before it was not so, one or other of them, if not both, must have been in process of change. It follows, then, that there will be a process of change previous to the first. (Further, how can there be any 'before' and 'after' without the existence of time? Or how can there be any time without the existence of motion? If, then, time is the number of motion or itself a kind of motion, it follows that, if there is always time, motion must also be eternal. But so far as time is concerned we see that all with one exception are in agreement in saying that it is uncreated: in fact, it is just this[2] that enables Democritus to show that all things cannot have had a becoming: for time, he says, is uncreated. Plato alone asserts the creation of time, saying[3] that it had a becoming together with the universe, the universe according to him having had a becoming. Now since time cannot exist and is unthinkable apart from the moment, and the moment is a kind of middle-point, uniting as it does in itself both a beginning and an end, a beginning of future time and an end of past time, it follows that there must always be time: for the extremity of the last period of time that we take must be found in some moment, since time contains no point of contact[4] for us except the moment. Therefore, since the moment is both a beginning and an end, there must always be time on both sides of it. But if this is true of time, it is evident

[1] Reading in l. 4 *ὡς ἦν*, and in l. 6 *ὡς ἦν δυνάμενα*, with E. Cf. *Met.* 1048^a 6.

[2] Reading in l. 16 *τούτου*, with EH.

[3] Aristotle is thinking of a passage in the *Timaeus* (38 B).

[4] It is difficult to give the exact force of *λαβεῖν*. Aristotle means that we can only 'lay hold of' or 'have at command' the present moment, since all the rest of time is either no longer or not yet in existence.

that it must also be true of motion, time being a kind of affection of motion.)

The same reasoning will also serve to show the imperishability of motion: just as a becoming of motion would involve, as we saw, the existence of a process of change previous to the first, in the same way a perishing of motion would involve the existence of a process of change subsequent to the last: for when a thing ceases to be moved, it does not therefore at the same time cease to be movable—e. g. the cessation of the process of being burned does not involve the cessation of the capacity of being burned, since a thing may be capable of being burned without being in process of being burned—nor, when a thing ceases to be movent, does it therefore at the same time cease to be motive. Again, the destructive agent will 252a
have to be destroyed, after what it destroys has been destroyed,[1] and then that which has the capacity of destroying *it* will have to be destroyed afterwards, (so that there will be a process of change subsequent to the last,) for being destroyed also is a kind of change. If, then, the view which we are criticizing involves these impossible consequences, it is clear that motion is eternal and cannot have existed at one time and not at another: in fact, such a view can hardly be described as anything else than fantastic.

And much the same may be said of the view that such is the ordinance of nature and that this must be regarded as a principle, as would seem to be the view of Empedocles when he says that the constitution of the world is of necessity such that Love and Strife alternately predominate and cause motion, while in the intermediate period of time there is a state of rest. Probably also those who, like Anaxagoras, assert a single principle (of motion[2]) would hold this view. But that which is produced or directed by nature can never be anything disorderly: for nature is

[1] Reading in l. 1 καὶ τὸ φθαρτικὸν δὴ . . . φθαρῇ, with E.

[2] It is necessary to insert these words, as Anaxagoras is of course a pluralist, and Aristotle is only thinking of the place assigned to νοῦς in his system as the sole cause of motion in contradistinction to the two causes (φιλία and νεῖκος) asserted by Empedocles.

everywhere the cause of order. Moreover, there is no ratio in the relation of the infinite to the infinite, whereas order always means ratio. But if we say that there is first a state of rest for an infinite time, and then motion is started at some moment, and that the fact that it is this rather than a previous moment is of no importance, and involves no order, then we can no longer say that it is nature's work: for if anything is of a certain character *naturally*, it either[1] is so invariably and is not sometimes of this and sometimes of another character (e. g. fire, which travels upwards naturally, does not sometimes do so and sometimes not) or there is a ratio in the variation. It would be better, therefore, to say with Empedocles and any one else who may have maintained such a theory as his that the universe is alternately at rest and in motion: for in a system of this kind we have at once a certain order. But even here the holder of the theory ought not only to assert the fact: he ought also to explain the cause of it: i. e. he should not make any mere assumption or lay down any gratuitous axiom, but should employ either inductive or demonstrative reasoning. The Love and Strife postulated by Empedocles are not in themselves causes of the fact in question, nor is it of the essence of either that it should be so, the essential function of the former being to unite, of the latter to separate. If he is to go on to explain this alternate predominance, he should adduce cases where such a state of things exists, as he points to the fact that among mankind we have something that unites men, namely Love, while on the other hand enemies avoid one another: thus from the observed fact that this occurs in certain cases comes the assumption that it occurs also in the universe. Then, again, some argument is needed to explain why the predominance of each of the two forces lasts for an equal period of time. But it is a wrong assumption to suppose universally that we have an adequate first principle in virtue of the fact that something always is so or always happens so. Thus Democritus reduces the causes that explain nature to the fact that

[1] Reading in l. 17 ἢ.

things happened in the past in the same way as they happen now: but he does not think fit to seek for a first principle to explain this 'always': so, while his theory is right in so far as it is applied to certain individual cases, he is wrong in making it of universal application. Thus, a triangle always has its angles equal to two right angles, but there is nevertheless an ulterior cause of the eternity of this truth, whereas first principles are eternal and have no ulterior cause. Let this conclude what we have to say in support of our contention that there never was a time when there was not motion, and never will be a time when there will not be motion.

2 The arguments that may be advanced against this position are not difficult to dispose of. The chief considerations that might be thought to indicate that motion may exist though at one time it had not existed at all are the following:

First, it may be said that no process of change is eternal: for the nature of all change is such that it proceeds *from* something *to* something, so that every process of change must be bounded by the contraries that mark its course, and no motion can go on to infinity.

Secondly, we see that a thing that neither is in motion nor contains any motion within itself can be set in motion; e.g. inanimate things that are (whether the whole or some part is in question) not in motion but at rest, are at some moment set in motion: whereas, if motion cannot have a becoming before which it had no being, these things ought to be either always or never in motion.

Thirdly, the fact[1] is evident above all in the case of animate beings: for it sometimes happens that there is no motion in us and we are quite still, and that nevertheless we are then at some moment set in motion, that is to say it sometimes happens that we produce a beginning of motion in ourselves spontaneously without anything having set us in motion from without. We see nothing like this in the case of inanimate things, which are always set in

[1] sc. τὸ κίνησιν εἶναί ποτε μὴ οὖσαν.

motion by something else from without: the animal, on the other hand, we say, moves itself: therefore, if an animal is ever in a state of absolute rest, we have a motionless thing in which motion can be produced from the thing itself, and not from without. Now if this can occur in an animal, why should not the same be true also of the universe as a whole? If it can occur in a small world [1] it could also occur in a great one: and if it can occur in the world, it could also occur in the infinite; that is, if the infinite could as a whole possibly be in motion or at rest.

Of these objections, then, the first-mentioned—that motion to opposites is not always the same and numerically one—is a correct statement; in fact, this may be said to be a necessary conclusion, provided that it is possible for the motion of that which is one and the same to be not always one and the same. (I mean that e.g. we may question whether the note given by a single string is one and the same, or is different each time the string is struck, although the string is in the same condition and is moved in the same way.) But still, however this may be, there is nothing to prevent there being a motion that is the same
253a in virtue of being continuous and eternal: we shall have something to say later [2] that will make this point clearer.

As regards the second objection, no absurdity is involved in the fact [3] that something not in motion may be set in motion, that which caused the motion from without being at one time present, and at another absent. Nevertheless, how this can be so remains matter for inquiry; how it comes about, I mean, that the same motive force at one time causes a thing to be in motion, and at another does not do so: for the difficulty raised by our objector really amounts to this—why is it that some things are not always at rest, and the rest always in motion?

The third objection may be thought to present more difficulty than the others, namely, that which alleges that motion arises in things in which it did not exist before, and

[1] Cf. Democr. fr. 34. [2] Chapter 8.
[3] i. e. this fact does not prove the theory of ἀΐδιος κίνησις to be absurd.

adduces in proof the case of animate things: thus an animal is first at rest and afterwards walks, not having been set in motion apparently by anything from without. This, however, is false: for we observe that there is always some part of the animal's organism in motion, and the cause of the motion of this part is not the animal itself, but, it may be, its environment. Moreover, we say that the animal itself originates not all of its motions but its locomotion. So it may well be the case—or rather we may perhaps say that it must necessarily be the case—that many motions are produced in the body by its environment, and some of these set in motion the intellect or the appetite, and this again then sets the whole animal in motion: this is what happens when animals are asleep: though there is then no perceptive motion in them, there is some motion that causes them to wake up again. But we will leave this point also to be elucidated at a later[1] stage in our discussion.

3 Our enquiry will resolve itself at the outset into a consideration of the above-mentioned problem—what can be the reason why some things in the world at one time are in motion and at another are at rest again? Now one of three things must be true: either all things are always at rest, or all things are always in motion, or some things are in motion and others at rest: and in this last case again either the things that are in motion are always in motion and the things that are at rest are always at rest, or they are all constituted so as to be capable alike of motion and of rest; or there is yet a third possibility remaining—it may be that some things in the world are always motionless, others always in motion, while others again admit of both conditions. This last is the account of the matter that we must give: for herein lies the solution of all the difficulties raised and the conclusion of the investigation upon which we are engaged.

[1] Chapter 6.

To maintain that all things are at rest,[1] and to disregard sense-perception in an attempt to show the theory to be reasonable,[2] would be an instance of intellectual weakness: it would call in question a whole system, not a particular detail: moreover, it would be an attack not only on the physicist but on almost all sciences and all received

253b opinions, since motion plays a part in all of them. Further, just as in arguments about mathematics objections that involve first principles do not affect the mathematician—and the other sciences are in similar case—so, too, objections involving the point that we have just raised do not affect the physicist: for it is a fundamental assumption with him that motion is ultimately referable to nature herself.[3]

The assertion that all things are in motion we may fairly regard as equally false, though it is less subversive of physical science:[4] for though in our course on physics[5] it was laid down that rest no less than motion is ultimately referable to nature herself, nevertheless[6] motion is the characteristic fact of nature: moreover, the view is actually held by some that not merely some things but all things in the world are in motion and always in motion, though we cannot apprehend the fact by sense-perception. Although the supporters of this theory do not state clearly what kind of motion they mean, or whether they mean all kinds, it is no hard matter to reply to them: thus we may point

[1] The Greek as it stands is not quite logical: the *διανοίας ἀρρωστία* is not *τὸ πάντ' ἠρεμεῖν* but *τὸ πάντ' ἠρεμεῖν λέγειν*. Some such word as *λέγειν* must be supplied from *ζητεῖν* following.

[2] The words *ζητεῖν λόγον* mean to seek an explanation or *rationale* of the theory, to give a *rational account* of it.

[3] *lit.* 'nature is the original cause of motion': i.e. motion is an ultimate fact in the constitution of the world. See i. 2. 184b 25 sqq.

[4] *lit.* 'less contrary to the investigation', sc. physical investigation.

[5] ii. 1. 192b 21. See note on 251a 9 above.

[6] Reading in l. 9 *ὅμως*. It is impossible to get any sense out of *ὁμοίως*, the reading of all the MSS. The two words are often confused: moreover Pacius has *ὅμως* and mentions no other reading. Even so the sense given to *φυσικόν* is somewhat strained: it must mean that whereas *ἠρεμία* is a mere *στέρησις* of motion, *κίνησις* is a positive fact in nature, *φύσις* being conceived of as emphatically a process. We might perhaps get this sense more easily by reading *οὐχ ὁμοίως*: 'motion is natural in a different sense', i.e. in a more special sense.

out that there cannot be a continuous process either of increase or of decrease: that which comes between the two has to be included.[1] The theory resembles that about the stone being worn away by the drop of water or split by plants growing out of it: if so much has been extruded or removed by the drop, it does not follow that half the amount has previously been extruded or removed in half the time: the case of the hauled ship is exactly comparable: here we have so many drops setting so much in motion, but a part of them will not set as much in motion in any period of time. The amount removed is, it is true, divisible into a number of parts, but no one of these was set in motion separately: they were all set in motion together. It is evident, then, that from the fact that the decrease is divisible into an infinite number of parts it does not follow that some part must always be passing away: it all passes away at a particular moment. Similarly, too, in the case of any alteration whatever if that which suffers alteration is infinitely divisible it does not follow from this that the same is true of the alteration itself, which often occurs all at once, as in freezing. Again, when any one has fallen ill, there must follow a period of time in which his restoration to health is in the future: the process of change cannot take place in an instant: yet the change cannot be a change to anything else but health.[2] The assertion, therefore, that alteration is continuous is an extravagant calling into question of the obvious: for alteration is a change from one contrary to another. Moreover, we notice that a stone becomes neither harder nor softer.[3] Again, in the matter of locomotion, it would be a strange thing if a stone could be falling or resting on the ground without our being able to perceive the fact. Further, it is a law of nature that earth and all other bodies should remain in their proper

[1] i.e. a thing cannot go on increasing or decreasing to infinity: there comes a time when it either remains constant or changes to the contrary process, and the two processes must be separated by at least a moment of ἠρεμία (τὸ μέσον).

[2] Thus ὑγίανσις, a particular form of ἀλλοίωσις, is not συνεχής.

[3] An argument from ordinary experience: a stone retains the same degree of hardness at least for a very long period: it cannot therefore be always changing in this respect.

places and be moved from them only by violence: from the fact then that some of them are in their proper places it follows that in respect of place also all things cannot be 254a in motion. These and other similar arguments, then, should convince us that it is impossible either that all things are always in motion or that all things are always at rest.

Nor again can it be that some things are always at rest, others always in motion, and nothing sometimes at rest and sometimes in motion. This theory must be pronounced impossible on the same grounds as those previously mentioned: viz. that we see the above-mentioned changes occurring in the case of the same things.[1] We may further point out that the defender of this position is fighting against the obvious, for on this theory there can be no such thing as increase: nor can there be any such thing as compulsory motion, if it is impossible that a thing can be at rest before being set in motion unnaturally.[2] This theory, then, does away with [3] becoming and perishing. Moreover, motion, it would seem, is generally thought to be a sort of becoming and perishing, for that to which a thing changes comes to be,[4] or occupancy of it comes to be,[5] and that from which a thing changes ceases to be, or there ceases to be occupancy of it. It is clear, therefore, that there are cases of occasional motion and occasional rest.

We have now to take the assertion that all things are sometimes at rest and sometimes in motion and to confront it with the arguments previously advanced. We must take our start as before from the possibilities that we distinguished just above. Either all things are at rest, or all things are in motion, or some things are at rest and others in motion. And if some things are at rest and

[1] i.e. we make the same appeal to sense-perception: we observe the same thing to be now in motion, now at rest (e.g. a falling stone) and vice versa.

[2] The clause *εἰ μὴ . . . πρότερον* refers only to *βίαιος κίνησις*. The reason why the theory does away wlth *αὔξησις* is not stated, because what has been said above (253b 13), that *αὔξησις* cannot be *συνεχής*, applies here too.

[3] sc. because neither *γένεσις* nor *φθορά* can be *συνεχής*.

[4] sc. in *γένεσις* proper and *ἀλλοίωσις*.

[5] sc. in *φορά*.

others in motion, then it must be that either all things are sometimes at rest and sometimes in motion, or some things are always at rest and the remainder always in motion,[1] or some of the things are always at rest and others always in motion while others again are sometimes at rest and sometimes in motion. Now we have said before that it is impossible that all things should be at rest: nevertheless we may now repeat that assertion. We may point out that, even if it is really the case, as certain persons assert,[2] that the existent is infinite and motionless, it certainly does not appear to be so if we follow sense-perception: many things that exist appear to be in motion. Now if there is such a thing as false opinion or opinion at all, there is also motion: and similarly if there is such a thing as imagination, or if it is the case that anything seems to be different at different times: for imagination and opinion are thought to be motions of a kind.[3] But to investigate this question at all—to seek a reasoned justification of a belief with regard to which we are too well off to require reasoned justification—implies bad judgement of what is better and what is worse, what commends itself to belief and what does not, what is ultimate and what is not. It is likewise impossible that all things should be in motion or that some things should be always in motion and the remainder always at rest. We have sufficient ground for rejecting all these theories in the single fact that we *see* some things that are sometimes in motion and sometimes at rest. It is 254^b evident, therefore, that it is no less impossible that some things should be always in motion and the remainder always at rest than that all things should be at rest or that all things should be in motion continuously. It remains, then, to consider whether all things are so constituted as to be capable both of being in motion and of being at rest, or whether, while some things are so constituted, some are

[1] Repeating in l. 22 ἢ τὰ μὲν ἀεὶ ἠρεμεῖν τὰ δ' ἀεὶ κινεῖσθαι before αὐτῶν, a simple and easy correction, to make the enumeration complete. Prantl inserts the words after αὐτῶν, but the other position seems slightly better and palaeographically easier.

[2] Melissus is meant; cf. 185^a 32.

[3] Cf. *De An.* iii. 3. 428^b 11.

always at rest and some are always in motion: for it is this last view that we have to show to be true.

Now of things that cause motion or suffer motion, to 4
some the motion is accidental, to others essential: thus it is accidental to what merely belongs to or contains as a part a thing that causes motion or suffers motion, essential to a thing that causes motion or suffers motion not merely by belonging to such a thing or containing it as a part.

Of things to which the motion is essential some derive their motion from themselves, others from something else: and in some cases their motion is natural, in others violent and unnatural. Thus in things that derive their motion from themselves, e. g. all animals, the motion is natural (for when an animal is in motion its motion is derived from itself): and whenever the source of the motion of a thing is in the thing itself we say that the motion of that thing is natural. Therefore the animal as a whole moves itself naturally: but the body of the animal may be in motion unnaturally as well as naturally: it depends upon the kind [1] of motion that it may chance to be suffering and the kind of element [2] of which it is composed. And the motion of things that derive their motion from something else is in some cases natural, in others unnatural: e. g. upward motion of earthy things and downward motion of fire are unnatural. Moreover the parts of animals are often in motion in an unnatural way, their positions [3] and the character of the motion [4] being abnormal. The fact that a thing that is in motion derives its motion from something is most evident in things that are in motion unnaturally, because in such cases it is clear that the motion is derived from something other than the thing itself. Next to things that are in motion unnaturally those whose motion while natural is

[1] e. g. the motion of jumping natural to the animal as a whole is unnatural to the body *qua* body, which is γεηρόν and naturally has a downward tendency.

[2] i. e. the material of which a body is composed may be so light as naturally to have an upward tendency.

[3] e. g. a man may walk on his hands.

[4] e. g. a man may roll along the ground instead of walking.

derived from themselves—e.g. animals—make this fact clear: for here the uncertainty is not as to whether the motion is derived from something but as to how we ought to distinguish in the thing between the movent and the moved. It would seem that in animals, just as in ships and things not naturally organized, that which causes motion is separate from that which suffers motion, and that it is only in this sense that the animal as a whole causes its own motion.

The greatest difficulty, however, is presented by the remaining case of those that we last distinguished. Where things derive their motion from something else we distinguished the cases in which the motion is unnatural: we are left with those that are to be contrasted with the others by reason of the fact that the motion is natural. It is in 255a
these cases that difficulty would be experienced in deciding whence the motion is derived, e.g. in the case of light and heavy things. When these things are in motion to positions the reverse of those they would properly occupy, their motion is violent: when they are in motion to their proper positions—the light thing up and the heavy thing down—their motion is natural; but in this latter case it is no longer evident, as it is when the motion is unnatural, whence their motion is derived. It is impossible to say that their motion is derived from themselves: this is a characteristic of life and peculiar to living things. Further, if it were, it would have been in their power to stop themselves (I mean that if e.g. a thing can cause itself to walk it can also cause itself not to walk), and so, since on this supposition fire itself possesses the power of upward locomotion, it is clear that it should also possess the power of downward locomotion. Moreover if things move themselves, it would be unreasonable to suppose that in only one kind of motion is their motion derived from themselves. Again, how can anything of continuous and naturally connected substance move itself? In so far as a thing is one and continuous not merely in virtue of contact, it is impassive: it is only in so far as a thing is divided that one part of it is by nature active and another

passive. Therefore none of the things[1] that we are now considering move themselves (for they are of naturally connected substance), nor does anything else that is continuous: in each case the movent must be separate from the moved, as we see to be the case with inanimate things when an animate thing moves them. It is the fact that these things[2] also always derive their motion from something: what it is would become evident if we were to distinguish the different kinds of cause.

The above-mentioned distinctions can also be made in the case of things that cause motion: some of them are capable of causing motion unnaturally (e. g. the lever is not naturally capable of moving the weight), others naturally (e. g. what is actually hot is naturally capable of moving[3] what is potentially hot): and similarly in the case of all other things of this kind.

In the same way, too, what is potentially of a certain quality or of a certain quantity or in a certain place is naturally movable when it contains the corresponding principle in itself and not accidentally (for the same thing may be both of a certain quality and of a certain quantity, but the one is an accidental, not an essential property of the other[4]). So when fire or earth is moved by something the motion is violent when it is unnatural, and natural when it brings to actuality the proper activities[5] that they potentially possess. But the fact that the term 'potentially' is used in more than one sense is the reason why it is not evident whence such motions as the upward motion of fire and the downward motion of earth are derived. One who is learning a science potentially knows it in a different sense from one who while already possessing the knowledge is not actually exercising it. Wherever we have something capable of acting and something

[1] sc. πῦρ and the like (τὰ κατὰ φύσιν κινούμενα).
[2] sc. τὰ κατὰ φύσιν κινούμενα.
[3] i. e. causing to become hot.
[4] i. e. a thing may, in the process of becoming ποιόν, incidentally become ποσόν, and vice versa: but the becoming ποσόν is irrelevant to the change or motion from ποιόν to ποιόν or from ποῦ to ποῦ.
[5] sc. upward motion and downward motion respectively.

capable of being correspondingly acted on, in the event of any such pair being in contact what is potential becomes at times actual:[1] e.g. the learner becomes from one poten- 255b
tial something another potential something: for one who possesses knowledge of a science but is not actually exercising it knows the science potentially in a sense, though not in the same sense as he knew it potentially before he learnt it. And when he is in this condition, if something does not prevent him, he actively exercises his knowledge: otherwise he would be in the contradictory state of not knowing. In regard to natural bodies also the case is similar. Thus what is cold is potentially hot: then a change takes place and it is fire, and it burns, unless something prevents and hinders it. So, too, with heavy and light: light is generated from heavy, e.g. air from water (for water is the first thing that is potentially light), and air is actually light, and will at once realize its proper activity as such unless something prevents it. The activity of lightness consists in the light thing being in a certain situation, namely high up:[2] when it is in the contrary situation, it is being prevented from rising. The case is similar also in regard to quantity and quality. But, be it noted, this is the question we are trying to answer—how can we account for the motion of light things and heavy things to their proper situations? The reason for it is that they have a natural tendency respectively towards a certain position: and this constitutes the essence of lightness and heaviness, the former being determined by an upward, the latter by a downward, tendency. As we have said, a thing may be potentially light or heavy in more senses than one. Thus not only when a thing is water is it in a sense potentially light, but when it has become air it may be still potentially light: for

[1] The sentence is awkwardly expressed, ἀεί and ἐνίοτε seeming to contradict one another, but I do not think any alteration in the text is necessary. Certainly it will not do to omit ἐνιότε, without which the statement would not be true: e.g. to produce ἐπιστήμη something more than the mere contact of the teacher's mind with the learner's mind is needed. I take ἀεί to mean that there is no exceptional *class* of ποιητικόν and παθητικόν that as such does not conform to the rule: ἐνίοτε virtually means in 'favourable circumstances'.

[2] i.e. above anything that is heavier.

it may be that through some hindrance it does not occupy an upper position, whereas, if what hinders it is removed, it realizes its activity and continues to rise higher. The process whereby what is of a certain quality changes to a condition of active existence is similar: thus the exercise of knowledge follows at once upon the possession of it unless something prevents it. So, too, what is of a certain quantity extends itself over a certain space unless something prevents it.[1] The thing in a sense is and in a sense is not moved by one who moves what is obstructing and preventing its motion (e.g. one who pulls away a pillar from under a roof or one who removes a stone from a wine-skin in the water is the accidental cause of motion:[2] and in the same way the real cause of the motion of a ball rebounding from a wall is not the wall but the thrower.[3] So it is clear that in all these cases the thing does not move itself, but it contains within itself the source of motion—not of moving something or of causing motion, but of suffering it.[4]

If then the motion of all things that are in motion is either natural or unnatural and violent, and all things whose motion is violent and unnatural are moved by something, and something other than themselves, and again all things whose motion is natural are moved by something—both those that are moved by themselves and those that are not moved by themselves (e.g. light things and heavy
256a things, which are moved either by that which brought the thing into existence as such and made it light and heavy, or by that which released what was hindering and preventing it); then all things that are in motion must be moved by something.

Now this may come about in either of two ways. Either the movent is not itself responsible for the motion, which

[1] i.e. it may be possibly compressed so that it does not occupy the amount of space that such a ποσόν would normally occupy: in that case it is δυνάμει ποσόν in the second sense.

[2] The real cause here is the upward or downward tendency.

[3] In this case the wall is an instance of a κατὰ συμβεβηκὸς κινοῦν.

[4] i.e. the quality of being affected by or responsive to the activity of τὸ κινοῦν.

is to be referred to something else which moves the movent, or the movent is itself responsible for the motion. Further, in the latter case, either the movent immediately precedes the last thing in the series,[1] or there may be one or more intermediate links: e.g. the stick moves the stone and is moved by the hand, which again is moved by the man: in the man, however, we have reached a movent that is not so in virtue of being moved by something else. Now we say that the thing is moved both by the last and by the first movent in the series, but more strictly by the first, since the first movent moves the last, whereas the last does not move the first, and the first will move the thing without the last, but the last will not move it without the first: e.g. the stick will not move anything unless it is itself moved by the man. If then everything that is in motion must be moved by something, and the movent must either itself be moved by something else or not, and in the former case there must be some first movent that is not itself moved by anything else, while in the case of the immediate movent being of this kind there is no need of an intermediate movent that is also moved[2] (for it is impossible that there should be an infinite series of movents, each of which is itself moved by something else,[3] since in an infinite series there is no first term)—if then everything that is in motion is moved by something, and the first movent is moved but not by anything else, it must be moved by itself.

This same argument may also be stated in another way as follows. Every movent moves something and moves it with something, either with itself or with something else: e.g. a man moves a thing either himself or with a stick,

[1] i.e. the thing that is moved.

[2] The argument is stated so concisely that it is perhaps hardly clear: but the reasoning appears to be as follows. Z (τὸ ἔσχατον, the thing whose motion is to be accounted for) must be moved directly either by X (a κινοῦν οὐχ ὑπ' ἄλλου κινούμενον) or by Y (a κινοῦν ὑπ' ἄλλου κινούμενον). Now Y implies an ultimate X, though Y', Y'' may intervene: but X does not necessarily imply Y in order to move Z: otherwise if Y is necessary in order to enable X to move Z, Y' will be necessary to enable it to move Y, and so on *ad infinitum*.

[3] Reading in l. 17 τὸ κινοῦν καὶ κινούμενον with EK.

and a thing is knocked down either by the wind itself or by a stone propelled by the wind. But it is impossible for that with which a thing is moved to move it without being moved by that which imparts motion by its own agency:[1] on the other hand, if a thing imparts motion by its own agency, it is not necessary that there should be anything else with which it imparts motion, whereas if there is a different thing with which it imparts motion, there must be something that imparts motion not with something else but with itself, or else there will be an infinite series. If, then, anything is a movent while being itself moved, the series must stop somewhere and not be infinite. Thus, if the stick moves something in virtue of being moved by the hand, the hand moves the stick: and if something else moves with the *hand*, the hand also is moved by something different from itself. So when motion by means of an instrument is at each stage caused by something different from the instrument, this must always be preceded by something else[2] which imparts motion with itself. Therefore, if this last movent is in motion and there is nothing
256b else that moves it, it must move itself. So this reasoning also shows that, when a thing is moved, if it is not moved immediately by something that moves itself, the series brings us at some time or other to a movent of this kind.

And if we consider the matter in yet a third way we shall get this same result as follows. If everything that is in motion is moved by something that is in motion, either this being in motion is an accidental attribute of the movents in question, so that each of them moves something while being itself in motion, but not always because it is itself in motion, or it is not an accidental but an essential attribute. Let us consider the former alternative. If then it is an accidental attribute, it is not necessary that that which is in motion should be in motion: and if this is so it is clear that there may be a time when nothing that exists is in motion, since the accidental is not necessary

[1] αὐτό is written in l. 25 for αὐτοῦ to avoid the possible misinterpretation of τοῦ αὐτοῦ. Cf. 257b 13, 27, 258b 23, 259a 1.
[2] Reading in l. 31 ταύτῃ.

but contingent. Now if we assume the existence of a possibility, any conclusion that we thereby reach will not be an impossibility, though it may be contrary to fact. But the non-existence of motion is an impossibility: for we have shown above [1] that there must always be motion.

Moreover, the conclusion to which we have been led is a reasonable one. For there must be three things—the moved, the movent, and the instrument of motion. Now the moved must be in motion, but it need not move anything else: the instrument of motion must both move something else and be itself in motion (for it changes together with the moved, with which it is in contact and continuous, as is clear in the case of things that move other things locally, in which case the two things must up to a certain point [2] be in contact): and the movent—that is to say, that which causes motion in such a manner that it is not merely the instrument of motion—must be unmoved. Now we have visual experience of the last term in this series, namely that which has the capacity of being in motion, but does not contain a motive principle, and also of that which is in motion but is moved by itself and not by anything else [3]: it is reasonable, therefore, not to say necessary, to suppose the existence of the third term also, that which causes motion but is itself unmoved. So, too, Anaxagoras is right when he says that Mind is

[1] Chapter I.

[2] i. e. not necessarily continuously: e. g. a thing thrown continues its course after contact with the thrower has ceased.

[3] I am convinced that Bekker's reading (which is that of two MSS. including the best) is right—ὃ κινεῖται μέν, οὐχ ὑπ' ἄλλου δὲ ἀλλ' ὑφ' αὑτοῦ. Prantl reads ὃ κινεῖ μέν, ὑπ' ἄλλου δὲ (κινεῖται) ἀλλ' οὐχ ὑφ' αὑτοῦ. For the transposition of οὐχ there is MS. authority: but the substitution of κινεῖ for κινεῖται and the insertion of κινεῖται later are alterations of Prantl's own, based as it seems to me on a complete misunderstanding of Aristotle's meaning. Apparently he would equate the middle term here with the βακτηρία of the previous illustration. But there is no essential difference between the λίθος and the βακτηρία as regards their motion, and we have no right at all to infer from their existence the existence of a κινοῦν ἀκίνητον: the most that we could infer εὐλόγως would be the existence of an αὐτοκίνητον. As I read the passage, from the admitted existence of what is αὐτοκίνητον (e. g. a stone) and of what is both κινοῦν and κινούμενον (e. g. an animal, which as moving itself shows the amalgamation of both principles) Aristotle infers by ἀναλογία that presumably what is κινοῦν only also exists.

impassive and unmixed, since he makes it the principle of motion: for it could cause motion in this sense[1] only by being itself unmoved, and have supreme control only by being unmixed.

We will now take the second alternative. If the movent is not accidentally but necessarily in motion—so that, if it were not in motion, it would not move anything—then the movent, in so far as it is in motion, must be in motion in one of two ways: it is moved either as that is which is moved[2] with the same kind of motion, or with a different kind—either that which is heating, I mean, is itself in process of becoming hot, that which is making healthy in process of becoming healthy, and that which is causing locomotion in process of locomotion, or else that which is making healthy is, let us say, in process of locomotion, and that which is causing locomotion in process of, say, increase. But it is evident that this is impossible. For if we adopt the first assumption we have to make it apply within each of the very lowest species into which
257a motion can be divided: e. g. we must say that if some one[3] is teaching some lesson in geometry, he is also in process of being taught that same lesson in geometry, and that if he is throwing he is in process of being thrown in just the same manner. Or if we reject this assumption we must say that one kind of motion is derived from another; e. g. that that which is causing locomotion is in process of increase, that which is causing this increase is in process of being altered by something else, and that which is causing this alteration is in process of suffering some different kind of motion. But the series must stop somewhere, since the kinds of motion are limited; and if we say that the process is reversible, and that that which is causing alteration is in process of locomotion, we do no more than if we had said at the outset that that which is causing locomotion is in process of locomotion, and that one who is teaching is in process of being taught: for it is

[1] sc. as ἀρχὴ κινήσεως.
[2] Reading in l. 30 ὡς τό (ὥστε τό E).
[3] The neuter would sound absurd here in English.

clear that everything that is moved is moved by the movent that is further back in the series as well as by that which immediately moves it: in fact the earlier movent is that which more strictly moves it. But this is of course impossible: for it involves the consequence that one who is teaching is in process of learning what he is teaching, whereas teaching necessarily implies possessing knowledge, and learning not possessing it. Still more unreasonable is the consequence involved that, since everything that is moved is moved by something that is itself moved by something else,[1] everything that has a capacity for causing motion has as such a corresponding capacity for being moved: i.e. it will have a capacity for being moved in the sense in which one might say that everything that has a capacity for making healthy, and exercises that capacity,[2] has as such a capacity for being made healthy, and that which has a capacity for building has as such a capacity for being built. It will have the capacity for being thus moved either immediately or through one or more links (as it will if, while everything that has a capacity for causing motion has as such a capacity for being moved by something else, the motion that it has the capacity for suffering is not that with which it affects what is next to it, but a motion of a different kind; e.g. that which has a capacity for making healthy might as such have a capacity for learning:[3] the series, however, could be traced back, as we said before, until at some time or other we arrived at the same kind of motion). Now the first alternative is impossible, and the second is fantastic:[4] it is absurd that that

[1] It is necessary to insert 'by something else' in view of the possibility admitted below (257a 27) that τὸ κινούμενον πρῶτον αὐτὸ ἑαυτὸ κινήσει.

[2] The words καὶ ὑγιάζον in l. 17 seem pointless and irrelevant, and there is no trace of them in Simplicius.

[3] Reading in l. 21 (with three MSS. including the best) μαθητικόν.

[4] Alexander (quoted by Simplicius) interpreted this to mean that while both alternatives are impossible, the second has the additional characteristic of being πλασματῶδες. Simplicius himself, however, considers that the second alternative, while certainly πλασματῶδες, is not logically impossible, since it might be denied that κινήσεις are πεπερασμέναι or that a thing κινεῖται μᾶλλον ὑπὸ τοῦ προτέρου τῶν κινούντων. If Simplicius is right, the connexion is very loose, since the

which has a capacity for causing alteration should as such necessarily have a capacity, let us say, for increase. It is not necessary, therefore, that that which is moved should always be moved by something else that is itself moved by something else: so there will be an end to the series. Consequently the first thing that is in motion will derive its motion either from something that is at rest or from itself. But if there *were* any need to consider which of the two, that which moves itself or that which is moved by something else, is the cause and principle of motion, every one would decide for the former: for that which is itself independently a cause is always prior as a cause[1] to that which is so only in virtue of being itself dependent upon something else that makes it so.

We must therefore make a fresh start and consider the question; if a thing moves itself, in what sense and in what manner does it do so? Now everything that is in motion must be infinitely divisible, for it has been shown already[2]
257b in our general course on Physics,[3] that everything that is essentially in motion is continuous. Now it is impossible that that which moves itself should in its entirety move itself: for then, while being specifically one and indivisible, it would as a whole both undergo and cause the same locomotion or alteration: thus it would at the same time be both teaching and being taught (the same thing), or both restoring to and being restored to the same health. Moreover, we have[4] established the fact that it is the movable that is moved; and this is potentially, not actually, in motion, but the potential is in process to actuality, and motion is an incomplete actuality of the movable. The movent on the other hand is already in activity: e. g. it is that which is hot that produces heat: in fact, that which

second alternative has just been distinctly declared to be only a special case of the first.

[1] This must be the sense, whether we read with Bekker in l. 30 *αἴτιον ἀεὶ πρότερον* or with EK *ἀεὶ πρότερον αἴτιον*: in either case *αἴτιον* is wanted both as subject and as predicate.

[2] The reference is apparently to vi. 4. 234b 10 sqq.

[3] See note on 251a 9.

[4] Ch. 1. 251a 9 sqq.

produces the form[1] is always something that possesses it. Consequently (if a thing can move itself as a whole), the same thing in respect of the same thing[2] may be at the same time both hot and not hot. So, too, in every other case where the movent must be described by the same name in the same sense as the moved.[3] Therefore when a thing moves itself[4] it is one part of it that is the movent and another part that is moved. But it is not self-moving[5] in the sense that each of the two parts is moved by the other part: the following considerations make this evident. In the first place, if each of the two parts is to move the other, there will be no first movent. If a thing is moved by a series of movents, that which is earlier in the series is more the cause of its being moved than that which comes next, and will be more truly the movent: for we found that there are two kinds of movent, that which is itself moved by something else and that which derives its motion from itself: and that which is further from the thing that is moved is nearer to the principle of motion than that which is intermediate.[6] In the second place, there is no necessity for the movent part to be moved by anything but itself: so it can only be accidentally that the other part moves it in return. I take then the possible case of its not moving it: then there will be a part that is moved and a part that is an unmoved movent. In the third place, there is no necessity for the movent to be moved in return: on the contrary the necessity that there should always be motion makes it necessary that there should be some movent that is either unmoved or moved by itself. In the fourth place we should then have a thing undergoing the same motion that it is causing—that which is producing heat, therefore, being heated. But as a matter

[1] i.e. any particular characteristic such as heat.

[2] i.e. the whole of itself: there is no question of one *part* of a thing heating another part.

[3] i.e. in respect of the imparted characteristic: thus τὸ *θερμαῖνον* and τὸ *θερμαινόμενον* both have the predicative *θερμόν* applied to them in the same sense (*συνωνύμως*).

[4] Cf. 256a 25 n.

[5] Reading in l. 14 *κινοῦν*, with EK Simp.

[6] sc. between τὸ *πορρώτερον* and τὸ *κινούμενον*.

of fact that which primarily moves itself[1] cannot contain either a single part that moves itself or a number of parts each of which moves itself. For, if the whole is moved by itself, it must be moved either by some part of itself or as a whole by itself as a whole. If, then, it is moved in virtue of some part of it being moved by that part itself, it is this part that will be the primary self-movent, since, if this part is separated from the whole, the part will still move itself, but the whole will do so no longer. If on the other hand the whole is moved by itself as a whole, it must be accidentally that the parts move themselves: and therefore, their self-motion not being necessary, we may take the case
258a of their not being moved by themselves. Therefore in the whole of the thing we may distinguish that which imparts motion without itself being moved and that which is moved: for only in this way is it possible for a thing to be self-moved. Further, if the whole moves itself we may distinguish in it that which imparts the motion and that which is moved: so while we say that AB is moved by itself, we may also say that it is moved by A. And since that which imparts motion may be either a thing that is moved by something else or a thing that is unmoved, and that which is moved may be either a thing that imparts motion to something else or a thing that does not, that which moves itself must be composed of something that is unmoved but imparts motion and also of something that is moved but does not necessarily impart motion but may or may not do so. Thus let A be something that imparts motion but is unmoved, B something that is moved by A and moves Γ, Γ something that is moved by B but moves nothing (granted that we eventually arrive at Γ we may take it that there is only one intermediate term, though there may be more). Then the whole ABΓ moves itself. But if I take away Γ, AB will move itself, A imparting motion and B being moved, whereas Γ will not move itself or in fact be moved at all. Nor again will BΓ move itself apart from A: for B imparts motion only through being moved by something else, not through being moved by any part of itself. So

[1] Cf. 256a 25 n.

only AB moves itself. That which moves itself, therefore, must comprise something that imparts motion but is unmoved and something that is moved but does not necessarily move anything else: and each of these two things, or at any rate one of them,[1] must be in contact with the other. If, then, that which imparts motion is a continuous substance—that which is moved must of course be so—it is clear that it is not through some part of the whole being of such a nature as to be capable of moving itself that the whole moves itself: it moves itself as a whole, both being moved and imparting motion through containing a part that imparts motion and a part that is moved. It does not impart motion as a whole nor is it moved as a whole: it is A alone that imparts motion and B alone that is moved. It is not true, further, that T is moved by A, which is impossible.[2]

Here a difficulty arises: if something is taken away from A (supposing that that which imparts motion but is unmoved is a continuous substance), or from B the part that is moved, will the remainder of A continue to impart motion or the remainder of B continue to be moved? If so, it will not be AB primarily that is moved by itself, since, when something is taken away from AB, the remainder of AB will still continue to move itself. Perhaps we may state the case thus: there is nothing to prevent each 258b
of the two parts, or at any rate one of them, that which is moved, being divisible though actually undivided, so that if it is divided it will not continue in the possession of the same capacity: and so there is nothing to prevent self-

[1] If both are corporeal, the two things will be mutually in contact: but if one is incorporeal and the other not, the first may be said to be in contact with (ἅπτεσθαι) the second, but not vice versa. So here the κινοῦν ἀκίνητον may be said ἅπτεσθαι τοῦ κινουμένου, but τὸ κινούμενον cannot be said ἅπτεσθαι τοῦ κινοῦντος ἀκινήτου δέ. See *de Gen. et Corr.* i. 6. 323a 25 sqq.

[2] This sentence comes in awkwardly here, and I am inclined to think that it should be omitted. It was not known to Alexander, nor did it occur in most of the MSS. known to Simplicius. The best of our MSS. omits it. The point of the sentence, if it is kept, seems to be that in AB we have one complete *αὐτοκίνητον*: A may accidentally through B impart motion to Γ: but Γ is irrelevant to the *αὐτοκίνητον* that we are considering.

motion residing primarily in things that are potentially divisible.

From what has been said, then, it is evident that that which primarily imparts motion is unmoved: for, whether the series is closed at once by that which is in motion but moved by something else deriving its motion directly from the first unmoved, or whether the motion is derived from what is in motion but moves itself and stops its own motion, on both suppositions we have the result that in all cases of things being in motion that which primarily imparts motion is unmoved.

Since there must always be motion without intermission, 6
there must necessarily be something, one thing or it may be a plurality, that first imparts motion, and this first movent must be unmoved. Now the question whether each of the things that are unmoved but impart motion[1] is eternal is irrelevant to our present argument: but the following considerations will make it clear that there must necessarily be some such thing, which, while it has the capacity of moving something else, is itself unmoved and exempt from all change,[2] which can affect it neither in an unqualified nor in an accidental sense.[3] Let us suppose, if any one likes, that in the case of certain things[4] it is possible for them at different times to be and not to be, without any process of becoming and perishing (in fact it would seem to be necessary, if a thing that has not parts at one time is and at another time is not,[5] that any such thing should without undergoing any process of change at one time be and at

[1] e. g. individual ψυχαί.

[2] Omitting in l. 14 τῆς before ἐκτός with Simplicius and three MSS. one of which has τε for τῆς and another καὶ before πάσης: any one of these variations will give the sense required. Simplicius gives no hint of a reading τῆς ἐκτὸς μεταβολῆς, which would have to be taken as a loose genitive after ἀκίνητον—'unmoved in respect of all external change': this, though possible, is not quite the sense required: we want to have exemption from μεταβολή clearly marked as an additional attribute, more extensive than exemption from κίνησις.

[3] i. e. neither directly nor indirectly: e. g. a man walking μεταβάλλει ἁπλῶς, a man sailing in a ship μεταβάλλει κατὰ συμβεβηκός.

[4] sc. ψυχαί: Aristotle is answering an objection to the effect that here we may find an ἀκίνητος ἀρχὴ κινήσεως that is not ἀΐδιος.

[5] Reading in l. 19 a comma before ἄνευ and not before ὁτέ.

another time not be). And let us further suppose it possible that some principles that are unmoved but capable of imparting motion at one time are and at another time are not. Even so, this cannot be true of *all* such principles, since there must clearly be something that *causes* things that move themselves[1] at one time to be and at another not to be. For, since nothing that has not parts can be in motion, that which moves itself must as a whole have magnitude, though nothing that we have said makes this necessarily true of every movent. So the fact that some things become and others perish, and that this is so continuously, cannot be caused by any one of those things that, though they are unmoved, do not always exist: nor again can it be caused by any of those which move certain particular things, while others[2] move other things. The eternity and continuity of the process cannot be caused either by any one of them singly or by the sum of them, because this causal relation must be eternal and necessary, whereas the sum of these movents is infinite and they do not all exist together. It is clear, then, that though there may be countless instances of the perishing of some principles that are unmoved but impart motion, and though many things that move themselves[3] perish and are succeeded by others that come into being, and though one thing that is unmoved moves one thing while another moves another, nevertheless there is something that comprehends them all, and that as something apart from each one of them, and this it is that is the cause of the fact that some things are and others are not and of the continuous process of change: and this causes the motion of the other movents, while they are the causes of the motion of other things. Motion, then, being eternal, the first movent, if there is but one, will be eternal also: if there are more than one, there will be a plurality of such eternal movents. We ought, however, to suppose that there is one rather than many, and a finite rather than an infinite number.

[1] Cf. 256a 25 n.
[2] Reading in l. 29 τῶν for τούτων, with Simp.
[3] Cf. 256a 25 n.

When the consequences of either assumption are the same,[1] we should always assume that things are finite rather than infinite in number, since in things constituted by nature that which is finite and that which is better ought, if possible, to be present rather than the reverse: and here it is sufficient to assume only one movent, the first of unmoved things, which being eternal will be the principle of motion to everything else.

The following argument also makes it evident that the first movent must be something that is one and eternal. We have shown[2] that there must always be motion. That being so, motion must also be continuous, because what is always is continuous, whereas what is merely in succession is not continuous. But further, if motion is continuous, it is one: and it is one only if the movent and the moved that constitute it are each of them one, since in the event of a thing's being moved now by one thing and now by another the whole motion will not be continuous but successive.

Moreover a conviction that there is a first unmoved something may be reached not only from the foregoing arguments, but also by considering again the principles operative in movents. Now it is evident that among existing things there are some that are sometimes in motion and sometimes at rest. This fact has served above[3] to make it clear that it is not true either that all things are in motion or that all things are at rest or that some things are always at rest and the remainder always in motion: on this matter proof is supplied by things that fluctuate between the two and have the capacity of being sometimes in motion and sometimes at rest. The existence of things of this kind is clear to all:[4] but we wish to explain also the nature of each of the other two kinds and show that there are some things that are always unmoved and some things that are always

[1] i.e. when either will equally explain the facts.
[2] Chapter 1.
[3] Chapter 3.
[4] The apodosis to the ἐπεί clause does not begin till 259b 3 (ταῦτα δὴ κτλ.).

in motion. In the course of our argument directed to this end we established the fact that everything that is in motion is moved by something,[1] and that the movent is either unmoved or in motion, and that, if it is in motion, it is moved either by itself or by something else and so on throughout the series:[2] and so we proceeded to the position[3] that the first principle that directly[4] causes things that are in motion to be moved is that which moves itself, and the first principle of the whole series[5] is the unmoved. Further it is evident from actual observation that there are 259b things that have the characteristic of moving themselves, e. g. the animal kingdom and the whole class of living things.[6] This being so, then, the view was suggested[7] that perhaps it may be possible for motion to come to be in a thing without having been in existence at all before, because we see this actually occurring in animals: they are unmoved at one time and then again they are in motion, as it seems. We must grasp the fact, therefore, that animals move themselves[8] only with one kind of motion,[9] and that this is not strictly originated by them. The cause of it is not derived from the animal itself: it is connected with other natural motions in animals, which they do not experience through their own instrumentality, e. g. increase, decrease, and respiration: these are experienced by every animal while it is at rest and not in motion in respect of the motion set up by its own agency:[10] here the motion is caused by the atmosphere and by many things that enter into the animal: thus in some cases the cause is nourishment: when it is being digested animals sleep, and when it is being distributed through the system they awake and

[1] Chapter 4.
[2] *ἀεί*. i.e. if a particular *κινοῦν* derives its motion from another *κινοῦν* the same question arises with regard to the second *κινοῦν*, and so on.
[3] Chapter 5.
[4] *κινουμένων μέν* in l. 33 can hardly stand. It may have displaced *προσεχὴς μέν*, which Simp. seems to read, or *κινήσεως*.
[5] sc. *κινούμενα* and *ὁ αὐτὸ ἑαυτὸ κινεῖ* together.
[6] *ἔμψυχα*, including plants.
[7] 253a 7 sqq.
[8] Reading in l. 7 *αὐτά*, with Simp.
[9] sc. locomotion.
[10] sc. locomotion.

move themselves, the first principle of this motion being thus originally derived from outside. Therefore animals are not always in continuous motion by their own agency: it is something else that moves them, itself being in motion and changing as it comes into relation with each several thing that moves itself. (Moreover in all these self-moving things the first movent and cause of their self-motion[1] is itself moved by itself,[2] though in an accidental sense: that is to say, the body changes its place, so that that which is in the body changes its place also and is a self-movent through its exercise of leverage.[3]) Hence we may confidently conclude that if a thing belongs to the class of unmoved movents that are also themselves moved accidentally, it is impossible that it should cause continuous motion. So the necessity that there should be motion continuously requires that there should be a first movent that is unmoved even accidentally,[4] if, as we have said,[5] there is to be in the world of things an unceasing and undying motion, and the world is to remain[6] permanently self-contained and within the same limits: for if the first principle is permanent, the universe must also be permanent, since it is continuous with the first principle. (We must distinguish, however, between accidental motion of a thing by itself and such motion by something else, the former being confined to perishable things, whereas the latter belongs also to certain first principles of heavenly bodies, of all those, that is to say, that experience more than one locomotion.[7])

[1] sc. *ἡ ψυχή*.
[2] i.e. it is not a true *ἀκίνητον* after all.
[3] Reading in l. 19 (with three MSS.) *καὶ τῇ μοχλείᾳ*: the ordinary reading *καὶ τὸ ἐν τῇ μοχλείᾳ* seems meaningless. The sense appears to be that the soul may be said to move itself by means of the body, the body acting as a sort of lever.
[4] Reading in l. 24 *καὶ κατὰ συμβεβηκός*: the *μὴ* before *κατὰ* is omitted by one MS. and erased in another: also it clearly was not read by Simplicius. It might quite easily have been inserted by some one who, not understanding the construction, thought that the words following *καὶ* must denote another attribute in addition to *ἀκίνητον*.
[5] Chapter 1.
[6] Reading in l. 26 *μενεῖν*, with Themistius.
[7] sc. the planets.

And further, if there is always something of this nature, a movent that is itself unmoved and eternal, then that 260a which is first moved by it must be eternal. Indeed this is clear also from the consideration that there would otherwise be no becoming and perishing and no change of any kind in other things, which require something that is in motion to move them: for the motion imparted by the unmoved will always be imparted in the same way and be one and the same, since the unmoved does not itself change in relation to that which is moved by it. But that[1] which is moved by something[2] that, though it is in motion, is moved directly by the unmoved stands in varying relations to the things that it moves, so that the motion that it causes will not be always the same: by reason of the fact that it occupies contrary positions or assumes contrary forms at different times it will produce contrary motions in each several thing that it moves and will cause it to be at one time at rest and at another time in motion.

The foregoing argument, then, has served to clear up the point about which we raised a difficulty at the outset[3]—why is it that instead of all things being either in motion or at rest, or some things being always in motion and the remainder always at rest, there are things that are sometimes in motion and sometimes not? The cause of this is now plain: it is because, while some things are moved by an eternal unmoved movent and are therefore always in motion,[4] other things are moved by a movent that is in motion and changing, so that they too must change. But the unmoved movent, as has been said, since it remains permanently simple and unvarying and in the same state, will cause motion that is one and simple.

[1] e.g. any one of the heavenly bodies.

[2] sc. ὁ οὐρανός, which imparts motion to terrestrial things through the medium of the various heavenly bodies. I see no reason to depart from the reading adopted by Bekker with most MSS.: to my mind this reading will account for the reading of K and of Simplicius (adopted by Prantl) τὸ δὲ κινούμενον ὑπὸ τοῦ ἀκινήτου ἢ κινουμένου more easily than *vice versa*.

[3] Chapter 3.

[4] Reading in l. 15 διὸ ἀεὶ κινεῖται, with EK Them. Phil. Simp.

7

This matter will be made clearer, however, if we start afresh from another point. We must consider whether it is or is not possible that there should be a continuous motion, and, if it is possible, which this motion is, and which is the primary motion: for it is plain that if there must always be motion, and a particular motion is primary and continuous, then it is this motion that is imparted by the first movent, and so it is necessarily one and the same and continuous and primary.

Now of the three kinds of motion that there are—motion in respect of magnitude, motion in respect of affection, and motion in respect of place—it is this last, which we call locomotion, that must be primary. This may be shown as follows. It is impossible that there should be increase without the previous occurrence of alteration: for that which is increased, although in a sense it is increased by what is like itself, is in a sense increased by what is unlike itself: thus it is said that contrary is nourishment to contrary:[1] but growth is effected only by things becoming like to like. There must be alteration, then, in that there is this change from contrary to contrary. But the fact that a thing is altered requires that there should be something that alters it, something e.g. that makes the potentially hot into the actually hot: so it is plain that the movent does not maintain a uniform relation to it but is at one time nearer to and at another farther from that which is altered: and we cannot have this without locomotion. If, therefore, there must always be motion, there must also always be locomotion as the primary motion, and, if there is a primary as distinguished from a secondary form of locomotion, it must be the primary form. Again, all affections have their origin in condensation and rarefaction: thus heavy and light, soft and hard, hot and cold, are considered to be forms of density and rarity. But condensation and rarefaction are nothing more than combination and separation, processes in accordance with which substances are said to become and perish: and in being combined and separated things must change in respect of place.

[1] Cf. *De An.* ii. 4. 416^{a} 21 sqq.

And further, when a thing is increased or decreased its magnitude changes in respect of place.

Again, there is another point of view from which it will be clearly seen that locomotion is primary. As in the case of other things so too in the case of motion the word 'primary' may be used in several senses. A thing is said to be prior to other things when, if it does not exist, the others will not exist, whereas it can exist without the others: and there is also priority in time and priority in perfection of existence. Let us begin, then, with the first sense. Now there must be motion continuously, and there may be continuously either continuous motion or successive motion, the former, however, in a higher degree than the latter: moreover it is better that it should be continuous rather than successive motion, and we always assume the presence in nature of the better, if it be possible: since, then, continuous motion is possible (this will be proved later:[1] for the present let us take it for granted), and no other motion can be continuous except locomotion, locomotion must be primary. For there is no necessity for the subject of locomotion to be the subject either of increase or of alteration, nor need it become or perish: on the other hand there cannot be any one of these processes without the existence of the continuous motion imparted by the first movent.

Secondly, locomotion must be primary in time: for this is the only motion possible for eternal things. It is true indeed that, in the case of any individual thing that has a becoming, locomotion must be the last of its motions: for after its becoming it first experiences alteration and increase, and locomotion is a motion that belongs to such things only when they are perfected. But there must previously 261a
be something else that is in process of locomotion to be the cause even of the becoming of things that become, without itself being in process of becoming, as e.g. the begotten is preceded by what begot it: otherwise becoming might be thought to be the primary motion on the ground that the thing must first become. But though this is so in the case

[1] Chapter 8.

of any individual thing that becomes, nevertheless before anything becomes, something else must be in motion, not itself becoming but being, and before this there must again be something else. And since becoming cannot be primary—for, if it were, everything that is in motion would be perishable—it is plain that no one of the motions next in order can be prior to locomotion. By the motions next in order I mean increase and then alteration, decrease, and perishing. All these are posterior to becoming: consequently, if not even becoming is prior to locomotion, then no one of the other processes of change is so either.

Thirdly, that which is in process of becoming appears universally as something imperfect and proceeding to a first principle: and so what is posterior in the order of becoming is prior in the order of nature. Now all things that go through the process of becoming acquire locomotion last. It is this that accounts for the fact that some living things, e.g. plants and many kinds of animals, owing to lack of the requisite organ, are entirely without motion, whereas others acquire it in the course of their being perfected. Therefore, if the degree in which things possess locomotion corresponds to the degree in which they have realized their natural development, then this motion must be prior to all others in respect of perfection of existence: and not only for this reason but also because a thing that is in motion loses its essential character less in the process of locomotion than in any other kind of motion: it is the only motion that does not involve a change of being in the sense in which there is a change in quality when a thing is altered and a change in quantity when a thing is increased or decreased. Above all it is plain that this motion, motion in respect of place, is what is in the strictest sense produced by that which moves itself; but it is the self-movent that we declare to be the first principle of things that are moved and impart motion and the primary source to which things that are in motion are to be referred.

It is clear, then, from the foregoing arguments that locomotion is the primary motion. We have now to show which kind of locomotion is primary. The same process

of reasoning will also make clear at the same time the truth of the assumption we have made both now and at a previous stage[1] that it is possible that there should be a motion that is continuous and eternal. Now it is clear from the following considerations that no other than locomotion can be continuous. Every other motion and change is from an opposite to an opposite: thus for the processes of becoming and perishing the limits are the existent and the non-existent, for alteration the various pairs of contrary affections, and for increase and decrease either greatness and smallness or perfection and imperfection of magnitude: and changes to the respective contraries are contrary changes. Now a thing that is undergoing any particular 261b
kind of motion, but though previously existent has not always undergone it, must previously have been at rest so far as that motion is concerned. It is clear, then, that for the changing thing the contraries will be states of rest.[2] And we have a similar result in the case of changes that are not motions:[3] for becoming and perishing, whether regarded simply as such without qualification or as affecting something in particular, are opposites: therefore provided it is impossible for a thing to undergo opposite changes at the same time, the change will not be continuous, but a period of time will intervene between the opposite processes. The question whether these contradictory changes are contraries or not makes no difference, provided only it is impossible for them both to be present to the same thing at the same time: the point is of no importance to the argument.[4] Nor does it matter if the thing need not *rest* in the contradictory state, or if there is no state of rest as a contrary to the process of change:[5] it may be true

[1] 253a 29. Omit the second τό in l. 29, with EK Simp.

[2] Hence the κίνησις in question cannot be συνεχής.

[3] It seems necessary to translate μεταβολῶν here in this way: Aristotle has been dealing with μεταβολαί all along, but so far only with such of them as are also κινήσεις: he now extends his results to include μεταβολαί that are not κινήσεις in the strict sense, namely γένεσις and φθορά, which also proceed from ἀντικείμενον to ἀντικείμενον, though in this case the ἀντικείμενα are not ἐναντία.

[4] Reading in l. 10 λόγῳ. Bekker's ὅλῳ is apparently a mere slip.

[5] Reading in l. 11 μεταβολῇ ἠρεμία, with HI.

that the non-existent is not at rest, and that perishing is a process to the non-existent. All that matters is the intervention of a time: it is this that prevents the change from being continuous: so, too, in our previous instances[1] the important thing was not the relation of contrariety but the impossibility of the two processes being present to a thing at the same time. And there is no need to be disturbed by the fact that on this showing there may be more than one contrary to the same thing, that a particular motion will be contrary both to rest and to motion in the contrary direction. We have only to grasp the fact that a particular motion is in a sense the opposite both of a state of rest and of the contrary motion, in the same way as that which is of equal or standard measure is the opposite both of that which surpasses it and of that which it surpasses, and that it is impossible for the opposite motions or changes to be present to a thing at the same time. Furthermore, in the case of becoming and perishing it would seem to be an utterly absurd thing if as soon as anything has become it must necessarily perish and cannot continue to exist for any time: and, if this is true of becoming and perishing, we have fair grounds for inferring the same to be true of the other kinds of change, since it would be in the natural order of things that they should be uniform in this respect.

Let us now proceed to maintain that it is possible that 8
there should be an infinite motion that is single and continuous, and that this motion is rotatory motion. The motion of everything that is in process of locomotion is either rotatory or rectilinear or a compound of the two: consequently, if one of the former two is not continuous, that which is composed of them both cannot be continuous either. Now it is plain that if the locomotion of a thing is rectilinear and finite it is not continuous locomotion: for the thing must turn back, and that which turns back in a straight line undergoes two contrary locomotions, since, so far as motion in respect of place is concerned, upward

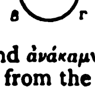
[1] sc. the instances of κινήσεις given above.

motion is the contrary of downward motion, forward motion of backward motion, and motion to the left of motion to the right, these being the pairs of contraries in the sphere of place. But we have already[1] defined single and continuous motion to be motion of a single thing in a single period of time and operating within a sphere admitting of no further specific differentiation (for we have three things to consider, first that which is in motion, e.g. a man or a god, secondly the 'when' of the motion, that is to say, the time, and thirdly the sphere within which it operates, which may be either place or affection or essential form or magnitude): and contraries are specifically not one and the same but distinct: and within the sphere of place we have the above-mentioned distinctions. Moreover we have an indication that motion from A to B is the contrary of motion from B to A[2] in the fact that, if they occur at the same time, they arrest and stop each other. And the same is true in the case of a circle: the motion from A towards B is the contrary of the motion from A towards Γ[3]: for even if they are continuous and there is no turning back they arrest each other,[4] because contraries annihilate or obstruct one another. On the other hand lateral motion is not the contrary of upward motion.[5] But what shows most clearly that rectilinear motion cannot be continuous is the fact that turning back necessarily implies coming to a stand, not only when it is a straight line that is traversed, but also in the case of locomotion in a circle (which is not the same thing as rotatory locomotion: for, when a thing merely traverses a circle, it may either proceed on its course without a break or turn back again when it has reached the same point from which it started). We may assure ourselves of the necessity of this coming to a stand

[1] v. 4.

[2]

[3]



[4] Reading in ll. 10, 11 commas after γάρ and ἀνάκαμψις.

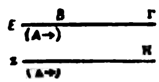
[5] sc. here we have the opposite conclusion from the fact that these two motions do not interfere with each other.

not only on the strength of observation, but also on theoretical grounds. We may start as follows: we have three points, starting-point, middle-point, and finishing-point, of which the middle-point in virtue of the relations in which it stands severally to the other two is both a starting-point and a finishing-point, and though numerically one is theoretically two. We have further the distinction between the potential and the actual. So in the straight line in question any one of the points lying between the two extremes is potentially a middle-point: but it is not actually so unless that which is in motion divides the line by coming to a stand at that point and beginning its motion again: thus the middle-point becomes both a starting-point and a goal, the starting-point of the latter part and the finishing-point of the first part of the motion. This is the case e. g. when A in the course of its locomotion comes to a stand at B and starts again towards Γ: but when its motion is continuous A cannot either have come to be or have ceased to be at the point B: it can only have been there at the moment of passing, its passage not being contained within any period of time except the whole[1] of which the particular moment is a dividing-point. To maintain that it has come to be and ceased to be there will involve the consequence that A in the course of its locomotion will always be coming to a stand: for it
262b is impossible that A should simultaneously have come to be at B and ceased to be there, so that the two things must have happened at different points of time, and therefore there will be the intervening period of time: consequently A will be in a state of rest at B, and similarly at all other points, since the same reasoning holds good in every case. When to A, that which is in process of locomotion, B, the middle-point, serves both as a finishing-point and as a starting-point for its motion, A must come to a stand at B, because it makes it two just as one might do in thought. However, the point A is the real starting-point at which the moving body has ceased to be, and it is at Γ that it

[1] Omitting τῷ ΑΒΓ in l. 31, with EK.

has really come to be when its course is finished and it comes to a stand. So this is how we must meet the difficulty that then arises, which is as follows. Suppose the line E is equal to the line Z, that A proceeds in continuous locomotion from the extreme point of E to Γ, and that, at the moment when A is at the point B, Δ is proceeding in uniform locomotion and with the same velocity as A from the extremity of Z to H:[1] then, says the argument, Δ will have reached H before A has reached Γ: for that which makes an earlier start and departure must make an earlier arrival: the reason, then, for the late arrival of A is that it has not simultaneously come to be and ceased to be at B: otherwise it will not arrive later: for this to happen it will be necessary that it should come to a stand there. Therefore we must not hold that there was a moment when A came to be at B and that at the same moment Δ was in motion from the extremity of Z: for the fact of A's having come to be at B will involve the fact of its also ceasing to be there, and the two events will not be simultaneous, whereas the truth is that A is at B at a sectional point of time and does not occupy time there. In this case, therefore, where the motion of a thing is continuous,[2] it is impossible to use this form of expression.[3] On the other hand in the case of a thing that turns back in its course we must do so. For suppose H in the course of its locomotion proceeds to Δ and then turns back and proceeds downwards again:[4] then the extreme point Δ has served

[1]



[2] The MSS. in l. 22 vary between τῆς συνεχοῦς (sc. κινήσεως) and τοῦ συνεχοῦς (Bekker) with which it is difficult to see what word to supply. I suspect the true reading to be τοῦ συνεχῶς (sc. κινουμένου.

[3] sc. to speak of it as γεγονός at any intermediate point.

[4]

as finishing-point and as starting-point for it, one point thus serving as two: therefore H must have come to a stand there: it cannot have come to be at Δ and departed from Δ simultaneously, for in that case it would simultaneously be there and not be there at the same moment. And here we cannot apply the argument used to solve the difficulty stated above: we cannot argue that H is at Δ at a sectional point of time and has not come to be or ceased to be there. For here the goal that is reached is necessarily one that is actually, not potentially, existent. Now the point in the middle is potential: but this one is actual, and regarded from below it is a finishing-point, while regarded from above it is a starting-point, so that it stands in these
263a same two respective relations to the two motions.[1] Therefore that which turns back in traversing a rectilinear course must in so doing come to a stand. Consequently there cannot be a continuous rectilinear motion that is eternal.[2]

The same method should also be adopted in replying to those who ask, in the terms of Zeno's argument,[3] whether we admit that before any distance can be traversed half the distance must be traversed, that these half-distances are infinite in number, and that it is impossible to traverse distances infinite in number—or some on the lines of this same argument put the questions in another form, and would have us grant that in the time during which a motion is in progress it should be possible to reckon a half-motion before the whole for every half-distance that we get, so that we have the result that when the whole distance is traversed we have reckoned an infinite number, which is admittedly impossible. Now when we first discussed the question of motion we put forward a solution[4] of this difficulty turning

[1] i. e. it is τελευτή in relation to the first (upward) part of the motion (up to Δ) and ἀρχή in relation to the second (downward) part (down from Δ).

[2] Reading in l. 3 ἐπὶ τῆς εὐθείας ἀίδιον. Bekker's reading ἐπὶ ἀίδιον τῆς εὐθείας is apparently a mere slip.

[3] καὶ ἀξιοῦντας in l. 5 seems to be a gloss introduced under the influence of ἀξιοῦντες, l. 7.

[4] vi. 2. 233a 21 sqq., and vi. 9.

on the fact that the period of time occupied in traversing the distance contains within itself an infinite number of units: there is no absurdity, we said, in supposing the traversing of infinite distances in infinite time, and the element of infinity is present in the time no less than in the distance. But, although this solution is adequate as a reply to the questioner (the question asked being whether it is possible in a finite time to traverse or reckon an infinite number of units), nevertheless as an account of the fact and explanation of its true nature it is inadequate. For suppose the distance to be left out of account and the question asked to be no longer whether it is possible in a finite time to traverse an infinite number of distances, and suppose that the inquiry is made to refer to the time taken by itself (for the time contains an infinite number of divisions): then this solution will no longer be adequate, and we must apply the truth that we enunciated in our recent discussion, stating it in the following way. In the act of dividing the continuous distance into two halves one point is treated as two, since we make it a starting-point and a finishing-point: and this same result is also produced by the act of reckoning halves as well as by the act of dividing into halves. But if divisions are made in this way, neither the distance nor the motion will be continuous: for motion if it is to be continuous must relate to what is continuous: and though what is continuous contains an infinite number of halves, they are not actual but potential halves. If the halves are made actual, we shall get not a continuous but an intermittent motion. In the case of reckoning the halves, it is clear that this result follows: for then one point must be reckoned as two: it will be the finishing-point of 263b
the one half and the starting-point of the other, if we reckon not the one continuous whole but the two halves. Therefore to the question whether it is possible to pass through an infinite number of units either of time or of distance we must reply that in a sense it is and in a sense it is not. If the units are actual, it is not possible: if they are potential, it is possible. For in the course of a continuous motion the traveller has traversed an infinite number of

units in an accidental sense but not in an unqualified sense: for though it is an accidental characteristic of the distance to be an infinite number of half-distances, this is not its real and essential character. It is also plain that unless we hold that the point of time that divides earlier from later always belongs only to the later so far as the thing is concerned, we shall be involved in the consequence that the same thing is at the same moment existent and not existent, and that a thing is not existent at the moment when it has become. It is true that the point is common to both times, the earlier as well as the later, and that, while numerically one and the same, it is theoretically not so, being the finishing-point of the one and the starting-point of the other: but so far as the thing is concerned it belongs to the later stage of what happens to it. Let us suppose a time ΑΒΓ[1] and a thing Δ, Δ being white in the time A and not-white in the time B. Then Δ is at the moment Γ white and not-white: for if we were right in saying that it is white during the whole time A, it is true to call it white at any moment of A, and not-white in B, and Γ is in both A and B. We must not allow, therefore, that it is white in the whole of A, but must say that it is so in all of it except the last moment Γ. Γ belongs already to the later period,[2] and if in the whole of A not-white was in process of becoming and white of perishing, at Γ the process is complete. And so Γ is the first moment at which it is true to call the thing white or not-white respectively.[3] Otherwise a thing may be non-existent at the moment when it has become and existent at the moment when it has perished: or else it must be possible for a thing at the same time to be white and not white and in fact to be existent and non-existent. Further, if anything that exists after having been previously non-existent must become existent and does not exist when it is becoming, time cannot be divisible into time-atoms.

[1] Reading in l. 15 ΑΓΒ. Bekker has ΑΒΓ, apparently a slip. The first and third letters denote periods of time, the second the moment that divides them.
[2] Reading in l. 21 τοῦ ὑστέρου, with (apparently) Phil. Simp.
[3] Only the latter case has been mentioned above.

For suppose that Δ was becoming white in the time A and that at another time B, a time-atom consecutive with the last atom of A, Δ has already become white and so is white at that moment: then, inasmuch as in the time A it was becoming white and so was not white and at the moment B it is white, there must have been a becoming beween A and B and therefore also a time in which the becoming took place. On the other hand, those who deny atoms of 264a
time ⟨as we do⟩ are not affected by this argument: according to them Δ has become and so is white at the last point of the actual time in which it was becoming white: and this point has no other point consecutive with or in succession to it, whereas time-atoms are conceived as successive. Moreover it is clear that if Δ was becoming white in the whole time A, the time occupied by it in having become white in addition to having been in process of becoming white is no more than all that it occupied in the mere process of becoming white.[1]

These and such-like, then, are the arguments for our conclusion that derive cogency from the fact that they have a special bearing on the point at issue. If we look at the question from the point of view of general theory, the same result would also appear to be indicated by the following arguments. Everything whose motion is continuous must, on arriving at any point in the course of its locomotion, have been previously also in process of locomotion to that point, if it is not forced out of its path by anything: e.g. on arriving at B a thing must also have been in process of locomotion to B, and that not merely when it was near to B, but from the moment of its starting on its course, since there can be no reason for its being so at any particular stage rather than at an earlier one. So, too, in the case of the other kinds of motion. Now we are to suppose that a thing proceeds in locomotion from A to Γ and that at the moment of its arrival at Γ the continuity of its motion is unbroken and will remain so until it has

[1] sc. and therefore τὸ ἐν ᾧ γέγονε cannot be χρόνος, since it makes no addition to the total: it is merely a σημεῖον χρόνου.

arrived back at Α. Then when it is undergoing locomotion from Α to Γ it is at the same time undergoing also its locomotion to Α from Γ: consequently it is simultaneously undergoing two contrary motions, since the two motions that follow the same straight line are contrary to each other. With this consequence there also follows another: we have a thing that is in process of change from a position in which it has not yet been: so, inasmuch as this is impossible, the thing must come to a stand at Γ. Therefore the motion is not a single motion, since motion that is interrupted by stationariness is not single.

Further, the following argument will serve better to make this point clear universally in respect of every kind of motion. If the motion undergone by that which is in motion is always one of those already enumerated, and the state of rest that it undergoes is one of those that are the opposites of the motions (for we found[1] that there could be no other besides these), and moreover that which is undergoing but does not always undergo a particular motion (by this I mean one of the various specifically distinct motions, not some particular part of the whole motion) must have been previously undergoing the state of rest that is the opposite of the motion, the state of rest being privation of motion;[2] then, inasmuch as the two motions that follow the same straight line are contrary motions, and it is impossible for a thing to undergo simultaneously two contrary motions, that which is undergoing locomotion from Α to Γ cannot also simultaneously be undergoing locomotion from Γ[3] to Α: and since the latter locomotion is not simultaneous with the former but is still to be undergone, before it is undergone there must occur a state of rest at Γ: for this, as we found,[4] is the state of rest that is the opposite of the motion from Γ. The foregoing argument, then, makes it plain that the motion in question[5] is not continuous.

[1] v. 2.
[2] Reading in l. 28 a colon before εἰ, with Bonitz.
[3] Reading in l. 30 Γ. Bekker's Α is apparently a mere slip.
[4] v. 6. 229^b 28 sqq.
[5] sc. ἡ ἐπὶ τῆς εὐθείας.

Our next argument has a more special bearing than the 264b foregoing on the point at issue. We will suppose that there has occurred in something simultaneously a perishing of not-white and a becoming of white. Then if the alteration to white and from white is a continuous process and the white does not remain any time, there must have occurred simultaneously a perishing of not-white, a becoming of white, and a becoming of not-white: for the time of the three will be the same.

Again, from the continuity of the time in which the motion takes place we cannot infer continuity in the motion, but only successiveness: in fact, how could contraries, e.g. whiteness and blackness, meet in the same extreme point?[1]

On the other hand, in motion on a circular line we shall find singleness and continuity: for here we are met by no impossible consequence: that which is in motion from A will in virtue of the same direction of energy be simultaneously in motion to A (since it is in motion to the point at which it will finally arrive), and yet will not be undergoing two contrary or opposite motions: for a motion to a point and a motion from that point are not always contraries or opposites: they are contraries only if they are on the same straight line (for then they are contrary to one another in respect of place, as e.g. the two motions along the diameter of the circle, since the ends of this are at the greatest possible distance from one another), and they are opposites only if they are along the same line.[2] Therefore in the case we are now considering there is nothing to prevent the motion being continuous and free from all intermission: for rotatory motion is motion of a thing from its place to its place,[3] whereas rectilinear motion is motion from its place to another place.

[1] sc. as would be necessary if there is to be συνέχεια between the two contrary processes.

[2] i. e. they must traverse the same course in opposite directions, though their ἀρχή and τελευτή need not be πλεῖστον ἀπέχουσαι as in the case of ἐναντίαι κινήσεις, which, however, are of course included in the term ἀντικείμεναι.

[3] Reading in ll. 18–19 εἰς αὐτό.

Moreover the progress of rotatory motion is never localized within certain fixed limits, whereas that of rectilinear motion repeatedly is so.[1] Now a motion that is always shifting its ground from moment to moment can be continuous: but a motion that is repeatedly localized within certain fixed limits cannot be so, since then the same thing would have to undergo simultaneously two opposite motions. So, too, there cannot be continuous motion in a semicircle or in any other arc of a circle, since here also the same ground must be traversed repeatedly and two contrary processes of change must occur. The reason is that in these motions the starting-point and the termination do not coincide, whereas in motion over a circle they do coincide, and so this is the only perfect motion.[2]

This differentiation also provides another means of showing that the other kinds of motion cannot be continuous either: for in all of them we find that there is the same ground to be traversed repeatedly: thus in alteration there are the intermediate stages of the process, and in quantitative change there are the intervening degrees of magnitude: and in becoming and perishing the same thing is true. It makes no difference whether we take the intermediate stages of the process to be few or many, or whether we
265a add or subtract one: for in either case we find that there is still the same ground to be traversed repeatedly. Moreover it is plain from what has been said that those physicists who assert that all sensible things are always in motion are wrong: for their motion must be one or other of the motions just mentioned: in fact they mostly conceive it as alteration (things are always in flux and decay, they say), and they go so far as to speak even of becoming and perishing as a process of alteration. On the other hand, our argument has enabled us to assert the fact, applying universally to all motions, that no motion admits of continuity except rotatory motion: consequently neither altera-

[1] i. e. the ἀρχή and τελευτή of the line are fixed extreme points, and the motion is repeatedly taking place between them, whereas on the circle there are no such points.

[2] Because finite lines may be extended, whereas a circle is once for all complete.

tion nor increase[1] admits of continuity. We need now say no more in support of the position that there is no process of change that admits of infinity or continuity except rotatory locomotion.

9 It can now be shown plainly that rotation is the primary locomotion. Every locomotion, as we said before,[2] is either rotatory or rectilinear or a compound of the two: and the two former must be prior to the last, since they are the elements of which the latter consists. Moreover rotatory locomotion is prior to rectilinear locomotion, because it is more simple and complete, which may be shown as follows. The straight line traversed in rectilinear motion cannot be infinite: for there is no such thing as an infinite straight line; and even if there were, it would not be traversed by anything in motion: for the impossible does not happen and it is impossible to traverse an infinite distance. On the other hand rectilinear motion on a finite straight line is if it turns back a composite motion, in fact two motions, while if it does not turn back it is incomplete and perishable: and in the order of nature, of definition, and of time alike the complete is prior to the incomplete and the imperishable to the perishable. Again, a motion that admits of being eternal is prior to one that does not. Now rotatory motion can be eternal: but no other motion, whether locomotion or motion of any other kind, can be so, since in all of them rest must occur, and with the occurrence of rest the motion has perished. Moreover the result at which we have arrived, that rotatory motion is single and continuous, and rectilinear motion is not, is a reasonable one. In rectilinear motion we have a definite starting-point, finishing-point, and middle-point, which all have their place in it in such a way that there is a point from which that which is in motion can be said to start and a point at which it can be said to finish its course (for when anything is at the limits of its course, whether at the starting-point or at the finishing-point, it must be in a state of rest[3]). On the

[1] *αὔξησις* and *φθίσις* regarded as one process.
[2] Ch. 8. 261b 28.
[3] And therefore the motion must have limits.

other hand in circular motion there are no such definite points: for why should any one point on the line be a limit rather than any other? Any one point as much as any other is alike starting-point, middle-point, and finishing-point, so that we can say of certain things[1] both that they are always and that they never are at a starting-point and
265b at a finishing-point (so that a revolving sphere, while it is in motion, is also in a sense at rest, for it continues to occupy the same place). The reason of this is that in this case all these characteristics belong to the centre: that is to say, the centre is alike starting-point, middle-point, and finishing-point of the space traversed; consequently since this point is not a point on the circular line, there is no point at which that which is in process of locomotion can be in a state of rest as having traversed its course, because in its locomotion it is proceeding always about a central point and not to an extreme point: therefore it remains still, and the whole is in a sense always at rest as well as continuously in motion. Our next point gives a convertible result: on the one hand, because rotation is the measure[2] of motions it must be the primary motion (for all things are measured by what is primary): on the other hand, because rotation is the primary motion it is the measure of all other motions. Again, rotatory motion is also the only motion that admits of being regular. In rectilinear locomotion the motion of things in leaving the starting-point is not uniform with their motion in approaching the finishing-point, since the velocity of a thing always increases proportionately as it removes[3] itself farther from its position of rest: on the other hand rotatory motion is the only motion whose course is naturally such that it has no starting-point or finishing-point in itself but is determined from elsewhere.

As to locomotion being the primary motion, this is

[1] sc. things that rotate about an axis.
[2] Cf. iv. 14. 223b 19 sqq.
[3] I translate ἀφίστηται as a true middle in order to bring out the fact that this remark refers only to things that are in motion κατὰ φύσιν: the motion of things that are moved παρὰ φύσιν, e. g. of a stone thrown upwards, becomes slower: cf. v. 6. 230b 23 sqq.

a truth that is attested by all who have ever made mention of motion in their theories: they all assign their first principles of motion to things that impart motion of this kind. Thus 'separation' and 'combination' are motions in respect of place, and the motion imparted by 'Love' and 'Strife'[1] takes these forms, the latter 'separating' and the former 'combining'. Anaxagoras, too, says that 'Mind', his first movent, 'separates'. Similarly those[2] who assert no cause of this kind but say that 'void' accounts for motion—they also hold that the motion of natural substance is motion in respect of place: for their motion that is accounted for by 'void' is locomotion, and its sphere of operation may be said to be place. Moreover they are of opinion that the primary substances are not subject to any of the other motions, though the things that are compounds of these substances are so subject: the processes of increase and decrease and alteration, they say, are effects of the 'combination' and 'separation' of 'atoms'. It is the same, too, with those who make out that the becoming or perishing of a thing is accounted for by 'density' or 'rarity':[3] for it is by 'combination' and 'separation' that the place of these things in their systems is determined. Moreover to these we may add those who make Soul the cause of motion:[4] for they say that things that undergo motion have as their first principle 'that which moves itself': and when animals and all living things move themselves, the motion is motion in respect of place. Finally it 266a
is to be noted that we say that a thing 'is in motion' in the strict sense of the term only when its motion is motion in respect of place: if a thing is in process of increase or decrease or is undergoing some alteration while remaining at rest in the same place, we say that it is in motion in some particular respect: we do not say that it 'is in motion' without qualification.

Our present position, then, is this: We have argued that

[1] The motive forces in the system of Empedocles.
[2] Leucippus and Democritus.
[3] The early Ionian school: Thales, Anaximenes, and Heraclitus, the last two of whom are known to have employed these terms.
[4] Plato and the Platonists.

there always was motion and always will be motion throughout all time, and we have explained what is the first principle of this eternal motion: we have explained further which is the primary motion and which is the only motion that can be eternal: and we have pronounced the first movent to be unmoved.

We have now to assert that the first movent must be without parts and without magnitude, beginning with the establishment of the premisses on which this conclusion depends.

One of these premisses is that nothing finite can cause motion during an infinite time. We have three things, the movent, the moved, and thirdly that in which the motion takes place, namely the time: and these are either all infinite or all finite or partly—that is to say two of them or one of them—finite and partly infinite. Let A be the movent, B the moved, and Γ the infinite time. Now let us suppose that Δ[1] moves E, a part of B. Then the time occupied by this motion cannot be equal to Γ: for the greater the amount moved, the longer the time occupied.[2] It follows that the time Z[3] is not infinite. Now we see that by continuing to add to Δ I shall use up A and by continuing to add to E I shall use up B: but I shall not use up the time by continually subtracting a corresponding amount from it, because it is infinite. Consequently the duration of the part of Γ which is occupied by all A in moving the whole of B, will be finite. Therefore a finite thing cannot impart to anything an infinite motion. It is clear, then, that it is impossible for the finite to cause motion during an infinite time.

It has now to be shown that in no case is it possible for an infinite force to reside in a finite magnitude. This can be shown as follows: we take it for granted that the greater force is always that which in less time than another does an equal amount of work when engaged in any activity—

[1] sc. a part of A.
[2] Clearly Δ must be a larger fraction of A than E is of B.
[3] The time occupied by Δ in moving E to the same extent as B is moved by A. Read in l. 19 ὁ τὸ Ζ.

in heating, for example, or sweetening or throwing; in fact, in causing any kind of motion. Then that on which the forces act must be affected to some extent by our supposed finite magnitude possessing an infinite force as well as by anything else, in fact to a greater extent than by anything else, since the infinite force is greater than any other. But then there cannot be any time in which its action could take place. Suppose that A is the time occupied by the infinite power in the performance of an act of heating or pushing, and that AB[1] is the time occupied by a finite power in the performance of the same act: then by adding to the latter another finite power and continually increasing 266b the magnitude of the power so added I shall at some time or other reach a point at which the finite power has completed the motive act in the time A: for by continual addition to a finite magnitude I must arrive at a magnitude that exceeds any assigned limit, and in the same way by continual subtraction I must arrive at one that falls short of any assigned limit. So we get the result that the finite force will occupy the same amount of time in performing the motive act as the infinite force. But this is impossible. Therefore nothing finite can possess an infinite force. So it is also impossible for a finite force to reside in an infinite magnitude. It is true that a greater force can reside in a lesser magnitude: but the superiority of any such greater force can be still greater if the magnitude in which it resides is greater. Now let AB be an infinite magnitude. Then BΓ[2] possesses a certain force that occupies a certain time, let us say the time EZ,[3] in moving Δ. Now if I take a magnitude twice as great as BΓ, the time occupied by this magnitude in moving Δ will be half of EZ (assuming this to be the proportion[4]): so we may call this time ZH. That being so, by continually taking a greater magnitude in this way I shall never arrive at the full AB, whereas

[1] Reading in l. 33 ἐν τῷ δ' AB, with Simplicius.
[2] sc. a part of AB.
[3] E being presumably the time occupied by AB in moving Δ.
[4] He assumes that the force increases proportionately to the magnitude, so that the time decreases proportionately. This simplifies the argument, though of course it is not essential to it.

I shall always be getting a lesser fraction of the time originally given. Therefore the force must be infinite, since it exceeds any finite force. Moreover the time occupied by the action of any finite force must also be finite: for if a given force moves something in a certain time, a greater force will do so in a lesser time, but still a definite time, in inverse proportion.[1] But a force must always be infinite—just as a number or a magnitude is—if it exceeds all definite limits. This point may also be proved in another way—by taking a finite magnitude in which there resides a force the same in kind as that which resides in the infinite magnitude, so that this force will be a measure of the finite force residing in the infinite magnitude.[2]

It is plain, then, from the foregoing arguments that it is impossible for an infinite force to reside in a finite magnitude or for a finite force to reside in an infinite magnitude. But before proceeding to our conclusion it will be well to discuss a difficulty that arises in connexion with locomotion. If everything that is in motion with the exception of things that move themselves is moved by something else, how is it that some things, e. g. things thrown, continue to be in motion when their movent is no longer in contact with them? If we say that the movent in such cases moves something else at the same time, that the thrower e. g. also moves the air, and that this in being moved is also a movent, then it would be no more possible for this second thing than for the original thing to be in motion when the original movent is not in contact with it or moving it: all the things moved would have to be in motion simultaneously and also to have ceased simultaneously to be in motion
267a when the original movent ceases to move them, even if,

[1] i. e. greater force : lesser force = time occupied by lesser force : time occupied by greater force.

[2] The argument is left incomplete: the point is that then either the finite magnitude is the measure of the infinite magnitude (which is impossible) or it is a measure of so much of the infinite magnitude as can be said to possess the force, the rest not possessing any force, in which case it is not justifiable to say that it is the infinite magnitude that possesses the finite force.

like the magnet, it makes that which it has moved capable of being a movent.[1] Therefore, while we must accept this explanation to the extent of saying that the original movent gives the power of being a movent either to air[2] or to water or to something else of the kind, naturally adapted for imparting and undergoing motion, we must say further that this thing does not cease simultaneously to impart motion and to undergo motion: it ceases to be in motion at the moment when its movent ceases to move it, but it still remains a movent, and so it causes something else[3] consecutive with it to be in motion, and of this again the same may be said. The motion begins to cease when the motive force produced in one member of the consecutive series is at each stage[4] less than that possessed by the preceding member, and it finally ceases when one member no longer causes the next member to be a movent but only causes it to be in motion. The motion of these last two—of the one as movent and of the other as moved—must cease simultaneously, and with this the whole motion ceases. Now the things in which this motion is produced are things that admit of being sometimes in motion and sometimes at rest, and the motion is not continuous but only appears so: for it is motion of things that are either successive or in contact, there being not one movent but a number of movents consecutive with one another: and so motion of this kind takes place in air and water. Some say[5] that it is 'mutual replacement': but we must recognize that the difficulty raised cannot be solved otherwise than in the way we have described.[6] So far as they

[1] Reading in l. 1 (with H Simp.) *ποιεῖ, ὥσπερ ἡ λίθος, οἷον κινεῖν*, which seems clearly indicated by the next sentence: *κινεῖ* gives no satisfactory sense and seems to contradict *παύσηται* immediately preceding. The point is that the magnet can attract one piece of iron through the medium of another.

[2] Reading in l. 3 *οἷόν τε κινεῖν ἢ τὸν ἀέρα* [*τοιοῦτον*].

[3] Reading in l. 7 *κινεῖ τι ἄλλο*, with K.

[4] Reading in l. 8 *ὅταν ἀεὶ ἐλάττων*, with EK Simp., and in l. 9 *ἐγγίνηται*, with FH Them. Simp.

[5] Cf. Pl. *Tim.* 59 A, 79 B, C, E, 80 C.

[6] i. e. *ἀντιπερίστασις* may be a fact, but it does not in itself constitute an explanation. (Simplicius defines *ἀντιπερίστασις* thus: *ἀντιπερίστασίς ἐστιν, ὅταν ἐξωθουμένου τινὸς σώματος ὑπὸ σώματος ἀνταλλαγὴ γένηται τῶν*

are affected by 'mutual replacement', all the members of the series are moved and impart motion simultaneously, so that their motions also cease simultaneously: but our present problem concerns the appearance of continuous motion in a single thing, and therefore, since it cannot be moved throughout its motion by the same movent, the question is, what moves it?

Resuming our main argument, we proceed from the positions that there must be continuous motion in the world of things, that this is a single motion, that a single motion must be a motion of a magnitude (for that which is without magnitude cannot be in motion), and that the magnitude must be a single magnitude moved by a single movent (for otherwise there will not be continuous motion but a consecutive series of separate motions), and[1] that if the movent is a single thing, it is either itself in motion or itself unmoved: if, then, it is in motion, it will have to be subject to the same conditions as that which it moves, that is to say it will itself be in process of change and in being
267b so will also have to be moved by something: so we have a series that must come to an end, and a point will be reached at which motion is imparted by something that is unmoved. Thus we have a movent that has no need to change along with that which it moves but will be able to cause motion always (for the causing of motion under these conditions[2] involves no effort): and this motion alone is regular, or at least it is so in a higher degree than any other, since the movent is never subject to any change. So, too, in order that the motion may continue to be of the same character, the moved must not be subject to change in respect of its relation to the movent.[3]

τόπων, καὶ τὸ μὲν ἐξωθῆσαν ἐν τῷ τοῦ ἐξωθηθέντος στῇ τόπῳ, τὸ δὲ ἐξωθηθὲν τὸ προσεχὲς ἐξωθῇ καὶ ἐκεῖνο τὸ ἐχόμενον, ὅταν πλείονα ᾖ, ἕως ἂν τὸ ἔσχατον ἐν τῷ τόπῳ γένηται τοῦ πρώτου ἐξωθήσαντος.

[1] Reading δέ in l. 24, and a colon after ὄν in l. 25 (so Bonitz).

[2] sc. μὴ συμμεταβάλλον.

[3] Reading in l. 5 (with three MSS. and almost certainly Simplicius) ἐκεῖνο. It is hard to see how any satisfactory sense can be got out of ἐκείνου, since τὸ κινούμενον obviously μεταβάλλει πρὸς (= ὑπὸ) τοῦ κινοῦντος: the point is that μεταβολή must always be the same μεταβολή, namely κυκλοφορία. Cf. l. 17.

Moreover[1] the movent must occupy either the centre or the circumference, since these are the first principles from which a sphere is derived. But the things nearest the movent are those whose motion is quickest, and in this case it is the motion of the circumference[2] that is the quickest: therefore the movent occupies the circumference.

There is a further difficulty in supposing it to be possible for anything that is in motion to cause motion continuously and not merely in the way in which it is caused by something repeatedly pushing (in which case the continuity amounts to no more than successiveness). Such a movent must either itself continue[3] to push or pull or perform both these actions, or else the action must be taken up by something else and be passed on from one movent to another (the process that we described before as occurring in the case of things thrown, since the air or the water, being divisible, is a movent only in virtue of the fact that different parts of the air are moved one after another[4]): and in either case the motion cannot be a single motion, but only a consecutive series of motions. The only continuous motion, then, is that which is caused by the unmoved movent: and this motion is continuous because the movent remains always invariable, so that its relation to that which it moves remains also invariable and continuous.

Now that these points are settled, it is clear that the first unmoved movent cannot have any magnitude. For if it has magnitude, this must be either a finite or an infinite magnitude. Now we have already[5] proved in our course on Physics[6] that there cannot be an infinite magnitude: and we have now proved that it is impossible for a finite

[1] Reading in l. 6 δ' ἢ, with FI.

[2] Reading in l. 9 κύκλου with HK Simp. If ὅλου be kept, the general sense will have to be the same, but it is in that case very much obscured: in particular the reference of ἐκεῖ in the next clause becomes very awkward.

[3] Reading in l. 12 δεῖ ἀεί, with EK.

[4] Reading in l. 13 εἰ διαιρετὸς ὢν ὁ ἀὴρ ἢ τὸ ὕδωρ κινεῖ ἄλλος ἀεί, with Simplicius.

[5] iii. 5.

[6] See note on 251a 9.

magnitude to have an infinite force, and also that it impossible for a thing to be moved by a finite magnitu during an infinite time. But the first movent causes motion that is eternal and does cause it during an infini time. It is clear, therefore, that the first movent is i divisible and is without parts and without magnitude.

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DE GENERATIONE
ET
CORRUPTIONE

BY

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OXFORD
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PREFACE

THIS translation has been made from a revised text, which is now being published for me by the Delegates of the Clarendon Press as part of an edition of Aristotle's περὶ γενέσεως καὶ φθορᾶς. I have indicated in a few brief footnotes the chief passages in which the readings I have adopted differ from those of Bekker; a full explanation, and a defence of my interpretation in detail, will be found in my edition.

To Mr. W. D. Ross, Fellow of Oriel College, I am greatly indebted for many most valuable criticisms and suggestions. The references in the footnotes to Burnet are to the third edition of that author's *Early Greek Philosophy* (London, 1920); and the references to Diels are to the second edition of *Die Fragmente der Vorsokratiker* (Berlin, 1906).

H. H. J.

ANALYSIS

BOOK I.

cc. 1–5. *Coming-to-be and passing-away are distinguished from 'alteration' and from growth and diminution.*

CH.

1. Are coming-to-be and passing-away distinct from 'alteration'? It is clear that, amongst the ancient philosophers, the monists are logically bound to identify, and the pluralists to distinguish, these changes. Hence both Anaxagoras and Empedokles (who are pluralists) are inconsistent in their statements on this subject. Empedokles, it must be added, is inconsistent and obscure in many other respects as well.
2. There are no indivisible magnitudes. Nevertheless, coming-to-be and passing-away may well occur and be distinct from 'alteration'. For coming-to-be is not effected by the 'association' of discrete constituents, nor passing-away by their 'dissociation'; and 'change in what is continuous' is not always 'alteration'.
3. Coming-to-be and passing-away (in the strict or 'unqualified' sense of the terms) are in fact always occurring in Nature. Their ceaseless occurrence is made possible by the character of Matter (*materia prima*).
4. 'Alteration' is change of quality. It is thus essentially distinct from coming-to-be and passing-away, which are changes of substance.
5. Definition and explanation of growth and diminution.

cc. 6–10. *What comes-to-be is formed out of certain material constituents, by their 'combination'. Combination implies 'action and passion', which in turn imply 'contact'.*

6. Definition and explanation of 'contact'.
7. Agent and patient are neither absolutely identical with, nor sheerly other than, one another. They must be contrasted species of the same genus, opposed formations of the same matter.
8. Bodies do not consist of indivisible solids with void interspaces, as the Atomists maintain: nor are there 'pores' or empty channels running through them, as Empedokles supposes. Neither of these theories could account for 'action-passion'.
9. The true explanation of 'action-passion' depends (*a*) upon the distinction between a body's *actual* and *potential* possession of a quality, and (*b*) upon the fact that potential possession (i.e. 'susceptibility') may vary in intensity or degree in different parts of the body.
10. What 'combination' is, and how it can take place.

BOOK II.

cc. 1–8. *The material constituents of all that comes-to-be and passes-away are the so-called 'elements', i.e. the 'simple' bodies. What these are, how they are transformed into one another, and how they 'combine'.*

CH.

1. Earth, Air, Fire, and Water are not really 'elements' of body, but 'simple' bodies. The 'elements' of body are 'primary matter' and certain 'contrarieties'.
2. The 'contrarieties' in question are 'the hot and the cold' and 'the dry and the moist'.
3. These four 'elementary qualities' (hot, cold, dry, moist) are diversely coupled so as to constitute four 'simple' bodies analogous to, but purer than, Earth, Air, Fire, and Water.
4. The four 'simple' bodies undergo reciprocal transformation in various manners.
5. Restatement and confirmation of the preceding doctrine.
6. Empedokles maintains that his four 'elements' cannot be transformed into one another. How then can they be 'equal' (i.e. comparable) as he asserts? His whole theory, indeed, is thoroughly unsatisfactory. In particular, he entirely fails to explain how compounds (e.g. bone or flesh) come-to-be out of his 'elements'.
7. How the 'simple' bodies combine to form compounds.
8. Every compound body requires all four 'simple' bodies as its constituents.

cc. 9–10. *The causes of coming-to-be and passing-away.*

9. Material, formal, and final causes of coming-to-be and passing-away. The failure of earlier theories—e.g. of the 'materialist' theory and of the theory advanced by Sokrates in the *Phaedo*—must be ascribed to inadequate recognition of the efficient cause.
10. The sun's annual movement in the ecliptic or zodiac circle is the efficient cause of coming-to-be and passing-away. It explains the occurrence of these changes and their ceaseless alternation.

Appendix.

11. In what sense, and under what conditions, the things which come-to-be are 'necessary'. Absolute necessity characterizes every sequence of transformations which is cyclical.

ON COMING-TO-BE AND PASSING-AWAY

BOOK I

1 OUR next task is to study coming-to-be and passing- 314a away. We are to distinguish the causes, and to state the definitions, of these processes considered in general—as changes predicable uniformly of all the things that come-to-be and pass-away by nature. Further, we are to study growth and 'alteration'. We must inquire what each of them is; and whether 'alteration' is to be identified with coming-to-be, or whether to these different names there correspond two separate processes with distinct natures.

On this question, indeed, the early philosophers are divided. Some of them assert that the so-called 'unqualified coming-to-be' is 'alteration', while others maintain that 'alteration' and coming-to-be are distinct. For those who say that the universe is one something (i. e. those who generate all things out of one thing) are bound to assert that coming-to-be is 'alteration', and that whatever 'comes-to-be' in the proper sense of the term is 'being altered': but those who make the matter of things more than one must distinguish coming-to-be from 'alteration'. To this latter class belong Empedokles, Anaxagoras, and Leukippos. And yet Anaxagoras himself failed to understand his own utterance. He *says*, at all events, that coming-to-be and passing-away are the same as 'being altered':[1] yet, in common with other thinkers, he affirms that the elements are many. Thus Empedokles holds that the corporeal elements are four, while all the elements—including those which initiate movement—are six in number; whereas

[1] Cf. fr. 17 (Diels, pp. 320–1).

Anaxagoras agrees with Leukippos and Demokritos that the elements are infinite.

(Anaxagoras posits as elements the 'homoeomeries', viz. bone, flesh, marrow, and everything else which is such that part and whole are the same in name and nature; while Demokritos and Leukippos say that there are indivisible bodies, infinite both in number and in the varieties of their shapes, of which everything else is composed—the compounds differing one from another according to the shapes, 'positions', and 'groupings' of their constituents.)

For the views of the school of Anaxagoras seem diametrically opposed to those of the followers of Empedokles. Empedokles says that Fire, Water, Air, and Earth are four elements, and are thus 'simple' rather than flesh, bone, and bodies which, like these, are 'homoeomeries'. But the followers of Anaxagoras regard the 'homoeomeries' as 'simple' and elements, whilst they affirm that Earth, Fire, Water, and Air are composite; for each of these is (according to them) a 'common seminary' of all the 'homoeomeries'.[1]

314^b Those, then, who construct all things out of a single element, must maintain that coming-to-be and passing-away are 'alteration'. For they must affirm that the underlying something always remains identical and one; and change of such a *substratum* is what we call 'altering'. Those, on the other hand, who make the ultimate kinds of things more than one, must maintain that 'alteration' is distinct from coming-to-be: for coming-to-be and passing-away result from the consilience and the dissolution of the many kinds. That is why Empedokles too[2] uses language to this effect, when he says 'There is no coming-to-be of anything, but only a mingling and a divorce of what has been mingled'.[3] Thus it is clear (i) that to describe coming-

[1] Aristotle's point (from 314^a 11 to 314^b 1) is that Anaxagoras, Empedokles, Leukippos, and Demokritos are all pluralists, and therefore logically bound (whatever they may say) to distinguish coming-to-be and 'alteration'. They are all pluralists, though their theories differ, and though the theory of Anaxagoras is actually 'contrary' to that of Empedokles.

[2] i. e. as well as Anaxagoras: cf. above, 314^a 13–15.

[3] Cf. fr. 8 (Diels, p. 175), and the paraphrase in MXG 975^{a}36–^{b}16.

to-be and passing-away in these terms is in accordance with their fundamental assumption, and (ii) that they do in fact so describe them: nevertheless, they too[1] must recognize 'alteration' as a fact distinct from coming-to-be, though it is impossible for them to do so consistently with what they say.

That we are right in this criticism is easy to perceive. For 'alteration' is a fact of observation. While the substance of the thing remains unchanged, we *see* it 'altering' just as we *see* in it the changes of magnitude called 'growth' and 'diminution'. Nevertheless, the statements of those who posit more 'original reals' than one make 'alteration' impossible. For 'alteration', as we assert, takes place in respect to certain qualities: and these qualities (I mean, e.g., hot-cold, white-black, dry-moist, soft-hard, and so forth) are, all of them, differences characterizing the 'elements'. The actual words of Empedokles may be quoted in illustration—

> The sun everywhere bright to see, and hot;
> The rain everywhere dark and cold;[2]

and he distinctively characterizes his remaining elements in a similar manner. Since, therefore, it is not possible[3] for Fire to become Water, or Water to become Earth, neither will it be possible for anything white to become black, or anything soft to become hard; and the same argument applies to all the other qualities. Yet this is what 'alteration' essentially is.

It follows, as an obvious corollary, that a single matter must always be assumed as underlying the contrary 'poles' of any change—whether change of place, or growth and diminution, or 'alteration'; further, that the being of this matter and the being of 'alteration' stand and fall together. For if the change is 'alteration', then the *substratum* is 315a
a single element; i.e. all things which admit of change into one another have a single matter. And, conversely, if the *substratum* of the changing things is one, there is 'alteration'.

[1] i.e. as well as ordinary people: cf. b 13 ff.
[2] Cf. fr. 21, ll. 3 and 5 (Diels, p. 180).
[3] i.e. according to Empedokles.

Empedokles, indeed, seems to contradict his own statements as well as the observed facts. For he denies that any one of his elements comes-to-be out of any other, insisting on the contrary that they are the things out of which everything else comes-to-be; and yet (having brought the entirety of existing things, except Strife, together into one) he maintains, simultaneously with this denial, that each thing once more comes-to-be out of the One. Hence it was clearly out of a One that *this* came-to-be Water, and *that* Fire, various portions of it being separated off by certain characteristic differences or qualities—as indeed he calls the sun 'white and hot', and the earth 'heavy and hard'. If, therefore, these characteristic differences be taken away (for they can be taken away, since they came-to-be), it will clearly be inevitable for Earth to come-to-be out of Water and Water out of Earth, and for each of the other elements to undergo a similar transformation—not only *then*,[1] but also *now*—if, and because, they change their qualities. And, to judge by what he says, the qualities are such that they *can* be 'attached' to things and *can* again be 'separated' from them, especially since Strife and Love are still fighting with one another for the mastery. It was owing to this same conflict that the elements were generated from a One at the former period. I say 'generated', for presumably Fire, Earth, and Water had no distinctive existence at all while merged in one.

There is another obscurity in the theory of Empedokles. Are we to regard the One as his 'original real'? Or is it the Many—i.e. Fire and Earth, and the bodies co-ordinate with these? For the One is an 'element' in so far as it underlies the process as matter—as that out of which Earth and Fire come-to-be through a change of qualities due to 'the motion'.[2] On the other hand, in so far as the One results from *composition* (by a consilience of the Many), whereas they result from *disintegration*, the Many are more 'elementary' than the One, and prior to it in their nature.

[1] i.e. at the period when Empedokles himself appears to recognize that his 'elements' come-to-be.

[2] i.e. the motion of dissociation initiated by Strife.

2 We have therefore to discuss the whole subject of 'unqualified' coming-to-be and passing-away; we have to inquire whether these changes do or do not occur and, if they occur, to explain the precise conditions of their occurrence. We must also discuss the remaining forms of change, viz. growth and 'alteration'. For though, no doubt, Plato investigated the conditions under which things come-to-be and pass-away, he confined his inquiry to these changes; and he discussed not *all* coming-to-be, but only that of the elements. He asked no questions as to how flesh or bones, or any of the other similar compound things, come-to-be; nor again did he examine the conditions under which 'alteration' or growth are attributable to things.

A similar criticism applies to all our predecessors with the single exception of Demokritos. Not one of them penetrated below the surface or made a thorough examination of a single one of the problems. Demokritos, however, does seem not only to have thought carefully about all the problems, but also to be distinguished from the outset by 315^{b}
his method. For, as we are saying, none of the other philosophers made any definite statement about growth, except such as any amateur might have made. They said that things grow 'by the accession of like to like', but they did not proceed to explain the manner of this accession. Nor did they give any account of 'combination': and they neglected almost every single one of the remaining problems, offering no explanation, e. g., of 'action' or 'passion'—how in physical actions one thing acts and the other undergoes action. Demokritos and Leukippos, however, postulate the 'figures', and make 'alteration' and coming-to-be result from them. They explain coming-to-be and passing-away by their 'dissociation' and 'association', but 'alteration' by their 'grouping' and 'position'. And since they thought that the truth lay in the appearance, and the appearances are conflicting and infinitely many, they made the 'figures' infinite in number.[1] Hence—owing to the changes of the compound—*the same* thing seems different and conflicting to different people: it is 'transposed' by a small additional

[1] And in variety of shape also: cf. above, 314^{a} 22–3.

ingredient, and appears utterly other by the 'transposition' of a single constituent. For Tragedy and Comedy are both composed of *the same* letters.

Since almost all our predecessors think (i) that coming-to-be is distinct from 'alteration', and (ii) that, whereas things 'alter' by change of their qualities, it is by 'association' and 'dissociation' that they come-to-be and pass-away, we must concentrate our attention on these theses. For they lead to many perplexing and well-grounded dilemmas. If, on the one hand, coming-to-be *is* 'association', many impossible consequences result: and yet there are other arguments, not easy to unravel, which force the conclusion upon us that coming-to-be cannot possibly be anything else. If, on the other hand, coming-to-be *is not* 'association', either there is no such thing as coming-to-be at all or it is 'alteration': or else[1] we must endeavour to unravel this dilemma too—and a stubborn one we shall find it.

The fundamental question, in dealing with all these difficulties, is this: 'Do things come-to-be and "alter" and grow, and undergo the contrary changes, because the primary "reals" are indivisible magnitudes? Or is no magnitude indivisible?' For the answer we give to this question makes the greatest difference. And again, if the primary 'reals' are indivisible magnitudes, are these *bodies*, as Demokritos and Leukippos maintain? Or are they *planes*, as is asserted in the *Timaeus*?

To resolve bodies into planes and no further—this, as we have also remarked elsewhere,[2] is in itself a paradox. Hence there is more to be said for the view that there are indivisible bodies. Yet even these involve much of paradox. Still, as we have said, it is possible to construct 'alteration' and coming-to-be with them, if one 'transposes' *the same*
316a by 'turning' and 'intercontact', and by 'the varieties of the figures', as Demokritos does. (His denial of the reality of colour is a corollary from this position: for, according to

[1] i.e. if we still wish to maintain that coming-to-be (though it actually occurs and is distinct from 'alteration') is not 'association'.
[2] Cf. e.g. *de Caelo* 299a 6–11.

him, things get coloured by 'turning' of the 'figures'.) But the possibility of such a construction no longer exists for those who divide bodies into planes. For nothing except solids results from putting planes together: they do not even attempt to generate any quality from them.

Lack of experience diminishes our power of taking a comprehensive view of the admitted facts. Hence those who dwell in intimate association with nature and its phenomena grow more and more able to formulate, as the foundations of their theories, principles such as to admit of a wide and coherent development: while those whom devotion to abstract discussions has rendered unobservant of the facts are too ready to dogmatize on the basis of a few observations. The rival treatments of the subject now before us will serve to illustrate how great is the difference between a 'scientific' and a 'dialectical' method of inquiry. For, whereas the Platonists argue that there must be atomic magnitudes 'because otherwise "The Triangle" will be more than one', Demokritos would appear to have been convinced by arguments appropriate to the subject, i.e. drawn from the science of nature. Our meaning will become clear as we proceed.

For to suppose that a body (i. e. a magnitude) is divisible through and through, and that this division is possible, involves a difficulty. What will there be in the body which escapes the division?

If it is divisible through and through, and if this division is possible, then it might *be*, at one and the same moment, *divided* through and through, even though the dividings had not been effected simultaneously: and the actual occurrence of this result would involve no impossibility. Hence the same principle will apply whenever a body is by nature divisible through and through, whether by bisection,[1] or generally by any method whatever: nothing impossible will have resulted if it has actually been divided—not even if it has been divided into innumerable parts, themselves divided innumerable times. Nothing impossible

[1] i. e. by progressive bisection *ad infinitum*.

will have resulted, though perhaps nobody in fact could so divide it.

Since, therefore, the body is divisible through and through, let it have been divided. What, then, will remain? A magnitude? No: that is impossible, since then there will be something not divided, whereas *ex hypothesi* the body was divisible *through and through*. But if it be admitted that neither a body nor a magnitude will remain, and yet division[1] is to take place, the constituents of the body will *either* be points (i.e. without magnitude) *or* absolutely nothing. If its constituents are nothings, then it might both come-to-be out of nothings and exist as a composite of nothings: and thus presumably the whole body will be nothing but an appearance. But if it consists of points, a similar absurdity will result: it will not possess any magnitude. For when the points were in contact and coincided to form a single magnitude, they did not make the whole any bigger (since, when the body was divided into two or more parts, the whole[2] was not a bit smaller or bigger than it was before the division): hence, even if all the points[3] be put together, they will not make any magnitude.

But suppose that, as the body is being divided, a minute
316b section—a piece of sawdust, as it were—is extracted, and that in this sense a body 'comes away' from the magnitude, evading the division. Even then the same[4] argument applies. For in what sense is that section divisible? But if what 'came away' was not a body but a separable form or quality, and if the magnitude *is* 'points or contacts thus qualified': it is paradoxical that a magnitude should consist of elements which are not magnitudes. Moreover, *where* will the points be? And are they motionless or moving? And every contact is always a contact of two somethings, i.e. there is always something besides the contact or the division or the point.

[1] i.e. 'through and through' division.
[2] i.e. the sum of the now separated parts.
[3] i.e. all the points into which the body has been dissolved by the 'through and through' division.
[4] Cf. above, 316a 24–5.

These, then, are the difficulties resulting from the supposition that any and every body, whatever its size, is divisible through and through. There is, besides, this further consideration. If, having divided a piece of wood or anything else, I put it together, it is again equal to what it was, and is one. Clearly this is so, whatever the point at which I cut the wood. The wood, therefore, has been divided *potentially* through and through. What, then, is there in the wood besides the division? For even if we suppose there is some quality, yet how is the wood dissolved into such constituents [1] and how does it come-to-be out of them? Or how are such constituents separated so as to exist apart from one another?

Since, therefore, it is impossible for magnitudes to consist of contacts or points, there must be indivisible bodies and magnitudes. Yet, if we *do* postulate the latter, we are confronted with equally impossible consequences, which we have examined in other works.[2] But we must try to disentangle these perplexities, and must therefore formulate the whole problem over again.

On the one hand, then, it is in no way paradoxical that every perceptible body should be indivisible as well as divisible at any and every point. For the second predicate will attach to it *potentially*, but the first *actually*. On the other hand, it would seem to be impossible for a body to be, even potentially, divisible at all points simultaneously. For if it were possible, then it might actually occur, with the result, not that the body would simultaneously be actually *both* (indivisible and divided), but that it would be simultaneously divided at any and every point. Consequently, nothing will remain and the body will have passed-away into what is incorporeal: and so it might come-to-be again either out of points or absolutely out of nothing. And how is that possible?

But now it is obvious that a body is in fact divided into separable magnitudes which are smaller at each division—into magnitudes which fall apart from one another and are

[1] i. e. points-of-division and quality.
[2] Cf. *Physics* 231a 21 ff.; *de Caelo* 303a 3 ff.; *de Lin. Insec.* 969b 29 ff.

actually separated. Hence (it is urged) the process of dividing a body part by part is not a 'breaking up' which could continue *ad infinitum*; nor can a body be simultaneously divided at every point, for that is not possible; but there is a limit, beyond which the 'breaking up' cannot proceed. The necessary consequence—especially if coming-to-be and passing-away are to take place by 'association' and 'dissociation' respectively—is that a body[1] must contain atomic magnitudes which are invisible.

317a Such is the argument which is believed to establish the necessity of atomic magnitudes: we must now show that it conceals a faulty inference, and exactly where it conceals it.

For, since point is not 'immediately-next' to point, magnitudes are 'divisible through and through' in one sense, and yet not in another. When, however, it is admitted that a magnitude is 'divisible through and through', it is thought there is a point not only anywhere, but also everywhere, in it: hence it is supposed to follow, from the admission, that the magnitude must be divided away into nothing. For—it is supposed—there is a point everywhere within it, so that it consists either of contacts or of points. But it is only *in one sense* that the magnitude is 'divisible through and through', viz. in so far as there is one point *anywhere* within it and all its points are *everywhere* within it if you take them singly one by one. But there are not more points than one *anywhere* within it, for the points are not 'consecutive': hence it is not simultaneously 'divisible through and through'. For if it were, then, if it be divisible at its centre, it will be divisible also at a point 'immediately-next' to its centre. But it is not so divisible: for position is not 'immediately-next' to position, nor point to point—in other words, division is not 'immediately-next' to division, nor composition to composition.

Hence there are both 'association' and 'dissociation', though neither (*a*) into, and out of, atomic magnitudes (for that involves many impossibilities), nor (*b*) so that division takes place through and through—for this would have resulted only if point had been 'immediately-next' to

[1] i.e. every perceptible body: cf. above, 316b 21.

point: but 'dissociation' takes place into small (i.e. relatively small) parts, and 'association' takes place out of relatively small parts.

It is wrong, however, to suppose, as some assert, that coming-to-be and passing-away in the unqualified and complete sense are distinctively defined by 'association' and 'dissociation', while the change that takes place in what is continuous is 'alteration'. On the contrary, this is where the whole error lies. For unqualified coming-to-be and passing-away are not effected by 'association' and 'dissociation'. They take place when a thing changes, from *this* to *that*, as a whole. But the philosophers we are criticizing suppose that all such change[1] is 'alteration': whereas in fact there is a difference. For in that which underlies the change there is a factor corresponding to the definition[2] and there is a material factor. When, then, the change is in these constitutive factors, there will be coming-to-be or passing-away: but when it is in the thing's qualities, i.e. a change of the thing *per accidens*, there will be 'alteration'.

'Dissociation' and 'association' affect the thing's susceptibility to passing-away. For if water has first been 'dissociated' into smallish drops, air comes-to-be out of it more quickly: while, if drops of water have first been 'associated', air comes-to-be more slowly. Our doctrine will become clearer in the sequel.[3] Meantime, so much may be taken as established—viz. that coming-to-be cannot be 'association', at least not the kind of 'association' some philosophers assert it to be.

3 Now that we have established the preceding distinctions, we must first[4] consider whether there is anything which comes-to-be and passes-away in the unqualified sense: or whether nothing comes-to-be in this strict sense, but everything always comes-to-be *something* and *out of something*—I mean, e.g., comes-to-be-healthy out of being-ill

[1] i.e. all change 'in what is continuous'.
[2] i.e. a 'formal' factor.
[3] Cf. $328^a 23$ ff.
[4] The second main topic of investigation is formulated below, $317^b 34$–5.

and ill out of being-healthy, comes-to-be-small out of being-
317b big and big out of being-small, and so on in every other instance. For if there is to be coming-to-be without qualification, 'something' must—without qualification—'come-to-be out of not-being', so that it would be true to say that 'not-being is an attribute of some things'. For *qualified* coming-to-be is a process out of *qualified* not-being (e.g. out of not-white or not-beautiful), but *unqualified* coming-to-be is a process out of *unqualified* not-being.

Now 'unqualified' means either (i) the primary predication within each Category, or (ii) the universal, i.e. the all-comprehensive, predication. Hence, if 'unqualified not-being' means the negation of 'being' in the sense of the primary term of the Category in question, we shall have, in 'unqualified coming-to-be', a coming-to-be of a substance out of not-substance. But that which is not a substance or a 'this' clearly cannot possess predicates drawn from any of the other Categories either—e.g. we cannot attribute to it any quality, quantity, or position. Otherwise, properties would admit of existence in separation from substances. If, on the other hand, 'unqualified not-being' means 'what is not in any sense at all', it will be a universal negation of all forms of being, so that what comes-to-be will have to come-to-be out of nothing.

Although we have dealt with these problems at greater length in another work,[1] where we have set forth the difficulties and established the distinguishing definitions, the following concise restatement of our results must here be offered:—

In one sense things come-to-be out of that which has no 'being' without qualification: yet in another sense they come-to-be always out of 'what is'. For coming-to-be necessarily implies the pre-existence of something which *potentially* 'is', but *actually* 'is not'; and this something is spoken of both as 'being' and as 'not-being'.

These distinctions may be taken as established: but even then it is extraordinarily difficult to see how there can be 'unqualified coming-to-be' (whether we suppose it to occur

[1] *Physics* A. 6–9.

out of what potentially 'is', or in some other way), and we must recall this problem for further examination. For the question might be raised whether substance (i. e. the 'this') comes-to-be at all. Is it not rather the 'such', the 'so great', or the 'somewhere', which comes-to-be? And the same question might be raised about 'passing-away' also. For if a substantial thing comes-to-be, it is clear that there will 'be' (not actually, but potentially) a substance, out of which its coming-to-be will proceed and into which the thing that is passing-away will necessarily change. Then will any predicate belonging to the remaining Categories attach *actually* to this presupposed substance? In other words, will that which is only potentially a 'this' (which only potentially *is*), while without the qualification 'potentially' it is not a 'this' (i. e. *is not*), possess, e. g., any determinate size or quality or position? For (i) if it possesses none of these determinations actually, but all of them only potentially, the result is *first* that a being, which is not a determinate being, is capable of separate existence; and *in addition* that coming-to-be proceeds out of nothing pre-existing—a thesis which, more than any other, preoccupied and alarmed the earliest philosophers. On the other hand (ii) if, although it is not a 'this somewhat' or a substance, it is to possess some of the remaining determinations quoted above, then (as we said)[1] properties will be separable from substances.

We must therefore concentrate all our powers on the discussion of these difficulties and on the solution of a further question—viz. What is the cause of the perpetuity of coming-to-be? Why is there always unqualified,[2] as well as *partial*,[3] coming-to-be?

'Cause' in this connexion has two senses. It means 318a
(i) the source from which, as we say, the process 'originates', and (ii) the matter. It is the material cause that we have here to state. For, as to the other cause, we have already

[1] Cf. above, 317b 10–11.
[2] 'Unqualified coming-to-be' = substantial change.
[3] 'Partial' = 'qualified' coming-to-be, i. e. change of quality, quantity, or place.

explained (in our treatise on Motion[1]) that it involves (*a*) something immovable through all time and (*b*) something always being moved. And the accurate treatment of the first of these—of the immovable 'originative source'—belongs to the province of the other, or 'prior', philosophy:[2] while as regards 'that which sets everything else in motion by being itself continuously moved', we shall have to explain later[3] which amongst the so-called 'specific' causes exhibits this character. But at present we are to state the material cause—the cause classed under the head of matter—to which it is due that passing-away and coming-to-be never fail to occur in Nature. For perhaps, if we succeed in clearing up this question, it will simultaneously become clear what account we ought to give of that which perplexed us just now, i. e. of *unqualified* passing-away and coming-to-be.

Our new question too—viz. 'what is the cause of the unbroken continuity of coming-to-be?'—is sufficiently perplexing, if in fact what passes-away vanishes into 'what is not' and 'what is not' is nothing (since 'what is not' is neither a thing, nor possessed of a quality or quantity, nor in any place). If, then, some one of the things 'which are' is constantly disappearing, why has not the whole of 'what is' been used up long ago and vanished away—assuming of course that the material of all the several comings-to-be was finite? For, presumably, the unfailing continuity of coming-to-be cannot be attributed to the infinity of the material. That is impossible, for nothing is actually infinite. A thing is infinite only potentially, i. e. the dividing of it can continue indefinitely: so that we should have to suppose there is only one kind of coming-to-be in the world—viz. one which never fails, because it is such that what comes-to-be is on each successive occasion smaller than before. But in fact this is not what we see occurring.

Why, then, is this form of change necessarily ceaseless? Is it because the passing-away of *this* is a coming-to-be of

[1] *Physics* Θ. 3 ff., especially 258b 10 ff.
[2] i. e. πρώτη φιλοσοφία or θεολογική.
[3] Cf. below, II. 10.

something else, and the coming-to-be of *this* a passing-away of *something else*?

The cause implied in this solution[1] must no doubt be considered adequate to account for coming-to-be and passing-away in their general character as they occur in all existing things alike. Yet, if the same process is a coming-to-be of *this* but a passing-away of *that*, and a passing-away of *this* but a coming-to-be of *that*, why are some things said to come-to-be and pass-away without qualification, but others only with a qualification?

This distinction must be investigated once more,[2] for it demands some explanation. ⟨It is applied in a twofold manner.⟩[3] For (i) we say 'it is now passing-away' without qualification, and not merely '*this* is passing-away':[4] and we call *this* change 'coming-to-be', and *that* 'passing-away', without qualification. And (ii) so-and-so 'comes-to-be-something', but does not 'come-to-be' without qualification; for we say that the student 'comes-to-be-learned', not 'comes-to-be' without qualification.

(i) Now we often divide terms into those which signify 318b a 'this somewhat' and those which do not. And ⟨the first form of⟩[5] the distinction, which we are investigating, results from a similar division of terms: for it makes a difference *into what* the changing thing changes. Perhaps, e.g., the passage into Fire is 'coming-to-be' *unqualified*, but 'passing-away-of-something' (e.g. of Earth): whilst the coming-to-be of Earth is *qualified* (not *unqualified*) 'coming-to-be', though *unqualified* 'passing-away' (e.g. of Fire). This would be the case on the theory set forth in Parmenides:[6] for he says that the things into which change takes place are two, and he asserts that these two, viz. *what is* and *what is not*, are Fire and Earth. Whether we postulate

[1] i.e. the material cause, in the sense of πρώτη ὕλη: cf. 319^a 18–22.

[2] 'Once more': for it was from this same peculiarity of linguistic usage that Aristotle started (317^a 32 ff.) to establish the being of ἁπλῆ γένεσις.

[3] I have inserted this sentence in view of what follows: cf. 319^a 3–11.

[4] i.e. not merely '*this* is passing-away and *that* is coming-to-be'.

[5] See note 3.

[6] The theory is put forward by Parmenides (fr. 8, ll. 51 ff.; Diels, pp. 121–2) as the prevalent, but erroneous, view. See Burnet, §§ 90, 91.

these,[1] or other things of a similar kind, makes no difference. For we are trying to discover not what undergoes these changes, but what is their characteristic manner. The passage, then, into what 'is' not except with a qualification is unqualified passing-away, while the passage into what 'is' without qualification is unqualified coming-to-be. Hence whatever the contrasted 'poles' of the changes may be—whether Fire and Earth, or some other couple—the one of them will be 'a being' and the other 'a not-being'.[2]

We have thus stated one characteristic manner in which *unqualified* will be distinguished from *qualified* coming-to-be and passing-away: but they are also distinguished according to the special nature of the material of the changing thing. For a material, whose constitutive differences signify more a 'this somewhat', is itself more 'substantial' or 'real': while a material, whose constitutive differences signify privation, is 'not real'. (Suppose, e.g., that 'the hot' is a positive predication, i.e. a 'form', whereas 'cold' is a privation, and that Earth and Fire differ from one another by these constitutive differences.)

The opinion, however, which most people are inclined to prefer, is that the distinction[3] depends upon the difference between 'the perceptible' and 'the imperceptible'. Thus, when there is a change into perceptible material, people say there is 'coming-to-be'; but when there is a change into invisible material, they call it 'passing-away'. For they distinguish 'what is' and 'what is not' by their perceiving and not-perceiving, just as what is knowable 'is' and what is unknowable 'is not'—perception on their view having the force of knowledge. Hence, just as they deem themselves to live and to 'be' in virtue of their perceiving or their capacity to perceive, so too they deem the things to 'be' *qua* perceived or perceptible—and in this they are in a sense on the track of the truth, though what they actually say is not true.

[1] *sc.* as the things into which the unqualified changes take place—as the contrasted 'poles' of unqualified γένεσις and φθορά.

[2] i.e. one will be 'a positive real' and the other 'a negative something'.

[3] *sc.* between the *unqualified* and the *qualified* changes.

Thus unqualified coming-to-be and passing-away turn out to be different according to common opinion from what they are in truth.[1] For Wind and Air are in truth more real—more a 'this somewhat' or a 'form'—than Earth. But they are less real to perception—which explains why things are commonly said to 'pass-away' without qualification when they change into Wind and Air, and to 'come-to-be'[2] when they change into what is tangible, i.e. into Earth.

We have now explained why there is 'unqualified coming-to-be' (though it is a passing-away-of-something) and 'unqualified passing-away' (though it is a coming-to-be-of-something). For this distinction of appellation depends upon a difference in the material out of which, and into which, the changes are effected. It depends *either* upon whether the material is or is not 'substantial', *or* upon whether it is 319a
more or less 'substantial', *or* upon whether it is more or less perceptible.

(ii) But why are some things said to 'come-to-be' without qualification, and others only to 'come-to-be-so-and-so', in cases different from the one we have been considering where two things come-to-be reciprocally out of one another? For at present we have explained no more than this:—why, when two things change reciprocally into one another, we do not attribute coming-to-be and passing-away *uniformly* to them both, although every coming-to-be is a passing-away of something else and every passing-away some other thing's coming-to-be. But the question subsequently formulated involves a different problem—viz. why, although the learning thing is said to 'come-to-be-learned' but not to 'come-to-be' without qualification, yet the growing thing *is* said to 'come-to-be'.

The distinction here turns upon the difference of the Categories. For some things signify a *this somewhat*, others a *such*, and others a *so-much*. Those things, then, which do not signify substance, are not said to 'come-to-be' without qualification, but only to 'come-to-be-so-and-so'.

[1] 'In truth', i.e. according to Aristotle's own view which he has just stated (above, 318b 14–18).
[2] *sc.* without qualification.

Nevertheless, in all changing things alike, we speak of 'coming-to-be'[1] when the thing comes-to-be something in *one*[2] of the two Columns—e.g. in Substance, if it comes-to-be Fire but not if it comes-to-be Earth; and in Quality, if it comes-to-be learned but not when it comes-to-be ignorant.

We have explained why some things come-to-be without qualification, but not others—both in general, and also when the changing things are substances and nothing else; and we have stated that the *substratum* is the material cause of the continuous occurrence of coming-to-be, because it is such as to change from contrary to contrary and because, in substances, the coming-to-be of one thing is always a passing-away of another, and the passing-away of one thing is always another's coming-to-be. But there is no need even to discuss the other question we raised viz. why coming-to-be continues though things are constantly being destroyed.[3] For just as people speak of 'a passing-away' without qualification when a thing has passed into what is imperceptible and what in that sense 'is not', so also they speak of 'a coming-to-be out of a not-being' when a thing emerges from an imperceptible. Whether, therefore, the *substratum* is or is not something, what comes-to-be emerges out of a 'not-being':[4] so that a thing 'comes-to-be out of a not-being' just as much as it 'passes-away into what is not'. Hence it is reasonable enough that coming-to-be should never fail. For coming-to-be is a passing-away of 'what is not' and passing-away is a coming-to-be of 'what is not'.[5]

But what about that which 'is' not except with a qualification?[6] Is it one of the two contrary poles of the change—e.g. is Earth (i.e. the heavy) a 'not-being', but Fire (i.e.

[1] i.e. without qualification.

[2] i.e. in the Column containing the positive terms: cf. above, 318b 14–18.

[3] Cf. above, 318a 13–23.

[4] A 'not-being' in the popular sense of the term, i.e. an 'imperceptible'. The imperceptibility of the material is irrelevant to the question of its reality.

[5] 'what is not' = what is imperceptible.

[6] The matter of substantial change, according to Aristotle's own theory, is μὴ ὂν ἁπλῶς—i.e. it *is* not, unless you qualify 'is' and say it 'is-potentially'. Cf. above, 317b 15–18.

the light) a 'being'? Or, on the contrary, does 'what is' include Earth as well as Fire, whereas 'what is not' is matter—the matter of Earth and Fire alike? And again, is the matter of each different? Or is it the same, since otherwise they would not come-to-be reciprocally out of one another, 319b
i. e. contraries out of contraries? For these things—Fire, Earth, Water, Air—are characterized by 'the contraries'.[1]

Perhaps the solution is that their matter is in one sense the same, but in another sense different. For that which underlies them, whatever its nature may be *qua* underlying them, is the same: but its actual being is not the same. So
4 much, then, on these topics. Next we must state what the difference is between coming-to-be and 'alteration'—for we maintain that these changes are distinct from one another.

Since, then, we must distinguish (*a*) the *substratum*, and (*b*) the property whose nature it is to be predicated of the *substratum*; and since change of each of these occurs; there is 'alteration' when the *substratum* is perceptible and persists, but changes in its own properties, the properties in question being opposed to one another either as contraries or as intermediates. The body, e.g., although persisting as the same body, is now healthy and now ill; and the bronze is now spherical and at another time angular, and yet remains the same bronze. But when nothing perceptible persists in its identity as a *substratum*, and the thing changes as a whole (when e.g. the seed as a whole is converted into blood, or water into air, or air as a whole into water), such an occurrence is no longer 'alteration'. It is a coming-to-be of one substance and a passing-away of the other—especially if the change proceeds from an imperceptible something to something perceptible (either to touch or to all the senses), as when water comes-to-be out of, or passes-away into, air: for air is pretty well imperceptible. If, however, in such cases, any property (being one of a pair of contraries) persists, in the thing that has come-to-be, the same as it was in the thing

[1] Cf. below, II. 1–3.

which has passed-away—if, e.g., when water comes-to-be out of air, both are transparent or cold[1]—the *second* thing, into which the *first* changes, must not be a property of this persistent identical something. Otherwise the change will be 'alteration'.

Suppose, e.g., that *the musical man* passed-away and *an unmusical man* came-to-be, and that *the man* persists as something identical. Now, if 'musicalness and unmusicalness' had not been a property essentially inhering in man, these changes would have been a coming-to-be of unmusicalness and a passing-away of musicalness: but in fact 'musicalness and unmusicalness' are a property of the persistent identity, viz. man.[2] (Hence, as regards *man*, these changes are 'modifications'; though, as regards *musical man* and *unmusical man*, they are a passing-away and a coming-to-be.) Consequently such changes are 'alteration'.[3]

When the change from contrary to contrary is *in quantity*, it is 'growth and diminution'; when it is *in place*, it is 'motion'; when it is in property, i.e. *in quality*, it is 'alteration': but when nothing persists, of which the resultant is a property (or an 'accident' in any sense of the term), it is 'coming-to-be', and the converse change is 'passing-away'.

'Matter', in the most proper sense of the term, is to be identified with the *substratum* which is receptive of coming-to-be and passing-away: but the *substratum* of the remaining kinds of change is also, in a certain sense, 'matter', because all these *substrata* are receptive of 'contrarieties' of some kind. So much, then, as an answer to the ques-

[1] Aristotle is not saying that water and air are in fact 'cold', but is only quoting a common view in illustration.

[2] I follow Philoponos in transposing νῦν . . . ὑπομένοντος (which the manuscripts read after φθορά in l. 30) to l. 28 after τοῦ δὲ φθορά.

[3] Aristotle's doctrine is: (i) If 'musicalness and unmusicalness' were not a property of man, the change in which 'a musical man becomes unmusical' would be a φθορά of *musicalness* and a γένεσις of *unmusicalness*. But (ii) since 'musicalness and unmusicalness' are a property of man, the change is in fact an 'alteration' of man from a state of musicalness to a state of unmusicalness. At the same time, (iii) the change is a φθορά of *musical man* and a γένεσις of *unmusical man*.

tions (i) whether coming-to-be 'is' or 'is not'—i. e. what are the precise conditions of its occurrence—and (ii) what 'alteration' is: but we have still to treat of growth.[1] We must explain (i) wherein growth differs from coming-to-be and from 'alteration', and (ii) what is the process of growing and the process of diminishing in each and all of the things that grow and diminish.

Hence our first question is this: Do these changes differ from one another solely because of a difference in their respective 'spheres'? In other words, do they differ because, while a change from *this* to *that* (viz. from potential to actual *substance*) is coming-to-be, a change in the sphere of *magnitude* is growth and one in the sphere of *quality* is 'alteration'—both growth and 'alteration' being changes from what is-potentially to what is-actually magnitude and quality respectively? Or is there also a difference in the manner of the change, since it is evident that, whereas neither what is 'altering' nor what is coming-to-be necessarily changes its place, what is growing or diminishing changes its spatial position of necessity, though in a different manner from that in which the moving thing does so? For that which is being moved changes its place as a whole: but the growing thing changes its place like a metal that is being beaten, retaining its position as a whole while its parts change their places. They change their places, but not in the same way as the parts of a revolving globe. For the parts of the globe change their places while the whole continues to occupy an equal place: but the parts of the growing thing expand over an ever-increasing place and the parts of the diminishing thing contract within an ever-diminishing area.

It is clear, then, that these changes—the changes of that which is coming-to-be, of that which is 'altering', and of that which is growing—differ *in manner* as well as *in sphere*. But how are we to conceive the 'sphere' of the change which is growth and diminution? The 'sphere' of growing and diminishing is believed to be magnitude. Are we to

[1] Cf. above, 315a 26–28.

suppose that body and magnitude come-to-be out of something which, though potentially magnitude and body, is actually incorporeal and devoid of magnitude? And since this description may be understood in two different ways, in which of these two ways are we to apply it to the process of growth? Is the matter,[1] out of which growth takes place, (i) 'separate' and existing alone by itself, or (ii) 'separate' but contained in another body?[2]

Perhaps it is impossible for growth to take place in either
320b of these ways. For since the matter[3] is 'separate', either (*a*) it will occupy no place (as if it were a point), or (*b*) it will be a 'void', i.e. a non-perceptible body. But the first of these alternatives is impossible. For since what comes-to-be out of this incorporeal and sizeless something will always be 'somewhere', it too must be 'somewhere'—either intrinsically or indirectly.[4] And the second alternative necessarily implies that the matter is contained in some other body. But if it is to be 'in' another body and yet remains 'separate' in such a way that it is in no sense a part of that body (neither a part of its substantial being nor an 'accident' of it), many impossibilities will result. It is as if we were to suppose that when, e.g., air comes-to-be out of water the process were due not to a change of the water, but to the matter of the air being 'contained in' the water as in a vessel. This is impossible. For (i) there is nothing to prevent an indeterminate number of matters being thus 'contained in' the water, so that they might come-to-be actually an indeterminate quantity of air;[5] and (ii) we do not in fact see air coming-to-be out of water in this fashion, viz. withdrawing out of it and leaving it unchanged.

It is therefore better to suppose that in all instances of

[1] i.e. the supposed incorporeal and sizeless matter.

[2] It is clear from what follows that the incorporeal and sizeless matter is assumed to be 'separate'—to be real independently of body—under both alternatives.

[3] i.e. the supposed incorporeal and sizeless matter.

[4] i.e. either as itself occupying a place, or as contained within a body which itself occupies a place.

[5] The original is obscure owing to its extreme compression: I have expanded it in accordance with Zabarella's interpretation.

coming-to-be the matter is inseparable,[1] being numerically identical and one with the 'containing' body, though isolable from it by definition. But the same reasons also forbid us to regard the matter, out of which the body comes-to-be, as points or lines. The matter is that of which points and lines are limits, and it is something that can never exist without quality and without form.

Now it is no doubt true, as we have also established elsewhere,[2] that one thing 'comes-to-be' (in the unqualified sense) out of another thing: and further it is true that the efficient cause of its coming-to-be is either (i) an actual thing (which is the same as the effect either *generically* —for the efficient cause of the coming-to-be of a hard thing is not a hard thing[3]—or *specifically*, as e.g. fire is the efficient cause of the coming-to-be of fire or one man of the birth of another), or (ii) an actuality.[4] Nevertheless, since there is also a matter out of which corporeal substance itself comes-to-be (corporeal substance, however, already characterized as such-and-such a determinate body, for there is no such thing as body in general), this same matter is also the matter of magnitude and quality—being separable from these matters by definition, but not separable in place unless Qualities are, in their turn, separable.[5]

It is evident, from the preceding[6] development and discussion of difficulties, that growth is not a change out of something which, though potentially a magnitude, actually possesses no magnitude. For, if it were, 'the void' would exist in separation; but we have explained in a former work[7] that this is impossible. Moreover, a change of that kind is not peculiarly distinctive of growth, but characterizes

[1] 'inseparable' from the actual body in which it is contained.

[2] Cf. *Physics* A. 7; *Metaph.* 1032^a 12 ff.

[3] The efficient cause of the coming-to-be of a hard thing (e.g. of ice or terra-cotta) is something cold or hot (a freezing wind or a baking fire); cf. *Meteor.* 382^a 22 ff. Such efficient causes are only generically, not specifically, identical with their effects. I have transposed the words σκληρὸν γὰρ οὐχ ὑπὸ σκληροῦ γίνεται so as to read them as a parenthesis after ὁμογενοῦς in 320^b 19.

[4] An 'actuality' or 'form': cf. *Metaph.* 1032^a 25 ...

[5] i.e. unless Qualities or Adjectivals are separable from Substances.

[6] Cf. above, 320^a 27–^{b} 12.

[7] Cf. *Physics* Δ. 6–9.

coming-to-be as such or in general. For growth is an increase, and diminution is a lessening, of the magnitude which is there already—that, indeed, is why the growing thing must possess some magnitude. Hence growth must not be regarded as a process from a matter without magnitude to an actuality of magnitude: for this would be a body's coming-to-be rather than its growth.

We must therefore come to closer quarters with the
321a subject of our inquiry. We must 'grapple' with it (as it were) from its beginning, and determine the precise character of the growing and diminishing whose causes we are investigating.

It is evident (i) that any and every part of the growing thing has increased, and that similarly in diminution every part has become smaller: also (ii) that a thing grows by the accession, and diminishes by the departure, of something. Hence it must grow by the accession either (*a*) of something incorporeal or (*b*) of a body. Now, if (*a*) it grows by the accession of something incorporeal, there will exist *separate* a void: but (as we have stated before)[1] it is impossible for *a matter of magnitude* to exist 'separate'. If, on the other hand, (*b*) it grows by the accession of a body, there will be two bodies—that which grows and that which increases it—in the same place: and this too is impossible.

But neither is it open to us to say that growth or diminution occurs in the way in which e.g. air is generated from water. For, although the volume has then become greater, the change will not be growth, but a coming-to-be of the one—viz. of that into which the change is taking place—and a passing-away of the contrasted body. It is not a *growth* of either. Nothing grows in the process; unless indeed there be something common to both things (to that which is coming-to-be and to that which passed-away), e.g. 'body', and this grows. The water has not grown, nor has the air: but the former has passed-away and the latter has come-to-be; and—if anything has grown—there has been a growth of 'body'. Yet this too

[1] Cf. above, 320a27 – b25.

is impossible. For our account of growth must preserve the characteristics of that which is growing and diminishing. And these characteristics are three: (i) any and every part of the growing magnitude is made bigger (e. g. if flesh grows, every particle of the flesh gets bigger), (ii) by the accession of something, and (iii) in such a way that the growing thing is preserved and persists. For whereas a thing does not persist in the processes of unqualified coming-to-be or passing-away, that which grows or 'alters' persists in its identity through the 'altering' and through the growing or diminishing, though the quality (in 'alteration') and the size (in growth) do not remain the same. Now if the generation of air from water is to be regarded as growth, a thing might grow without the accession (and without the persistence) of anything, and diminish without the departure of anything—and that which grows need not persist. But this characteristic [1] must be preserved: for the growth we are discussing has been assumed to be thus characterized.

One might raise a further difficulty. What is 'that which grows'? Is it that to which something is added? If, e.g., a man grows in his shin, is it the shin which is greater [2]—but not that 'whereby' he grows, viz. not the food? Then why have not both 'grown'? For when A is added to B, both A and B are greater, as when you mix wine with water; for each ingredient is alike increased in volume. Perhaps the explanation is that the substance of the one [3] remains unchanged, but the substance of the other (viz. of the food) does not. For indeed, even in the mixture of wine 321b
and water, it is the prevailing ingredient which is said to have increased in volume. We say, e. g., that the wine has increased, because the whole mixture acts as wine but not as water. A similar principle applies also to 'alteration'. Flesh is said to have been 'altered' if, while its character and substance remain, some one of its essential properties, which was not there before, now qualifies it: on the other

[1] viz. the third characteristic—that the growing thing 'persists'.
[2] i. e. has 'grown'.
[3] i. e. the substance of the shin.

hand, that 'whereby' it has been 'altered' may have undergone no change, though sometimes it too has been affected. The altering agent, however, and the originative source of the process are in the growing thing and in that which is being 'altered': for the efficient cause is in these.[1] No doubt the food, which has come in, may sometimes expand as well as the body that has consumed it (that is so, e. g., if, after having come in, a food is converted into wind[2]), but when it has undergone this change it has passed-away: and the efficient cause is not in the food.

We have now developed the difficulties sufficiently and must therefore try to find a solution of the problem. Our solution must preserve intact the three characteristics of growth—that the growing thing persists, that it grows by the accession (and diminishes by the departure) of something, and further that every perceptible particle of it has become either larger or smaller. We must recognize also (*a*) that the growing body is not 'void' and that yet there are not two magnitudes in the same place, and (*b*) that it does not grow by the accession of something incorporeal.

Two preliminary distinctions will prepare us to grasp the cause of growth. We must note (i) that the organic parts[3] grow by the growth of the tissues[4] (for every organ is composed of these as its constituents); and (ii) that flesh, bone, and every such part[5]—like every other thing which has its form immersed in matter—has a twofold nature: for the form as well as the matter is called 'flesh' or 'bone'.

Now, that any and every part of the tissue *qua* form should grow—and grow by the accession of something—is possible, but not that any and every part of the tissue *qua* matter should do so. For we must think of the tissue after

[1] And therefore it is these which are said to grow or to be 'altered'.

[2] Aristotle may be thinking of the conversion of a flatulent food into wind. But more probably he has in mind the maintenance and growth of the ἔμφυτον (or σύμφυτον) πνεῦμα: cf. *de Spiritu* 481a 1 ff.

[3] The Greek is τὰ ἀνομοιομερῆ, i.e. those parts (of the living thing) whose texture is not uniform throughout.

[4] The Greek is τὰ ὁμοιομερῆ, i. e. those parts whose texture is uniform throughout: cf. above, 314a 19–20. In living things such parts correspond roughly to 'the tissues'.

[5] i.e. every 'homoeomerous' part (or every 'tissue').

the image of flowing water that is measured by one and the same measure: particle after particle comes-to-be, and each successive particle is different.[1] And it is in this sense that the matter of the flesh grows, some flowing out and some flowing in fresh; not in the sense that fresh matter accedes to every particle of it. There is, however, an accession to every part of its figure or 'form'.

That growth has taken place proportionally,[2] is more manifest in the organic parts—e.g. in the hand. For *there* the fact that the matter is distinct from the form is more manifest than in flesh, i.e. than in the tissues. That is why there is a greater tendency to suppose that a corpse still possesses flesh and bone than that it still has a hand or an arm.

Hence in one sense it is true that any and every part of the flesh has grown; but in another sense it is false. For there has been an accession to every part of the flesh in respect to its form, but not in respect to its matter. The whole, however, has become larger. And this increase is due (*a*) on the one hand to the accession of something, which is called 'food' and is said to be 'contrary' to flesh, 322a
but (*b*) on the other hand to the transformation of this food into the same form as that of flesh—as if, e.g., 'moist' were to accede to 'dry' and, having acceded, were to be transformed and to become 'dry'. For in one sense 'Like grows by Like', but in another sense 'Unlike grows by Unlike'.

One might discuss what must be the character of that 'whereby' a thing grows. Clearly it must be potentially that which is growing—potentially flesh, e.g., if it is flesh that is growing. Actually, therefore, it must be 'other' than the growing thing. This 'actual other', then, has passed-away and come-to-be flesh. But it has not been transformed into flesh alone by itself (for that would have

[1] I think this clause refers to the matter of the tissue, not to the water. In Aristotle's simile, the 'measure' corresponds to the tissue's form, and the 'water' to its matter. The matter is a flux of different particles always coming-to-be and passing-away, always 'flowing in and out' of the structural plan which is the 'form'.

[2] i.e. by an expansion of all parts of the 'form'.

been a coming-to-be, not a growth): on the contrary, it is the growing thing which has come-to-be flesh ⟨and grown⟩[1] *by* the food. In what way, then, has the food been modified by the growing thing?[2] Perhaps we should say that it has been 'mixed' with it, as if one were to pour water into wine and the wine were able to convert the new ingredient into wine. And as fire lays hold of the inflammable,[3] so the active principle of growth, dwelling in the growing thing (i.e. in that which is actually flesh), lays hold of an acceding food which is potentially flesh and converts it into actual flesh. The acceding food, therefore, must be *together with* the growing thing:[4] for if it were apart from it, the change would be a coming-to-be.[5] For it is possible to produce fire by piling logs on to the already burning fire. That is 'growth'. But when the logs themselves are set on fire, that is 'coming-to-be'.

'Quantum-in-general' does not come-to-be any more than 'animal' which is neither man nor any other of the specific forms of animal: what 'animal-in-general' is in coming-to-be, that 'quantum-in-general' is in growth. But what does come-to-be in growth is flesh or bone—or a hand or arm (i.e. the tissues of these organic parts).[6] Such things come-to-be, then, by the accession not of quantified-flesh but of a quantified-something. In so far as this acceding food is potentially the double result—e.g. is potentially so-much-flesh—it produces growth: for it is bound to become actually both *so-much* and *flesh*. But in so far as it is potentially flesh only, it nourishes: for it is thus that 'nutrition' and 'growth' differ by their definition. That is why a body's 'nutrition' continues so

[1] All the manuscripts read ηὐξήθη after τούτου in 322^{a} 9. We must either delete it, or correct it into ηὔξησεν (cf. Philoponos, ed. Vitelli, p. 117, l. 12), or transpose it so as to read it after τούτῳ in ^{a} 8. I have adopted the last alternative in my translation.

[2] i.e. 'been modified' so as to be transformed into flesh.

[3] i.e. 'lays hold' of it and converts it into fire.

[4] i.e. 'must be together with' it when this conversion takes place.

[5] i.e. an independent coming-to-be of flesh, not a growth of the already existing tissue.

[6] i.e. what comes-to-be in growth is so-much flesh or bone, or a hand or arm of such and such a size: not 'quantum-in-general', but a 'quantified-something'.

long as it is kept alive (even when it is diminishing), though not its 'growth'; and why nutrition, though 'the same' as growth, is yet different from it in its actual being. For in so far as that which accedes is potentially 'so-much-flesh' it tends to increase flesh: whereas, in so far as it is potentially 'flesh' only, it is nourishment.

The form of which we have spoken[1] is a kind of power immersed in matter—a duct, as it were. If, then, a matter accedes—a matter, which is potentially a duct and also potentially possesses determinate quantity—the ducts to which it accedes will become bigger. But if it[2] is no longer able to act—if it has been weakened by the continued influx of matter, just as water, continually mixed in greater and greater quantity with wine, in the end makes the wine watery and converts it into water—then it will cause a diminution of the *quantum*;[3] though still the form persists.[4]

6 ⟨In discussing the causes of coming-to-be⟩[5] we must first 322b
investigate the *matter*, i.e. the so-called 'elements'. We must ask whether they really are elements or not, i.e. whether each of them is eternal or whether there is a sense in which they come-to-be: and, if they do come-to-be, whether all of them come-to-be in the same manner, reciprocally out of one another, or whether one amongst them is something

[1] i.e. the form which grows in every part of itself: cf. above, 321b 22–34.

[2] i.e. this form or power immersed in matter.

[3] i.e. a diminution of the size of the tissue whose form it is.

[4] For the reading and interpretation of 322a 28–33 see my text and commentary.

[5] I have added these words to explain 'first': cf. Zabarella, whose interpretation I have followed.

primary. Hence we must begin by explaining certain preliminary matters, about which the statements now current are vague.

For all (the pluralist philosophers)—those who generate the 'elements' as well as those who generate the bodies that are compounded of the elements—make use of 'dissociation' and 'association', and of 'action' and 'passion'. Now 'association' is 'combination'; but the precise meaning of the process we call 'combining' has not been explained. Again, (all the monists make use of 'alteration': but) without an agent and a patient there cannot be 'altering' any more than there can be 'dissociating' and 'associating'. For not only those who postulate a plurality of elements employ their reciprocal action and passion to generate the compounds: those who derive things from a single element are equally compelled to introduce 'acting'.[1] And in this respect Diogenes is right when he argues that 'unless all things were derived from one, reciprocal action and passion could not have occurred'.[2] The hot thing, e.g., would not be cooled and the cold thing in turn be warmed: for heat and cold do not change reciprocally into one another, but what changes (it is clear) is the *substratum*. Hence, whenever there is action and passion between two things, that which underlies them must be a single something. No doubt, it is not true to say that *all* things are of this character:[3] but it is true of all things between which there is reciprocal action and passion.

But if we must investigate 'action-passion' and 'combination', we must also investigate 'contact'. For action and passion (in the proper sense of the terms) can only occur between things which are such as to touch one another; nor can things enter into combination at all unless they have come into a certain kind of contact. Hence

[1] I have added the explicit reference to 'the pluralists' at b6 and to 'the monists' at b9, because Aristotle's argument in the present passage presupposes this classification and the consequences that were drawn from it in the first chapter.

[2] Cf. Diogenes, fr. 2 (Diels, p. 334).

[3] i.e. are transformations of a single *substratum*, or 'derived from one thing' as Diogenes maintained.

we must give a definite account of these three things—of 'contact', 'combination', and 'acting'.

Let us start as follows. All things which admit of 'combination' must be capable of reciprocal contact: and the same is true of any two things, of which one 'acts' and the other 'suffers action' in the proper sense of the terms. For this reason we must treat of 'contact' first.

Now every term which possesses a variety of meanings includes those various meanings *either* owing to a mere coincidence of language, *or* owing to a real order of derivation in the different things to which it is applied: but, though this may be taken to hold of 'contact' as of all such terms, it is nevertheless true that 'contact' *in the proper sense* applies only to things which have 'position'. And 'position' belongs only to those things which also have a 'place': for in so far as we attribute 'contact' to the 323[a]
mathematical things, we must also attribute 'place' to them, whether they exist in separation or in some other fashion.[1] Assuming, therefore, that 'to touch' is—as we have defined it in a previous work[2]—'to have the extremes together', only those things will touch one another which, being separate magnitudes and possessing position, have their extremes 'together'. And since position belongs only to those things which also have a 'place', while the primary differentiation of 'place' is 'the above' and 'the below' (and the similar pairs of opposites), all things which touch one another will have 'weight' or 'lightness'—*either* both these qualities *or* one or the other of them.[3] But bodies which are heavy or light are such as to 'act' and 'suffer action'. Hence it is clear that those things are by nature such as to touch one another, which (being separate magnitudes) have their extremes 'together' and are able to move, and be moved by, one another.

The manner in which the 'mover' moves the 'moved' is

[1] i.e. whether they exist in separation from the perceptible things, or whether they 'are' e.g. as inseparable adjectives of the φυσικὰ σώματα or as abstracted objects of thought.

[2] Cf. *Physics* 226[b] 21–23.

[3] i.e. if A and B are in reciprocal contact, *either* A must be heavy and B light, or A light and B heavy: *or* A and B must both be heavy, or both be light.

not always the same: on the contrary, whereas one kind of 'mover' can only impart motion by being itself moved, another kind can do so though remaining itself unmoved. Clearly therefore we must recognize a corresponding variety in speaking of the 'acting' thing too: for the 'mover' is said to 'act' (in a sense) and the 'acting' thing to 'impart motion'. Nevertheless there is a difference and we must draw a distinction. For not every 'mover' can 'act', if (*a*) the term 'agent' is to be used in contrast to 'patient' and (*b*) 'patient' is to be applied only to those things whose motion is a 'qualitative affection'—i.e. a quality, like 'white' or 'hot', in respect to which they are 'moved' only in the sense that they are 'altered': on the contrary, to 'impart motion' is a wider term than to 'act'.[1] Still, so much, at any rate, is clear: the things which are 'such as to impart motion', if that description be interpreted in one sense, will touch the things which are 'such as to be moved by them'—while they will not touch them, if the description be interpreted in a different sense. But the disjunctive definition of 'touching' must include and distinguish (*a*) 'contact in general' as the relation between two things which, having position, are such that one is able to impart motion and the other to be moved, and (*b*) 'reciprocal contact' as the relation between two things, one able to impart motion and the other able to be moved in such a way that 'action and passion' are predicable of them.

As a rule, no doubt, if A touches B, B touches A. For indeed practically all the 'movers' within our ordinary experience impart motion by being moved: in their case, what touches inevitably must, and also evidently does, touch something which reciprocally touches it. Yet, if A moves B, it is possible—as we sometimes express it—for A 'merely to touch' B, and that which touches need not touch a something which touches it. Nevertheless it is commonly supposed that 'touching' must be reciprocal. The reason of this belief is that 'movers' which belong to the same kind as the 'moved' impart motion by being moved. Hence if anything imparts motion without itself

[1] i. e. if to 'act' be understood in the narrow sense just explained.

being moved, it may touch the 'moved' and yet itself be touched by nothing—for we say sometimes that the man who grieves us 'touches' us, but not that we 'touch' him.

The account just given may serve to distinguish and define the 'contact' which occurs in the things of Nature.

7 Next in order we must discuss 'action' and 'passion'. 323b
The traditional theories on the subject are conflicting. For (i) most thinkers are unanimous in maintaining (*a*) that 'like' is always unaffected by 'like', because (as they argue) neither of two 'likes' is more apt than the other either to act or to suffer action, since all the properties which belong to the one belong identically and in the same degree to the other; and (*b*) that 'unlikes', i.e. 'differents', are by nature such as to act and suffer action reciprocally. For even when the smaller fire is destroyed by the greater, it suffers this effect (they say) owing to its 'contrariety'—since the great is contrary to the small. But (ii) Demokritos dissented from all the other thinkers and maintained a theory peculiar to himself. He asserts that agent and patient are identical, i.e. 'like'. It is not possible (he says) that 'others', i.e. 'differents', should suffer action from one another: on the contrary, even if two things, being 'others', do act in some way on one another, this happens to them not *qua* 'others' but *qua* possessing an identical property.

Such, then, are the traditional theories, and it looks as if the statements of their advocates were in manifest conflict. But the reason of this conflict is that each group is in fact stating *a part*, whereas they ought to have taken a comprehensive view of the subject *as a whole*. For (i) if A and B are 'like'—absolutely and in all respects without difference from one another—it is reasonable to infer that neither is in any way affected by the other. Why, indeed, should either of them tend to act any more than the other? Moreover, if 'like' can be affected by 'like', a thing can also be affected by itself: and yet if that were so—if 'like' tended in fact to act *qua* 'like'—there would be nothing indestructible or immovable, for everything would move itself. And (ii) the same consequence follows if A and B are absolutely 'other', i.e. in no respect identical. *Whiteness* could not be affected in any way by *line* nor *line* by *whiteness*—

except perhaps 'coincidentally', viz. if the line happened to be white or black: for unless two things either are, or are composed of, 'contraries', neither drives the other out of its natural condition. But (iii) since only those things which either involve a 'contrariety' or are 'contraries'—and not any things selected at random—are such as to suffer action and to act, agent and patient must be 'like' (i.e. identical) in kind and yet 'unlike' (i.e. contrary) in species. (For it is a law of nature that body is affected by body, flavour by flavour, colour by colour, and so in
324a general what belongs to any kind by a member of the same kind—the reason being that 'contraries' are in every case within a single identical kind, and it is 'contraries' which reciprocally act and suffer action.) Hence agent and patient must be in one sense identical, but in another sense other than (i.e. 'unlike') one another. And since (*a*) patient and agent are generically identical (i.e. 'like') but specifically 'unlike', while (*b*) it is 'contraries' that exhibit this character: it is clear that 'contraries' and their 'intermediates' are such as to suffer action and to act reciprocally—for indeed it is these that constitute the entire sphere of passing-away and coming-to-be.

We can now understand why fire heats and the cold thing cools, and in general why the active thing assimilates to itself the patient. For agent and patient are contrary to one another, and coming-to-be is a process into the contrary: hence the patient *must* change into the agent, since it is only thus that coming-to-be will be a process into the contrary. And, again, it is intelligible that the advocates of both views, although their theories are not the same, are yet in contact with the nature of the facts. For sometimes we speak of the *substratum* as suffering action (e.g. of 'the man' as being healed, being warmed and chilled, and similarly in all the other cases), but at other times we say 'what is cold is being warmed', 'what is sick is being healed': and in both these ways of speaking we express the truth, since in one sense it is the 'matter', while in another sense it is the 'contrary', which suffers action. (We make the same distinction in speaking of the agent: for sometimes we say that 'the man', but at other times that 'what is hot', produces heat.) Now the one group of thinkers supposed that agent and patient must possess something identical, because they fastened their attention on the *substratum*: while the other group maintained the opposite because their attention was concentrated on the 'contraries'.

We must conceive the same account to hold of action and passion as that which is true of 'being moved' and 'imparting motion'. For the 'mover', like the 'agent', has two meanings. Both (*a*) that which contains the originative source of the motion is thought to 'impart motion' (for the originative source is first amongst the causes), and also (*b*) that which is last, i.e. immediately next to the moved thing and to the coming-to-be.[1] A similar distinction holds also of the agent: for we speak not only (*a*) of the doctor, but also (*b*) of the wine, as healing. Now, in motion, there is nothing to prevent *the first mover* being unmoved (indeed, as regards some 'first movers' this is actually necessary) although *the last mover* always imparts motion by being itself moved: and, in action, there is nothing to prevent *the first agent* being unaffected, while *the last agent* only acts by suffering action itself. For (*a*) if agent and patient have not the same matter, agent acts without being affected: thus the art of healing produces health without itself being acted upon in any way by that which is being healed. But (*b*) the food, in acting, is itself in some way acted upon: for, in acting, it is simultaneously heated or cooled or otherwise affected. Now the art of healing corresponds to an 'originative source', while the food corresponds to 'the last' (i.e. 'contiguous') mover.[2]

Those active powers, then, whose forms are not embodied in matter, are unaffected: but those whose forms are in matter are such as to be affected in acting. For we maintain that one and the same 'matter' is *equally*, so to say, the basis of either of the two opposed things—being as it were a 'kind';[3] and that *that which can be hot* must be made hot, provided the heating agent is there, i.e. comes near. Hence (as we have said) some of the active powers

[1] By 'the coming-to-be' (τὴν γένεσιν) we must apparently understand 'that which is coming-to-be' (τὸ γινόμενον).

[2] Cf. above, 324a 26–9.

[3] i.e. a kind, of which the two opposed things are contrasted species.

are unaffected while others are such as to be affected; and what holds of motion is true also of the active powers. For as in motion 'the first mover' is unmoved, so among the active powers 'the first agent' is unaffected.

The active power is a 'cause' in the sense of that from which the process originates: but the end, for the sake of which it takes place, is not 'active'. (That is why *health* is not 'active', except metaphorically.) For when the agent is there, the patient *becomes* something: but when 'states'[1] are there, the patient no longer *becomes* but already *is*—and 'forms' (i.e. 'ends') are a kind of 'state'. As to the 'matter', it (*qua* matter) is passive. Now fire contains 'the hot' embodied in matter: but a 'hot' separate from matter (if such a thing existed) could not suffer any action. Perhaps, indeed, it is impossible that 'the hot' should exist in separation from matter: but if there are any entities thus separable, what we are saying would be true of them.

We have thus explained what action and passion are, what things exhibit them, why they do so, and in what manner. We must go on[2] to discuss how it is possible for 8
action and passion to take place.

Some philosophers think that the 'last' agent—the 'agent' in the strictest sense—enters in through certain pores, and so the patient suffers action. It is in this way, they assert, that we see and hear and exercise all our other senses. Moreover, according to them, things are seen through air and water and other transparent bodies, because such bodies possess pores, invisible indeed owing to their minuteness, but close-set and arranged in rows: and the more transparent the body, the more frequent and serial they suppose its pores to be.

Such was the theory which some philosophers (including Empedokles) advanced in regard to the structure of certain bodies. They do not restrict it to the bodies which act and suffer action: but 'combination' too, they say, takes place 'only between bodies whose pores are in reciprocal symmetry'. The most systematic and consistent theory,
325a however, and one that applied to all bodies, was advanced

[1] i.e. like 'health'.

[2] For this sense of πάλιν see Bonitz, *Index* 559b 13 ff. Perhaps, however, Aristotle means 'We must go back and discuss'.

by Leukippos and Demokritos: and, in maintaining it, they took as their starting-point what naturally comes first.[1]

For some of the older philosophers[2] thought that 'what is' must of necessity be 'one' and immovable. The void, they argue, 'is not': but unless there is a void with a separate being of its own, 'what is' cannot be moved—nor again can it be 'many', since there is nothing to keep things apart. And in *this* respect,[3] they insist, the view that the universe is not 'continuous' but 'discretes-in-contact'[4] is no better than the view that there are 'many' (and not 'one') and a void.[5] For ⟨suppose that the universe is discretes-in-contact. Then⟩,[6] if it is divisible through and through, there is no 'one', and therefore no 'many' either, but the Whole is void; while to maintain that it is divisible at some points, but not at others, looks like an arbitrary fiction. For up to what limit is it divisible? And for what reason is part of the Whole indivisible, i.e. a *plenum*, and part divided? Further, they maintain, it is equally[7] necessary to deny the existence of motion.

Reasoning in this way, therefore, they were led to transcend sense-perception, and to disregard it on the ground that 'one ought to follow the argument': and so they assert that the universe is 'one' and immovable. Some of them add that it is 'infinite', since the limit (if it had one) would be a limit against the void.[8]

There were, then, certain thinkers who, for the reasons we have stated, enunciated views of this kind as their theory of 'The Truth'.[9] . . . Moreover,[10] although these

[1] Perhaps we should read κατὰ φύσιν, ᾗπερ ἔστιν and understand the words as a reference to Parmenides (cf. e.g. fr. 8, l. 1; Diels, p. 118).

[2] The reference is to Parmenides, Melissos, and (probably) Zeno.

[3] i.e. for rendering intelligible the being of a 'many'.

[4] This appears to be the view of Empedokles, as Aristotle here expresses it: cf. below, 325b 5–10.

[5] This appears to be the view of the Pythagoreans: cf. *Physics* 213b 22–7.

[6] I have added these words to bring out the connexion of thought, which is clear enough in the original without any addition.

[7] i.e. the existence of motion is just as impossible on the hypothesis of Empedokles as on that of the Pythagoreans.

[8] Cf. Melissos, e.g. fr. 3, 5, 7 (Diels, pp. 144, 145).

[9] These words (περὶ τῆς ἀληθείας) seem to be intended to suggest 'The Way of Truth' in the poem of Parmenides.

[10] One or more arguments against the Eleatic theory appear to have dropped out before ἔτι in a 17.

opinions appear to follow logically in a dialectical discussion, yet to believe them seems next door to madness when one considers the facts. For indeed no lunatic seems to be so far out of his senses as to suppose that fire and ice are 'one': it is only between what *is* right, and what *seems* right from habit, that some people are mad enough to see no difference.

Leukippos, however, thought he had a theory which harmonized with sense-perception and would not abolish either coming-to-be and passing-away or motion and the multiplicity of things. He made these concessions to the facts of perception: on the other hand, he conceded to the Monists that there could be no motion without a void. The result is a theory which he states as follows: 'The void is a "not-'being", and no part of "what is" is a "not-being"; for 'what "is" in the strict sense of the term is an absolute '*plenum*. This *plenum*, however, is not "one": on the 'contrary, it is a "many" infinite in number and invisible 'owing to the minuteness of their bulk. The "many" 'move in the void (for there is a void)[1]: and by coming 'together they produce "coming-to-be", while by separating 'they produce "passing-away".[2] Moreover, they act and 'suffer action wherever they chance to be in contact (for '*there* they are not "one"), and they generate by being put 'together and becoming intertwined. From the genuinely-'one, on the other hand, there never could have come-to-be 'a multiplicity, nor from the genuinely-many a "one":
325b 'that is impossible. But' (just as Empedokles and some of the other philosophers say that things suffer action through their pores,[3] so) 'all "alteration" and all "passion" take 'place in the way that has been explained: breaking-up (i.e. 'passing-away) is effected by means of the void, and so too 'is growth—solids creeping in to fill the void places.'

Empedokles too is practically bound to adopt the same

[1] i.e. there is a void, though it is a 'not-being' or 'unreal'.

[2] I am greatly indebted to the translation given by Burnet (§ 173) of 324b 35—325a 32, though I have not been able to accept his version in all its details.

[3] The comparison with 'Empedokles and some of the other philosophers' is of course not part of the argument which Aristotle is here reproducing from Leukippos.

theory as Leukippos. For he must say that there are certain solids which, however, are indivisible—unless there are continuous pores all through the body. But this last alternative is impossible: for *then* there will be nothing solid in the body (nothing beside the pores) but all of it will be void. It is necessary, therefore, for his 'contiguous discretes' to be indivisible, while the intervals between them—which he calls 'pores'—must be void. But this is precisely Leukippos's theory of action and passion.

Such, approximately, are the current explanations of the manner in which some things 'act' while others 'suffer action'. And as regards the Atomists, it is not only clear what their explanation is: it is also obvious that it follows with tolerable consistency from the assumptions they employ. But there is less obvious consistency in the explanation offered by the other thinkers. It is not clear, for instance, how, on the theory of Empedokles, there is to be 'passing-away' as well as 'alteration'. For the primary bodies of the Atomists—the primary constituents of which bodies are composed, and the ultimate elements into which they are dissolved—are indivisible, differing from one another only in figure. In the philosophy of Empedokles, on the other hand, it is evident that all the other bodies down to the 'elements' have their coming-to-be and their passing-away: but it is not clear how the 'elements' themselves, severally in their aggregated masses, come-to-be and pass-away. Nor is it possible for Empedokles to explain how they do so, since he does not assert that Fire too[1] (and similarly every one of his other 'elements') possesses 'elementary constituents' of itself.

Such an assertion would commit him to doctrines like those which Plato has set forth in the *Timaeus*.[2] For although both Plato and Leukippos postulate elementary constituents that are indivisible and distinctively characterized by figures, there is this great difference between the two theories: the 'indivisibles' of Leukippos (i) are solids, while those of Plato are planes, and (ii) are characterized by an infinite variety of figures, while the characterizing

[1] i.e. as well as the composite bodies.
[2] Cf. *Timaeus* 53 c ff.

figures employed by Plato are limited in number. Thus the 'comings-to-be' and the 'dissociations' result from the 'indivisibles' (*a*) *according to Leukippos* through the void and through contact (for it is at the point of contact that each of the composite bodies is divisible[1]), but (*b*) *according to Plato* in virtue of contact alone, since he denies there is a void.

Now we have discussed 'indivisible planes' in the preceding treatise.[2] But with regard to the assumption of 'indivisible solids', although we must not now enter upon a detailed study of its consequences, the following criticisms fall within the compass of a short digression:—

326a (I) The Atomists are committed to the view that every 'indivisible' is incapable alike of receiving a sensible property (for nothing can 'suffer action' except through the void) and of producing one—no 'indivisible' can be, e.g., either hard or cold.[3] Yet it is surely a paradox that an exception is made of 'the hot'—'the hot' being assigned as peculiar to the spherical figure: for, that being so, its 'contrary' also ('the cold') is bound to belong to another of the figures. If, however, these properties (heat and cold) do belong to the 'indivisibles', it is a further paradox that they should not possess heaviness and lightness, and hardness and softness. And yet Demokritos says 'the more any indivisible exceeds, the heavier it is'—to which we must clearly add 'and the hotter it is'. But if *that* is their character, it is impossible they should not be affected by one another: the 'slightly-hot indivisible', e.g., will inevitably suffer action from one which far exceeds it in heat.[4] Again, if any 'indivisible' is 'hard', there must also be one which is 'soft': but 'the soft' derives its very name from the fact that it suffers a certain action—for 'soft' is that which yields to pressure. (II) But further,

[1] Cf. above, 325a 32–4.

[2] Cf. *de Caelo* Γ. 1, especially 298b 33 ff., Γ. 7 and Δ. 2.

[3] Or perhaps this clause is a quotation: 'since "no indivisible can be either hard or cold".'

[4] If, as Demokritos asserts, the 'indivisibles' differ in weight, being heavy in direct proportion to their mass, his 'spherical indivisibles' (Aristotle argues) must differ in the degree of their heat on the same principle. But if A is hotter than B, B is susceptible to the action of A. Hence Demokritos has violated a fundamental thesis of his own theory (cf. 326a 1–2), viz. that every 'indivisible' must be ἀπαθές.

not only is it paradoxical (i) that no property except figure should belong to the 'indivisibles': it is also paradoxical (ii) that, if other properties do belong to them, one only of these additional properties should attach to each—e.g. that *this* 'indivisible' should be cold and *that* 'indivisible' hot. For, on that supposition, their substance would not even be uniform.[1] And it is equally impossible (iii) that more than one of these additional properties should belong to the single 'indivisible'. For, being *indivisible*, it will possess these properties in the same point[2]—so that, if it 'suffers action' by being chilled, it will also, *qua* chilled, 'act' or 'suffer action' in some other way. And the same line of argument applies to all the other properties too: for the difficulty we have just raised confronts, as a necessary consequence, all who advocate 'indivisibles' (whether solids or planes), since their 'indivisibles' cannot become either 'rarer' or 'denser' inasmuch as there is no void in them. (III) It is a further paradox that there should be small 'indivisibles', but not large ones. For it is natural enough, from the ordinary point of view, that the larger bodies should be more liable to fracture than the small ones, since they (viz. the large bodies) are easily broken up because they collide with many other bodies. But why should indivisibility *as such* be the property of small, rather than of large, bodies? (IV) Again, is the substance of all those solids uniform, or do they fall into sets which differ from one another—as if, e.g., some of them, in their aggregated bulk,[3] were 'fiery', others 'earthy'? For (i) if all of them are uniform in substance, what is it that separated one from another? Or why, when they come into contact, do they not coalesce into one, as drops of water run together when drop touches drop (for the two cases are precisely parallel)? On the other hand (ii) if they fall into differing sets, how are these characterized? It is clear, too, that *these*,[4] rather than the 'figures', ought to be postulated as 'original reals', 326^{b}

[1] The uniformity of the substance or 'stuff' of the atoms was a fundamental doctrine in the theory. Cf. *Physics* 203^{a} 34 – ^{b}2, *de Caelo* 275^{b} 31–2; Burnet, p. 336_{3}.

[2] i.e. in its single, indivisible, undifferentiated identity.

[3] Cf. above, 325^{b} 22.

[4] i.e. these qualitatively-distinct sets of atoms.

i.e. causes from which the phenomena result. Moreover, if they differed in substance, they would both act and suffer action on coming into reciprocal contact. (V) Again, what is it which sets them moving? For if their 'mover' is other than themselves, they are such as to 'suffer action'. If, on the other hand, each of them sets itself in motion, either (*a*) it will be divisible ('imparting motion' *qua this*, 'being moved' *qua that*), or (*b*) contrary properties will attach to it in the same respect—i.e. 'matter' will be identical-in-potentiality as well as numerically-identical.[1]

As to the thinkers who explain modification of property through the movement facilitated by the pores, if this is supposed to occur notwithstanding the fact that the pores are filled, their postulate of pores is superfluous. For if the whole body suffers action under these conditions, it would suffer action in the same way even if it had no pores but were just its own continuous self. Moreover, how can their account of 'vision through a *medium*' be correct? It is impossible for ⟨the visual ray⟩[2] to penetrate the transparent bodies at their 'contacts'; and impossible for it to pass through their pores if every pore be full. For how will that[3] differ from having no pores at all? The body will be uniformly 'full' throughout. But, further, even if these passages, though they must *contain* bodies, are 'void', the same consequence will follow once more.[4] And if they are 'too minute to admit any body', it is absurd to suppose there is a 'minute' void and yet to deny the existence of a 'big' one (no matter how small the 'big' may be[5]), or to imagine 'the void' means anything else than a body's place—whence it clearly follows that to every body there will correspond a void of equal cubic capacity.

[1] For the doctrine implied in this argument, cf. *Physics* $190^b 24$, $192^a 1$ ff.

[2] I have added these words because Aristotle is referring to Empedokles's theory of vision. Cf. Empedokles, fr. 84 (Diels, pp. 196-7); Plato, *Timaeus* 45 B ff.

[3] *sc.* having pores, all of which are 'full'.

[4] i.e. the body will still be impenetrable, even if the pores as such (as channels) are distinguished in thought from what fills them. For *in fact* the pores are always 'full' and the body is a *plenum* throughout—though perhaps not a 'uniform' *plenum*.

[5] 'Big' is a relative term and may include a void in any degree bigger than the infinitesimal.

As a general criticism we must urge that to postulate pores is superfluous. For if the agent produces no effect by touching the patient, neither will it produce any by passing through its pores. On the other hand, if it acts by contact, then—even without pores—some things will 'suffer action' and others will 'act', provided they are by nature adapted for reciprocal action and passion. Our arguments have shown that it is either false or futile to advocate pores in the sense in which some thinkers conceive them. But since bodies are divisible through and through, the postulate of pores is ridiculous: for, *qua* divisible, a body can fall into separate parts.[1]

9 Let us explain the way in which things in fact possess the power of generating, and of acting and suffering action: and let us start from the principle we have often enunciated. For, assuming the distinction between (*a*) that which is *potentially* and (*b*) that which is *actually* such-and-such, it is the nature of the first, precisely in so far as it is what it is, to suffer action *through and through*, not merely to be susceptible in some parts while insusceptible in others. But its susceptibility varies in degree, according as it is more or less such-and-such, and one would be more justified in speaking of 'pores' in this connexion[2]: for instance, in the metals there are veins of 'the susceptible' stretching continuously through the substance. 327a

So long, indeed, as any body is naturally coherent and one, it is insusceptible. So, too, bodies are insusceptible so long as they are not in contact either with one another or with other bodies which are by nature such as to act and suffer action. (To illustrate my meaning: Fire heats not only when in contact, but also from a distance. For the fire heats the air, and the air—being by nature such as both to act and suffer action—heats the body.) But the supposition that a body is 'susceptible in some parts, but insusceptible in others' ⟨is only possible for those who hold an erroneous view concerning the divisibility of magnitudes.

[1] Cf. above, $316^{b}28$–9. Division *eo ipso* opens a channel in the body.

[2] viz. to express such lines of greater susceptibility.

For us)[1] the following account results from the distinctions we established at the beginning.[2] For (i) if magnitudes are not divisible through and through—if, on the contrary, there are indivisible solids or planes—then indeed no body would be susceptible through and through: but neither would any be continuous. Since, however, (ii) this is false, i. e. since every body is divisible, there is no difference between 'having been divided into parts which remain in contact' and 'being divisible'. For if a body '*can* be separated at the contacts' (as some thinkers express it), then, even though it has not yet been divided, it will be in a state of dividedness—since, as it *can* be divided, nothing inconceivable results.[3] And (iii) the supposition is open to this general objection—it is a paradox that 'passion' should occur in this manner *only*, viz. by the bodies being split. For this theory abolishes 'alteration': but we see the same body *liquid* at one time and *solid* at another, without losing its continuity. It has suffered this change not by 'division' and 'composition', nor yet by 'turning' and 'intercontact' as Demokritos asserts; for it has passed from the liquid to the solid state without any change of 'grouping' or 'position' in the constituents of its substance.[4] Nor are there contained within it those 'hard' (i.e. congealed) particles 'indivisible in their bulk': on the contrary, it is liquid—and again, solid and congealed—uniformly all through. This theory, it must be added, makes growth and diminution impossible also. For if there is to be *apposition* (instead of the growing thing having changed as a whole, either by the admixture of something or by its own transformation), increase of size will not have resulted in any and every part.[5]

So much, then, to establish that things generate and are generated, act and suffer action, reciprocally; and to distinguish the way in which these processes *can* occur from the (impossible) way in which some thinkers say they occur.

[1] A clause to this effect appears to have dropped out before διορίσαντας in a6.

[2] Cf. above, 316a 14—317a 17.

[3] i.e. if this potentiality be realized: cf. 316a 19. The argument turns on Aristotle's conception of τὸ δυνατόν: cf. *Metaph.* 1047a 24-6.

[4] Cf. above, 315b 33—316a 1.

[5] Cf. above, 321a 2-26.

10 But we have still to explain 'combination', for that was the third of the subjects we originally[1] proposed to discuss. Our explanation will proceed on the same method as before. We must inquire: What is 'combination', and what is that which can 'combine'? Of what things, and under what conditions, is 'combination' a property? And, further, does 'combination' exist in fact, or is it false to assert its existence?

For, according to some thinkers, it is impossible for one thing to be combined with another. They argue that (i) if *both* the 'combined' constituents persist unaltered, they are 327b
no more 'combined' now than they were before, but are in the same condition: while (ii) if *one* has been destroyed, the constituents have not been 'combined'—on the contrary, one constituent *is* and the other *is not*, whereas 'combination' demands uniformity of condition in them both: and on the same principle (iii) even if *both* the combining constituents have been destroyed as the result of their coalescence, *they* cannot 'have been combined' since *they* have no being at all.

What we have in this argument is, it would seem, a demand for the precise distinction of 'combination' from coming-to-be and passing-away (for it is obvious that 'combination', if it exists, must differ from these processes) and for the precise distinction of the 'combinable' from that which is such as to come-to-be and pass-away. As soon, therefore, as these distinctions are clear, the difficulties raised by the argument would be solved.

Now (i) we do not speak of the wood as 'combined' with the fire, nor of its burning as a 'combining' either of its particles with one another or of itself with the fire: what we say is that 'the fire is coming-to-be, but the wood is passing-away'. Similarly, we speak neither (ii) of the food as 'combining' with the body, nor (iii) of the shape as 'combining' with the wax and thus fashioning the lump. Nor can body 'combine' with white, nor (to generalize) 'properties' and 'states' with 'things': for we *see* them persisting unaltered.[2] But again (iv) white and knowledge cannot

[1] Cf. above, 322b 5 ff.
[2] *sc.* in the resulting complex (e.g. 'white-body' or 'learned-man').

be 'combined' either, nor any other of the 'adjectivals'. (Indeed, this is a blemish in the theory of those[1] who assert that 'once upon a time all things were together and combined'. For not everything can 'combine' with everything. On the contrary, both of the constituents that are combined in the compound must originally have existed in separation: but no property can have separate existence.)

Since, however, some things *are-potentially* while others *are-actually*, the constituents combined in a compound can 'be' in a sense and yet 'not-be'. The compound may *be-actually* other than the constituents from which it has resulted; nevertheless each of them may still *be-potentially* what it was before they were combined, and both of them may survive undestroyed. (For this was the difficulty that emerged in the previous argument: and it is evident that the combining constituents not only coalesce, having formerly existed in separation, but also can again be separated out from the compound.) The constituents, therefore, neither (*a*) *persist actually*, as 'body' and 'white' persist: nor (*b*) are they *destroyed* (either one of them or both), for their 'power of action'[2] is preserved. Hence these difficulties may be dismissed: but the problem immediately connected with them—'whether combination is something relative to perception'—must be set out and discussed.

When the combining constituents have been divided into parts so small, and have been juxtaposed in such a manner, that perception fails to discriminate them one from another,
328a have they then 'been combined'? Or ought we to say 'No, not until any and every part of one constituent is juxtaposed to a part of the other'?[3] The term, no doubt, is applied in the former sense: we speak, e.g., of wheat having been 'combined' with barley when each *grain* of the one is juxtaposed to a *grain* of the other. But every body is divisible and therefore, since body 'combined'[4]

[1] Aristotle is perhaps thinking of the 'Sphere' of Empedokles, as well as of the μίγμα of Anaxagoras.

[2] Cf. below, 328a 28–31 and 334b 8–30.

[3] The difference between these two views—both of which Aristotle rejects—is one of degree. According to the first view, the constituents are divided into parts too small for the normal vision to discriminate, and then shuffled. According to the second, the constituents are divided into 'least' parts, i. e. into atoms: and these are shuffled.

[4] For μικτόν = μιχθέν cf. e.g. below, 334b 31.

with body is uniform in texture throughout, *any and every part* of each constituent ought to be juxtaposed to a part of the other.

No body, however, can be divided into its 'least' parts: and 'composition' is not identical with 'combination', but other than it. From these premises it clearly follows (i) that so long as the constituents are preserved in small particles, we must not speak of them as 'combined'. (For this will be a 'composition' instead of a 'blending' or 'combination': nor will every portion of the resultant exhibit the same ratio between its constituents as the whole. But we maintain that, if 'combination' has taken place, the compound *must* be uniform in texture throughout—any part of such a compound being the same as the whole, just as any part of water is water: whereas, if 'combination' is 'composition of the small particles', nothing of the kind will happen. On the contrary, the constituents will only be 'combined' relatively to perception: and the same thing will be 'combined' to one percipient, if his sight is not sharp, ⟨but not to another,⟩[1] while to the eye of Lynkeus nothing will be 'combined'.) It clearly follows (ii) that we must not speak of the constituents as 'combined' in virtue of a division such that *any and every part* of each is juxtaposed to a part of the other: for it is impossible for them to be thus divided. Either, then, there is no 'combination', or we have still to explain the manner in which it can take place.

Now, as we maintain,[2] some things are such as to act and others such as to suffer action from them. Moreover, some things—viz. those which have the same matter—'reciprocate', i. e. are such as to act upon one another and to suffer action from one another; while other things, viz. agents which have not the same matter as their patients, act without themselves suffering action. Such agents cannot 'combine'—that is why neither the art of healing nor health produces health by 'combining' with the bodies of the patients. Amongst those things, however, which are reci-

[1] The words I have added represent the antithesis implied by the beginning of the sentence: but Aristotle prefers to clinch his argument by the reference to Lynkeus, at the cost of a slight anacoluthon.

[2] Cf. above, I. 7.

procally active and passive, some are easily-divisible. Now (i) if a great quantity (or a large bulk) of one of these easily-divisible 'reciprocating' materials be brought together with a little (or with a small piece) of another, the effect produced is not 'combination', but increase of the dominant: for the other material is transformed into the dominant. (That is why a drop of wine does not 'combine' with ten thousand gallons of water: for its form is dissolved, and it[1] is changed so as to merge in the total volume of water.) On the other hand (ii) when there is a certain equilibrium between their 'powers of action', then each of them changes out of its own nature towards the dominant: yet neither becomes the other, but both become an intermediate with properties common to both.[2]

Thus it is clear that only those agents are 'combinable' which involve a contrariety—for these are such as to suffer action reciprocally. And, further, they combine more freely if small pieces of each of them are juxtaposed. For in that condition they change one another more easily and more quickly; whereas this effect takes a long time when agent and patient are present in bulk.

328b Hence, amongst the divisible susceptible materials, those whose shape is readily adaptable have a tendency to combine: for they are easily divided into small particles, since that is precisely what 'being readily adaptable in shape' implies. For instance, liquids are the most 'combinable' of all bodies—because, of all divisible materials, the liquid is most readily adaptable in shape, unless it be viscous. Viscous liquids, it is true, produce no effect except to increase the volume and bulk. But when one of the constituents is alone susceptible—or superlatively susceptible, the other being susceptible in a very slight degree—the compound resulting from their combination is either no greater in volume or only a little greater. This is what happens when tin is combined with bronze. For some things display a hesitating and ambiguous attitude towards

[1] *sc.* the drop of wine.

[2] Each of the constituents, *qua* acting on the other, is *relatively* 'dominant'. Neither of them is *absolutely* 'dominant', for each 'suffers action' from the other. Hence each meets the other half-way, and the resultant is a compromise between them.

one another—showing a slight tendency to combine and also an inclination to behave as 'receptive matter' and 'form' respectively. The behaviour of these metals is a case in point. For the tin almost vanishes, behaving as if it were an immaterial property of the bronze: having been combined, it disappears, leaving no trace except the colour it has imparted to the bronze. The same phenomenon occurs in other instances too.

It is clear, then, from the foregoing account, that 'combination' occurs, what it is, to what it is due, and what kind of thing is 'combinable'. The phenomenon depends upon the fact that some things are such as to be (*a*) reciprocally susceptible and (*b*) readily adaptable in shape, i.e. easily divisible. For such things can be 'combined' without its being necessary *either* that they should have been destroyed *or* that they should survive absolutely unaltered: and their 'combination' need not be a 'composition', nor merely 'relative to perception'. On the contrary: anything is 'combinable' which, being readily adaptable in shape, is such as to suffer action and to act; and it is 'combinable with' another thing similarly characterized (for the 'combinable' is relative to the 'combinable'); and 'combination' is unification of the 'combinables', resulting from their 'alteration'

BOOK II

1 We have explained under what conditions 'combination', 'contact', and 'action-passion' are attributable to the things which undergo natural change. Further, we have discussed 'unqualified' coming-to-be and passing-away, and explained under what conditions they are predicable, of what subject, and owing to what cause. Similarly, we have also discussed 'alteration', and explained what 'altering' is and how it

differs from coming-to-be and passing-away. But we have still to investigate the so-called 'elements' of bodies.

For the complex substances whose formation and maintenance are due to natural processes all presuppose the perceptible bodies as the condition of their coming-to-be and passing-away: but philosophers disagree in regard to the matter which underlies these perceptible bodies. Some maintain it is single, supposing it to be, e. g., Air or Fire, or an 'intermediate' between these two (but still a body 329a with a separate existence). Others, on the contrary, postulate two or more materials—ascribing to their 'association' and 'dissociation', or to their 'alteration', the coming-to-be and passing-away of things. (Some, for instance, postulate Fire and Earth: some add Air, making three: and some, like Empedokles, reckon Water as well, thus postulating four.)

Now we may agree that the primary materials, whose change (whether it be 'association and dissociation' or a process of another kind) results in coming-to-be and passing-away, are rightly described as 'originative sources, i. e. elements'. But (i) those thinkers are in error who postulate, beside the bodies we have mentioned, a single matter—and that a corporeal and separable matter. For this 'body' of theirs cannot possibly exist without a 'perceptible contrariety': this 'Boundless', which some thinkers identify with the 'original real', must be either light or heavy, either cold or hot.[1] And (ii) what Plato has written in the *Timaeus* is not based on any precisely-articulated conception. For he has not stated clearly whether his 'Omnirecipient'[2] exists in separation from the 'elements'; nor does he make any use of it. He says, indeed, that it is a *substratum* prior to the so-called 'elements'—underlying them, as gold underlies the things that are fashioned of gold. (And yet this comparison, if thus expressed, is itself open to criticism. Things which come-to-be and pass-away cannot be called by the name of the material out of which they have come-to-be: it is only the results of 'alteration' which retain the name of the *substratum* whose 'alterations' they

[1] Cf. below, 332a 20-6.

[2] Cf. *Timaeus* 51 a.

are. However, he actually says[1] that 'far the truest account is to affirm that each of them[2] is "gold"'.) Nevertheless he carries his analysis of the 'elements'—solids though they are—back to 'planes',[3] and it is impossible for 'the Nurse'[4] (i.e. the primary matter) to be identical with 'the planes'.

Our own doctrine is that although there is a matter of the perceptible bodies (a matter out of which the so-called 'elements' come-to-be), it has no separate existence, but is always bound up with a contrariety. A more precise account of these presuppositions has been given in another work[5]: we must, however, give a detailed explanation of the primary bodies as well, since they too are similarly derived from the matter.[6] We must reckon as an 'originative source' and as 'primary' the matter which underlies, though it is inseparable from, the contrary qualities: for 'the hot' is not matter for 'the cold' nor 'the cold' for 'the hot', but the *substratum* is matter for them both. We therefore have to recognize three 'originative sources': *firstly* that which is potentially perceptible body, *secondly* the contrarieties (I mean, e.g., heat and cold), and *thirdly* Fire, Water, and the like. *Only* 'thirdly', however: for these bodies change into one another (they are not immutable 329
as Empedokles and other thinkers assert, since 'alteration' would then have been impossible), whereas the contrarieties do not change.

Nevertheless, even so[7] the question remains: What sorts of contrarieties, and how many of them, are to be accounted 'originative sources' of body? For all the other thinkers assume and use them without explaining why they are *these* or why they are just *so many*.

2 Since, then, we are looking for 'originative sources' of

[1] Cf. *Timaeus* 49 d–50 c.
[2] i.e. each of the things that are 'fashioned of gold'.
[3] Cf. *Timaeus* 53 c ff.
[4] Cf. *Timaeus*, e.g. 49 a, 52 d.
[5] Cf. *Physics* A. 6–9, where πρώτη ὕλη and 'the contrariety' (εἶδος and στέρησις) are accurately defined and distinguished as presuppositions of γένεσις.
[6] The account in the *Physics* applied generally to the γένεσις of any and every perceptible body. Aristotle now proposes to apply it to the γένεσις of the *primary* perceptible bodies in particular.
[7] i.e. notwithstanding the sketch Aristotle has just given.

perceptible body; and since 'perceptible' is equivalent[1] to 'tangible', and 'tangible' is that of which the perception is touch; it is clear that not all the contrarieties constitute 'forms' and 'originative sources' of body, but only those which correspond to touch. For it is in accordance with a contrariety—a contrariety, moreover, of *tangible* qualities—that the primary bodies are differentiated. That is why neither whiteness (and blackness), nor sweetness (and bitterness), nor (similarly) any quality belonging to the other[2] perceptible contrarieties either, constitutes an 'element'. And yet vision is prior to touch, so that its object also is prior to the object of touch. The object of vision, however, is a quality of tangible body not *qua* tangible, but *qua* something else—*qua* something which may well be naturally prior to the object of touch.

Accordingly, we must segregate the tangible differences and contrarieties, and distinguish which amongst them are primary. Contrarieties correlative to touch are the following: hot-cold, dry-moist, heavy-light, hard-soft, viscous-brittle, rough-smooth, coarse-fine. Of these (i) heavy and light are neither active nor susceptible. Things are not called 'heavy' and 'light' because they act upon, or suffer action from, other things. But the 'elements' must be reciprocally active and susceptible, since they 'combine' and are transformed into one another. On the other hand (ii) hot and cold, and dry and moist, are terms, of which the first pair implies *power to act* and the second pair *susceptibility*. 'Hot' is that which 'associates' things of the same kind (for 'dissociating', which people attribute to Fire as its function, *is* 'associating' things of the same class, since its effect is to eliminate what is foreign), while 'cold' is that which brings together, i.e. 'associates', homogeneous and heterogeneous things alike. And 'moist' is that which, being readily adaptable in shape, is not determinable by any limit of its own: while 'dry' is that which is readily determinable by its own limit, but not readily adaptable in shape.

[1] *sc.* in this connexion: the tangible qualities are the only qualities which characterize *all* perceptible bodies.

[2] *sc.* the other *non-tangible* perceptible contrarieties.

From moist and dry are derived (iii) the fine and coarse, viscous and brittle, hard and soft, and the remaining tangible differences. For (*a*) since the moist has no determinate shape, but is readily adaptable and follows the outline of that which is in contact with it, it is characteristic of it to be 'such as to fill up'. Now 'the fine' is 'such as to fill up'. For 'the fine' consists of subtle particles; but that which consists of small particles is 'such as to fill up', inasmuch as it is in contact[1] whole with whole—and 'the fine' exhibits this character[2] in a superlative degree. Hence it is evident that the fine derives from the moist, while the coarse derives from the dry. Again (*b*) 'the viscous' derives from the moist: for 'the viscous' (e.g. oil) is a 'moist' modified in a certain way. 'The brittle', on the other hand, derives from the dry: for 'brittle' is that which is *completely* dry—so completely, that its solidification has actually been due to failure of moisture. Further (*c*) 'the soft' derives from the moist. For 'soft' is that which yields to pressure by retiring into itself, though it does not yield by total displacement as the moist does—which explains why the moist is not 'soft', although 'the soft' derives from the moist. 'The hard', on the other hand, derives from the dry: for 'hard' is that which is solidified, and the solidified is dry.

The terms 'dry' and 'moist' have more senses than one. For 'the damp', as well as the moist, is opposed to the dry: and again 'the solidified', as well as the dry, is opposed to the moist. But all these qualities derive from the dry and moist we mentioned first.[3] For (i) the dry is opposed to the damp: i.e. 'damp' is that which has foreign moisture on its surface ('sodden' being that which is penetrated to its core[4]), while 'dry'[5] is that which has lost foreign moisture. Hence it is evident that the damp will derive from the moist, and 'the dry' which is opposed to it will derive from the primary dry. Again (ii) the 'moist' and the solidified derive in the same way from the primary pair.

[1] 'in contact' with the vessel which contains it.

[2] The fine, owing to the subtlety (= the smallness) of its particles, leaves no corner of its containing receptacle unfilled.

[3] Cf. above, 329b 30-2.

[4] *sc.* by foreign moisture: cf. below, a 22.

[5] i.e. the 'dry' which is contrasted with the damp: the 'dried'.

For 'moist'[1] is that which contains moisture *of its own* deep within it ('sodden' being that which is deeply penetrated by *foreign* moisture), whereas 'solidified' is that which has lost this inner moisture. Hence these too derive from the primary pair, the 'solidified' from the dry and the 'liquefiable' from the moist.

It is clear, then, that all the other differences reduce to the first four, but that these admit of no further reduction. For the hot is not *essentially* moist or dry, nor the moist *essentially* hot or cold: nor are the cold and the dry derivative forms, either of one another or of the hot and the moist. Hence these must be four.

The elementary qualities are four, and any four terms 3
can be combined in six couples. Contraries, however, refuse to be coupled: for it is impossible for the same thing to be hot and cold, or moist and dry. Hence it is evident that the 'couplings' of the elementary qualities will be four:
330b hot with dry and moist with hot, and again cold with dry and cold with moist. And these four couples have attached themselves to the *apparently* 'simple' bodies (Fire, Air, Water, and Earth) in a manner consonant with theory. For Fire is hot and dry, whereas Air is hot and moist (Air being a sort of aqueous vapour); and Water is cold and moist, while Earth is cold and dry. Thus the differences are reasonably distributed among the primary bodies, and the number of the latter is consonant with theory. For all who make the simple bodies 'elements' postulate either one, or two, or three, or four. Now (i) those who assert there is *one* only, and then generate everything else by condensation and rarefaction, are in effect making their 'originative sources' two, viz. the rare and the dense, or rather the hot and the cold: for it is these which are the moulding forces, while the 'one'[2] underlies them as a 'matter'. But (ii) those who postulate *two* from the start—as Parmenides postulated Fire and Earth—make the intermediates (e.g. Air and Water) blends of these.

[1] i.e. the 'moist' which is contrasted with the solidified: the 'liquefiable'.

[2] i.e. the single 'element' which these monistic theories postulate.

The same course is followed (iii) by those who advocate *three*.[1] (We may compare what Plato does in 'The Divisions': for he makes 'the middle' a blend.[2]) Indeed, there is practically no difference between those who postulate *two* and those who postulate *three*, except that the former split the middle 'element' into two, while the latter treat it as only one. But (iv) some advocate *four* from the start, e. g. Empedokles: yet he too draws them together so as to reduce them to *the two*, for he opposes all the others to Fire.

In fact, however, fire and air, and each of the bodies we have mentioned, are not simple, but blended. The 'simple' bodies are indeed similar in nature to them, but not identical with them. Thus the 'simple' body corresponding to fire is 'such-as-fire', not fire: that which corresponds to air is 'such-as-air': and so on with the rest of them. But fire is an excess of heat, just as ice is an excess of cold. For freezing and boiling are excesses of heat and cold respectively. Assuming, therefore, that ice is a freezing of moist and cold, fire analogously will be a boiling of dry and hot: a fact, by the way, which explains why nothing comes-to-be either out of ice or out of fire.

The 'simple' bodies, since they are four, fall into two pairs which belong to the two regions, each to each: for Fire and Air are forms of the body moving towards the 'limit', while Earth and Water are forms of the body which moves towards the 'centre'.[3] Fire and Earth, moreover, are extremes and purest: Water and Air, on the contrary, 331^a
are intermediates and more like blends. And, further, the members of either pair are contrary to those of the other, Water being contrary to Fire and Earth to Air; for the qualities constituting Water and Earth are contrary to those that constitute Fire and Air. Nevertheless, since they are four, each of them is characterized *par excellence*

[1] Cf. above, 329^a 2. Philoponos attributes this trialistic theory to Ion of Chios.

[2] I take 'The Divisions' to mean that section of the *Timaeus* (35 a ff.) in which Plato describes the making of the Soul. Aristotle's point is merely that Plato makes 'the middle' of his three kinds of 'substance' a 'blend' of the other two.

[3] Cf. *de Caelo*, e. g. 269^b 20–9, 308^a 14–33, 311^a 15 ff.

by a single quality: Earth by dry rather than by cold, Water by cold rather than by moist, Air by moist rather than by hot, and Fire by hot rather than by dry.

It has been established before[1] that the coming-to-be of 4
the 'simple' bodies is reciprocal. At the same time, it is manifest, even on the evidence of perception, that they *do* come-to-be: for otherwise there would not have been 'alteration', since 'alteration' is change in respect to the qualities of the objects of touch. Consequently, we must explain (i) what is the manner of their reciprocal transformation, and (ii) whether every one of them can come-to-be out of every one—or whether some can do so, but not others.

Now it is evident that all of them are by nature such as to change into one another: for coming-to-be is a change into contraries and out of contraries, and the 'elements' all involve a contrariety in their mutual relations because their distinctive qualities are contrary. For in some of them *both* qualities are contrary—e.g. in Fire and Water, the first of these being dry and hot, and the second moist and cold: while in others *one* of the qualities (though only one) is contrary—e.g. in Air and Water, the first being moist and hot, and the second moist and cold. It is evident, therefore, if we consider them in general, that every one is by nature such as to come-to-be out of every one: and when we come to consider them severally, it is not difficult to see the manner in which their transformation is effected. For, though all will result from all, both the speed and the facility of their conversion will differ in degree.

Thus (i) the process of conversion will be quick between those which have interchangeable 'complementary factors', but slow between those which have none. The reason is that it is easier for a single thing to change than for many. Air, e.g., will result from Fire if a single quality changes: for Fire, as we saw, is hot and dry while Air is hot and moist, so that there will be Air if the dry be overcome by the moist. Again, Water will result from Air if the hot be overcome by the cold: for Air, as we saw, is hot and moist

[1] The reference is probably neither to 314^b 15–26 nor to 329^a 35, but to *de Caelo* 304^b 23 ff.

while Water is cold and moist, so that, if the hot changes, there will be Water. So too, in the same manner, Earth will result from Water and Fire from Earth, since the two 'elements' in both these couples have interchangeable 'complementary factors'. For Water is moist and cold while Earth is cold and dry—so that, if the moist be overcome, there will be Earth: and again, since Fire is dry and hot while Earth is cold and dry, Fire will result from Earth 331b
if the cold pass-away.

It is evident, therefore, that the coming-to-be of the 'simple' bodies will be cyclical; and that this cyclical method of transformation is the easiest, because the *consecutive* 'elements' contain interchangeable 'complementary factors'.[1] On the other hand (ii) the transformation of Fire into Water and of Air into Earth, and again of Water and Earth into Fire and Air respectively, though possible, is more difficult because it involves the change of more qualities. For if Fire is to result from Water, both the cold and the moist must pass-away: and again, both the cold and the dry must pass-away if Air is to result from Earth. So, too, if Water and Earth are to result from Fire and Air respectively—both qualities must change.

This second method of coming-to-be, then, takes a longer time. But (iii) if one quality in each of two 'elements' pass-away, the transformation, though easier, is not reciprocal. Still, from Fire *plus* Water there will result Earth and[2] Air, and from Air *plus* Earth Fire and[3] Water. For there will be Air, when the cold of the Water and the dry of the Fire have passed-away (since the hot of the latter and the moist of the former are left): whereas, when the hot of the Fire and the moist of the Water have passed-away, there will be Earth, owing to the survival of the dry of the Fire and the cold of the Water. So, too, in the same way, Fire and Water will result from Air *plus* Earth. For there will be Water, when the hot of the Air and the dry

[1] Aristotle has shown that, by the conversion of a single quality in each case, Fire is transformed into Air, Air into Water, Water into Earth, and Earth into Fire. This is a *cycle* of transformations. Moreover, the 'elements' have been taken in their natural consecutive series, according to their order in the Cosmos.

[2] *sc.* alternatively.

[3] *sc.* alternatively.

of the Earth have passed-away (since the moist of the former and the cold of the latter are left): whereas, when the moist of the Air and the cold of the Earth have passed-away, there will be Fire, owing to the survival of the hot of the Air and the dry of the Earth—qualities essentially constitutive of Fire. Moreover, this mode of Fire's coming-to-be is confirmed by perception. For flame is *par excellence* Fire: but flame is burning smoke, and smoke consists of Air and Earth.

No transformation, however, into any of the 'simple' bodies can result from the passing-away of one elementary quality in each of two 'elements' when they are taken in their consecutive order,[1] because either *identical* or *contrary* qualities are left in the pair: but no 'simple' body can be formed either out of identical, or out of contrary, qualities. Thus no 'simple' body would result, if the dry of Fire and the moist of Air were to pass-away: for the hot is left in both. On the other hand, if the hot pass-away out of both, the contraries—dry and moist—are left. A similar result will occur in all the others too: for all the *consecutive* 'elements' contain one identical, and one contrary, quality.[2] Hence, too, it clearly follows that, when one of the *consecutive* 'elements' is transformed into one, the coming-to-be is effected by the passing-away of a single quality: whereas, when two of them are transformed into a third, more than one quality must have passed-away.[3]

332a We have stated that all the 'elements' come-to-be out of any one of them; and we have explained the manner in which their mutual conversion takes place. Let us nevertheless supplement our theory by the following speculations concerning them.

[1] Cf. above, note on 331b 4.

[2] If the 'elements' are taken in their natural order, Water (e.g.) is 'consecutive' to Earth, and Air to Water. Water is moist and cold. It shares its 'cold' with Earth and its 'moist' with Air: its 'moist' is contrary to Earth's 'dry', and its 'cold' is contrary to Air's 'hot'.

[3] If, e.g., Fire *plus* Air are to be transformed into Water or into Earth, it is not enough that a single quality should be eliminated from each of the generating pair: for this would leave either two 'hots' or a 'dry' and a 'moist' (cf. 331b 26–33). Either Fire's 'dry' or Air's 'moist' must be eliminated: and, *in addition*, the 'hot' of one must be eliminated and the 'hot' of the other be converted into 'cold'.

If Water, Air, and the like are a 'matter' of which the natural bodies consist, as some thinkers in fact believe, these 'elements' must be either one, or two, or more. Now they cannot all of them be *one*—they cannot, e.g., all be Air or Water or Fire or Earth—because 'Change is into contraries'.[1] For if they all were Air, then (assuming Air to persist) there will be 'alteration' instead of coming-to-be. Besides, nobody supposes a single 'element' to persist, as the basis of all, in such a way that it is Water as well as Air (or any other 'element') *at the same time*. So there will be a certain contrariety, i.e. a differentiating quality:[2] and the other member of this contrariety, e.g. heat, will belong to some other 'element', e.g. to Fire. But Fire will certainly not be 'hot Air'. For a change of that kind[3] (*a*) is 'alteration', and (*b*) is not what is observed. Moreover (*c*) if Air is again to result out of the Fire, it will do so by the conversion of the hot into its contrary: this contrary, therefore, will belong to Air, and Air will be a cold something: hence it is impossible for Fire to be 'hot Air', since in that case the same thing will be simultaneously hot and cold. Both Fire and Air, therefore, will be something else which is the same; i.e. there will be some 'matter', other than either, common to both.

The same argument applies to all the 'elements', proving that there is no single one of them out of which they all originate. But neither is there, beside these four, some other body from which they originate—a something intermediate, e.g., between Air and Water (coarser than Air, but finer than Water), or between Air and Fire (coarser than Fire, but finer than Air). For the supposed 'intermediate' will be Air and Fire when a pair of contrasted qualities is added to it: but, since one of every two contrary qualities is a 'privation', the 'intermediate' never can exist—as some thinkers assert the 'Boundless' or the 'Environing' exists—in isolation.[4] It is, therefore, equally

[1] For this 'law of nature', cf. *Physics* 224a 21—226b 17.

[2] If Air is to 'alter' into (e.g.) Fire, we must assume a pair of contrasted differentiating qualities, and assign one to Fire and the other to Air.

[3] i.e. Air becoming Fire by being heated.

[4] i.e. bare of all qualities. The 'Boundless' was criticized above,

and indifferently any one of the 'elements', or else it is nothing.

Since, then, there is nothing—at least, nothing *perceptible*—prior to these,[1] they must be all.[2] That being so, either they must always persist and not be transformable into one another: or they must undergo transformation—either all of them, or some only (as Plato wrote in the *Timaeus*).[3] Now it has been proved before[4] that they must undergo reciprocal transformation. It has also been proved[5] that the speed with which they come-to-be, one out of another, is not uniform—since the process of reciprocal transformation is relatively *quick* between the 'elements' with a 'complementary factor', but relatively *slow* between those which possess no such factor. Assuming, then, that the contrariety, in respect to which they are transformed, is *one*, the 'elements' will inevitably be two: for it is 'matter' that is the 'mean' between the two contraries, and matter
332b is imperceptible and inseparable from them.[6] Since, however, the 'elements' are seen to be more than two, the contrarieties must at the least be two. But the contrarieties being two, the 'elements' must be four (as they evidently are) and cannot be three: for the 'couplings' are four, since, though six are possible,[7] the two in which the qualities are contrary to one another cannot occur.

These subjects have been discussed before[8]: but the following arguments will make it clear that, since the 'elements' are transformed into one another, it is impossible for any one of them—whether it be at the end or in the middle[9]—to be an 'originative source' of the rest. There

329^a 8–13: there too Aristotle attributes the conception to 'some people', without mentioning Anaximander by name.

[1] *sc.* Earth, Air, Fire, and Water.

[2] i.e. all the 'simple' bodies there are.

[3] Cf. *Timaeus* 54 b–d.

[4] Cf. above, 331^a 12–20.

[5] Cf. above, 331^a 22 ff.

[6] One contrariety produces two 'elements' only: for πρώτη ὕλη has no separate subsistence and does not constitute a *third* 'element' alongside of its two contrary informations. Perhaps, however, we ought to translate: 'for the supposed "intermediate" is nothing but "matter", and that is imperceptible and incapable of separate existence.'

[7] i.e. *mathematically* 'possible'.

[8] Cf. above, II. 2 and 3.

[9] i.e. at either end, or in the middle, of the 'natural series' of the 'elements'.

can be no such 'originative element' at the ends: for all of them would then be Fire or Earth, and this theory amounts to the assertion that all things[1] are made of Fire or Earth. Nor can a 'middle-element' be such an 'originative source' —as some thinkers suppose that Air is transformed both into Fire and into Water, and Water both into Air and into Earth, while the 'end-elements' are not further transformed into one another. For the process must come to a stop, and cannot continue *ad infinitum* in a straight line in either direction, since otherwise an infinite number of contrarieties would attach to the single 'element'. Let E stand for Earth, W for Water, A for Air, and F for Fire. Then (i) since A is transformed into F and W, there will be a contrariety belonging to A F. Let these contraries be whiteness and blackness. Again (ii) since A is transformed into W, there will be another contrariety[2]: for W is not the same as F. Let this second contrariety be dryness and moistness, D being dryness and M moistness. Now if, when A is transformed into W, the 'white' persists, Water will be moist and white: but if it does not persist, Water will be black since change is into contraries. Water, therefore, must be either white or black. Let it then be the first. On similar grounds, therefore, D (dryness) will also belong to F. Consequently F (Fire) as well as Air will be able to be transformed into Water: for it has qualities contrary to those of Water, since Fire was *first* taken to be black and *then* to be dry, while Water was moist and *then* showed itself white. Thus it is evident that all the 'elements' will be able to be transformed out of one another; and that, in the instances we have taken, E (Earth) also will contain the remaining two 'complementary factors', viz. the black and the moist (for these have not yet been coupled).

We have dealt with this last topic before the thesis we set out to prove.[3] That thesis—viz. that the process cannot continue *ad infinitum*—will be clear from the following considerations. If Fire (which is represented by F) is not

[1] Or perhaps 'that all the "elements" result from Fire or Earth by "alteration"'—a view which Aristotle has already refuted (cf. 332a 6-20).

[2] *sc.* belonging to A W.

[3] Cf. above, 332b 12-13.

to revert, but is to be transformed in turn into some other 'element' (e. g. into Q), a new contrariety, other than those mentioned, will belong to Fire and Q: for it has been
333a assumed that Q is not the same as any of the four, E W A and F. Let K, then, belong to F and Y to Q. Then K will belong to all four, E W A and F: for they are transformed into one another. This last point, however, we may admit, has not yet been proved: but at any rate it is clear that if Q is to be transformed in turn into yet another 'element', yet another contrariety will belong not only to Q but also to F (Fire). And, similarly, every addition of a new 'element' will carry with it the attachment of a new contrariety to the preceding 'elements'. Consequently, if the 'elements' are infinitely many, there will also belong *to the single 'element'* an infinite number of contrarieties. But if that be so, it will be impossible to define any 'element': impossible also for any to come-to-be. For if one is to result from another, it will have to pass through such a vast number of contrarieties—and indeed even more than any determinate number. Consequently (i) into some 'elements' transformation will never be effected—viz. if the intermediates are infinite in number, as they must be if the 'elements' are infinitely many: further (ii) there will not even be a transformation of Air into Fire, if the contrarieties are infinitely many: moreover (iii) all the 'elements' become one. For all the contrarieties of the 'elements' above F must belong to those below F, and *vice versa*: hence they will all be one.

As for those who agree with Empedokles that the 6
'elements' of body are more than one, so that they are not transformed into one another[1]—one may well wonder in what sense it is open to them to maintain that the 'elements' are comparable. Yet Empedokles says 'For these are all not only equal . . .'[2]

If (i) it is meant that they are comparable in their amount, all the 'comparables' must possess an identical something whereby they are measured. If, e. g., one pint of Water

[1] i. e. so that the 'elements' are genuinely or irreducibly 'many'. The theory of Empedokles is directly opposed to the theory Aristotle has been maintaining.

[2] Empedokles, fr. 17, l. 27 (Diels, p. 179).

yields ten of Air, both are measured by the same unit; and therefore both were from the first an identical something. On the other hand, suppose (ii) they are not 'comparable in their amount' in the sense that so-much of the one yields so-much of the other, but comparable in 'power of action'[1] (a pint of Water, e.g., having a power of cooling equal to that of ten pints of Air); even so, they *are* 'comparable in their amount', though not *qua* 'amount' but *qua* 'so-much power'.[2] There is also (iii) a third possibility. Instead of comparing their powers by the measure of their amount, they might be compared as terms in a 'correspondence': e.g., 'as x is hot, so correspondingly y is white'. But 'correspondence', though it means equality in the *quantum*, means similarity[3] in a *quale*. Thus it is manifestly absurd that the 'simple' bodies, though they are not transformable, are comparable not merely as 'corresponding', but by a measure of their powers; i.e. that so-much Fire is comparable with many-times-that-amount of Air, as being 'equally' or 'similarly' hot. For the same thing, if it be greater in amount, will, since it belongs to the same kind,[4] have its *ratio* correspondingly increased.

A further objection to the theory of Empedokles is that it makes even *growth* impossible, unless it be increase by addition. For his Fire increases by Fire: 'And Earth 333b increases its own frame and Ether increases Ether.'[5] These, however, are cases of addition: but it is not by addition that growing things are believed to increase. And it is far more difficult for him to account for the *coming-to-be* which occurs in nature. For the things which come-to-be by natural process all exhibit, in their coming-to-be, a uniformity either absolute or highly regular: while any

[1] Cf. above, 327^b 31, 328^a 28–31; below, 334^b 8–30.

[2] i.e. we are comparing the *amounts of cooling energy* possessed by one pint of Water and ten pints of Air respectively.

[3] i.e. *only* 'similarity'. Empedokles might have said the 'elements' were all *analogous* or *similar* without inconsistency: but he asserts that they are *equal*, i.e. quantitatively comparable (and therefore, ultimately, transformable).

[4] *sc.* as the thing of less amount with which it is being compared.

[5] Cf. Empedokles, fr. 37 (Diels, p. 186). By αἰθήρ Empedokles means Air (not Fire) as Aristotle recognizes elsewhere: perhaps, therefore, the words 'Fire increases by Fire' are a paraphrase of a verse now lost.

exceptions—any results which are in accordance neither with the invariable nor with the general rule—are products of chance and luck. Then what is the cause determining that man comes-to-be from man, that wheat (instead of an olive) comes-to-be from wheat, either invariably or generally? Are we to say 'Bone comes-to-be if the "elements" be put together in such-and-such a manner'? For, according to his own statements, nothing comes-to-be from their 'fortuitous consilience', but only from their 'consilience' in a certain proportion. What, then, is the cause of this proportional consilience? Presumably not Fire or Earth. But neither is it Love and Strife: for the former is a cause of 'association' only, and the latter only of 'dissociation'. No: the cause in question is the essential nature of each thing—not merely (to quote his words) 'a mingling and a divorce of what has been mingled'.[1] And *chance*, not *proportion*, 'is the name given to these occurrences':[2] for things can be 'mingled' fortuitously.

The cause, therefore, of the coming-to-be of the things which owe their existence to nature is that they are in such-and-such a determinate condition:[3] and it is *this* which constitutes the 'nature' of each thing—a 'nature' about which he says nothing. What he says, therefore, is no explanation of 'nature'.[4] Moreover, it is *this* which is both 'the excellence' of each thing and its 'good': whereas he assigns the whole credit to the 'mingling'.[5] (And yet *the 'elements'* at all events are 'dissociated' not by Strife, but by Love: since the 'elements' are by nature prior to the Deity, and they too are Deities.)[6]

Again, his account of motion is vague. For it is not an adequate explanation to say that 'Love and Strife set things

[1] Cf. Empedokles, fr. 8 (Diels, p. 175). The same fragment is quoted above, 314b 7-8.

[2] Aristotle appears to be parodying the last line of Empedokles, fr. 8.

[3] i.e. that they are compounds produced by the consilience of their constituents in a certain proportion.

[4] i.e. Empedokles' poem, in spite of its title (Περὶ φύσεως), tells us nothing about nature.

[5] Cf. *Metaph.* 984b 32–985a 10.

[6] This sentence is a belated criticism of the functions Empedokles attributed to Love and Strife: perhaps we ought to read it after αἴτιον (above, b 13). The 'Deity' is the 'Sphere': cf. Empedokles, fr. 27, 28, 29 (Diels, pp. 183–184).

moving', unless the very nature of Love is a movement of *this* kind and the very nature of Strife a movement of *that* kind. He ought, then, either to have defined or to have postulated these characteristic movements, or to have demonstrated them—whether strictly or laxly or in some other fashion. Moreover, since (*a*) the 'simple' bodies *appear* to move 'naturally' as well as by compulsion, i.e. in a manner contrary to nature (fire, e.g., appears to move upwards without compulsion, though it appears to move by compulsion downwards); and since (*b*) what is 'natural' is contrary to that which is due to compulsion, and movement by compulsion actually occurs;[1] it follows that 'natural movement' can also occur in fact. Is *this*, then, the movement that Love sets going? No: for, on the contrary, the 'natural movement' moves Earth downwards and resembles 'dissociation', and Strife rather than Love is its cause—so that in general, too. Love rather than Strife would seem to be contrary to nature. And unless Love or Strife is actually setting them in motion, the 'simple' bodies themselves have absolutely no movement or rest. But this is paradoxical: and what is more, they do in fact obviously move.[2] For though Strife 'dissociated',[3] it was not by 334a
Strife that the 'Ether' was borne upwards. On the contrary, sometimes he attributes its movement to something like *chance* ('For *thus*, as it ran, it *happened* to meet them then, though often otherwise'[4]), while at other times he says it is the *nature* of Fire to be borne upwards, but 'the Ether' (to quote his words) 'sank down upon the Earth with long roots'.[5] With such statements, too, he combines the assertion that the Order of the World is the same *now*, in the reign of Strife, as it was *formerly* in the reign of Love. What, then, is the 'first mover' of the 'elements'? What causes their motion? Presumably not Love and Strife: on the contrary, these are causes of a *particular* motion, if at least we assume that 'first mover' to be an 'originative source'.[6]

[1] i.e. according to Empedokles himself.
[2] i.e. according to Empedokles' own statements.
[3] i.e. though Strife initiated the disintegration of the Sphere.
[4] Cf. Empedokles, fr. 53 (Diels, p. 189).
[5] Cf. fr. 54, *ibid.*
[6] *sc.* a first cause of motion in general.

An additional paradox is that the soul should consist of the 'elements', or that it should be one of them. How are the soul's 'alterations' to take place? How, e. g., is the change from being musical to being unmusical, or how is memory or forgetting, to occur? For clearly, if the soul be Fire, only such modifications will happen to it as characterize Fire *qua* Fire: while if it be compounded out of the 'elements', only the corporeal modifications will occur in it. But the changes we have mentioned are none of them corporeal.

The discussion of these difficulties, however, is a task 7
appropriate to a different investigation:[1] let us return to the 'elements' of which bodies are composed. The theories that 'there is something common to all the "elements"', and that 'they are reciprocally transformed', are so related that those who accept *either* are bound to accept *the other* as well. Those, on the other hand, who do not make their coming-to-be reciprocal—who refuse to suppose that any one of the 'elements' comes-to-be out of any other *taken singly*, except in the sense in which bricks come-to-be out of a wall—are faced with a paradox. How, on their theory, are flesh and bones or any of the other compounds to result from the 'elements' *taken together*?

Indeed, the point we have raised constitutes a problem even for those who generate the 'elements' out of one another. In what manner does anything other than, and beside, the 'elements' come-to-be out of them? Let me illustrate my meaning. Water can come-to-be out of Fire and Fire out of Water; for their *substratum* is something common to them both. But flesh too, presumably, and marrow come-to-be out of them. How, then, do such things come-to-be? For (*a*) how is the manner of their coming-to-be to be conceived by those who maintain a theory like that of Empedokles? They must conceive it as *composition*—just as a wall comes-to-be out of bricks and stones: and the 'Mixture', of which they speak, will be composed of the 'elements', these being preserved in it

[1] Cf. *de Anima*, A. 4 and 5, especially 408^a 18–23 and 409^b 23 ff., where Aristotle exposes the failure of Empedokles to account for the soul.

unaltered but with their small particles juxtaposed each to each. That will be the manner, presumably, in which flesh and every other compound results from the 'elements'. Consequently, it follows that Fire and Water do not come-to-be 'out of any and every part of flesh'. For instance, although a sphere might come-to-be out of *this* part of a lump of wax and a pyramid out of *some other* part, it was nevertheless possible for either figure to have come-to-be out of either part indifferently: *that* is the manner of coming-to-be when 'both Fire and Water come-to-be out of any and every part of flesh'. Those, however, who maintain the theory in question, are not at liberty to conceive 334b that 'both come-to-be out of flesh' in that manner, but only as a stone and a brick 'both come-to-be out of a wall'—viz. each out of a different place or part. Similarly (*b*) even for those who postulate a single matter of their 'elements' there is a certain difficulty in explaining how anything is to result from two of them taken together—e.g. from 'cold' and 'hot', or from Fire and Earth. For if flesh consists of both and is neither of them, nor again is a 'composition' of them in which they are preserved unaltered, what alternative is left except to identify the resultant of the two 'elements' with their matter? For the passing-away of either 'element' produces *either* the other *or* the matter.

Perhaps we may suggest the following solution. (i) There are differences of degree in hot and cold. Although, therefore, when either is fully real without qualification, the other will exist potentially; yet, when neither exists in the full completeness of its being, but both by combining destroy one another's excesses so that there exist instead a hot which (for a 'hot') is cold and a cold which (for a 'cold') is hot; then what results from these two contraries will be neither their matter, nor either of them existing in its full reality without qualification. There will result instead an 'intermediate': and this 'intermediate', according as it is potentially more hot than cold or *vice versa*, will possess a power-of-heating that is double or triple its power-of-cooling, or otherwise related thereto in some similar ratio.

Thus all the other bodies will result from the contraries, or rather from the 'elements', in so far as these have been 'combined': while the 'elements' will result from the contraries, in so far as these 'exist potentially' in a special sense—not as matter 'exists potentially', but in the sense explained above. And when a thing comes-to-be in *this* manner, the process is 'combination'; whereas what comes-to-be in the other manner[1] is matter. Moreover (ii) contraries also 'suffer action', in accordance with the disjunctively-articulated definition established in the early part of this work.[2] For the actually-hot is potentially-cold and the actually-cold potentially-hot; so that hot and cold, unless they are equally balanced, are transformed into one another (and all the other contraries behave in a similar way). It is thus, then, that *in the first place* the 'elements' are transformed; and that (*in the second place*)[3] out of the 'elements' there come-to-be flesh and bones and the like—the hot becoming cold and the cold becoming hot when they[4] have been brought to the 'mean'. For at the 'mean' is neither hot nor cold. The 'mean', however, is of considerable extent and not indivisible.[5] Similarly, it is *qua* reduced to a 'mean' condition that the dry and the moist, as well as the contraries we have used as examples, produce flesh and bone and the remaining compounds.

All the compound bodies—all of which exist in the region belonging to the central body[6]—are composed of all the 'simple' bodies. For they all contain Earth because every 'simple' body is to be found specially and most abundantly in its own place. And they all contain Water because (*a*) the compound must possess a definite outline 8

[1] *sc.* in the only manner which was taken into account in the formulation of the problem at 334b 6–7.

[2] Cf. above, I. 7, where Aristotle explains the precise sense in which action-passion is between contraries, and under what conditions contraries in 'acting' are themselves 'acted upon' by their patients.

[3] There is no expressed εἶτα (answering to πρῶτον in b 24) but it is implied.

[4] *sc.* these extremes, the completely-hot and the completely-cold.

[5] i.e. the 'mean' is a *stretch*, not a *point*.

[6] Or perhaps 'in the region about the centre'.

and Water, alone of the 'simple' bodies, is readily adaptable in shape: moreover (*b*) Earth has no power of cohesion without the moist. On the contrary, the moist is what holds it together; for it would fall to pieces if the moist were eliminated from it completely. 335a

They contain Earth and Water, then, for the reasons we have given: and they contain Air and Fire, because these are contrary to Earth and Water (Earth being contrary to Air and Water to Fire, in so far as one Substance can be 'contrary' to another). Now all compounds presuppose in their coming-to-be constituents which are contrary to one another: and in all compounds there is contained one set of the contrasted extremes.[1] Hence the other set[2] must be contained in them also, so that every compound will include all the 'simple' bodies.

Additional evidence seems to be furnished by the food each compound takes. For all of them are fed by substances which are the same as their constituents, and all of them are fed by more substances than one. Indeed, even the plants, though it might be thought they are fed by one substance only, viz. by Water, are fed by more than one: for Earth has been mixed with the Water. That is why farmers too endeavour to mix before watering.[3]

Although food is akin to the matter, that which is fed is the 'figure'—i.e. the 'form'—taken along with the matter.[4] This fact enables us to understand why, whereas all the 'simple' bodies come-to-be out of one another, Fire is the only one of them which (as our predecessors also assert) 'is fed'.[5] For Fire alone—or more than all the rest—is akin to the 'form' because it tends by nature to be borne towards the limit. Now each of them naturally tends to be borne towards its own place: but the 'figure'—i.e. the 'form'—of them all is at the limits.

[1] i.e. cold-dry (Earth) and cold-moist (Water).

[2] i.e. hot-moist (Air) and hot-dry (Fire).

[3] Plants are nourished *naturally* by water impregnated with earth and *artificially* by water mixed with manure, which is a kind of earth.

[4] Cf. above, 321^{b} 16—322^{a} 33.

[5] Cf. *de Vita et Morte* 469^{b} 21 ff., *Meteor.* 354^{b} 33 ff.; Theophrastos, fr. iii. 1, § 4 (Wimmer, iii, p. 51).

Thus we have explained that all the compound bodies are composed of all the 'simple' bodies.

Since some things are such as to come-to-be and pass- 9
away, and since coming-to-be in fact occurs in the region about the centre, we must explain the *number* and the *nature* of the 'originative sources' of all coming-to-be alike:[1] for a grasp of the true theory of any universal facilitates the understanding of its specific forms.

The 'originative sources', then, of the things which come-to-be are equal in number to, and identical in kind with, those in the sphere of the eternal and primary things. For there is *one* in the sense of 'matter', and a *second* in the sense of 'form': and, in addition, the *third* 'originative source' must be present as well. For the two first are not sufficient to bring things into being, any more than they are adequate to account for the primary things.

Now cause, in the sense of material origin, for the things which are such as to come-to-be is 'that which can be-and-not-be': and this is identical with 'that which can come-to-be-and-pass-away', since the latter, while it *is* at one time, at another time *is not*. (For whereas some things *are* of necessity, viz. the eternal things, others of necessity *are not*. And of these two sets of things, since they cannot
335b diverge from the necessity of their nature, it is impossible for the first *not to be* and impossible for the second *to be*. Other things, however, can both *be* and *not be*.) Hence coming-to-be and passing-away must occur within the field of 'that which can be-and-not-be'. This, therefore, is cause in the sense of material origin for the things which are such as to come-to-be; while cause, in the sense of their 'end', is their 'figure' or 'form'—and that is the formula expressing the essential nature of each of them.

But the third 'originative source' must be present as well—the cause vaguely dreamed of by all our predecessors,

[1] Cf. above, 314a 2 and 318a 25–27.

definitely stated by none of them. On the contrary (*a*) some amongst them thought the nature of 'the Forms' was adequate to account for coming-to-be. Thus Sokrates in the *Phaedo* first blames everybody else for having given no explanation;[1] and then lays it down that 'some things are Forms, others Participants in the Forms', and that 'while a thing is said to "be" in virtue of the Form, it is said to "come-to-be" *qua* "sharing in", to "pass-away" *qua* "losing", the Form'. Hence he thinks that 'assuming the truth of these theses, the Forms *must* be causes both of coming-to-be and of passing-away'.[2] On the other hand (*b*) there were others who thought 'the matter' was adequate by itself to account for coming-to-be, since 'the movement originates from the matter'.

Neither of these theories, however, is sound. For (*a*) if the Forms are causes, why is their generating activity intermittent instead of perpetual and continuous—since there always *are* Participants as well as Forms? Besides, in some instances we *see* that the cause is other than the Form. For it is the doctor who implants health and the man of science who implants science, although 'Health itself' and 'Science itself' *are* as well as the Participants: and the same principle applies to everything else that is produced in accordance with an art. On the other hand (*b*) to say that 'matter generates owing to its movement' would be, no doubt, more scientific than to make such statements as are made by the thinkers we have been criticizing. For what 'alters' and transfigures plays a greater part[3] in bringing things into being; and we are everywhere accustomed, in the products of nature and of art alike, to look upon that which can initiate movement as the producing cause. Nevertheless this second theory is not right either.

For, to begin with, it is characteristic of matter to suffer action, i.e. to be moved: but to move, i.e. to act, belongs to a different 'power'.[4] This is obvious both in the things

[1] Cf. Plato, *Phaedo* 96 a–99 c. [2] Cf. Plato, *Phaedo* 100 b–101 e.

[3] *sc.* than the Forms.

[4] Matter is a δύναμις in the passive sense: that which initiates movement is a δύναμις in the sense of an active force. Cf. e.g. *Metaph.* 1046a 9–29, 1048a 25–b 9.

that come-to-be by art and in those that come-to-be by nature. Water does not of itself produce out of itself an animal: and it is the art, not the wood, that makes a bed. Nor is this their only error. They make a second mistake in omitting the more controlling cause: for they
336a eliminate the essential nature, i.e. the 'form'. And what is more, since they remove the formal cause, they invest the forces they assign to the 'simple' bodies—the forces which enable these bodies to bring things into being—with too instrumental a character. For 'since' (as they say) 'it is the nature of the hot to dissociate, of the cold to bring together, and of each remaining contrary either to act or to suffer action', it is out of such materials and by their agency (so they maintain) that everything else comes-to-be and passes-away. Yet *(a)* it is evident that even Fire is itself moved, i.e. suffers action. Moreover *(b)* their procedure is virtually the same as if one were to treat the saw (and the various instruments of carpentry) as 'the cause' of the things that come-to-be: for the wood *must* be divided if a man saws, *must* become smooth if he planes, and so on with the remaining tools. Hence, however true it may be that Fire is active, i.e. sets things moving, there is a further point they fail to observe—viz. that Fire is inferior to the tools or instruments in the manner in which it sets things moving.

As to our own theory—we have given a general account of the causes in an earlier work,[1] and we have now explained and distinguished the 'matter' and the 'form'.[2] Further, since the change which is motion has been proved[3] to be eternal, the continuity of the occurrence of coming-to-be follows necessarily from what we have established: for the eternal motion, by causing 'the generator'[4] to approach and retire, will produce coming-to-be uninterruptedly. At the same time it is clear that we were also right when, in an earlier work,[5] we called motion (not coming-to-be) 'the primary form of change'. For it is far more reason-

[1] Cf. *Physics* B. 3–9.
[2] Cf. above, 335a 32–b 7.
[3] Cf. *Physics* Θ. 7–9.
[4] i.e. the sun, as will appear presently.
[5] Cf. *Physics* 260a26–261a26.

able that *what is* should cause the coming-to-be of *what is not*, than that *what is not* should cause the being of *what is*. Now that which is being moved *is*, but that which is coming-to-be *is not*: hence, also, motion is prior to coming-to-be.

We have assumed, and have proved,[1] that coming-to-be and passing-away happen to things continuously; and we assert that motion causes coming-to-be. That being so, it is evident that, if the motion be single, *both* processes cannot occur since they are contrary to one another: for it is a law of nature that the same cause, provided it remain in the same condition, always produces the same effect, so that, from a single motion, either coming-to-be or passing-away will always result. The movements must, on the contrary, be more than one, and they must be contrasted with one another either by the sense of their motion[2] or by its irregularity:[3] for contrary effects demand contraries as their causes.

This explains why it is not the primary motion[4] that causes coming-to-be and passing-away, but the motion along the inclined circle:[5] for this motion not only possesses the necessary continuity, but includes a duality of movements as well. For if coming-to-be and passing-away are 336b
always to be continuous, there must be some body always being moved (in order that these changes may not fail) and moved with a duality of movements (in order that both changes, not one only, may result). Now the continuity of this movement is caused by the motion of the whole:[6] but the approaching and retreating of the moving body are caused by the inclination.[7] For the consequence of the inclination is that the body becomes alternately remote and near; and since its distance is thus unequal, its movement will be irregular. Therefore, if it generates by approaching and by its proximity, it—this very same body—

[1] Cf. above, 317^b 33 ff. [2] Cf. *de Caelo* 270^b 32—271^a 33.
[3] Cf. *de Caelo* 288^a 13-27; *Physics* 228^b 15—229^a 6.
[4] i.e. the revolution of the πρῶτος οὐρανός.
[5] i.e. the annual movement of the sun in the ecliptic or zodiac circle.
[6] i.e. the revolution of the πρῶτος οὐρανός (the outermost sphere) which carries along with it all the concentric spheres.
[7] i.e. the inclination of the ecliptic to the equator of the outermost sphere, which (on Aristotle's theory) is the equator of the universe and is in the same plane as the terrestrial equator.

destroys by retreating and becoming remote: and if it generates by many successive approaches, it also destroys by many successive retirements. For contrary effects demand contraries as their causes; and the natural processes of passing-away and coming-to-be occupy equal periods of time. Hence, too, the times—i. e. the lives—of the several kinds of living things have a number by which they are distinguished: for there is an Order controlling all things, and every time (i. e. every life) is measured by a period. Not all of them, however, are measured by the same period, but some by a smaller and others by a greater one: for to some of them the period, which is their measure, is a year, while to some it is longer and to others shorter.

And there are facts of observation in manifest agreement with our theories. Thus we see that coming-to-be occurs as the sun approaches and decay as it retreats; and we see that the two processes occupy equal times. For the durations of the natural processes of passing-away and coming-to-be are equal. Nevertheless it often happens that things pass-away in too short a time. This is due to the 'intermingling' by which the things that come-to-be and pass-away are implicated with one another. For their matter is 'irregular', i. e. is not everywhere the same: hence the processes by which they come-to-be must be 'irregular' too, i. e. some too quick and others too slow. Consequently the phenomenon in question occurs, because the 'irregular' coming-to-be of these things is the passing-away of other things.[1]

Coming-to-be and passing-away will, as we have said, always be continuous, and will never fail owing to the cause we stated.[2] And this continuity has a sufficient reason on our theory. For in all things, as we affirm, Nature always strives after 'the better'. Now 'being' (we have explained elsewhere[3] the exact variety of meanings we recognize in this term) is better than 'not-being': but not all things can possess 'being', since they are too far removed from the 'originative source'. God therefore adopted the remaining

[1] For the reading and interpretation of 336b 20–24 see my text and commentary.
[2] Cf. above, 318a 9 ff.
[3] Cf. e.g. *Metaph.* 1017a 7 ff.

alternative, and fulfilled the perfection of the universe by making coming-to-be uninterrupted: for the greatest possible coherence would thus be secured to existence, because that 'coming-to-be should itself come-to-be perpetually' is the closest approximation to eternal being.

The cause of this perpetuity of coming-to-be, as we have often said, is circular motion: for that is the only motion 337a
which is continuous. That, too, is why all the other things—the things, I mean, which are reciprocally transformed in virtue of their 'passions' and their 'powers of action', e.g. the 'simple' bodies—imitate circular motion. For when Water is transformed into Air, Air into Fire, and the Fire back into Water, we say the coming-to-be 'has completed the circle', because it reverts again to the beginning. Hence it is by imitating circular motion that rectilinear motion too is continuous.

These considerations serve at the same time to explain what is to some people a baffling problem—viz. why the 'simple' bodies, since each of them is travelling towards its own place, have not become dissevered from one another in the infinite lapse of time. The reason is their reciprocal transformation. For, had each of them persisted in its own place instead of being transformed by its neighbour, they would have got dissevered long ago. They are transformed, however, owing to the motion with its dual character:[1] and because they are transformed, none of them is able to persist in any place allotted to it by the Order.[2]

It is clear from what has been said (i) that coming-to-be and passing-away actually occur, (ii) what causes them, and (iii) what subject undergoes them. But (*a*) if there is to be movement (as we have explained elsewhere, in an earlier work[3]) there must be something which initiates it; if there is to be movement always, there must always be something which initiates it; if the movement is to be continuous, what initiates it must be single, unmoved, ungenerated, and

[1] The sun's annual movement, by which it alternately approaches and retreats, causes the alternate ascent and descent of Water, Air, and Fire. They are thus brought into contact, with the result that their constitutive contrary qualities act and suffer action reciprocally, and the 'simple' bodies themselves are transformed.

[2] Cf. above, 336^{b} 12.

[3] *Physics* 255^{b} 31—260^{a} 10. Cf. also *Metaph.* 1072^{a} 19—1074^{b} 14.

incapable of 'alteration'; and if the circular[1] movements are more than one, their initiating causes[2] must all of them, in spite of their plurality, be in some way subordinated to a single 'originative source'. Further (*b*) since time is continuous, movement must be continuous, inasmuch as there can be no time without movement. Time, therefore, is a 'number'[3] of some continuous movement—a 'number', therefore, of the circular movement, as was established in the discussions at the beginning.[4] But (*c*) is movement[5] continuous because of the continuity of that which is moved, or because that in which the movement occurs (I mean, e.g., the place or the quality) is continuous? The answer must clearly be 'because that which is moved is continuous'. (For how can the quality be continuous except in virtue of the continuity of the thing to which it belongs? But if the continuity of 'that in which' contributes to make the movement continuous, this is true only of 'the place in which'; for that has 'magnitude' in a sense.) But (*d*) amongst continuous bodies which are moved, only that which is moved in a circle is 'continuous' in such a way that it preserves its continuity with itself throughout the movement. The conclusion therefore is that *this* is what produces continuous movement, viz. the body which is being moved in a circle; and its movement makes time continuous.

Wherever there is continuity in any process (coming-to- 11
be or 'alteration' or any kind of change whatever) we
337b observe 'consecutiveness', i.e. *this* coming-to-be after *that* without any interval. Hence we must investigate whether, amongst the consecutive members, there is any whose future being is necessary; or whether, on the contrary, every one

[1] i.e. the supposed continuous movements which, *qua* continuous, must be circular.

[2] I follow Philoponos and Pacius in referring *ταύτας* (a 21) to the *ἀρχαί* which the circular movements imply.

[3] i.e. time is that which is *numerable* (*ἀριθμός* = *τὸ ἀριθμούμενον* or *τὸ ἀριθμητόν*, not *ᾧ ἀριθμοῦμεν*) in continuous movement: cf. *Physics* 219b 1–8.

[4] *sc.* at the beginning of Aristotle's 'Philosophy of Nature': cf. *Physics* 217b 29—224a 17.

[5] Aristotle uses *κίνησις* in its general sense, in which it includes *ἀλλοίωσις* and *αὔξησις* as well as *φορά*, but he is thinking primarily of *φορά*.

of them may fail to come-to-be. For that some of them may fail to occur, is clear. (*a*) We need only appeal to the distinction between the statements '*x* will be' and '*x* is about to . . .', which depends upon this fact. For if it be true to say of *x* that it 'will be', it must at some time be true to say of it that 'it is': whereas, though it be true to say of *x now* that 'it is about to occur', it is quite possible for it not to come-to-be—thus a man might not walk, though he is now 'about to' walk. And (*b*) since (to appeal to a general principle) amongst the things which 'are' some are capable also of 'not-being', it is clear that the same ambiguous character will attach to them no less when they are coming-to-be: in other words, their coming-to-be will not be necessary.

Then are all the things that come-to-be of this contingent character? Or, on the contrary, is it absolutely necessary for some of them to come-to-be? Is there, in fact, a distinction in the field of 'coming-to-be' corresponding to the distinction, within the field of 'being', between things that cannot possibly 'not-be' and things that can 'not-be'? For instance, is it necessary that solstices shall come-to-be, i. e. impossible that they should fail to be able to occur?

Assuming that the antecedent must have come-to-be if the consequent is to be (e. g. that foundations must have come-to-be if there is to be a house: clay, if there are to be foundations), is the converse also true? If foundations have come-to-be, must a house come-to-be? The answer seems to be that the necessary *nexus* no longer holds, unless it is 'necessary' for the consequent (as well as for the antecedent)[1] to come-to-be—'necessary' *absolutely*. If that be the case, however, 'a house must come-to-be if foundations have come-to-be', as well as *vice versa*. For the antecedent was assumed to be so related to the consequent that, if the latter is to be, the antecedent must have come-to-be before it. If, therefore, it is necessary that the consequent should come-to-be, the antecedent also must have come-to-be: and if the antecedent has come-to-be, then the conse-

[1] Cf. above, ^{b}14-15: the coming-to-be of the antecedent was *conditionally* necessary, i. e. necessarily presupposed in the being of the consequent.

quent also must come-to-be—not, however, because of the antecedent, but because the future being of the consequent was assumed as necessary. Hence, in any sequence, when the being of the consequent is necessary, the *nexus* is reciprocal—in other words, when the antecedent has come-to-be the consequent must always come-to-be too.

Now (i) if the sequence of occurrences is to proceed *ad infinitum* 'downwards',[1] the coming-to-be of any determinate 'this' amongst the later members of the sequence will not be *absolutely*, but only *conditionally*, necessary. For it will always be necessary that some other[2] member shall have come-to-be before 'this' as the presupposed condition of the necessity that 'this' should come-to-be: consequently, since what is 'infinite' has no 'originative source', neither will there be in the infinite sequence any 'primary' member which will make it 'necessary' for the remaining members to come-to-be.[3]

Nor again (ii) will it be possible to say with truth, even in regard to the members of a limited sequence, that it is 'absolutely necessary' for any one of them to come-to-be. We cannot truly say, e.g., that 'it is absolutely necessary for a house to come-to-be when foundations have been laid': for (unless it is *always* necessary for a house to be coming-to-be) we should be faced with the consequence that, when foundations have been laid, a thing, which need not always be, must always be. No: if its coming-to-be is to be 'necessary', it must be 'always' in its coming-to-be. For what is 'of necessity' coincides with what is 'always',
338a since that which 'must be' cannot possibly 'not-be'. Hence a thing is eternal if its 'being' is necessary: and if it is eternal, its 'being' is necessary. And if, therefore, the 'coming-to-be' of a thing is necessary, its 'coming-to-be' is eternal; and if eternal, necessary.

It follows that the coming-to-be of anything, if it is absolutely necessary, must be cyclical—i. e. must return

[1] i. e. so that effect *will* succeed effect endlessly.

[2] i. e. some other *still later* member of the sequence.

[3] i. e. the infinite sequence will not contain any absolutely necessary member which will serve as the ground of the conditional necessity of the other members. The 'primary' member or ἀρχή, in the sequence proceeding *ad infinitum* 'downwards', would have to be a τέλος—i. e. an absolutely necessary 'end-event'.

upon itself. For coming-to-be must either be limited or not limited: and if not limited, it must be either rectilinear or cyclical. But the first of these last two alternatives is impossible if coming-to-be is to be eternal, because there could not be any 'originative source' whatever in an infinite rectilinear sequence, whether its members be taken 'downwards' (as future events) or 'upwards' (as past events). Yet coming-to-be must have an 'originative source' ⟨if it is to be necessary and therefore eternal⟩,[1] nor can it be eternal if it is limited.[2] Consequently it must be cyclical. Hence the *nexus* must be reciprocal. By this I mean that the necessary occurrence of 'this' involves the necessary occurrence of its antecedent: and conversely that, given the antecedent, it is also necessary for the consequent to come-to-be. And this reciprocal *nexus* will hold continuously throughout the sequence: for it makes no difference whether the reciprocal *nexus*, of which we are speaking, is mediated by two, or by many, members.

It is in circular movement, therefore, and in cyclical coming-to-be that the 'absolutely necessary' is to be found. In other words, if the coming-to-be of any things is cyclical, it is 'necessary' that each of them is coming-to-be and has come-to-be: and if the coming-to-be of any things is 'necessary', their coming-to-be is cyclical.

The result we have reached is logically concordant with the eternity of circular motion, i.e. the eternity of the revolution of the heavens (a fact which approved itself on other and independent evidence),[3] since precisely those movements which belong to, and depend upon, this eternal 338b
revolution 'come-to-be' of necessity, and of necessity 'will be'. For since the revolving body is always setting something else in motion, the movement of the things it moves must also be circular. Thus, from the being of the 'upper revolution' it follows that the sun revolves in this determinate manner; and since the sun revolves *thus*, the seasons in consequence come-to-be in a cycle, i.e. return upon themselves; and since they come-to-be cyclically, so in

[1] A clause to this effect seems to have dropped out after ἀρχήν in [a] 10.
[2] On the reading and interpretation see my text and commentary.
[3] Cf. *Physics* Θ. 7-9.

their turn do the things whose coming-to-be the seasons initiate.

Then why do some things manifestly come-to-be in this cyclical fashion (as, e. g., showers and air, so that it must rain if there is to be a cloud and, conversely, there must be a cloud if it is to rain), while men and animals do not 'return upon themselves' so that the same individual comes-to-be a second time (for though your coming-to-be presupposes your father's, his coming-to-be does not presuppose yours)? Why, on the contrary, does this coming-to-be seem to constitute a rectilinear sequence?

In discussing this new problem, we must begin by inquiring whether all things 'return upon themselves' in a uniform manner; or whether, on the contrary, though in some sequences what recurs is *numerically* the same, in other sequences it is the same *only in species*.[1] In consequence of this distinction, it is evident that those things, whose 'substance'—that which is undergoing the process—is imperishable, will be numerically, as well as specifically, the same in their recurrence: for the character of the process is determined by the character of that which undergoes it. Those things, on the other hand, whose 'substance' is perishable (not imperishable) must 'return upon themselves' in the sense that what recurs, though specifically the same, is not the same numerically. That is why, when Water comes-to-be from Air and Air from Water, the Air is the same 'specifically', not 'numerically': and if these too recur numerically the same,[2] at any rate this does not happen with things whose 'substance' comes-to-be—whose 'substance' is such that it is essentially capable of not-being.

[1] i. e. in some cycles the same individual eternally recurs: in others the same *species* or *specific form* is eternally represented in the succession of its perishing individual embodiments.

[2] As, e. g., a follower of Empedokles would maintain.

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DE CAELO

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OXFORD
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PREFACE

THIS translation was begun many years ago in co-operation with Mr. H. B. Wallis of the Board of Education. Unfortunately he was obliged to turn to other work, but his original draft formed the basis of nearly half my version of the book.

Rather full textual notes are given throughout, the text of Prantl being taken as basis. (A complete table of the passages dealt with will be found in the Index, *s.v.* Text.) For this purpose I have collated the Vienna MS., J, from a photograph, and the reading of this MS. is noted in each case, either explicitly or by implication.

Mr. Ross's generous conception of an editor's responsibilities has been of the greatest service. He has saved me from many mistakes and has made many useful suggestions for the improvement of the translation. A few of his suggestions will be found recorded in the foot-notes as his; but for the most part he is merged in his translator.

J. L. S.

31*st March*, 1922.

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DE CAELO

BOOK I

1 THE science which has to do with nature clearly concerns itself for the most part with bodies and magnitudes and their properties and movements, but also with the principles of this sort of substance, as many as they may be. For of things constituted by nature some are bodies and magnitudes, some possess body and magnitude,[1] and some are principles of things which possess these.[2] Now a continuum is that which is divisible into parts always capable of subdivision, and a body is that which is every way divisible. A magnitude if divisible one way is a line, if two ways a surface, and if three a body. Beyond these there is no other magnitude, because the three dimensions are all that there are, and that which is divisible in three directions is divisible in all. For, as the Pythagoreans say, the world and all that is in it is determined by the number three, since beginning and middle and end give the number of an 'all', and the number they give is the triad. And so, having taken these three[3] from nature as (so to speak) laws of it, we make further use of the number three in the worship of the Gods.[4] Further, we use the terms in practice in this way. Of two things, or men, we say 'both', but not 'all': three is the first number to which the term 'all' has been appropriated.[5] And in this, as we have said, we do but follow the lead which nature gives. Therefore, since 'every' and 'all' and 'complete' do not differ from one another in respect of form, but only, if at all,[6] in their 268a

[1] i. e. animate things, such as plants and animals.

[2] e. g. matter and form, movement, or, in the case of living things, soul.

[3] Viz. beginning, middle, and end.

[4] Oaths, for instance, usually appeal to three Gods, as in the Homeric appeal to Zeus, Athene, and Apollo (Prantl).

[5] Reading εἰλήφαμεν with E and Prantl. The other MSS. have φαμέν (FLM) or κατάφαμεν (HJ).

[6] Reading εἴπερ ἄρα with FHMJ.

matter and in that to which they are applied, body alone among magnitudes can be complete. For it alone is determined by the three dimensions, that is, is an 'all'.[1] But if it is divisible in three dimensions it is every way divisible, while the other magnitudes are divisible in one dimension or in two alone: for the divisibility and continuity of magnitudes depend upon the number of the dimensions, one sort being continuous in one direction, another in two, another in all. All magnitudes, then, which are divisible are also continuous. Whether we can also say that whatever is continuous is divisible does not yet, on our present grounds, appear. One thing, however, is clear. We cannot
268b pass beyond body to a further kind, as we passed from length to surface, and from surface to body. For if we could, it would cease to be true that body is complete magnitude. We could pass beyond it only in virtue of a defect in it; and that which is complete cannot be defective, since it has being in every respect.[2] Now bodies which are classed as parts of the whole[3] are each complete according to our formula, since each possesses every dimension. But each is determined relatively to that part which is next to it by contact, for which reason each of them is in a sense many bodies. But the whole of which they are parts must necessarily be complete, and thus, in accordance with the meaning of the word, have being, not in some respects only, but in every respect.[4]

The question as to the nature of the whole, whether it is 2
infinite in size or limited in its total mass, is a matter for

[1] Body alone is so determined, and only what is so determined is a totality (an 'all'). Put a comma, instead of a full stop, after τρισίν. The words τοῦτο δ' ἐστὶ πᾶν are difficult to interpret. Prantl makes τοῦτο predicate, and translates as though we had τὸ πᾶν instead of πᾶν. Simplicius gives no help.

[2] To be incomplete or defective is to lack being in some respect.

[3] i. e. the elements.

[4] The 'parts' or elements are bodies, and therefore complete in the sense just given to the word. They are, however, only parts, and as such limited in their being by the juxtaposition of other parts. This suggests a development of the notion of completeness which will make the term 'complete' applicable only to the unrestricted being of the whole.

subsequent inquiry.[1] We will now speak of those parts of the whole which are specifically distinct.[2] Let us take this as our starting-point. All natural bodies and magnitudes we hold to be, as such, capable of locomotion; for nature, we say, is their principle of movement.[3] But all movement that is in place, all locomotion, as we term it, is either straight or circular or a combination of these two, which are the only simple movements. And the reason of this is that these two, the straight and the circular line, are the only simple magnitudes. Now revolution about the centre is circular motion, while the upward and downward movements are in a straight line, 'upward' meaning motion away from the centre, and 'downward' motion towards it. All simple motion, then, must be motion either away from or towards or about the centre. This seems to be in exact accord with what we said above:[4] as body found its completion in three dimensions, so its movement completes itself in three forms.

Bodies are either simple or compounded of such; and by simple bodies I mean those which possess a principle of movement in their own nature, such as fire and earth with their kinds, and whatever is akin to them.[5] Necessarily, then, movements also will be either simple or in some sort compound—simple in the case of the simple bodies, com- 269a
pound in that of the composite—and in the latter case the motion will be that of the simple body which prevails in the composition. Supposing, then, that there is such a thing as simple movement, and that circular movement is an instance of it, and that both movement of a simple body is simple and

[1] See c. vii.

[2] i. e. the elements, which represent the ultimate distinctions of kind among bodies.

[3] Cf. *Phys.* 192b 20.

[4] Reading ἠκολουθηκέναι κατὰ λόγον with all MSS. except E.

[5] Τὰ τούτων εἴδη ('with their kinds') can hardly mean *kinds of* fire and earth (e.g. sandy and stony earth, flame and glowing coal), as Simplicius supposes, for there is no variety of movement corresponding to this variety of kind. Rather, as Alexander supposes, the phrase is a generalizing formula (ἀντὶ τοῦ καθόλου πᾶν πῦρ . . . καὶ καθόλου πᾶσαν γῆν): fire and its kind, earth and its. kind, and other species of the same genus (viz. air and water, and the 'fifth body' of which the stars are made).

[redacted]

simple movement is of a simple body (for if it is movement of a compound it will be in virtue of a prevailing simple element), then there must necessarily be some simple body which revolves naturally and in virtue of its own nature[1] with a circular movement. By constraint, of course, it may be brought to move with the motion of something else different from itself, but it cannot so move naturally, since there is one sort of movement natural to each of the simple bodies. Again, if the unnatural movement is the contrary of the natural and a thing can have no more than one contrary, it will follow that circular movement, being a simple motion, must be unnatural, if it is not natural, to the body moved. If then (1) the body, whose movement is circular, is fire or some other element, its natural motion must be the contrary of the circular motion. But a single thing has a single contrary; and upward and downward motion are the contraries of one another.[2] If, on the other hand, (2) the body moving with this circular motion which is unnatural to it is something different from the elements, there will be some other motion which is natural to it. But this cannot be. For if the natural motion is upward, it will be fire or air, and if downward, water or earth. Further, this circular motion is necessarily primary. For the perfect is naturally prior to the imperfect, and the circle is a perfect thing. This cannot be said of any straight line:—not of an infinite line; for, if it were perfect, it would have a limit and an end: nor of any finite line; for in every case there is something beyond it,[3] since any finite line can be extended. And so, since the prior movement belongs to the body which is naturally prior, and circular movement is prior to straight, and movement in a straight line belongs to simple bodies—fire moving straight upward and earthy bodies straight downward towards the centre—since this is so, it follows that circular movement also must

[1] Reading ἑαυτοῦ with all MSS. except E.

[2] Therefore neither of these can be *also* the contrary of circular motion. Thus there is *no* simple motion opposed as contrary to the circular.

[3] Reading πασῶν γάρ ἐστί τι ἐκτός (ἐστί is omitted by E alone).

be the movement of some simple body.[1] For the movement of composite bodies is, as we said, determined by that simple body which preponderates in the composition. These premises clearly give the conclusion that there is in nature some bodily substance other than the formations we know, prior to them all and more divine than they. But it may also be proved as follows. We may take it that all movement is either natural or unnatural, and that the movement which is unnatural to one body is natural to another—as, for instance, is the case with the upward and downward movements, which are natural and unnatural to fire and earth respectively. It necessarily follows that circular movement, being unnatural to these bodies, is the natural movement of some other. Further, if, on the one hand, circular movement is *natural* to something, it must surely be some simple and primary body which is ordained to move with a natural circular motion, as fire is ordained to fly up and earth down. If, on the other hand, the movement of the rotating bodies about the centre is *unnatural*, it would be remarkable and indeed quite inconceivable that this movement alone should be continuous and eternal, being nevertheless contrary to nature. At any rate the evidence of all other cases goes to show that it is the unnatural which quickest passes away. And so, if, as some say, the body so moved is fire, this movement is just as unnatural to it as downward movement; for any one can see that fire moves in a straight line away from the centre. On all these grounds, therefore, we may infer with confidence that there is something beyond the bodies that are about us on this earth, different and separate from them; and that the superior glory of its nature is proportionate to its distance from this world of ours.[2]

[1] From his premises Aristotle is here entitled to conclude, not merely that circular movement is the movement of a simple body, but also that it is the movement of a simple body prior to the other simple bodies. Prantl therefore inserts προτέρου after τινός and appeals to Simplicius's paraphrase for corroboration. Simplicius, however, not only does not corroborate the conjecture but actually points out that this part of the conclusion is suppressed (ὅπερ ὡς σαφὲς παρῆκε). The insertion of προτέρου does not really make the argument any clearer.

[2] Cf. Plato, *Phaedo*, 111 B.

In consequence of what has been said, in part by way of 3
assumption and in part by way of proof, it is clear that not every body either possesses lightness or heaviness. As a preliminary we must explain in what sense we are using the words 'heavy' and 'light', sufficiently, at least, for our present purpose:[1] we can examine the terms more closely later, when we come to consider their essential nature.[2] Let us then apply the term 'heavy' to that which naturally moves towards the centre, and 'light' to that which moves naturally away from the centre. The heaviest thing will be that which sinks to the bottom of all things that move downward, and the lightest that which rises to the surface of everything that moves upward. Now, necessarily,[3] everything which moves either up or down possesses lightness or heaviness or both—but not both relatively to the same thing: for things are heavy and light relatively to one another; air, for instance, is light relatively to water, and water light relatively to earth. The body, then, which moves in a circle cannot possibly possess either heaviness or lightness. For neither naturally nor unnaturally can it move either towards or away from the centre. Movement in a straight line certainly does not belong to it *naturally*, since one sort of movement is, as we saw, appropriate to each simple body, and so we should be compelled to identify it with one of the bodies which move in this way. Suppose, then, that the movement is *unnatural*. In that case, if it is
270a the downward movement which is unnatural, the upward movement will be natural; and if it is the upward which is unnatural, the downward will be natural. For we decided that of contrary movements, if the one is unnatural to anything, the other will be natural to it. But since the natural movement of the whole and of its part—of earth, for instance, as a whole and of a small clod—have one and the same direction, it results, in the first place, that this body can possess no lightness or heaviness at all (for that would mean that it could move by its own nature either from or

[1] Reading ἱκανῶς ὡς πρὸς (ὡς is omitted by E alone).
[2] Below, Bk. IV, cc. i–iv.
[3] Reading ἀνάγκη δή (δέ is in F alone).

towards the centre, which, as we know, is impossible); and, secondly, that it cannot possibly move in the way of locomotion by being forced violently aside in an upward or downward direction. For neither naturally nor unnaturally can it move with any other motion but its own, either itself or any part of it, since the reasoning which applies to the whole applies also to the part.

It is equally reasonable to assume that this body will be ungenerated and indestructible and exempt from increase and alteration, since everything that comes to be comes into being from its contrary and in some substrate, and passes away likewise in a substrate by the action of the contrary into the contrary, as we explained in our opening discussions.[1] Now the motions of contraries are contrary. If then this body can have no contrary, because there can be no contrary motion to the circular, nature seems justly to have exempted from contraries the body which was to be ungenerated and indestructible. For it is in contraries that generation and decay subsist. Again, that which is subject to increase increases upon contact with a kindred body, which is resolved into its matter.[2] But there is nothing out of which this body can have been generated.[3] And if it is exempt from increase and diminution,[4] the same reasoning leads us to suppose that it is also unalterable. For alteration is movement in respect of quality; and qualitative states and dispositions, such as health and disease, do not come into being without changes of properties. But all natural bodies which change their properties we see to be subject without exception to increase and diminution. This is the case, for instance, with the bodies of animals and

[1] *Phys.* I. vii–ix. For the phrase, cf. 311a 12.

[2] Omitting καὶ τὸ φθῖνον φθίνει (l. 23). These words are omitted by three representative MSS. (EFJ), are not referred to by Simplicius or Themistius, and are an awkward intrusion in the sentence since what follows applies only to increase. For the doctrine, cf. *De Gen. et Corr.* I. v.

[3] Increase is effected by generation of one kindred body out of another. This body has no contrary out of which it can be generated. Therefore it cannot increase.

[4] Reading ἄφθιτον with H (so Prantl). All other MSS. have ἄφθαρτον; but the rare ἄφθιτον would be easily altered to the commoner word. Simplicius has ἄφθαρτον, but explains that φθίσις is a kind of φθορά and so ἄφθαρτον may be used for ἄφθιτον.

their parts and with vegetable bodies, and similarly also with those of the elements. And so, if the body which moves with a circular motion cannot admit of increase or diminution, it is reasonable to suppose that it is also unalterable.

270b The reasons why the primary body is eternal and not subject to increase or diminution, but unaging and unalterable and unmodified, will be clear from what has been said to any one who believes in our assumptions. Our theory seems to confirm experience and to be confirmed by it. For all men have some conception of the nature of the gods, and all who believe in the existence of gods at all, whether barbarian or Greek, agree in allotting the highest place to the deity, surely because they suppose that immortal is linked with immortal and regard any other supposition as inconceivable. If then there is, as there certainly is, anything divine, what we have just said about the primary bodily substance was well said. The mere evidence of the senses is enough to convince us of this, at least with human certainty. For in the whole range of time past, so far as our inherited records reach,[1] no change appears to have taken place either in the whole scheme of the outermost heaven or in any of its proper parts. The common name, too, which has been handed down from our distant ancestors even to our own day, seems to show that they conceived of it in the fashion which we have been expressing. The same ideas, one must believe, recur in men's minds not once or twice but again and again. And so, implying that the primary body is something else beyond earth, fire, air, and water, they gave the highest place a name of its own, *aither*, derived from the fact that it 'runs always'[2] for an eternity of time. Anaxagoras, however, scandalously misuses this name, taking *aither* as equivalent to fire.[3]

It is also clear from what has been said why the number

[1] Simplicius says he 'has been told' that there are written astronomical records (*ἀστρῴας τηρήσεις ἀναγράπτους*) in Egypt for the past 630,000 years and in Babylon for the past 1,440,000 years.

[2] i.e. *αἰθήρ* from *ἀεὶ θεῖν*. The derivation was suggested by Plato (*Cratylus*, 410 B).

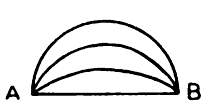
[3] i.e. deriving *αἰθήρ* from *αἴθειν*. Cf. Bk. III, 302b 4.

of what we call simple bodies cannot be greater than it is. The motion of a simple body must itself be simple, and we assert that there are only these two simple motions, the circular and the straight, the latter being subdivided into motion away from and motion towards the centre.

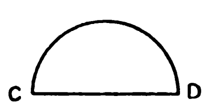
4 That there is no other form of motion opposed as contrary to the circular may be proved in various ways. In the first place, there is an obvious tendency to oppose the straight line to the circular. For concave and convex are not only regarded as opposed to one another, but they are also coupled together and treated as a unity in opposition to the straight. And so, if there is a contrary to circular motion, motion in a straight line must be recognized as having the best claim to that name. But the two forms of rectilinear motion are opposed to one another by reason of their places; for up and down is a difference and a contrary opposition in place.[1] Secondly, it may be thought that the same reasoning which holds good of the rectilinear path applies also to the circular, movement from *A* to *B* being opposed as contrary to movement from *B* to *A*. But what is meant is still rectilinear motion. For that is limited to a single path, while the circular paths which pass through the same two points are infinite in number.[2] Even if we are confined to the single semicircle and the opposition is between movement from *C* to *D* and from *D* to *C* along that semicircle, the case is no better. For the motion is the same as that along the diameter, since we invariably regard the distance between two points as the length of the straight line which joins them.[3] It is no more satisfactory to construct a circle and treat motion along one semicircle as contrary to motion along the other. For example, taking

[1] The point of this elliptical argument seems to be that, while the generally admitted case of contrary opposition (viz. that of upward and downward motion) rests on a contrary opposition of places (viz. above and below), no such ground can be suggested for the opposition of circular to rectilinear motion.

[2] FIG. I.

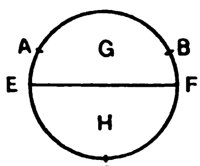


[3] FIG. II.



a complete circle, motion from *E* to *F* on the semicircle *G* may be opposed to motion from *F* to *E* on the semicircle *H*.[1] But even supposing these are contraries, it in no way follows that the reverse motions on the complete circumference are contraries. Nor again can motion along the circle from *A* to *B* be regarded as the contrary of motion from *A* to *C*:[1] for the motion goes from the same point towards the same point, and contrary motion was distinguished as motion from a contrary to its contrary.[2] And even if the motion round a circle is the contrary of the reverse motion, one of the two would be ineffective: for both move to the same point, because[3] that which moves in a circle, at whatever point it begins, must necessarily pass through all the contrary places alike. (By contrarieties of place I mean up and down, back and front, and right and left; and the contrary oppositions of movements are determined by those of places.) One of the motions, then, would be ineffective, for if the two motions were of equal strength,[4] there would be no movement either way, and if one of the two were preponderant, the other would be inoperative. So that if both bodies were there, one of them, inasmuch as it would not be moving with its own movement, would be useless, in the sense in which a shoe is useless when it is not worn. But God and nature create nothing that has not its use.[5]

[1] FIG. III.



[2] *Phys.* V. v, 229b 21.

[3] Reading ὅτι for the ἔτι of our MSS. after Simplicius, who had both readings before him.

[4] Prantl's alteration of γάρ into ἄρ' is not needed. The γάρ refers back to the remark 'one of the two would be ineffective'. That remark is therefore repeated in the text.

[5] The bearing of this argument is clear if it is remembered that the assertion of the existence of a certain movement necessarily involves for Aristotle the assertion of the existence of a body which naturally exhibits the movement. Similarly the assertion that a movement is inoperative involves the assertion that a body is inoperative.

5 This being clear, we must go on to consider the questions 271b
which remain. First, is there an infinite body, as the majority of the ancient philosophers thought, or is this an impossibility? The decision of this question, either way, is not unimportant, but rather all-important, to our search for the truth.[1] It is this problem which has practically always been the source of the differences of those who have written about nature as a whole. So it has been and so it must be; since the least initial deviation from the truth is multiplied later a thousandfold.[2] Admit, for instance, the existence of a minimum magnitude, and you will find that the minimum which you have introduced, small as it is, causes the greatest truths of mathematics to totter. The reason is that a principle is great rather in power than in extent; hence that which was small at the start turns out a giant at the end. Now the conception of the infinite possesses this power of principles, and indeed in the sphere of quantity possesses it in a higher degree than any other conception; so that it is in no way absurd or unreasonable that the assumption that an infinite body exists should be of peculiar moment to our inquiry. The infinite, then, we must now discuss, opening the whole matter from the beginning.

Every body is necessarily to be classed either as simple or as composite;[3] the infinite body, therefore, will be either simple or composite. But it is clear, further, that if the simple bodies are finite, the composite must also be finite, since that which is composed of bodies finite both in number and in magnitude is itself finite in respect of number and magnitude: its quantity is in fact the same as that of the bodies which compose it. What remains for us to consider, then, is whether any of the simple bodies can be infinite in magnitude, or whether this is impossible. Let us try the primary body first, and then go on to consider the others.

The body which moves in a circle must necessarily be finite in every respect, for the following reasons. (1) If the body so moving is infinite, the radii drawn from the centre

[1] Reading τὴν περὶ τῆς with FHMJ. The phrase recurs in this form in *Met.* 993a 30.
[2] After Plato, *Cratylus*, 436 D.
[3] The ἔσται of all other MSS. is preferable to E's εἶναι.

[redacted]

will be infinite.[1] But the space between infinite radii is infinite: and by the space between the radii I mean the area outside which no magnitude which is in contact with the two lines can be conceived as falling.[2] This, I say, will be infinite: first, because in the case of finite radii it is always
272a finite; and secondly,[3] because in it one can always go on to a width greater than any given width; thus the reasoning which forces us to believe in infinite number, because there is no maximum, applies also to the space between the radii. Now the infinite cannot be traversed, and if the body is infinite the interval between the radii is necessarily infinite: circular motion therefore is an impossibility. Yet our eyes tell us that the heavens revolve in a circle, and by argument also we have determined that there is something to which circular movement belongs.

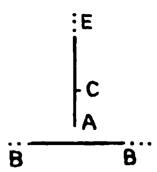
(2) Again, if from a finite time a finite time be subtracted, what remains must be finite and have a beginning. And if the time of a journey has a beginning, there must be a beginning also of the movement, and consequently also of the distance traversed. This applies universally. Take a line, *ACE*, infinite in one direction, *E*, and another line, *BB*, infinite in both directions.[4] Let *ACE* describe a circle,

[1] 'The centre', when not in any way qualified, means the centre of the earth, which is taken by Aristotle to be also the centre of all the revolutions of the heavenly bodies. He cannot here mean the centre of the supposed infinite body, since to that no shape has yet been given.

[2] The last phrase (οὗ μηδὲν ἔστιν ἔξω λαβεῖν) seems to have been misunderstood by Prantl. A comparison of this passage with others in which what is practically the same phrase occurs (esp. *Met.* 1021b 12, 1055a 12) shows (*a*) that οὗ is governed by ἔξω ('outside which'), and (*b*) that the phrase is roughly equivalent to τέλειον. The point here is that by διάστημα he means, not a straight line spanning the interval between the radii, but the whole area enclosed between the two radii and the portion of the circumference which connects their extremities. In l. 30 read, after διάστημα, δέ rather than γάρ, which is in E alone.

[3] Reading ἔτι with the MSS.; Prantl's ἐπεί seems to have nothing to recommend it. It will then be necessary to put a full-stop after διαστήματος in l. 3. This sentence gives, of course, a second reason for taking the διάστημα to be infinite.

[4] FIG. IV.



revolving upon *C* as centre. In its movement it will cut *BB* continuously for a certain time. This will be a finite time, since the total time is finite in which the heavens complete their circular orbit, and consequently the time subtracted from it, during which the one line in its motion cuts the other, is also finite. Therefore there will be a point at which *ACE* began for the first time to cut *BB*. This, however, is impossible.[1] The infinite, then, cannot revolve in a circle; nor could the world, if it were infinite.[2]

(3) That the infinite cannot move may also be shown as follows. Let *A* be a finite line moving past the finite line, *B*. Of necessity *A* will pass clear of *B* and *B* of *A* at the same moment; for each overlaps the other to precisely the same extent. Now if the two were both moving, and moving in contrary directions, they would pass clear of one another more rapidly; if one were still and the other moving past it, less rapidly; provided that the speed of the latter were the same in both cases. This, however, is clear: that it is impossible to traverse an infinite line in a finite time. Infinite time, then, would be required. (This we demonstrated above in the discussion of movement.[3]) And

[1] In this argument the ascertained fact that the revolution of the heavens occupies a limited time is used to prove the finitude of its path and consequently also of the body itself. *BB* represents an infinite line drawn within the infinite body and therefore 'traversed' by that body in its revolution. But there can be no point at which the contact of *ACE* with *BB* either begins or ends, while there is a time within which the revolution is completed. Therefore the revolving body is not infinite.—Possibly the centre of the movement of *ACE* should be *A* (as in F and Simpl.) rather than *C*.

[2] Movement of the 'world' (*κόσμος*) is here used for movement of the 'heaven' (*οὐρανός*). Either *κόσμος* stands for the heavenly body, as in *Nic. Eth.* 1141b 1, or the movement and the infinity are treated for the moment as attributes of the whole.

[3] Aristotle refers to the *Physics*, here and elsewhere, as continuous with the *De Caelo*. Different parts of the *Physics* are referred to by different names. Simplicius (p. 226, 19) observes that *Phys.* I–IV are cited as 'the discussion of principles' (*περὶ ἀρχῶν*) and *Phys.* V–VIII as 'the discussion of movement' (*περὶ κινήσεως*). In *Phys.* VIII, 257a 34, Aristotle refers back to an earlier passage as occurring *ἐν τοῖς καθόλου τοῖς περὶ φύσεως*; and Simplicius, commenting on this (*Comm. in Phys.* p. 1233, 30), 'infers' that *Phys.* I–V are the *περὶ φύσεως* and *Phys.* VI–VIII the *περὶ κινήσεως*. But his inference is false. The reference is not, as he thought, to V. iv. The principle had been asserted earlier, viz. in III. i. The 'general considerations concerning nature' may therefore be identified with the 'discussion of principles', and the *Physics* may be divided in the middle, i.e. at the end of Book IV.—The reference in this passage is to *Phys.* VI. vii.

[redacted]

it makes no difference whether a finite is passing by an
272b infinite or an infinite by a finite. For when A is passing B, then B overlaps[1] A, and it makes no difference whether B is moved or unmoved, except that, if both move, they pass clear of one another more quickly. It is, however, quite possible that a moving line should in certain cases pass one which is stationary quicker than it passes one moving in an opposite direction. One has only to imagine the movement to be slow where both move and much faster where one is stationary. To suppose one line stationary, then, makes no difficulty for our argument, since it is quite possible for A to pass B at a slower rate when both are moving than when only one is. If, therefore, the time which the finite moving line takes to pass the other is infinite, then necessarily the time occupied by the motion of the infinite past the finite is also infinite. For the infinite to move at all is thus absolutely impossible; since the very smallest movement conceivable must take an infinity of time. Moreover the heavens certainly revolve, and they complete their circular orbit in a finite time; so that they pass round the whole extent of any line within their orbit, such as the finite line AB. The revolving body, therefore, cannot be infinite.

(4) Again, as a line which has a limit cannot be infinite, or, if it is infinite, is so only in length,[2] so a surface cannot

[1] Reading κἀκείνη παραλλάττει ἐκείνην with FHMJ. The alternative to παραλλάττει, παρ', rests upon the sole authority of E: for L has παραλλάττῃ. Παρ' is intolerable, since it must stand for φέρεται παρά and thus attributes movement to B, of which in the same sentence it is said that it may be unmoved.

[2] The reading is doubtful. It is difficult to attach any other sense to the possession of πέρας ('limit') than a denial of infinity; in which case ἀλλ' εἴπερ, ἐπὶ μῆκος means 'or if a finite line is infinite, it is so in length'. The antecedent thus appears to contradict both itself and the consequent. Simplicius preserves a variant for ἐπὶ μῆκος, ἐπὶ θάτερα. ('A finite line can only be infinite, if at all, in one direction'.) —Perhaps, however, the text is correct. The sentence may be paraphrased as follows. A limited line cannot be infinite: lines, in fact, can only be infinite, if at all, in that respect in which they are unlimited: but there is nothing in the nature of 'line' to determine the length of any given line: consequently, it is only in respect to length that infinity is ever ascribed to lines. (Mr. Ross suggests that ᾗ should be read instead of ἧς in l. 17. 'A line cannot be infinite in that respect in which it is a limit.' The line is the limit of the plane, i. e. a limit in respect of breadth. Similarly the plane is the limit in respect of depth. This correction has support from the translation of Argyropylus ('ex ea parte qua finis est'), and is probably right.)

be infinite in that respect in which it has a limit; or, indeed, if it is completely determinate, in any respect whatever. Whether it be a square or a circle or a sphere, it cannot be infinite, any more than a foot-rule can. There is then no such thing as an infinite sphere or square or circle, and where there is no circle there can be no circular movement, and similarly where there is no infinite at all there can be no infinite movement; and from this it follows that, an infinite circle being itself an impossibility, there can be no circular motion of an infinite body.

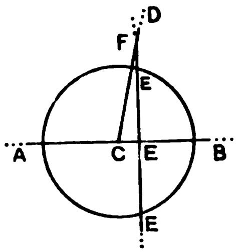
(5) Again, take a centre *C*, an infinite line, *AB*, another infinite line at right angles to it, *E*, and a moving radius, *CD*.[1] *CD* will never cease contact with *E*, but the position will always be something like *CE*, *CD* cutting *E* at *F*.[2] The infinite line, therefore, refuses to complete the circle.[3]

(6) Again, if the heaven is infinite and moves in a circle, we shall have to admit that in a finite time it has traversed the infinite. For suppose the fixed heaven infinite, and that which moves within it equal to it. It results that when the infinite body has completed its revolution, it has traversed an infinite equal to itself in a finite time. But 273a
that we know to be impossible.

(7) It can also be shown, conversely, that if the time of revolution is finite, the area traversed must also be finite;

[1] Also, of course, infinite.

[2] FIG. V.



[3] The 'infinite line' is the infinite radius *CD*, which is unable to complete the circle owing to its inability to extricate its outer extremity from that of the other infinite, *E*. The MSS. vary between κύκλωι (EL), κύκλῳ (M), and κύκλον (HFJ: the last, however, has ωι *suprascriptum*). In FMJ περίεισι follows instead of preceding κύκλον (κύκλῳ M). Perhaps κύκλον περίεισιν should be read with FJ, though either reading will give the sense required.

but the area traversed was equal to itself; therefore, it is itself finite.[1]

We have now shown that the body which moves in a circle is not endless or infinite, but has its limit.

Further, neither that which moves towards nor that which moves away from the centre can be infinite. 6 For the upward and downward motions are contraries and are therefore motions towards contrary places. But if one of a pair of contraries is determinate, the other must be determinate also. Now the centre is determined; for, from whatever point the body which sinks to the bottom starts its downward motion, it cannot go farther than the centre. The centre, therefore, being determinate, the upper place must also be determinate. But if these two places are determined and finite, the corresponding bodies must also be finite. Further, if up and down are determinate, the intermediate place is also necessarily determinate. For, if it is indeterminate, the movement within it will be infinite[2]; and that we have already shown to be an impossibility.[3] The middle region then is determinate, and consequently any body which either is in it, or might be in it, is determinate. But the bodies which move up and down may be in it, since the one moves naturally away from the centre and the other towards it.

From this alone it is clear that an infinite body is an impossibility; but there is a further point. If there is no such thing as infinite weight, then it follows that none of these bodies can be infinite. For the supposed infinite body would have to be infinite in weight. (The same argument applies to lightness: for as the one supposition involves infinite weight, so the infinity of the body which rises to the surface involves infinite lightness.) This is

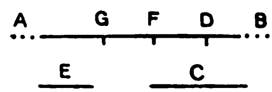
[1] The preceding six arguments start from the hypothesis of an infinite body and show the difficulties involved in the consequent assumption of an infinite path and in the infinite time needed for its completion. The converse argument starts from known finite time of revolution and argues from that to the finitude of the path traversed and of the body which traverses it.

[2] Reading εἴη ἡ κίνησις with FHMJ Simpl.

[3] *Phys.* VIII. viii.

proved as follows. Assume the weight to be finite, and take an infinite body, *AB*, of the weight *C*. Subtract from the infinite body a finite mass, *BD*, the weight of which shall be *E*. *E* then is less than *C*, since it is the weight of a lesser mass.[1] Suppose then that the smaller goes into the greater a certain number of times, and take *BF* bearing 273b
the same proportion to *BD* which the greater weight bears to the smaller. For you may subtract as much as you please from an infinite. If now the masses are proportionate to the weights, and the lesser weight is that of the lesser mass, the greater must be that of the greater. The weights, therefore, of the finite and of the infinite body are equal. Again, if the weight of a greater body is greater than that of a less, the weight of *GB* will be greater than that of *FB*;[1] and thus the weight of the finite body is greater than that of the infinite. And, further, the weight of unequal masses will be the same, since the infinite and the finite cannot be equal. It does not matter whether the weights are commensurable or not. If (*a*) they are ***incommensurable*** the same reasoning holds. For instance, suppose *E* multiplied by three is rather more than *C*: the weight of three masses of the full size of *BD* will be greater than *C*. We thus arrive at the same impossibility as before. Again (*b*) we may assume weights which are ***commensurate***; for it makes no difference whether we begin with the weight or with the mass. For example, assume the weight *E* to be commensurate with *C*, and take from the infinite mass a part *BD* of weight *E*. Then let a mass *BF* be taken having the same proportion to *BD* which the two weights have to one another. (For the mass being infinite you may subtract from it as much as you please.) These assumed bodies will be commensurate in mass and in weight alike. Nor again does it make any difference to our demonstration whether the total mass has its weight equally or unequally distributed. For it must always be possible to take from the infinite mass a body of equal

[1] Fig. VI.



weight to *BD* by diminishing or increasing the size of the section to the necessary extent.[1]

From what we have said, then, it is clear that the weight of the infinite body cannot be finite. It must then be infinite. We have therefore only to show this to be impossible in order to prove an infinite body impossible. But the impossibility of infinite weight can be shown in the following way. A given weight moves a given distance in a given time; a weight which is as great and more moves the same distance in a less time, the times being in inverse
274a proportion to the weights. For instance, if one weight is twice another, it will take half as long over a given movement. Further, a finite weight traverses any finite distance in a finite time. It necessarily follows from this that infinite weight, if there is such a thing, being, on the one hand, as great and more than as great as the finite,[2] will move accordingly, but being, on the other hand, compelled to move in a time inversely proportionate to its greatness, cannot move at all.[3] The time should be less in proportion as the weight is greater. But there is no proportion between the infinite and the finite: proportion can only hold between a less and a greater *finite* time. And though you may say that the time of the movement can be continually diminished, yet there is no minimum.[4] Nor, if there were,

[1] Delete comma after ΒΔ.

[2] There can be no doubt that the comma should follow, not precede, *καὶ ἔτι* (l. 5). The phrase *τοσόνδε ὅσον τὸ πεπερασμένον καὶ ἔτι* is parallel to the *τοσοῦτον καὶ ἔτι* of 273b 31. Bonitz (*Ind.* 291a 7) takes *καὶ ἔτι* in this way, but appears to interpret the phrase as indicating the distance moved, which is impossible.—For the use of *καὶ ἔτι* cf. *Met.* 1021a 6.

[3] Because, as explained in the following sentences, there is no time for it to move in. The argument is: the infinite may (*μέν*) be regarded loosely as something exceedingly great, in which case it follows simply that it moves exceedingly fast: so far there is no difficulty: but (*δέ*) as soon as you begin to specify *how* great it is and *how* fast it moves the difficulties become insuperable.

[4] *ἀλλ' ἀεὶ ἐν ἐλάττονι* is probably an opponent's objection. It is an application of the argument mentioned in 272a 1. We talk of number as infinite, A. says there, because there is no maximum. Similarly the advocate of infinite weight says, 'At any rate the weight can be increased and the time proportionately diminished *ad infinitum*'. But the motion of the infinite, to be conceivable, must according to Aristotle occupy *a time*; and any time, however small, will be a time in which the given movement could be effected by a finite body.

would it help us. For some finite body could have been found greater than the given finite in the same proportion which is supposed to hold between the infinite and the given finite;[1] so that an infinite and a finite weight must have traversed an equal distance in equal time. But that is impossible. Again, whatever the time, so long as it is finite, in which the infinite performs the motion, a finite weight must necessarily move a certain finite distance in that same time. Infinite weight is therefore impossible, and the same reasoning applies also to infinite lightness. Bodies then of infinite weight and of infinite lightness are equally impossible.

That there is no infinite body may be shown, as we have shown it, by a detailed consideration of the various cases. But it may also be shown universally, not only by such reasoning as we advanced in our discussion of principles[2] (though in that passage we have already determined universally the sense in which the existence of an infinite is to be asserted or denied), but also suitably to our present purpose in the following way. That will lead us to a further question. Even if the total mass is not infinite, it may yet be great enough to admit a plurality of universes. The question might possibly be raised whether there is any obstacle to our believing that there are other universes composed on the pattern of our own, more than one, though stopping short of infinity. First, however, let us treat of the infinite universally.

[1] What difficulty there is in this sentence is due to the elliptical expression and to the tacit inference from a proportion between the times to a proportion between the bodies. What is known is the ratio between the imaginary minimum time assigned to the infinite body and some other finite time. A. speaks of this known ratio as a ratio between the infinite body and another body. The argument is: take any other finite body (ἕτερον): its ratio to the infinite may be determined by their respective times: but another finite body (ἄλλο τι πεπερασμένον) could be found in the same ratio (on the basis of a comparison of times) to the first. Thus a finite body will cover the same distance as the infinite body in the same time, which is absurd.—The comma after λόγῳ in l. 11 should be deleted. μεῖζον belongs to the predicate both of the relative clause and of the main sentence. Neither Simplicius nor Alexander (as reported by Simplicius) seems to have interpreted the words quite correctly.

[2] *Phys.* III. iv–viii (see n. on 272a 30). Read εἰρημένους with FM.

Every body must necessarily be either finite or infinite, 7
and if infinite, either of similar or of dissimilar parts. If its parts are *dissimilar*, they must represent either a finite or an infinite number of kinds. That the kinds cannot be *infinite* is evident, if our original presuppositions remain 274b unchallenged. For the primary movements being finite in number, the kinds of simple body are necessarily also finite, since the movement of a simple body is simple, and the simple movements are finite, and every natural body must always have its proper motion. Now if[1] the infinite body is to be composed of a *finite* number of kinds, then each of its parts must necessarily be infinite in quantity, that is to say, the water, fire, &c., which compose it. But this is impossible, because, as we have already shown, infinite weight and lightness do not exist. Moreover it would be necessary also that their places should be infinite in extent, so that the movements too of all these bodies would be infinite. But this is not possible, if we are to hold to the truth of our original presuppositions and to the view that neither that which moves downward, nor, by the same reasoning, that which moves upward, can prolong its movement to infinity. For it is true in regard to quality, quantity, and place alike that any process of change is impossible which can have no end. I mean that if it is impossible for a thing to have come to be white, or a cubit long, or in Egypt, it is also impossible for it to be in process of coming to be any of these. It is thus impossible for a thing to be moving to a place at which in its motion it can never by any possibility arrive. Again, suppose the body to exist in dispersion, it may be maintained none the less that the total of all these scattered particles, say, of fire, is infinite.[2] But body we saw to be that which has extension every way. How can there be several dissimilar elements, each infinite? Each would have to be infinitely extended every way.

It is no more conceivable, again, that the infinite should exist as a whole of *similar* parts. For, in the first place,

[1] Reading εἴγε with FHMJ.
[2] 'As Anaxagoras seems to have supposed' (Simpl.).

there is no other ⟨straight⟩ movement beyond those mentioned: we must therefore give it one of them. And if so, we shall have to admit either infinite weight or infinite lightness. Nor, secondly, could the body whose movement is circular be infinite, since it is impossible for the infinite to move in a circle. This, indeed, would be as good as saying that the heavens are infinite, which we have shown to be impossible.

Moreover, in general, it is impossible that the infinite should move at all. If it did, it would move either naturally or by constraint: and if by constraint, it possesses also a natural motion, that is to say, there is another place, infinite like itself, to which it will move. But that is impossible.[1]

That in general it is impossible for the infinite to be acted upon by the finite or to act upon it may be shown as follows.

⟨1. *The infinite cannot be acted upon by the finite.*⟩ Let 275a
A be an infinite, *B* a finite, *C* the time of a given movement produced by one in the other. Suppose, then, that *A* was heated, or impelled, or modified in any way, or caused to undergo any sort of movement whatever, by *B* in the time *C*. Let *D* be less than *B*; and, assuming that a lesser agent moves a lesser patient in an equal time, call the quantity thus modified by *D*, *E*. Then, as *D* is to *B*, so is *E* to some finite quantum. We assume that the alteration of equal by equal takes equal time, and the alteration of less by less or of greater by greater takes the same time, if the quantity of the patient is such as to keep the proportion which obtains between the agents, greater and less. If so, no movement can be caused in the infinite[2] by any finite agent in any time whatever. For a less agent will produce that movement in a less patient in an equal time, and the proportionate equivalent of that patient will be a finite

[1] Because an infinite place cannot exclude, or be 'other' than, any finite place. This argument applies to natural as well as unnatural movement: for a body moves naturally in the effort to reach its place. —Read τόπος ἄλλος ἴσος with EL, confirmed by Simplicius (τόπος ἴσος ἄλλος, 239, 24).

[2] Read κινηθήσεται with Simplicius and all MSS. except E.

quantity, since no proportion holds between finite and infinite.

⟨2. *The infinite cannot act upon the finite.*⟩ Nor, again, can the infinite produce a movement in the finite in any time whatever. Let *A* be an infinite, *B*[1] a finite, *C* the time of action. In the time *C*, *D* will produce that motion in a patient less than *B*, say *F*. Then take *E*, bearing the same proportion to *D* as the whole *BF* bears to *F*. *E* will produce the motion in *BF* in the time *C*. Thus the finite and the infinite effect the same alteration in equal times. But this is impossible; for the assumption is that the greater effects it in a shorter time. It will be the same with any time that can be taken, so that there will be no time in which the infinite can effect this movement. And, as to infinite time, in that nothing can move another or be moved by it. For such time has no limit, while the action and reaction have.

⟨3. *There is no interaction between infinites.*⟩ Nor can infinite be acted upon in any way by infinite. Let *A* and *B* be infinites, *CD* being the time of the action of *A* upon *B*. Now the whole *B* was modified in a certain time, and the part of this infinite, *E*, cannot be so modified in the same time, since we assume that a less quantity makes the movement in a less time. Let *E* then, when acted upon by *A*, complete the movement in the time *D*. Then, as *D* is to *CD*, so is *E* to some finite part of *B*. This part will necessarily be moved by *A* in the time *CD*. For we suppose that the same agent produces a given effect on a greater
275b and a smaller mass in longer and shorter times, the times and masses varying proportionately. There is thus no finite time in which infinites can move one another. Is their time then infinite? No, for infinite time has no end, but the movement communicated has.

If therefore every perceptible body possesses the power of acting or of being acted upon, or both of these, it is impossible that an infinite body should be perceptible. All bodies, however, that occupy place are perceptible. There is therefore no infinite body beyond the heaven. Nor again is there anything of limited extent beyond it. And so

[1] Called *BF* a few lines below.

beyond the heaven there is no body at all. For if you suppose it an object of intelligence, it will be in a place—since place is what 'within' and 'beyond' denote—and therefore an object of perception. But nothing that is not in a place is perceptible.[1]

The question may also be examined in the light of more general considerations as follows. The infinite, considered as a whole of similar parts, cannot, on the one hand, move in a circle. For there is no centre of the infinite, and that which moves in a circle moves about the centre. Nor again can the infinite move in a straight line. For there would have to be another place infinite like itself to be the goal of its natural movement and another, equally great, for the goal of its unnatural movement. Moreover, whether its rectilinear movement is natural or constrained, in either case the force which causes its motion will have to be infinite. For infinite force is force of an infinite body, and of an infinite body the force is infinite. So the motive body also will be infinite. (The proof of this is given in our discussion of movement,[2] where it is shown that no finite thing possesses infinite power, and no infinite thing finite power.) If then that which moves naturally can also move unnaturally, there will be two infinites, one which causes, and another which exhibits the latter motion. Again, what is it that moves the infinite? If it moves itself, it must be animate. But how can it possibly be conceived as an infinite animal? And if there is something else that moves it, there will be two infinites, that which moves and that which is moved, differing in their form and power.[3]

[1] These sentences are rather disjointed and read more like rough notes than a finished argument. The final remark seems inconsequent. We should expect: 'but what is not perceptible cannot occupy a place'; so that the hypothesis that the body beyond the heaven is νοητόν contradicts itself. The main point, however, is that all these connected attributes are inapplicable to an object of intelligence like the Platonic εἶδος.

[2] *Phys.* VIII. x.

[3] The last argument (from 'Again, what is it . . .') is not a mere repetition of the preceding. The preceding sentence shows that an infinite disturbing force is needed to account for any unnatural movement of an infinite body. Finally, it is suggested that even the natural or normal movement of such a body would presuppose an independent infinite force. Again, the foregoing argument applied only to rectilinear

If the whole is not continuous, but exists, as Democritus and Leucippus think, in the form of parts separated by void, there must necessarily be one movement of all the multitude. They are distinguished, we are told, from one
276a another by their figures; but their nature is one, like many pieces of gold separated from one another. But each piece must, as we assert, have the same motion. For a single clod moves to the same place as the whole mass of earth, and a spark to the same place as the whole mass of fire. So that if it be weight that all possess, no body is, strictly speaking, light; and if lightness[1] be universal, none is heavy. Moreover, whatever possesses weight or lightness will have its place either at one of the extremes or in the middle region. But this is impossible while the world is conceived as infinite. And, generally, that which has no centre or extreme limit, no up or down, gives the bodies no place for their motion; and without that movement is impossible. A thing must move either naturally or unnaturally, and the two movements are determined by the proper and alien places. Again, a place in which a thing rests or to which it moves unnaturally, must be the natural place for some other body, as experience shows. Necessarily, therefore, not everything possesses weight or lightness, but some things do and some do not. From these arguments then it is clear that the body of the universe is not infinite.

We must now proceed to explain why there cannot be 8
more than one heaven—the further question mentioned above.[2] For it may be thought that we have not proved universally of bodies that none whatever can exist outside

movement, since unnatural circular movement has been shown to be impossible: but the last argument would apply equally to circular movement. The remark 'if it moves itself, it must be animate' implies that it is incorrect to think of the natural movement of the elements as self-movement. It is only movement uninfluenced by any sublunary body. That self-movement is impossible Aristotle has already shown in *Phys.* VII.

[1] Prantl misprints εἰ for εἰ.

[2] In l. 18 Prantl's λέγομεν seems to be a misprint for λέγωμεν.—'Heaven' here stands of course for world (οὐρανός = κόσμος).—The reference is to c. vi (274a 24).

our universe, and that our argument applied only to those of indeterminate extent.

Now all things rest and move naturally and by constraint. A thing moves naturally to a place in which it rests without constraint, and rests naturally in a place to which it moves without constraint. On the other hand, a thing moves by constraint to a place in which it rests by constraint, and rests by constraint in a place to which it moves by constraint. Further, if a given movement is due to constraint, its contrary is natural. If, then, it is by constraint that earth moves from a certain place to the centre here, its movement from here to there will be natural, and if earth from there rests here without constraint, its movement hither will be natural. And the natural movement in each case is one.[1] Further, these worlds, being similar in nature to ours, must all be composed of the same bodies as it. Moreover each of the bodies, fire, I mean, and earth and their intermediates, must have the same power as in 276b
our world. For if these names are used equivocally, if the identity of name does not rest upon an identity of form in those elements and ours, then the whole to which they belong can only be called a world by equivocation. Clearly, then, one of the bodies will move naturally away from the centre and another towards the centre, since fire must be identical with fire, earth with earth, and so on, as the fragments of each are identical in this world. That this must be the case is evident from the principles laid down in our discussion of the movements;[2] for these are limited in number, and the distinction of the elements depends upon the distinction of the movements. Therefore, since the movements are the same, the elements must also be the same everywhere. The particles of earth, then, in another world move naturally also to our centre and its fire to our circumference. This, however, is impossible, since, if it were true, earth must, in its own world, move upwards, and fire to the centre; in the same way the earth of our world

[1] Reading μία δ' ἡ with EF²M Alex. The γάρ of the other MSS. and Simpl. is misleading and suggests an argument where there is none. The principle is simply stated for future use.
[2] Above, cc. ii–iv.

must move naturally away from the centre when it moves towards the centre of another universe.[1] This follows from the supposed juxtaposition of the worlds. For either we must refuse to admit the identical nature of the simple bodies in the various universes, or, admitting this, we must make the centre and the extremity one as suggested. This being so, it follows that there cannot be more worlds than one.[2]

To postulate a difference of nature in the simple bodies according as they are more or less distant from their proper places is unreasonable. For what difference can it make whether we say that a thing is this distance away or that? One would have to suppose a difference proportionate to the distance and increasing with it, but the form is in fact the same. Moreover, the bodies must have some movement, since the fact that they move is quite evident.[3] Are we to say then that all their movements, even those which are mutually contrary, are due to constraint? No, for a body which has no natural movement at all cannot be moved by constraint. If then the bodies have a natural movement,

[1] In l. 17 the comma which Prantl places after φύσιν should be placed instead after μέσον. It is needed in this place in order to show that the following clause (διὰ τὸ . . . ἀλλήλους) is explanatory of the ἀνάγκη of l. 14, not of φέρεσθαι in l. 16.

[2] If there is one centre and one extremity, there is only one heaven or world. (Read τούτου δ' ὄντος, ἀδύνατον κτλ. Prantl's ἀτόπου is found only in F and J, and in both it is preceded by τοῦ, which shows that it is an adscript intended to explain the meaning of τούτου.)—The argument of the chapter down to this point is a single *reductio ad absurdum*. Simplicius tries unsuccessfully to interpret it as a series of reductions. The remainder of the chapter reasserts the conclusion here drawn by closing up various pathways of escape. In truth there is only one way of escape, as Aristotle here says, viz. to deny the identity of the fire and earth in the other worlds with that in our own; but the contention takes a variety of forms—(1) 'distance makes a difference'; (2) 'they have no movement, or only move by constraint'; (3) 'the goal of their movement is only the same *in kind* as that of the corresponding elements here'. These suggestions are refuted in what follows.

[3] Throughout this paragraph when Aristotle speaks of 'the bodies' he is thinking of the fire, earth, &c., supposed to constitute another κόσμος. He is not proving over again the proposition that the four elements have each a natural motion, but considering what would be their motion in another world existing beside our own. The empirical evidence of movement here appealed to must be that of the fire and earth of this world; but a thing that did not move would not be a body at all.

the movement of the particular instances of each form must necessarily have for goal a place numerically one, i.e. a particular centre or a particular extremity. If it be suggested that the goal in each case is one in form but numerically more than one, on the analogy of particulars 277a
which are many though each undifferentiated in form, we reply that the variety of goal cannot be limited to this portion or that but must extend to all alike.[1] For all are equally undifferentiated in form, but any one is different numerically from any other. What I mean is this: if the portions in this world behave similarly both to one another and to those in another world, then the portion which is taken hence will not behave differently either from the portions in another world or from those in the same world, but similarly to them, since in form no portion differs from another. The result is that we must either abandon our present assumptions or assert that the centre and the extremity are each numerically one. But this being so, the heaven, by the same evidence and the same necessary inferences, must be one only and no more.

A consideration of the other kinds of movement also makes it plain that there is some point to which earth and fire move naturally. For in general that which is moved changes from something into something, the starting-point and the goal being different in form, and always it is a finite change.[2] For instance, to recover health is to change from disease to health, to increase is to change from smallness to greatness. Locomotion must be similar: for it also has its goal and starting-point—and therefore the starting-point and the goal of the natural movement must differ in form—just as the movement of coming to health does not take any direction which chance

[1] Read τῷ μὲν τῷ δ' οὔ with FLJ Simpl. The meaning is that since none but a 'numerical' difference can be postulated between the portions (e.g. of earth) in this world and those in another, and since a difference of goal can only be justified by a difference in the body, we should have to suppose a distinct goal for every single portion of earth; which is absurd.

[2] A full-stop, rather than a comma, is needed after μεταβολή in l. 16. Three principles are laid down and all are illustrated in the case of locomotion. But the instances of health and increase are used only to illustrate the first.

or the wishes of the mover may select.[1] Thus, too, fire and earth move not to infinity but to opposite points; and since the opposition in place is between above and below, these will be the limits of their movement.[2] (Even in circular movement there is a sort of opposition between the ends of the diameter, though the movement as a whole has no contrary: so that here too the movement has in a sense an opposed and finite goal.) There must therefore be some end to locomotion: it cannot continue to infinity.

This conclusion that local movement is not continued to infinity is corroborated by the fact that earth moves more quickly the nearer it is to the centre, and fire the nearer it is to the upper place. But if movement were infinite speed would be infinite also; and if speed then weight and lightness. For as superior speed in downward movement implies superior weight, so infinite increase of weight necessitates infinite increase of speed.[3]

277b Further, it is not the action of another body that makes one of these bodies move up and the other down; nor is it constraint, like the 'extrusion' of some writers.[4] For in that case the larger the mass of fire or earth the slower would be the upward or downward movement; but the fact

[1] ll. 18–19, the full-stop after ποί should be deleted, and the words δεῖ ἄρα . . . φέρεσθαι should be marked as a parenthesis. Locomotion, like healing, has a determinate direction, and that involves a difference of form between its two terms.

[2] The remarks which follow concerning circular motion are a kind of footnote and would be best marked as a parenthesis.

[3] In l. 29 it is tempting to read εἰ δ' εἰς ἄπειρον ἦν for εἰ δ' ἄπειρον ἦν, but no evidence of such a reading survives. The sense of the paragraph is plain. We observe an increase of speed in a falling body as it approaches the earth. The explanation, on our view, is the proximity of the goal. But if there is no goal, the movement, and with it the increase of speed, is capable of continuing to infinity. But infinite speed means infinite weight, which has already (c. vi) been proved impossible. The Greek of the last sentence is puzzling and may be corrupt. Accepting the text of Bekker and Prantl, we must translate as follows: 'as that which by reason of speed is lower than another body would be presumed speedy by reason of weight, so if there were infinite increase of weight there would also be infinite increase of speed.' (The alteration of an accent is required: βάρει for βαρεῖ in l. 32.) The sentence is clumsy, but it gives the required sense. Simplicius seems to have interpreted the passage as above. In l. 31 ἑτέρου is found in F alone, all the other MSS. giving ἕτερον; but ἑτέρου must be right.

[4] The atomists, Leucippus and Democritus.

is the reverse: the greater the mass of fire or earth the quicker always is its movement towards its own place. Again, the speed of the movement would not increase towards the end if it were due to constraint or extrusion; for a constrained movement always diminishes in speed as the source of constraint becomes more distant, and a body moves without constraint to the place whence it was moved by constraint.

A consideration of these points, then, gives adequate assurance of the truth of our contentions. The same could also be shown with the aid of the discussions which fall under First Philosophy,[1] as well as from the nature of the circular movement, which must be eternal both here and in the other worlds. It is plain, too, from the following considerations that the universe must be one.

The bodily elements are three, and therefore the places of the elements will be three also; the place, first, of the body which sinks to the bottom, namely the region about the centre; the place, secondly, of the revolving body, namely the outermost place, and thirdly, the intermediate place, belonging to the intermediate body. Here in this third place will be the body which rises to the surface; since, if not here, it will be elsewhere, and it cannot be elsewhere: for we have two bodies, one weightless, one endowed with weight, and below is the place of the body endowed with weight, since the region about the centre has been given to the heavy body. And its position cannot be unnatural to it, for it would have to be natural to something else, and there is nothing else. It must then occupy the intermediate place. What distinctions there are within the intermediate itself we will explain later on.

We have now said enough to make plain the character and number of the bodily elements, the place of each, and further, in general, how many in number the various places are.

9 We must show not only that the heaven is one,[2] but also that more than one heaven is impossible, and, further,

[1] i.e. Metaphysics. Cf. *Met.* Λ. 8.

[2] Prantl misprints εἰς for εἷς. For οὐρανὸς read ὁ οὐρανός with M. J, like EHL, omits the word οὐρανός altogether.

that, as exempt from decay and generation, the heaven is eternal. We may begin by raising a difficulty. From one point of view it might seem impossible that the heaven should be one and unique,[1] since in all formations and products whether of nature or of art we can distinguish the shape in itself and the shape in combination with matter.
278a For instance the form of the sphere is one thing and the gold or bronze sphere another; the shape of the circle again is one thing, the bronze or wooden circle another. For when we state the essential nature of the sphere or circle we do not include in the formula gold or bronze, because they do not belong to the essence, but if we are speaking of the copper or gold sphere we do include them. We still make the distinction even if we cannot conceive or apprehend any other example beside the particular thing. This may, of course, sometimes be the case: it might be, for instance, that only one circle could be found; yet none the less the difference will remain between the being of circle and of this particular circle, the one being form, the other form in matter, i. e. a particular thing. Now since the universe is perceptible it must be regarded as a particular; for everything that is perceptible subsists, as we know, in matter. But if it is a particular, there will be a distinction between the being of 'this universe' and of 'universe' unqualified. There is a difference, then, between 'this universe' and simple 'universe'; the second is form and shape, the first form in combination with matter; and any shape or form has, or may have, more than one particular instance.

On the supposition of Forms such as some assert, this must be the case, and equally on the view that no such entity has a separate existence. For in every case in which the essence is in matter it is a fact of observation that the particulars of like form are several or infinite in number. Hence there either are, or may be, more heavens

[1] More correctly: that the heaven should be *necessarily* one and unique. The argument here set out only attempts to prove the possibility of more than one world, and Aristotle replies by proving the impossibility of more than one. Alexander (cited by Simpl.) points out this defect in the statement.

than one.[1] On these grounds, then, it might be inferred either that there are or that there might be several heavens. We must, however, return and ask how much of this argument is correct and how much not.

Now it is quite right to say that the formula of the shape apart from the matter must be different from that of the shape in the matter, and we may allow this to be true. We are not, however, therefore compelled to assert a plurality of worlds. Such a plurality is in fact impossible if this world contains the entirety of matter, as in fact it does. But perhaps our contention can be made clearer in this way. Suppose 'aquilinity' to be curvature in the nose or flesh, and flesh to be the matter of aquilinity. Suppose, further, that all flesh came together into a single whole of flesh endowed with this aquiline quality. Then neither would there be, nor could there arise, any other thing that was aquiline. Similarly, suppose flesh and bones to be the matter of man, and suppose a man to be created of all flesh and all bones in indissoluble union. The possibility of another man would be removed. Whatever case you took it would be the same. The general rule 278b
is this: a thing whose essence resides in a substratum of matter can never come into being in the absence of all matter.[2] Now the universe is certainly a particular and a material thing: if however it is composed not of a part but of the whole of matter, then though the being of 'universe' and of 'this universe' are still distinct, yet there is no other universe, and no possibility of others being made, because all the matter is already included in this. It remains, then, only to prove that it is composed of all natural perceptible body.

First, however, we must explain what we mean by 'heaven' and in how many senses we use the word, in order to make clearer the object of our inquiry. (*a*) In one sense, then, we call

[1] The οἱ before οὐρανοί is attributed only to E, and to it 'dubio'. J has it. But the article does not seem to be required here. In corresponding passages in this chapter it is omitted.

[2] Read τινὸς ὕλης. The omission of τινός in E must be a mere slip. All the other MSS., as well as Simpl., have τινὸς ὕλης, and E is full of small omissions.

'heaven' the substance of the extreme circumference of the whole, or that natural body whose place is at the extreme circumference. We recognize habitually a special right to the name 'heaven' in the extremity or upper region, which we take to be the seat of all that is divine.[1] (*b*) In another sense, we use this name for the body continuous with the extreme circumference, which contains the moon, the sun, and some of the stars; these we say are 'in the heaven'. (*c*) In yet another sense we give the name to all body included within the extreme circumference, since we habitually call the whole or totality 'the heaven'. The word, then, is used in three senses.

Now the whole included within the extreme circumference must be composed of *all* physical and sensible body, because there neither is, nor can come into being, any body outside the heaven. For if there is a natural body outside the extreme circumference it must be either a simple or a composite body, and its position must be either natural or unnatural. But it cannot be any of the simple bodies. For, first, it has been shown[2] that that which moves in a circle cannot change its place. And, secondly, it cannot be that which moves from the centre or that which lies lowest. *Naturally* they could not be there, since their proper places are elsewhere; and if these are there *unnaturally*, the exterior place will be natural to some other body, since a place which is unnatural to one body must be natural to another: but we saw that there is no other body besides these.[3] Then it is not possible that any simple body should
279a be outside the heaven. But, if no simple body, neither can any mixed body be there: for the presence of the simple body is involved in the presence of the mixture. Further neither can any body come into that place: for it will do so either naturally or unnaturally, and will be either simple or composite; so that the same argument will apply, since it makes no difference whether the question is 'does *A*

[1] Place a full-stop after φαμεν. In the next line συνὲχες should be συνεχές.

[2] Read τὸ μὲν γάρ. The μέν is wanted, and is omitted by E alone. The reference is to cc. ii and iii above.

[3] c. ii above.

exist?' or 'could *A* come to exist?' From our arguments then it is evident not only that there is not, but also that there could never come to be, any bodily mass whatever outside the circumference. The world as a whole, therefore, includes *all* its appropriate matter, which is, as we saw, natural perceptible body. So that neither are there now, nor have there ever been, nor can there ever be formed more heavens than one, but this heaven of ours is one and unique and complete.

It is therefore evident that there is also no place or void or time outside the heaven. For in every place body can be present; and void is said to be that in which the presence of body, though not actual, is possible; and time is the number of movement. But in the absence of natural body there is no movement, and outside the heaven, as we have shown, body neither exists nor can come to exist. It is clear then that there is neither place, nor void, nor time, outside the heaven. Hence whatever is there, is of such a nature as not to occupy any place, nor does time age it; nor is there any change in any of the things which lie beyond the outermost motion; they continue through their entire duration unalterable and unmodified, living the best and most self-sufficient of lives. As a matter of fact, this word 'duration' possessed a divine significance for the ancients, for the fulfilment which includes the period of life of any creature, outside of which no natural development can fall, has been called its duration. On the same principle the fulfilment of the whole heaven, the fulfilment which includes all time and infinity, is 'duration'—a name based upon the fact that it *is always*[1]—duration immortal and divine. From it derive the being and life which other things, some more or less articulately but others feebly, enjoy. So, too, in its discussions concerning the divine, popular philosophy[2] often propounds the view that whatever is

[1] i.e. αἰὼν is derived from ἀεὶ ὤν.

[2] Aristotle refers apparently under this name to elementary handbooks of philosophy current among his audience. It is usual to identify them with the ἐξωτερικοὶ λόγοι, as Simpl. does in his commentary on this passage. See Bonitz, *Ind. Ar.*, s. v. Ἀριστοτέλης, 105a 27.

divine, whatever is primary and supreme, is necessarily unchangeable. This fact confirms what we have said. For there is nothing else stronger than it to move it—since that would mean more divine—and it has no defect
279b and lacks none of its proper excellences. Its unceasing movement, then, is also reasonable, since everything ceases to move when it comes to its proper place, but the body whose path is the circle has one and the same place for starting-point and goal.

Having established these distinctions, we may now pro- 10
ceed to the question whether the heaven is ungenerated or generated, indestructible or destructible. Let us start with a review of the theories of other thinkers; for the proofs of a theory are difficulties for the contrary theory.[1] Besides, those who have first heard the pleas of our adversaries will be more likely to credit the assertions which we are going to make. We shall be less open to the charge of procuring judgement by default. To give a satisfactory decision as to the truth it is necessary to be rather an arbitrator than a party to the dispute.

That the world was generated all are agreed, but, generation over, some say that it is eternal, others say that it is destructible like any other natural formation.[2] Others again, with Empedocles of Acragas and Heraclitus of Ephesus, believe that there is alternation in the destructive process, which takes now this direction, now that, and continues without end.[3]

[1] Prantl misprints τῦν ἐναντίων for τῶν ἐναντίων in l. 6.

[2] The former view, according to Alexander (*ap.* Simpl.), is that of Orpheus (i.e. of Orphic cosmogony), Hesiod, and Plato, while the latter is that of Democritus and his school.

[3] Cf. Burnet, E.G.P.[3] p. 157 (§ 77). Heraclitus and Empedocles are agreed in believing in periodic changes in the constitution of our world as a whole. For both, the world exists, as it were, in a succession of lives (below, 280a 14); and the view is a kind of compromise between that which regards it as eternal and that which gives it a single life ended by annihilation. The phrase 'alternation in the destructive process' is somewhat inaccurate, since the alternation may be described as between generation and destruction (Empedocles' Love and Strife, Stoic διακόσμησις and ἐκπύρωσις). But it is intelligible. Aristotle is here classing the theory for convenience with those that hold to a destructible world, and the antithesis is between destruction ἁπλῶς and destruction with alternation. Later he explains that this

Now to assert that it was generated and yet is eternal is to assert the impossible; for we cannot reasonably attribute to anything any characteristics but those which observation detects in many or all instances. But in this case the facts point the other way: generated things are seen always to be destroyed. Further, a thing whose present state had no beginning and which could not have been other than it was at any previous moment throughout its entire duration, cannot possibly be changed.[1] For there will have to be some cause of change, and if this had been present earlier it would have made possible another condition of that to which any other condition was impossible. Suppose that the world was formed out of elements which were formerly otherwise conditioned than as they are now. Then (1) if their condition was always so and could not have been otherwise, the world could never have come into being.[2] And (2) if the world did come into being, then, clearly, their condition must have been capable of change and not eternal: after combination therefore they will be dispersed, just as in the past after dispersion they came into combination, and this process either has been, or could have been, indefinitely repeated. But if this is so, the world cannot be indestructible, and it does not matter whether the change of condition has actually occurred or remains a possibility.

Some of those who hold that the world, though indestructible, was yet generated, try to support their case by a parallel which is illusory.[3] They say that in their statements about its generation they are doing what geometricians do when they construct their figures, not implying that the universe really had a beginning, but

alternation is not *φθορά* at all. Burnet in his first edition proposed to excise *φθειρόμενον*, but the suggestion is now tacitly retracted. In his later editions Burnet wrongly states that what is here in question is the eternity of the first heaven. That has already been proved in c. iii, and the first heaven would not be referred to as *ὁ κόσμος*.

[1] A comma is required after *αἰῶνα* in l. 22, unless the comma after *ἔχειν* in the preceding line is deleted.

[2] The close coordination of *εἰ μέν* (in l. 25) with *εἰ δέ* (in l. 26) demands a comma, rather than a full-stop, after *ἐγένετο*.

[3] Simpl. refers the following argument to Xenocrates and the Platonists.

280a for didactic reasons facilitating understanding by exhibiting the object, like the figure, as in course of formation. The two cases, as we said, are not parallel; for, in the construction of the figure, when the various steps are completed the required figure forthwith results; but in these other demonstrations what results is not that which was required.[1] Indeed it cannot be so; for antecedent and consequent, as assumed, are in contradiction. The ordered, it is said,[2] arose out of the unordered; and the same thing cannot be at the same time both ordered and unordered; there must be a process and a lapse of time separating the two states. In the figure, on the other hand, there is no temporal separation.[3] It is clear then that the universe cannot be at once eternal and generated.

To say that the universe alternately combines and dissolves is no more paradoxical than to make it eternal but varying in shape. It is as if one were to think that there was now destruction and now existence when from a child a man is generated, and from a man a child. For it is clear that when the elements come together the result is not a chance system and combination, but the very same as before—especially on the view of those who hold this theory, since they say that the contrary is the cause of each state.[4] So that if the totality of body, which is a continuum, is now in this order or disposition and now in that, and if the combination of the whole is a world or heaven, then it will not be the world that comes into being and is destroyed, but only its dispositions.

If the world is believed to be one, it is impossible to

[1] i.e. the geometricians can truly write Q. E. F. at the end of their construction, but these cosmogonists cannot. The figure, or world, constructed should be 'the same' (τὸ αὐτό) as that demanded in the ὑπόθεσις.

[2] Cp. Plato, *Timaeus* 30 A.

[3] The construction of the cosmogonist cannot be a mere didactic device like that of the geometrician; for the attributes successively assumed in the construction of the world cannot exist simultaneously as those assumed by the geometrician do.

[4] Here Aristotle clearly refers to Empedocles, rather than to Heraclitus. The two causes of Empedocles are Love and Strife (φιλία and νεῖκος), and since these are two it follows, Aristotle argues, that the world would merely oscillate between two arrangements or dispositions.

suppose that it should be, as a whole, first generated and then destroyed, never to reappear; since before it came into being there was always present the combination prior to it, and that, we hold, could never change if it was never generated. If, on the other hand, the worlds are infinite in number the view is more plausible. But whether this is, or is not, impossible will be clear from what follows. For there are some who think it possible both for the ungenerated to be destroyed and for the generated to persist undestroyed.[1] (This is held in the *Timaeus*,[2] where Plato says that the heaven, though it was generated, will none the less exist to eternity.) So far as the heaven is concerned we have answered this view with arguments appropriate to the nature of the heaven: on the general question we shall attain clearness when we examine the matter universally.[3]

11 We must first distinguish the senses in which we use the words 'ungenerated' and 'generated', 'destructible' and 'indestructible'.[4] These have many meanings, and though 280b

[1] In l. 29 Prantl misprints κμί for καί.

[2] A colon instead of a full-stop is needed after Τιμαίῳ. The reference is to Plato, *Timaeus* 31. Plato is quoted as authority for the indestructible-generated not for the ungenerated-destructible, as the context shows.

[3] The general question is the mutual relations of the terms 'generated', 'ungenerated', 'destructible', 'indestructible', which have so far been considered only in their application to the heaven. The terms are discussed universally, i.e. apart from any special application, in cc. xi and xii. The combination attributed to Plato is refuted at the end of that discussion (283a 1 ff.). Simplicius found the argument of the last paragraph of this chapter (ll. 23 ff.) somewhat obscure. It deals, provisionally and subject to further investigation, with the view that the world is subject both to generation and to destruction in the sense in which the man Socrates is. Simpl. is probably right in supposing that under this head Aristotle is thinking of the atomists. Their infinite worlds were successive, if also co-existent. Aristotle here argues that if that out of which the world was formed had the capacity to give birth to a world, then that into which the world is destroyed will have the same capacity. Thus the theory of world-annihilation is dismissed as absurd, while the infinite succession of destructible worlds is left open. But the refutation even of the first of these views, and therefore *a fortiori* of the second, cannot be regarded as complete until the whole problem of generation and destruction has been examined.

[4] It is unfortunate that 'generated' and 'destructible' are not similar grammatical forms as the Greek γεννητός and φθαρτός are. But from the analysis given by Aristotle it will be seen that in meaning the Greek verbal adjective tends to approximate to the past

it may make no difference to the argument, yet some confusion of mind must result from treating as uniform in its use a word which has several distinct applications. The character which is the ground of the predication will always remain obscure.

The word 'ungenerated' then is used (*a*) in one sense whenever something now is which formerly was not, no process of becoming or change being involved. Such is the case, according to some, with contact and motion, since there is no process of coming to be in contact or in motion. (*b*) It is used in another sense, when something which is capable of coming to be, with or without process, does not exist; such a thing is ungenerated in the sense that its generation is not a fact but a possibility. (*c*) It is also applied where there is general impossibility of any generation such that the thing now is which then was not. And 'impossibility' has two uses: first, where it is untrue to say that the thing can ever come into being, and secondly, where it cannot do so easily, quickly, or well. In the same way the word 'generated' is used, (*a*) first, where what formerly was not afterwards is, whether a process of becoming was or was not involved, so long as that which then was not, now is; (*b*) secondly, of anything capable of existing, 'capable' being defined with reference either to truth or to facility; (*c*) thirdly, of anything to which the passage from not being to being belongs,[1] whether already actual, if its existence is due to a past process of becoming, or not yet actual but only possible. The uses of the words 'destructible' and 'indestructible' are similar. 'Destructible' is applied (*a*) to that which formerly was and afterwards either is not or might not be, whether a period of being destroyed and changed intervenes or not;[2] and (*b*)

participle, and therefore it is not worth while to insist on 'generable', 'ungenerable' for *γενητός, ἀγένητος*.

[1] For *ἐὰν ἡ γένεσις* read *ἐὰν ᾖ γένεσις*. (M has ᾖ ἡ, but all other MSS. have ἡ.) The correction was suggested by Hayduck (Greifswald Gymnasium Program, 1871, p. 11).

[2] The evidence afforded by Simpl. and the MSS., together with the difficulty of establishing a precise correspondence between this definition of *φθαρτόν* and the parallel uses of 'ungenerated' (*b*) and 'generated' (*a*), might lead one to doubt the soundness of the text at this point; but it is guaranteed by Aristotle's own citation at 281b 27.

sometimes we apply the word to that which a process of destruction may cause not to be; and also (*c*) in a third sense, to that which is easily destructible, to the 'easily-destroyed', so to speak.[1] Of the indestructible the same account holds good. It is either (*a*) that which now is and now is not, without any process of destruction, like contact, which without being destroyed afterwards is not, though formerly it was; or (*b*) that which is but might not be, or which will at some time not be, though it now is.[2] For you exist now and so does the contact; yet both are destructible, because a time will come when it will not be true of you that you exist, nor of these things that they are in contact. Thirdly (*c*) in its most proper use, it is that which is, but is incapable of any destruction such that the thing which now is later ceases to be or might cease to be; or again, that which has not yet been destroyed, but in the future may cease to be.[3] For indestructible is also used of that which 281a
is destroyed with difficulty.[4]

[1] Aristotle carelessly omits to mention the other and more exact kind of possibility. Cf. 'ungenerated' (*c*) and 'generated' (*b*).

[2] The third ἤ (in l. 29) is not coordinate with the two which precede it (ll. 26, 28), and it would be well to mark this by putting a colon instead of a comma after *εἰσίν* in l. 28. Simplicius read ἢ καὶ οὐκ in l. 29, and the addition of *καί* would be an improvement.

[3] Omit the *οὐκ* inserted by Prantl before *ἐνδεχόμενον*. The ὂν δέ which Prantl's note attributes to Simplicius is found only in one inferior MS. and is not printed in Heiberg's text of the commentary. J also has no word between *ἐφθαρμένον* and *ἐνδεχόμενον*, nor had Alexander.

[4] Read *λέγεται γάρ* for *λέγεται δέ*, and place a colon instead of a full-stop before *λέγεται*. This alteration is conjectural, but it is preferable to Hayduck's excision of ἢ καὶ . . . εἶναι (ll. 33, 34), and without some alteration the Greek will not give a satisfactory sense. The account given of 'indestructible' is closely parallel to that given of 'ungenerated' above. Sense (*a*) of 'indestructible' (ll. 26–28) turns on the absence of process, like sense (*a*) of 'ungenerated', even repeating the same instance, touch. In sense (*b*) (ll. 28–31) 'indestructible' covers all that has not been destroyed, as 'ungenerated' in sense (*b*) covers what has not yet come into being: as 'ungenerated' includes all possible existents which are now non-existent, so 'indestructible' includes all possible non-existents which are now existent. There remains the third and proper sense, viz. potentiality or possibility, subdivided in the case of 'ungenerated', according to an ambiguity in the word possible, into (i) strict and final impossibility (*τῷ μὴ ἀληθὲς εἶναι εἰπεῖν*), (ii) popular or 'practical' impossibility (*τῷ μὴ ῥᾳδίως μηδὲ ταχὺ ἢ καλῶς*). The third sense of 'indestructible' is introduced by *τὸ δὲ μάλιστα κυρίως* in l. 31, and its subdivision is effected by ἢ *καί* in l. 33. The words before ἢ *καί* assert the final

This being so, we must ask what we mean by 'possible' and 'impossible'. For in its most proper use the predicate 'indestructible' is given because it is impossible that the thing should be destroyed, i. e. exist at one time and not at another. And 'ungenerated' also involves impossibility when used for that which cannot be generated, in such fashion that, while formerly it was not, later it is. An instance is a commensurable diagonal. Now when we speak of a power[1] to move[2] or to lift weights, we refer always to the maximum. We speak, for instance, of a power to lift a hundred talents or walk a hundred stades—though a power to effect the maximum is also a power to effect any part of the maximum—since we feel obliged in defining the power to give the limit or maximum. A thing, then, which is capable of a certain amount as maximum must also be capable of that which lies within it. If, for example, a man can lift a hundred talents, he can also lift two, and if he can walk a hundred stades, he can also walk two. But the power is of the maximum, and a thing said, with reference to its maximum,[3] to be incapable of so much is also incapable of any greater amount. It is, for instance, clear that a person who cannot walk a thousand stades will also be unable to walk a thousand and one. This point need not trouble us, for we may take it as settled that what is, in the strict sense, possible is determined by a limiting maximum. Now perhaps the objection might be raised that

removal of the possibility of non-existence, and the following clause relaxes the requirement as popular use demands. Even if the possibility of destruction has not been finally removed, a thing may be called 'indestructible' in this sense if it has not been destroyed. '*For* (λέγεται γάρ) what is not easily destroyed is called indestructible.' By calling this the proper sense, whether in its stricter or more popular use, Aristotle must mean that the verbal adjective in -τος should not in precise speech be allowed to approximate, as it often does, to a past participle passive. (Simplicius's interpretation of this passage is quite inadmissible, but he was confused by faulty MSS.)

[1] 'Power' (δύναμις) must be taken throughout as the noun corresponding to the adjective 'possible' (δυνατόν).

[2] The MSS. have κινηθῆναι στάδια ἑκατόν ('to move a hundred stades'). The translation omits the reference to distance, which seems clearly out of place. The words στάδια ἑκατόν, which occur more than once in the context, probably got their place in this clause through a copyist's mistake.

[3] Prantl misprints ὑπερβαλήν for ὑπερβολήν.

there is no necessity in this, since he who sees a stade need not see the smaller measures contained in it, while, on the contrary, he who can see a dot or hear a small sound will perceive what is greater. This, however, does not touch our argument. The maximum may be determined either in the power or in its object.[1] The application of this is plain. Superior sight is sight of the smaller body, but superior speed is that of the greater body.

12 Having established these distinctions we can now proceed to the sequel. If there are things capable both of being and of not being, there must be some definite maximum time of their being and not being; a time, I mean, during which continued existence is possible to them and a time during which continued non-existence is possible. And this is true in every category, whether the thing is, for example, 'man', or 'white', or 'three cubits long', or whatever it may be. For if the time is not definite in quantity, but longer than any that can be suggested and shorter than none, then it will be possible for one and the same thing to 281b exist for infinite time and not to exist for another infinity. This, however, is impossible.

Let us take our start from this point. The impossible and the false have not the same significance. One use of 'impossible' and 'possible', and 'false' and 'true', is hypothetical. It is impossible, for instance, on a certain hypothesis that the triangle should have its angles equal to two right angles, and on another the diagonal is commensurable. But there are also things possible and impossible, false and true, absolutely. Now it is one thing to be absolutely false, and another thing to be absolutely impossible. To say that you are standing when you are not standing is to assert a falsehood, but not an impossibility. Similarly

[1] i.e. sometimes the maximum is an actual maximum (determined 'in the object', ἐπὶ τοῦ πράγματος), e.g. in the case of weight-lifting, where the largest weight lifted serves to define the power; sometimes it is an actual minimum, determined as maximum 'in the power' (ἐπὶ τῆς δυνάμεως), e.g. in the case of vision, where the smallest object seen serves to define the capacity. Cf. the distinction between the μέσον τοῦ πράγματος (or κατὰ τὸ πρᾶγμα) and the μέσον πρὸς ἡμᾶς in *Eth. Nic.* 1106a 26 ff.

to say that a man who is playing the harp, but not singing, is singing, is to say what is false but not impossible. To say, however, that you are at once standing and sitting, or that the diagonal is commensurable, is to say what is not only false but also impossible. Thus it is not the same thing to make a false and to make an impossible hypothesis;[1] and from the impossible hypothesis impossible results follow. A man has, it is true, the capacity at once of sitting and of standing, because when he possesses the one he also possesses the other; but it does not follow that he can at once sit and stand, only that at another time he can do the other also. But[2] if a thing has for infinite time more than one capacity, another time is impossible and the times must coincide. Thus if anything which exists for infinite time is destructible, it will have the capacity of not being. Now if it exists for infinite time let this capacity be actualized;[3] and it will be in actuality at once existent and non-existent. Thus a false conclusion would follow because a false assumption was made, but if what was assumed had not been impossible its consequence would not have been impossible.[4]

Anything then which always exists is absolutely imperishable. It is also ungenerated, since if it was generated it will have the power for some time of not being. For as that which formerly was, but now is not, or is capable at some future time of not being, is destructible, so that which is capable of formerly not having been is generated.[5] But in the case of that which always is, there is no time for such a capacity of not being, whether the supposed time is finite

[1] Cf. *Anal. Prior.* 34a 1 ff. for this distinction. There should be a colon rather than a full-stop after ἀδύνατον. The production of like consequences is of course not peculiar to the impossible hypothesis: it applies equally to the false hypothesis. See *loc. cit.*

[2] Read εἰ δέ with FHMJ for εἰ δή. There is no semblance of inference. Simplicius makes the connexion antithetical.

[3] For ἔσται read ἔστω with all MSS. (except E) and Simpl. The μὴ εἶναι which follows δύναται in FHMJ must have been a copyist's mistake.

[4] The assumption in this case was both false and impossible.

[5] The words are taken in their 'most proper' sense, as the qualification 'absolutely' in l. 25 suggests; viz. as conveying a strict and demonstrable possibility or impossibility. See foregoing chapter.

or infinite; for its capacity of being must include the finite time since it covers infinite time.[1]

It is therefore impossible that one and the same thing should be capable of always existing and of always not-existing.[2] And 'not always existing', the contradictory, is also excluded. Thus it is impossible for a thing always to exist and yet to be destructible. Nor, similarly, can it be 282a generated. For of two attributes if *B* cannot be present without *A*, the impossibility of *A* proves the impossibility of *B*. What always is, then, since it is incapable of ever not being, cannot possibly be generated. But since the contradictory of 'that which is always capable of being' is 'that which is not always capable of being'; while 'that which is always capable of not being' is the contrary, whose contradictory in turn is 'that which is not always capable of not being', it is necessary that the contradictories of both terms should be predicable of one and the same thing, and thus that, intermediate between what always is and what always is not, there should be that to which being and not-being are both possible; for the contradictory of each will at times be true of it unless it always exists. Hence that which not always is not will sometimes be and sometimes not be; and it is clear that this is true also of that which cannot always be but sometimes is and therefore sometimes is not.[3] One thing, then, will have the power of being and of not being, and will thus be intermediate between the other two.

Expressed universally our argument is as follows. Let there be two attributes, *A* and *B*, not capable of being present in any one thing together, while either *A* or *C* and

[1] In l. 29 after *μὴ εἶναι* a full-stop is required instead of a comma. The construction of the following clauses is difficult. The translation given above proceeds on the hypothesis that no stop is required after *ἀεὶ ὄν* (l. 30) and that *δυνατὸν . . . ὥστε μὴ εἶναι* is equivalent to *δυνατὸν μὴ εἶναι*. I cannot find another case of *δυνατὸν ὥστε*, but similar uses of *ὥστε* are fairly common in Aristotle (see Bonitz, *Ind. Ar.*, p. 873a 20). *οὔτ' ἄπειρον οὔτε πεπερασμένον* (sc. *χρόνον*) is a loose epexegesis of *οὐκ ἔστιν ἐν ᾧ χρόνῳ*, and perhaps should be preceded by a comma.

[2] *Καὶ ἀεὶ μὴ εἶναι* is the reading of FJ Simpl. Since the omission of *ἀεί* in the other MSS. is easily accounted for, it seems best to accept this. (J at the first attempt omitted the *καί*.)

[3] After *ποτε ὄν* a comma, not a colon.

either *B* or *D* are capable of being present in everything. Then *C* and *D* must be predicated of everything of which neither *A* nor *B* is predicated. Let *E* lie between *A* and *B*; for that which is neither of two contraries is a mean between them. In *E* both *C* and *D* must be present, for either *A* or *C* is present everywhere and therefore in *E*. Since then *A* is impossible, *C* must be present, and the same argument holds of *D*.[1]

Neither that which always is, therefore, nor that which always is not is either generated or destructible. And clearly whatever is generated or destructible is not eternal. If it were, it would be at once capable of always being and capable of not always being, but it has already been shown[2] that this is impossible. Surely then whatever is ungenerated and in being must be eternal, and whatever is indestructible and in being must equally be so.[3] (I use the words 'ungenerated' and 'indestructible' in their proper sense, 'ungenerated' for that which now is and could not at any previous time have been truly said not to be; 'indestructible' for that which now is and cannot at any future time be truly said not to be.[4]) If, again, the two terms are coincident,[5] if the ungenerated is indestructible, and the indestructible ungenerated, then each of them is coincident

[1] The four letters *ABCD* are to be allotted as follows: *A* is 'that which is always capable of being' = 'what always is', *B* is its contrary, 'that which is always capable of not being' = 'what always is not', *C* is its contradictory, 'that which is not always capable of being', and *D* is the contradictory of *B*, 'that which is not always capable of not being'. *C* and *D* might also be described by the terms 'what not always is' and 'what not always is not' respectively.

[2] 281^b 18 ff.

[3] The question-mark should come at the end of the line after ἂν δέ, preceded by a comma at εἶναι.

[4] i.e. each term has its third sense as defined in chapter xi (280^b 11, 31).

[5] The term 'coincidence' is used in this passage to express the mutual involution (called by later writers ἀντακολουθία) of predicates. This mutual involution is here described by Aristotle in terms which mean that the two terms 'follow' or 'accompany' one another. But later on (e.g. in 282^b 10, 27, 32) he frequently says simply that one predicate 'follows' another when he means that the two terms are mutually involved. To avoid confusion I have expressed the relation in terms of coincidence throughout.—The ἤ following the parenthesis introduces an alternative proof to the same effect as that which preceded the parenthesis.

with 'eternal'; anything ungenerated is eternal and anything indestructible is eternal. This is clear too from the definition of the terms. Whatever is destructible must be generated; for it is either ungenerated or generated, but, if ungenerated, it is by hypothesis[1] indestructible. Whatever, further, is generated must be destructible. For it is either destructible or indestructible, but, if indestructible, it is by hypothesis[1] ungenerated. 282^b

If, however, 'indestructible' and 'ungenerated' are not coincident, there is no necessity that either the ungenerated or the indestructible should be eternal. But they must be coincident, for the following reasons. The terms 'generated' and 'destructible' are coincident; this is obvious from our former remarks, since between what always is and what always is not there is an intermediate which is neither, and that intermediate is the generated and destructible. For whatever is either of these is capable both of being and of not being for a definite time: in either case, I mean, there is a certain period of time during which the thing is and another during which it is not. Anything therefore which is generated or destructible must be intermediate. Now let A be that which always is and B that which always is not, C the generated, and D the destructible. Then C must be intermediate between A and B. For in their case there is no time in the direction of either limit,[2] in which either A is not or B is. But for the generated

[1] 281^{b}25 ff. But Aristotle proceeds to give a proof of the mutual involution of these terms. If the destructible is generated and the generated is destructible, it follows that the ungenerated is eternal and the indestructible is eternal, and this is the thesis set out for proof in 282^{a}25. But the proof here given of the antecedent depends on the assumption that 'ungenerated' and 'indestructible' are coincident, which assumption is now proved. Aristotle's procedure, however, is needlessly complicated. Having proved the coincidence of 'generated' and 'destructible' by assuming the coincidence of 'ungenerated' and 'indestructible', he now proves the coincidence of the latter by proving (on other lines) the coincidence of the former.

[2] i.e., in effect, 'neither in the past nor in the future'. But time, of course, has no limit. The notion of limit is transferred to the indestructible-ungenerated from the destructible-generated. The being of the latter class is necessarily limited in both directions, by birth on one side and death on the other, and the same terms limit its not-being. These two limits of finite existence are used to describe the two directions of infinite existence.

there must be such a time either actually or potentially, though not for *A* and *B* in either way. *C* then will be, and also not be, for a limited length of time, and this is true also of *D*, the destructible. Therefore each is both generated and destructible. Therefore 'generated' and 'destructible' are coincident. Now let *E* stand for the ungenerated, *F* for the generated, *G* for the indestructible, and *H* for the destructible. As for *F* and *H*, it has been shown that they are coincident. But when terms stand to one another as these do, *F* and *H* coincident, *E* and *F* never predicated of the same thing but one or other of everything, and *G* and *H* likewise, then *E* and *G* must needs be coincident. For suppose that *E* is not coincident with *G*, then *F* will be, since either *E* or *F* is predicable of everything. But of that of which *F* is predicated *H* will be predicable also. *H* will then be coincident with *G*, but this we saw to be impossible. And the same argument shows that *G* is coincident with *E*.

Now the relation of the ungenerated (*E*) to the generated (*F*) is the same as that of the indestructible (*G*) to the destructible (*H*). To say then that there is no reason why anything should not be generated and yet indestructible or ungenerated and yet destroyed, to imagine that in the one case generation and in the other case destruction occurs once for all, is to destroy part of the data.[1] For (1) everything is capable of acting or being acted upon, of being or not being, either for an infinite, or for a definitely limited space of time; and the infinite time is only a possible alternative because it is after a fashion defined, as a length of time which cannot be exceeded. But infinity in one direction is neither infinite nor finite. (2) Further, why, after always existing, was the thing destroyed, why, after an infinity of not being, was it generated, at one moment rather than another? If every moment is alike and the moments are infinite in number, it is clear that a generated or destructible thing existed for an infinite time. It has

[1] Aristotle now proceeds to apply his results to the refutation of the view attributed in 280a 30 to Plato's *Timaeus*. He there promised to give a clearer demonstration of its absurdity when the terms 'generated', 'ungenerated', &c. should be investigated on their own account and apart from the special case of the heaven.

therefore for an infinite time the capacity of not being (since the capacity of being and the capacity of not being will be present together),[1] if destructible, in the time before destruction, if generated, in the time after generation. If then we assume the two capacities to be actualized, opposites will be present together.[2] (3) Further, this second capacity will be present like the first at every moment, so that the thing will have for an infinite time the capacity both of being and of not being; but this has been shown to be impossible.[3] (4) Again, if the capacity is present prior to the activity, it will be present for all time, even while the thing was as yet ungenerated and non-existent, throughout the infinite time in which it was capable of being generated. At the time, then, when it was not, at that same time it had the capacity of being, both of being then and of being thereafter, and therefore for an infinity of time.[4]

It is clear also on other grounds that it is impossible that the destructible should not at some time be destroyed. For otherwise it will always be at once destructible and in actuality indestructible,[5] so that it will be at the same time

[1] The words *ἅμα γὰρ . . . καὶ εἶναι* are plainly parenthetical, since the *τὸ μέν, τὸ δέ* which follow explain the clause which precedes them. They should be enclosed in brackets and the colon after *χρόνον* deleted.

[2] Read *ἃ δύναται*. Prantl's note is incorrect. The facts are as follows: *ἃ δύναται* FM Simpl., *ἃ δύνανται* EL, *ἀδύνατα* HJ. Bekker prints the last, though attested by only one of his MSS.

[3] The third argument is distinct from the second in that the second arrives at an *absurdum* by actualizing the capacity, while the third points out that the co-presence of two such capacities has already been admitted to be impossible. Cf. 282a 5, 'that which is always capable of being' is the contrary of 'that which is always capable of not being'. Alexander seems to have maintained that our third argument was not a distinct argument at all; but the short account of his view given by Simpl. is not convincing.

[4] A colon is required after *ὕστερον*. Aristotle is proving that the capacity was present for infinite time, which in argument (3) he assumed as evident without proof.

[5] Prantl's note as to the reading in l. 26 is inaccurate. The words *καὶ ἄφθαρτον* (not *καὶ φθαρτόν*) were lacking in the MSS. used both by Alexander and by Simpl.; and they interpreted the sentence without those words to mean—'it will be at once eternal and in actuality destructible'; but 'in actuality destructible' means 'destroyed', and therefore the assertion is not justified by the context. Alex., however, suggested the insertion of the words *καὶ ἄφθαρτον*, and Simpl. says he 'has come across' a manuscript in which the words are found. *καὶ ἄφθαρτον* seems to have been added to E upon revision, but all our other MSS. have the words, and it is best to retain them in the text.

capable of always existing and of not always existing. Thus the destructible is at some time actually destroyed. The generable, similarly, has been generated, for it is capable of having been generated and thus also of not always existing.[1]

We may also see in the following way how impossible it is either for a thing which is generated to be thenceforward indestructible, or for a thing which is ungenerated and has always hitherto existed to be destroyed. Nothing that is by chance can be indestructible or ungenerated, since the pro-
283b ducts of chance and fortune are opposed to what is, or comes to be, always or usually, while anything which exists for a time infinite either absolutely or in one direction, is in existence either always or usually. That which is by chance, then, is by nature such as to exist at one time and not at another. But in things of that character the contradictory states proceed from one and the same capacity, the matter of the thing being the cause equally of its existence and of its non-existence. Hence contradictories would be present together in actuality.[2]

[1] The end of this paragraph from *καὶ εἰ γενητόν* seems to be a short statement of the parallel argument with regard to generation. If this is so we require a full-stop instead of a comma after *φθαρτόν*. *τὸ φθαρτόν* can hardly be the subject of *γέγονεν*, as Prantl's stopping suggests. The last words, *καὶ μὴ ἀεὶ ἄρα εἶναι*, are unsatisfactory, since, though they draw a true consequence, it is one more directly appropriate to *φθορά* than to *γένεσις*. It is tempting to read *καὶ μὴ ἀεὶ ἄρα μὴ εἶναι*. We should then have the relevant consequence and a more precise parallelism between the two arguments.—The point of the paragraph as a whole is to remove the possibility of an escape, by means of a doctrine of unrealized possibilities, from the conclusion already drawn that what is generated is also destructible. (Simpl. appositely quotes *Timaeus* 41 A, B, where the permanence of the world-order depends on the will and promise of the Demiurge.) Aristotle always maintains that an unrealized possibility in this sense is inconceivable.

[2] For Prantl's *καὶ ἅμα* read *ὅμα*. The *καί* is omitted by FMJ Simpl.—The notions of 'chance' (*τὸ αὐτόματον*) and 'fortune' (*τύχη*) are fully discussed in *Phys.* II. iv–vi, the exclusion of the 'necessary' and the 'usual' (283a 32) being explained in II. v. It is there plainly implied that chance had actually been suggested by earlier writers as the generative cause of the world (196a 33, 198a 10). The reason why they had recourse to this notion would be that chance means a cause quite external to the nature of the thing considered; and thus the chance generation or destruction of the world would not involve the consequence that in general and as such the world was either generated or destructible. Aristotle's reply to the suggestion is simply that chance necessarily implies intermittent being, so that a chance-

Further, it cannot truly be said of a thing now that it exists last year, nor could it be said last year that it exists now.[1] It is therefore impossible for what once did not exist later to be eternal. For in its later state it will possess the capacity of not existing, only[2] not of not existing at a time when it exists—since then it exists in actuality—but of not existing last year or in the past. Now suppose it to be in actuality what it is capable of being. It will then be true to say now that it does not exist last year. But this is impossible. No capacity relates to being in the past, but always to being in the present or future. It is the same with the notion of an eternity of existence followed later by non-existence. In the later state the capacity will be present for that which is not there in actuality.[3] Actualize, then, the capacity. It will be true to say now that this exists last year or in the past generally.

Considerations also not general like these but proper to the subject show it to be impossible that what was formerly eternal should later be destroyed or that what formerly was not should later be eternal. Whatever is destructible or generated is always alterable. Now alteration is due to contraries, and the things which compose the natural body are the very same that destroy it.[4]

eternal is a contradiction in terms. ('Fortune' is a name for chance within the sphere of conduct; and anything which can be caused by chance could also, according to Aristotle, be caused either by intelligence, as in the case of conduct, or by nature, as here. See *Phys.* l. c.)

[1] For ἐστί, ἐστίν read ἔστι, ἔστιν.—The concluding argument is introduced very abruptly, by a formula which shows that in Aristotle's mind the suggestion here criticized is only another form of the appeal to chance just dealt with. The suggestion is that a capacity may be limited in respect of time of fulfilment. Aristotle refutes it by assuming that its authors admit (*a*) that the *possession* of the capacity is not limited in time, and (*b*) that any capacity may be actualized.

[2] Before πλήν a comma is required instead of Prantl's full-stop.

[3] οὗ must be taken to stand for ἐκείνου ὅ, as in Simpl.'s paraphrase.—The meaning is that after the thing has ceased to be it still retains its capacity of existing at any time previous to that event.

[4] A comma is required after ἐναντίοις and, for συνίσταται, συνίσταται.

[redacted]

BOOK II

283b 26 THAT the heaven as a whole neither came into being 1 nor admits of destruction, as some assert, but is one and eternal, with no end or beginning of its total duration, containing and embracing in itself the infinity of time, we may convince ourselves not only by the arguments already set forth but also by a consideration of the views of those who differ from us in providing for its generation. If our view is a possible one, and the manner of generation which they 284a assert is impossible, this fact will have great weight in convincing us of the immortality and eternity of the world. Hence it is well to persuade oneself of the truth of the ancient and truly traditional theories, that there is some immortal and divine thing which possesses movement, but movement such as has no limit and is rather itself the limit of all other movement. A limit is a thing which contains; and this motion[1], being perfect, contains those imperfect motions which have a limit and a goal, having itself no beginning or end, but unceasing through the infinity of time, and of other movements, to some the cause of their beginning, to others offering the goal. The ancients gave to the Gods the heaven or upper place, as being alone immortal; and our present argument testifies that it is indestructible and ungenerated. Further, it is unaffected by any mortal discomfort, and, in addition, effortless; for it needs no constraining necessity to keep it to its path, and prevent it from moving with some other movement more natural to itself. Such a constrained movement would necessarily involve effort—the more so, the more eternal it were—and would be inconsistent with perfection. Hence we must not believe the old tale which says that the world needs some Atlas to keep it safe—a tale composed, it would seem, by men who, like later thinkers, conceived of all the

[1] Omit ἡ κυκλοφορία. The words are found only in L, and though harmless are quite superfluous. There is no reference to κυκλοφορία in Simpl.'s paraphrase.

upper bodies as earthy and endowed with weight, and therefore supported it in their fabulous way upon animate necessity. We must no more believe that than follow Empedocles when he says that the world, by being whirled round, received a movement quick enough to overpower its own downward tendency, and thus has been kept from destruction all this time. Nor, again, is it conceivable that it should persist eternally by the necessitation of a soul.[1] For a soul could not live in such conditions painlessly or happily, since the movement involves constraint, being imposed on the first body, whose natural motion is different, and imposed continuously.[2] It must therefore be uneasy and devoid of all rational satisfaction ; for it could not even, like the soul of mortal animals, take recreation in the bodily relaxation of sleep. An Ixion's lot must needs possess it, without end or respite. If then, as we said, the view already 284b
stated of the first motion is a possible one, it is not only more appropriate so to conceive of its eternity, but also on this hypothesis alone are we able to advance a theory consistent with popular divinations of the divine nature.[3] But of this enough for the present.

2 Since there are some who say that there is a right and a left in the heaven, with those who are known as Pythagoreans—to whom indeed the view really belongs—we must consider whether, if we are to apply these principles to the body of the universe, we should follow their statement of the matter or find a better way. At the start we may say

[1] The cosmic motions must not be regarded as imposed upon the body of the cosmos by a world-soul as the human soul imposes movement on the human body. Such a notion necessarily implies constraint on the part of the body and effort on the part of the soul, and therefore the movement could not be eternal. Aristotle has in mind, no doubt, the world-soul of the *Timaeus*.

[2] Read *εἴπερ κινεῖ φέρεσθαι πεφυκότος . . . ἄλλως καὶ κινεῖ συνεχῶς*, with all MSS. except E. Simpl.'s paraphrase supports this reading.—The remarks which follow as to the absence of 'rational satisfaction' recall verbally Plato, *Timaeus* 36 E *θείαν ἀρχὴν ἤρξατο* [*ἡ ψυχή*—the world-soul] *ἀπαύστου καὶ ἔμφρονος βίου πρὸς τὸν σύμπαντα χρόνον*.

[3] By 'divination' (*μαντεία*) Aristotle means, not any religious practice of prophecy or the like, but simply the inspired guesses of common sense—*τὴν κοινὴν ταύτην ἔννοιαν ἣν ἔχομεν περὶ τῆς ἀπονίας καὶ μακαριότητος τοῦ θείου* (Simpl.).

that, if right and left are applicable, there are prior principles which must first be applied. These principles have been analysed in the discussion of the movements of animals,[1] for the reason that they are proper to animal nature. For in some animals we find all such distinctions of parts as this of right and left clearly present, and in others some; but in plants we find only above and below. Now if we are to apply to the heaven such a distinction of parts, we must expect, as we have said, to find in it also that distinction which in animals is found first of them all. The distinctions are three,[2] namely, above and below, front and its opposite, right and left—all these three oppositions we expect to find in the perfect body—and each may be called a principle. Above is the principle of length, right of breadth, front of depth. Or again we may connect them with the various movements, taking principle to mean that part, in a thing capable of movement, from which movement first begins. Growth starts from above, locomotion from the right, sense-movement from in front (for front is simply the part to which the senses are directed). Hence we must not look for above and below, right and left, front and back, in every kind of body, but only in those which, being animate, have a principle of movement within themselves. For in no inanimate thing do we observe a part from which movement originates. Some do not move at all, some move, but not indifferently in any direction; fire,
285a for example, only upward, and earth only to the centre. It is true that we speak of above and below, right and left, in these bodies relatively to ourselves. The reference may be to our own right hands, as with the diviner, or to some similarity to our own members, such as the parts of a statue possess; or we may take the contrary spatial order, calling right that which is to our left, and left that which is to our right.[3] We observe, however, in the things

[1] *De Incessu Anim.*, cc. iv, v.
[2] Prantl misprints γάν for γάρ.
[3] Bekker and Prantl are probably right in regarding the words which follow δεξιῶν (viz. καὶ . . . ἔμπροσθεν) as spurious, though they are found in all MSS. except E. There is no trace of them in Simpl. or Them.

themselves none of these distinctions; indeed if they are turned round we proceed to speak of the opposite parts as right and left, above and below, front and back. Hence it is remarkable that the Pythagoreans should have spoken of these two principles, right and left, only, to the exclusion of the other four, which have as good a title as they. There is no less difference between above and below or front and back in animals generally than between right and left. The difference is sometimes only one of function,[1] sometimes also one of shape; and while the distinction of above and below is characteristic of all animate things, whether plants or animals, that of right and left is not found in plants. Further, inasmuch as length is prior to breadth, if above is the principle of length, right of breadth, and if the principle of that which is prior is itself prior, then above will be prior to right, or let us say, since 'prior' is ambiguous, prior in order of generation.[2] If, in addition, above is the region from which movement originates, right the region in which it starts, front the region to which it is directed, then on this ground too above has a certain original character as compared with the other forms of position. On these two grounds, then, they may fairly be criticized, first, for omitting the more fundamental principles, and secondly, for thinking that the two they mentioned were attributable equally to everything.

Since we have already determined that functions of this kind belong to things which possess a principle of movement,[3] and that the heaven is animate and possesses a principle of movement,[4] clearly the heaven must also exhibit

[1] The right and left hands, for instance, differ in function but not in shape. It is implied that the difference of function underlies all the oppositions and determines the differences of shape where these occur. The differences of function are summarized above, 284^b 25–30.

[2] For the four main kinds of 'priority', see *Cat.* ch. xii (14^a 26 ff.). Additional distinctions are made in *Met.* Δ, ch. xi.

[3] i.e. to animals. This is laid down at the beginning of the present chapter, 283^b 13, where reference is made to the *De Incessu Animalium*. Cf. also *Phys.* VIII. 4, 254^b 7.

[4] Bk. I, 279^a 28, where it is stated to be the source of all life and movement. The term 'animate' (ἔμψυχος) has not hitherto been applied to it. The notion that the stars are 'inanimate' is rejected below, 292^a 20.

above and below, right and left. We need not be troubled by the question, arising from the spherical shape of the world, how there can be a distinction of right and left
285b within it, all parts being alike and all for ever in motion. We must think of the world as of something in which right differs from left in shape as well as in other respects, which subsequently is included in a sphere. The difference of function will persist, but will appear not to by reason of the regularity of shape. In the same fashion must we conceive of the beginning of its movement. For even if it never began to move, yet it must possess a principle from which it would have begun to move if it had begun, and from which it would begin again if it came to a stand. Now by its length I mean the interval between its poles, one pole being above and the other below; for two hemispheres are specially distinguished from all others by the immobility of the poles.[1] Further, by 'transverse' in the universe we commonly mean, not above and below, but a direction crossing the line of the poles, which, by implication, is length: for transverse motion is motion crossing motion up and down. Of the poles, that which we see above us is the lower region, and that which we do not see is the upper. For right in anything is, as we say, the region in which locomotion originates, and the rotation of the heaven originates in the region from which the stars rise. So this will be the right, and the region where they set the left. If then they begin from the right and move round to the right, the upper must be the unseen pole. For if it is the pole we see, the movement will be leftward, which we deny to be the fact. Clearly then the invisible pole is above. And those who live in the other hemisphere are above and to the right, while we are below and to the left. This is just the opposite of the view of the Pythagoreans, who make us above and on the right side and those in the other hemisphere below and on the left side; the fact

[1] The unmoving poles mark out one among the infinite possible bisections of the sphere as natural and intelligible. We thus arrive, as explained in what follows, at an 'upper' and a 'lower' hemisphere.

being the exact opposite.[1] Relatively, however, to the secondary revolution, I mean that of the planets, we are above and on the right and they are below and on the left. For the principle of their movement has the reverse position, since the movement itself is the contrary of the other: hence it follows that we are at its beginning and they at its end. Here we may end our discussion of the distinctions 286a of parts created by the three dimensions and of the consequent differences of position.

3 Since circular motion is not the contrary of the reverse circular motion, we must consider why there is more than one motion, though we have to pursue our inquiries at a distance—a distance created not so much by our spatial position as by the fact that our senses enable us to perceive very few of the attributes of the heavenly bodies. But let

[1] Heath (*Aristarchus*, pp. 231–2) summarizes the argument as follows: '"Right" is the place from which motion in space starts; and the motion of the heaven starts from the side where the stars rise, i.e. the east; therefore the east is "right" and the west "left". If now (1) you suppose yourself to be lying along the world's axis with your head towards the *north* pole, your feet towards the *south* pole, and your right hand towards the east, then clearly the apparent motion of the stars from east to west is over your *back* from your right side towards your left; this motion, Aristotle maintains, cannot be called motion "to the right", and therefore our hypothesis does not fit the assumption from which we start, namely that the daily rotation "begins from the right and is carried round towards the right (ἐπὶ τὰ δεξιά)". We must therefore alter the hypothesis and suppose (2) that you are lying with your head towards the *south* pole and your feet towards the *north* pole. If then your right hand is to the east, the daily motion begins at your right hand and proceeds over the front of your body from your right hand to your left.' Heath points out that to us this still gives a wrong result: the motion across your front will still be from right to left; but he accepts Simpl.'s explanation that movement to the front is regarded as rightward and motion to the back as leftward—ἡ γὰρ ἐπὶ δεξιὰ πάντως εἰς τὸ ἔμπροσθέν ἐστι. If this is true, Heath's account is satisfactory. It is curious that the notion of rightward movement also gives trouble in the cosmology of Plato. Heath has an entirely different solution of that difficulty, in which the ordinary sense of 'to the right' is preserved (pp. 160–3). In view of the solution of the present passage quoted above, perhaps there is something after all to be said for the assertion of Proclus (*In Timaeum* 220 E), quoted by Heath only to be dismissed, that ἐπὶ δεξιά does not mean εἰς τὸ δεξιόν but is confined to circular motion and means 'the direction of a movement imparted by the right hand' (ἐφ' ἃ τὸ δεξιὸν κινεῖ). The discrimination of right and left in circular motions is peculiarly difficult and ambiguous, as every child knows; and some such use of ἐπὶ δεξιά may have been the Greek solution of the terminological problem.

not that deter us. The reason must be sought in the following facts. Everything which has a function exists for its function. The activity of God is immortality, i. e. eternal life.[1] Therefore the movement of that which is divine must be eternal. But such is the heaven, viz. a divine body, and for that reason to it is given the circular body whose nature it is to move always in a circle.[2] Why, then, is not the whole body of the heaven of the same character as that part? Because there must be something at rest at the centre of the revolving body; and of that body no part can be at rest, either elsewhere or at the centre. It could do so only if the body's natural movement were towards the centre. But the circular movement is natural, since otherwise it could not be eternal: for nothing unnatural is eternal.[3] The unnatural is subsequent to the natural, being a derangement of the natural which occurs in the course of its generation.[4] Earth then has to exist; for it is earth which is at rest at the centre. (At present we may take this for granted: it shall be explained later.[5]) But if earth must exist, so must fire. For, if one of a pair of contraries naturally exists, the other, if it is really contrary, exists also naturally. In some form it must be present, since the matter of contraries is the same. Also, the positive is prior to its privation (warm, for instance, to cold), and rest and heaviness stand for the priva-

[1] The argument is clear. 'God' or 'divine' means 'eternal'. All body has motion. Therefore the notion of a divine body necessarily involves the notion of an eternal movement.—Simpl. says wrongly that *θεός* here stands for *θεῖον σῶμα*.

[2] The nature of the circular motion, and the reasons why it alone is compatible with immutability and the other divine attributes, have been explained in Bk. I, chaps. iii and iv.—The adjective 'circular' (*ἐγκύκλιος*) here and in several other passages of this book is transferred from the motion to the body endowed with it.

[3] The body which is at the centre cannot be of the same nature, and endowed with the same motion, as that which is at the extremity; for the actual position and movement of one or the other would in that case be unnatural. There must therefore be a body whose natural position is at the centre and whose natural movement is towards the centre.

[4] All change involves 'derangement' (*ἔκστασις*), *Phys.* 222ᵇ 16; cf. *Phys.* 241ᵇ 2. *ἔκστασις* is opposed to *τελείωσις* ('fulfilment', or movement of a thing towards its ideal nature), *Phys.* 246ª 17, ᵇ 2, 247ª 3.

[5] See ch. xiv.

tion of lightness and movement. But further, if fire and earth exist, the intermediate bodies[1] must exist also: for each element stands in a contrary relation to every other. (This, again, we will here take for granted and try later to explain.[2]) With these four elements generation clearly is involved, since none of them can be eternal: for contraries interact with one another and destroy one another. Further, it is inconceivable that a movable body should be eternal, if its movement cannot be regarded as naturally eternal: and these bodies we know to possess movement.[3] Thus we 286b
see that generation is necessarily involved. But if so, there must be at least one other circular motion: for a single movement of the whole heaven would necessitate an identical relation of the elements of bodies to one another.[4] This matter also shall be cleared up in what follows: but for the present so much is clear, that the reason why there is more than one circular body is the necessity of generation, which follows on the presence of fire, which, with that of the other bodies, follows on that of earth; and earth is required because eternal movement in one body necessitates eternal rest in another.

4 The shape of the heaven is of necessity spherical; for that is the shape most appropriate to its substance and also by nature primary.

[1] viz. air and water.

[2] See *De Gen. et Corr.* II. iii, iv.

[3] Retaining the MSS. reading, which is confirmed by Simpl. and Them., τούτων δ' ἔστι κίνησις. If these words are taken to mean ταῦτα δ' ἐστι κινητά, the argument, though summarily stated, is complete and Prantl's conjecture is unnecessary. If it is granted that the sublunary elements move, generation is admitted, unless it can be shown that their movement is such as to be naturally eternal. But it has already been shown (*Phys.* 261a 31 ff.) that the rectilinear movements must be intermittent.

[4] A. is proving the necessity of the secondary revolution, i.e. that of the planets. 'If', he argues, 'there were only the movement of the fixed stars, and sun and moon were set in it and carried along with it, the varieties of summer and winter and the other seasons would disappear and the daily interchange would not follow its accustomed course. For if the sun were set in Cancer, we should have perpetual summer, and if it were set in Capricorn, perpetual winter: there would be no generation or destruction, not even the varied phases of the moon' (Simpl.). The further discussion promised here is to be found in *De Gen. et Corr.* II. x.

First, let us consider generally which shape is primary among planes and solids alike. Every plane figure must be either rectilinear or curvilinear. Now the rectilinear is bounded by more than one line, the curvilinear by one only. But since in any kind the one is naturally prior to the many and the simple to the complex, the circle will be the first of plane figures. Again, if by complete, as previously defined,[1] we mean a thing outside which no part of itself can be found, and if addition is always possible to the straight line but never to the circular, clearly the line which embraces the circle is complete. If then the complete is prior to the incomplete, it follows on this ground also that the circle is primary among figures. And the sphere holds the same position among solids. For it alone is embraced by a single surface, while rectilinear solids have several. The sphere is among solids what the circle is among plane figures. Further, those who divide bodies into planes and generate them out of planes[2] seem to bear witness to the truth of this. Alone[3] among solids they leave the sphere undivided, as not possessing more than one surface: for the division into surfaces is not just dividing a whole by cutting it into its parts, but division of another fashion into parts different in form.[4] It is clear, then, that the sphere is first of solid figures.

If, again, one orders figures according to their numbers, it is most natural to arrange them in this way. The circle
287a corresponds to the number one, the triangle, being the sum of two right angles, to the number two. But if one is assigned to the triangle, the circle will not be a figure at all.

[1] *Phys.* III. 207a 8. For the terms of the definition cf. *sup.* 271b 31. This notion of 'perfect' (or 'complete') is presupposed in the opening chapter of this treatise.—In l. 19 read τῶν αὐτοῦ: the τῶν is omitted only in E and F.

[2] Cf. *Phys.* VI. 1 and *inf.* Bk. III, ch. i for further criticisms of these theories. The theory criticized is that expressed by Timaeus the Pythagorean in Plato's dialogue of that name. (So Simpl. on 298b 33.)

[3] Prantl's μόνη is a misprint for μόνην.

[4] Both sphere and circle can of course be divided into parts, but they cannot be geometrically analysed into constituents not themselves spherical or circular. The geometrical analysis requires that the constituent or 'part' shall be different in form from the whole.

Now the first figure belongs to the first body, and the first body is that at the farthest circumference. It follows that the body which revolves with a circular movement must be spherical. The same then will be true of the body continuous with it: for that which is continuous with the spherical is spherical. The same again holds of the bodies between these and the centre. Bodies which are bounded by the spherical and in contact with it must be, as wholes, spherical; and the bodies below the sphere of the planets are contiguous with the sphere above them. The sphere then will be spherical throughout; for every body within it is contiguous and continuous with spheres.

Again, since the whole revolves, palpably and by assumption, in a circle, and since it has been shown that outside the farthest circumference there is neither void nor place, from these grounds also it will follow necessarily that the heaven is spherical. For if it is to be rectilinear in shape, it will follow that there is place and body and void without it. For a rectilinear figure as it revolves never continues in the same room, but where formerly was body, is now none, and where now is none, body will be in a moment because of the projection at the corners. Similarly, if the world had some other figure with unequal radii, if, for instance, it were lentiform, or oviform, in every case we should have to admit space and void outside the moving body, because the whole body would not always occupy the same room.[1]

Again, if the motion of the heaven is the measure of all movements whatever in virtue of being alone continuous and regular and eternal, and if, in each kind, the measure is the minimum, and the minimum movement is the swiftest, then, clearly, the movement of the heaven must be the swiftest of all movements. Now of lines which return upon themselves[2] the line which bounds the circle is the shortest;

[1] This depends, as Simpl. observes, after Alexander, on the position of the axis of revolution. In the case of a perfect sphere alone the position of the axis is immaterial.

[2] Reading ἀφ' ἑαυτοῦ ἐφ' ἑαυτό, with Simpl. and the consensus of the MSS. The τοῦ and τό in Prantl's text are conjectural insertions. J has ἀφ' αὑτοῦ ἐφ' αὑτό.

and that movement is the swiftest which follows the shortest line.[1] Therefore, if the heaven moves in a circle and moves more swiftly than anything else, it must necessarily be spherical.

Corroborative evidence may be drawn from the bodies whose position is about the centre. If earth is enclosed by water, water by air, air by fire, and these similarly by the upper bodies—which while not continuous are yet contiguous

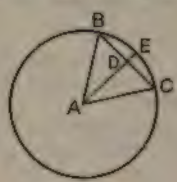
287b with them[2]—and if the surface of water is spherical, and that which is continuous with or embraces the spherical must itself be spherical, then on these grounds also it is clear that the heavens are spherical. But the surface of water is seen to be spherical if we take as our starting-point the fact that water naturally tends to collect in a hollow place—'hollow' meaning 'nearer the centre'. Draw from the centre the lines *AB*, *AC*, and let their extremities be joined by the straight line *BC*. The line *AD*, drawn to the base of the triangle, will be shorter than either of the radii.[3] Therefore the place in which it terminates will be a hollow place. The water then will collect there until equality is established, that is until the line *AE* is equal to the two radii. Thus water forces its way to the ends of the radii, and there only will it rest: but the line which connects the extremities of the radii is circular: therefore the surface of the water *BEC* is spherical.

It is plain from the foregoing that the universe is spherical. It is plain, further, that it is turned (so to speak) with a finish which no manufactured thing nor anything

[1] This is true if equality of effort (ἀπὸ τῆς αὐτῆς δυνάμεως Simpl.) is postulated. In a word, the underlying notion is rather the comparative *economy* than the comparative *swiftness* of movements.—For the origin of this argument Simpl. refers to *Tim.* 33 B.

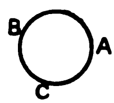
[2] 'Continuous', 'contiguous', and the related terms are defined in *Phys.* V. iii. If these bodies were continuous with the heavenly body they would have to move with the same motion as it.

[3]



else within the range of our observation can even approach. For the matter of which these are composed does not admit of anything like the same regularity and finish as the substance of the enveloping body; since with each step away from earth the matter manifestly becomes finer in the same proportion as water is finer than earth.

5 Now there are two ways of moving along a circle, from *A* to *B* or from *A* to *C*,[1] and we have already explained[2] that these movements are not contrary to one another. But nothing which concerns the eternal can be a matter of chance or spontaneity, and the heaven and its circular motion are eternal. We must therefore ask why this motion takes one direction and not the other. Either this is itself an ultimate fact or there is an ultimate fact behind it. It may seem evidence of excessive folly or excessive zeal to try to provide an explanation of some things, or of every-thing, admitting no exception. The criticism, however, is not always just: one should first consider what reason there is for speaking, and also what kind of certainty is looked for, whether human merely or of a more cogent kind.[3] When any one shall succeed in finding proofs of greater precision, 288a gratitude will be due to him for the discovery, but at present we must be content with a probable solution.[4] If nature always follows the best course possible, and, just as upward movement is the superior form of rectilinear move-ment, since the upper region is more divine than the lower, so forward movement is superior to backward, then front and back exhibits, like right and left, as we said before[5] and

[1] 

If *A* is the 'right' from which movement starts, why should the movement be towards *B* rather than towards *C*? Probably, answers Aristotle, because movement towards *B* is 'forward' and movement towards *C* 'backward' motion.

[2] I. iv.

[3] Bekker and Prantl prefer L's καρτερικώτερον to the καρτερώτερον of all other MSS. It is difficult to imagine why. There is good Platonic parallel for the use of καρτερός in this connexion (*Phaedo* 77 A, *Theaet.* 169 B).

[4] A similar caution is repeated at the beginning of ch. xii, 291b 25. For this use of φαινόμενον cf. Bonitz, *Ind. Ar.* 809a 24.

[5] Reading, with Prantl, ἔχει δὴ εἴπερ, and accepting his punctuation.

as the difficulty just stated itself suggests, the distinction of prior and posterior, which provides a reason and so solves our difficulty. Supposing that nature is ordered in the best way possible, this may stand as the reason of the fact mentioned. For it is best to move with a movement simple and unceasing, and, further, in the superior of two possible directions.

We have next to show that the movement of the heaven 6
is regular and not irregular. This applies only to the first heaven and the first movement; for the lower spheres exhibit a composition of several movements into one. If the movement is uneven, clearly there will be acceleration, maximum speed, and retardation, since these appear in all irregular motions. The maximum may occur either at the starting-point or at the goal or between the two; and we expect natural motion to reach its maximum at the goal, unnatural motion at the starting-point, and missiles midway between the two.[1] But circular movement, having no be-

The passage as punctuated by Bekker is untranslatable. The apodosis undoubtedly begins at the word ἔχει. EL give ἔχει δὲ εἴπερ, the remaining MSS. ἔχει εἴπερ.—The existence of a 'front' and 'back' in the world was asserted in ch. ii. The priority of 'up', 'right', and 'front' over 'down', 'left', and 'back' is assumed in the same chapter, 284ᵇ 24.—The gist of the present rather involved and hesitating statement is that the only way to account for the direction of the heavenly movements is by means of these oppositions and the priority commonly attributed in each to one term over the other.

[1] It appears from *Meteorologica* I. iv, 341ᵇ—342ᵃ that meteors and shooting stars come under the notion of 'missiles' or 'things thrown'. Their motion is compared to that of the stone of a fruit when it is made to fly through the air by being squeezed out from between the fingers. Ordinary throwing, e. g. of a stone or javelin, would of course also be included.—Simpl. and, by his report, Alexander are much puzzled by the statement in the text. Simpl. makes the wild suggestion that A. here regards animal movements as 'missile' motion, in that they are neither upward nor downward but horizontal. Alex. suggests that 'missile' movements may be said to have their maximum between goal and starting-point, because every earthly body has its goal either up or down, and the whole of the 'missile' movement, from beginning to end, takes place in the middle region. Alex. is probably right. It is to be remembered that all movement is either natural or unnatural, and that 'missile' movement can only be distinguished in principle as a mixture of the two; further that the body thrown must be composed of one or more of the four elementary bodies. 'Throwing' is thought of as a forced horizontal motion put upon one of these bodies, each of which has a 'goal', down (or up), and a 'starting-point', up (or down). In such a motion the maximum

ginning or limit or middle in the direct sense of the words, has neither whence nor whither nor middle: for in time it is eternal, and in length it returns upon itself without a break. If then its movement has no maximum, it can have no irregularity, since irregularity is produced by retardation and acceleration. Further, since everything that is moved is moved by something, the cause of the irregularity of movement must lie either in the mover or in the moved or in both. For if the mover moved not always with the same force, or if the moved were altered and did not remain the same, or if both were to change, the result might well be an irregular movement in the moved. But none of these possibilities can be conceived as actual in the case of the heavens. As to that which is moved, we have shown that it is primary and simple and ungenerated and indestructible and generally unchanging; and the mover has an even better right to these attributes. It is the primary that moves the primary, the simple the simple, the indestructible and ungenerated that which is indestructible and ungenerated. Since then that which is moved, being a body, is nevertheless unchanging, how should the mover, which is incorporeal, be changed?

It follows then, further, that the motion cannot be irregular. For if irregularity occurs, there must be change either in the movement as a whole, from fast to slow and slow to fast, or in its parts. That there is no irregularity in the parts is obvious, since, if there were, some divergence of the stars would have taken place[1] before now in the infinity of time, as one moved slower and another faster: but no alteration of their intervals is ever observed. Nor again is a change in the movement as a whole admissible. Retardation is always due to incapacity, and incapacity is unnatural. The incapacities of animals, age, decay, and the like, are all unnatural, due, it seems, to the fact that the

cannot be said to be attained at either terminus, since neither terminus is involved, but only 'between the two'. This means that in the case of natural motion 'goal' must be taken to be the natural place of the body, which is also the 'starting-point' of unnatural motion in the same body. In 'throwing', therefore, there is neither starting-point nor goal, but all is in the intermediate region.

[1] For γεγόνει read ἐγεγόνει with FHLMJ.

whole animal complex is made up of materials which differ in respect of their proper places, and no single part occupies its own place. If therefore that which is primary contains nothing unnatural, being simple and unmixed and in its proper place and having no contrary, then it has no place for incapacity, nor, consequently, for retardation or (since acceleration involves retardation) for acceleration. Again, it is inconceivable that the mover should first show incapacity for an infinite time, and capacity afterwards for another infinity. For clearly nothing which, like incapacity, is unnatural ever continues for an infinity of time; nor does the unnatural endure as long as the natural, or any form of incapacity as long as the capacity.[1] But if the movement is retarded it must necessarily be retarded for an infinite time.[2] Equally impossible is perpetual acceleration or perpetual retardation. For such movement would be infinite and indefinite,[3] but every movement, in our view, proceeds from one point to another and is definite in character. Again, suppose one assumes a minimum time in less than which the heaven could not complete its movement. For, as a given walk or a given exercise on the harp cannot take any and every time, but every performance has its definite minimum time which is unsurpassable, so, one might suppose, the movement of the heaven could not be
289a completed in any and every time. But in that case perpetual acceleration is impossible (and, equally, perpetual retardation: for the argument holds of both and each),[4]

[1] Reading οὐδ' ὅλως, with all MSS. except E, which Prantl follows in reading οὐδ' ἄλλως.—The effect of ἄλλως is to make the unnatural one species or department within the general notion of incapacity. ὅλως has much more varied uses and enables one to avoid this implication.

[2] i.e. equality of duration must be supposed between the incapacity (retardation) and the preceding capacity, as assumed in the foregoing argument, in which infinity (sc. in *one* direction) is attributed to each. For if the speed of movement has been everlastingly increasing, and now begins to decrease, it is impossible to suppose anything else but that it will decrease everlastingly.

[3] viz. in respect of its speed. The hypothesis now considered is retardation or acceleration not balanced by its opposite but having neither beginning nor end, i.e. infinite in *both* directions.

[4] Prantl's stopping needs correction. The words εἰ δὲ μὴ . . . θάτερον should be enclosed within brackets.

if we may take acceleration to proceed by identical or increasing additions of speed and for an infinite time. The remaining alternative is to say that the movement exhibits an alternation of slower and faster: but this is a mere fiction and quite inconceivable. Further, irregularity of this kind would be particularly unlikely to pass unobserved, since contrast makes observation easy.

That there is one heaven, then, only, and that it is ungenerated and eternal, and further that its movement is regular, has now been sufficiently explained.

7 We have next to speak of the stars, as they are called, of their composition, shape, and movements. It would be most natural and consequent upon what has been said that each of the stars should be composed of that substance in which their path lies,[1] since, as we said, there is an element whose natural movement is circular. In so saying we are only following the same line of thought as those who say that the stars are fiery because they believe the upper body to be fire, the presumption being that a thing is composed of the same stuff as that in which it is situated. The warmth and light which proceed from them are caused by the friction set up in the air by their motion. Movement tends to create fire in wood, stone, and iron; and with even more reason should it have that effect on air, a substance which is closer to fire than these.[2] An example is that of missiles, which as they move are themselves fired so strongly that leaden balls are melted; and if they are fired the surrounding air must be similarly affected. Now while the missiles are heated by reason of their motion in air, which is turned into fire by the agitation produced by their movement,[3] the upper bodies are carried on a moving sphere, so that, though they are not themselves fired, yet the air underneath the sphere of the revolving body is necessarily heated by its

[1] i.e. of the same substance as the spheres to which their motion is due.

[2] A colon is required after the word ἀήρ in l. 23.

[3] πληγή seems to stand here for the continuous beating of the missile upon the air rather than for a single blow. Cf. Simpl. 439. 25 ὑπὸ τῆς . . . πληγῆς καὶ παρατρίψεως. The same use recurs below, 291a 17.

motion, and particularly in that part where the sun is attached to it.[1] Hence warmth increases as the sun gets nearer or higher or overhead. Of the fact, then, that the stars are neither fiery nor move in fire, enough has been said.

289b Since changes evidently occur not only in the position of 8
the stars but also in that of the whole heaven, there are three possibilities. Either (1) both are at rest, or (2) both are in motion, or (3) the one is at rest and the other in motion.

(1) That both should be at rest is impossible; for, if the earth is at rest, the hypothesis does not account for the observations; and we take it as granted that the earth is at rest. It remains either that both are moved, or that the one is moved and the other at rest.

(2) On the view, first, that both are in motion, we have the absurdity that the stars and the circles move with the same speed, i. e. that the pace of every star is that of the circle in which it moves. For star and circle are seen to come back to the same place at the same moment; from which it follows that the star has traversed the circle and the circle has completed its own movement, i. e. traversed its own circumference, at one and the same moment. But it is difficult to conceive that the pace of each star should be exactly proportioned to the size of its circle. That the pace of each circle should be proportionate to its size is not absurd but inevitable: but that the same should be true of the movement of the stars contained in the circles is quite

[1] The stars are not themselves ignited because the substance of which they are composed cannot be transmuted into any other as fire, air, and the other sublunary substances can. It is, however, legitimate to object to the above account that fire, not air, is the substance in contact with the spheres, and that only with the innermost. How, then, is air ignited by the movement of the spheres? Alex. and Simpl. agree that 'air' must in some sense include fire (or ὑπέκκαυμα, the 'fuel of fire' which occupies the outer place); but that, even if true, will not solve the difficulties. The view here advanced is nowhere fully worked out; but some further suggestions are made in *Meteor.* I. iii and iv. Cf. Heath, *Aristarchus*, pp. 241–2. It seems certain that what Aristotle meant was that the 'fire' which is in contact with the spheres is ignited and agitated by their motion and the air beneath by it (341a 2–3 and 30–31).

incredible. For if, on the one hand, we suppose that the star which moves on the greater circle is necessarily swifter, clearly we also admit that if stars shifted their position so as to exchange circles, the slower would become swifter and the swifter slower. But this would show that their movement was not their own, but due to the circles. If, on the other hand, the arrangement was a chance combination, the coincidence in every case of a greater circle with a swifter movement of the star contained in it is too much to believe. In one or two cases it might not inconceivably fall out so, but to imagine it in every case alike is a mere fiction. Besides, chance has no place in that which is natural, and what happens everywhere and in every case is no matter of chance.

(3) The same absurdity is equally plain[1] if it is supposed that the circles stand still and that it is the stars themselves which move. For it will follow that the outer stars are the swifter, and that the pace of the stars corresponds to the size of their circles.

Since, then, we cannot reasonably suppose either that both are in motion or that the star alone moves, the remaining alternative is that the circles should move, while the stars are at rest and move with the circles to which they are attached. Only on this supposition are we involved in no absurd consequence. For, in the first place, the quicker movement of the larger circle is natural when all the circles are attached to the same centre. Whenever bodies are moving with their proper motion, the larger moves quicker. It is the same here with the revolving bodies: for the arc intercepted by two radii will be larger in the larger circle, and hence it is not surprising that the revolution of the larger circle should take the same time as that of the smaller. And secondly, the fact that the heavens do not break in pieces follows not only from this

[1] Bekker and Prantl read ταῦτα instead of τὰ αὐτά, which is the reading of all MSS. and of Simpl. The alteration is unnecessary. The difficulty is the same as that pointed out in the preceding argument—an unaccountable correspondence between the size of the circle and the speed of the star's movement.

but also from the proof already given[1] of the continuity of the whole.

Again, since the stars are spherical, as our opponents assert and we may consistently admit, inasmuch as we construct them out of the spherical body, and since the spherical body has two movements proper to itself, namely rolling and spinning,[2] it follows that if the stars have a movement of their own, it will be one of these. But neither is observed. (1) Suppose them to *spin*. They would then stay where they were, and not change their place, as, by observation and general consent, they do. Further, one would expect them all to exhibit the same movement: but the only star which appears to possess this movement is the sun, at sunrise or sunset, and this appearance is due not to the sun itself but to the distance from which we observe it. The visual ray being excessively prolonged becomes weak and wavering.[3] The same reason probably accounts for the apparent twinkling of the fixed stars and the absence of twinkling in the planets. The planets are near, so that the visual ray reaches them in its full vigour, but when it comes to the fixed stars it is quivering because of the distance and its excessive extension; and its tremor produces an appearance of movement in the star: for it makes no difference whether movement is set up in the ray or in the object of vision.

(2) On the other hand, it is also clear that the stars do not *roll*. For rolling involves rotation: but the 'face',

[1] Cf. c. iv. But there is no attempt to prove continuity in the *De Caelo*.

[2] By 'spinning' is meant rotation on a stationary axis, by 'rolling' a forward movement in which a body turns completely round in a distance equal to its own circumference. See Heath, *Aristarchus*, pp. 233–5.

[3] The term ὄψις (= visual ray) belongs to pre-Aristotelian psychology. Cf. Plato, *Meno*, 76 C–D. Aristotle's use of it here and elsewhere (e.g. *Meteor.* III. iv, 373b 2) seems to commit him 'to the view that the eye sees by rays issuing from a native fire within it' (Beare, *Greek Theories of Elementary Cognition*, p. 66, n. 1). But his own argument, when dealing with vision, is to the contrary effect. 'In seeing we take something in, not give something out' (*Top.* 105b 6); and the process is 'from object to eye, not conversely' (Beare, p. 86). Aristotle must be supposed here to be adopting popular or Platonic terminology.

as it is called, of the moon is always seen.[1] Therefore, since any movement of their own which the stars possessed would presumably be one proper to themselves, and no such movement is observed in them, clearly they have no movement of their own.

There is, further, the absurdity that nature has bestowed upon them no organ appropriate to such movement. For nature leaves nothing to chance, and would not, while caring for animals, overlook things so precious. Indeed, nature seems deliberately to have stripped them of everything which makes self-originated progression possible, and to have removed them as far as possible from things which have organs of movement. This is just why it seems proper that the whole heaven and every star should be 290b spherical. For while of all shapes the sphere is the most convenient for movement in one place, making possible, as it does, the swiftest and most self-contained motion, for forward movement it is the most unsuitable, least of all resembling shapes which are self-moved, in that it has no dependent or projecting part, as a rectilinear figure has, and is in fact as far as possible removed in shape from ambulatory bodies. Since, therefore, the heavens have to move in one place, and the stars are not required to move themselves forward, it is natural that both should be spherical—a shape which best suits the movement of the one and the immobility of the other.

9 From all this it is clear that the theory that the movement of the stars produces a harmony, i.e. that the sounds they make are concordant, in spite of the grace and originality with which it has been stated, is nevertheless untrue.[2] Some thinkers suppose that the motion of bodies

[1] It has been objected to Aristotle that if the moon always shows the same side to us it is thereby proved that it does rotate upon its axis. But such rotation (incidental, in Aristotle's view, to the movement of the sphere) is quite different from the rotation involved in 'rolling', which Aristotle is here concerned to deny. See Heath, p. 235.

[2] The doctrine of the 'harmony of the spheres' is no doubt, as Simpl. says, Pythagorean. The most famous statement of the doctrine is in Plato's *Republic* (Myth of Er, 617B), and the ratios given to the planets in *Timaeus*, 35B, seem to have a musical significance. For a discussion of the doctrine see Heath, *Aristarchus*, pp. 105–15.

of that size must produce a noise, since on our earth the motion of bodies far inferior in size and in speed of movement has that effect. Also, when the sun and the moon, they say, and all the stars, so great in number and in size, are moving with so rapid a motion, how should they not produce a sound immensely great? Starting from this argument and from the observation that their speeds, as measured by their distances, are in the same ratios as musical concordances, they assert that the sound given forth by the circular movement of the stars is a harmony. Since, however, it appears unaccountable that we should not hear this music, they explain this by saying that the sound is in our ears from the very moment of birth and is thus indistinguishable from its contrary silence, since sound and silence are discriminated by mutual contrast. What happens to men, then, is just what happens to coppersmiths, who are so accustomed to the noise of the smithy that it makes no difference to them. But, as we said before, melodious and poetical as the theory is, it cannot be a true account of the facts. There is not only the absurdity of our hearing nothing, the ground of which they try to remove, but also the fact that no effect other than sensitive is produced upon us. Excessive noises, we know, shatter the solid bodies even of inanimate things: the noise of thunder,
291a for instance, splits rocks and the strongest of bodies. But if the moving bodies are so great, and the sound which penetrates to us is proportionate to their size, that sound must needs reach us in an intensity many times that of thunder, and the force of its action must be immense. Indeed the reason why we do not hear, and show in our bodies none of the effects of violent force, is easily given: it is that there is no noise. But not only is the explanation evident; it is also a corroboration of the truth of the views we have advanced. For the very difficulty which made the Pythagoreans say that the motion of the stars produces a concord corroborates our view. Bodies which are themselves in motion, produce noise and friction: but those which are attached or fixed to a moving body, as the parts to a ship, can no more create noise, than a ship on a river

moving with the stream. Yet by the same argument one might say it was absurd that on a large vessel the motion of mast and poop should not make a great noise, and the like might be said of the movement of the vessel itself. But sound is caused when a moving body is enclosed in an unmoved body, and cannot be caused by one enclosed in, and continuous with, a moving body which creates no friction. We may say, then, in this matter that if the heavenly bodies moved in a generally diffused mass of air or fire, as every one supposes, their motion would necessarily cause a noise of tremendous strength and such a noise would necessarily reach and shatter us.[1] Since, therefore, this effect is evidently not produced, it follows that none of them can move with the motion either of animate nature or of constraint.[2] It is as though nature had foreseen the result, that if their movement were other than it is, nothing on this earth could maintain its character.

That the stars are spherical and are not self-moved, has now been explained.

10 With their order—I mean the position of each, as involving the priority of some and the posteriority of others, and their respective distances from the extremity—with this astronomy may be left to deal, since the astronomical discussion is adequate.[3] This discussion shows that the movements of the several stars depend, as regards the varieties of speed which they exhibit, on the distance

[1] Prantl misprints διακναίει for διακναίειν.

[2] If the stars moved in a non-moving medium either with a self-originated motion, like that of an animal, or with a motion imposed on them by external force, like that of a stone thrown, a great and destructive noise would result. There is no such noise or destruction. Therefore they do not so move. The Pythagorean doctrine is thus used to corroborate a conclusion already reached. It might be objected that Aristotle has already postulated friction with another substance to account for the brightness of the stars, and that this friction might well be expected to be accompanied with noise as in the case of missiles on the earth.

[3] The tone of this reference to 'astronomy', as well as the present tense in the verb λέγεται, suggest that Aristotle is not here referring to other works of his own but to contemporary works on astronomy, current in the school, by other writers. These sentences also clearly imply that 'astronomy' is more empirical in its methods than the *De Caelo*. Cf. *infra*, 291b21.—In l. 29 Prantl's ὃ is a misprint for ὃν.

of each from the extremity. It is established that the outermost revolution of the heavens is a simple movement 291b and the swiftest of all, and that the movement of all other bodies is composite and relatively slow, for the reason that each is moving on its own circle with the reverse motion to that of the heavens. This at once leads us to expect that the body which is nearest to that first simple revolution should take the longest time to complete its circle, and that which is farthest from it the shortest, the others taking a longer time the nearer they are and a shorter time the farther away they are. For it is the nearest body which is most strongly influenced, and the most remote, by reason of its distance, which is least affected, the influence on the intermediate bodies varying, as the mathematicians show, with their distance.[1]

With regard to the shape of each star, the most reasonable II view is that they are spherical. It has been shown[2] that it is not in their nature to move themselves, and, since nature is no wanton or random creator, clearly she will have given things which possess no movement a shape particularly unadapted to movement. Such a shape is the sphere, since it possesses no instrument of movement. Clearly then their mass will have the form of a sphere.[3] Again, what

[1] In regard to 'order' Aristotle only seeks to explain one point which might present a difficulty. It would be natural to expect the moon, which is the nearest planet to the earth, to have the slowest motion; but in fact it is the swiftest of the planets. His answer is that the movement of the planets, being the reverse of that of the outer heaven, is hampered by proximity to it; and the planet nearest to the earth is least influenced and therefore moves swiftest. Simpl. raises the objection: is not the planetary motion then in some degree constrained or unnatural? He quotes with approval from Alex. the reply: 'No: for the planetary sphere is not unwilling. This accords with its purpose and desire. It may be necessity, but it is also good, and recognized as such.' Simpl. is not altogether satisfied by this solution.

[2] Ch. viii.

[3] Simpl. notes a circle in Aristotle's argument, since he has already used the spherical shape of the stars to prove that they have no independent motion (c. viii). (The same charge is brought against Aristotle by Dreyer, *Planetary Systems*, p. 111.) He is not satisfied with Alex.'s rejoinder that neither of these arguments stands alone. The true answer is that the argument of c. viii is explicitly based, in respect of the spherical shape of the stars, on a premise borrowed from the opposition: see 290a 7. Aristotle's own proof of the matter precedes it. This argument is therefore in order.

holds of one holds of all, and the evidence of our eyes shows us that the moon is spherical. For how else should the moon as it waxes and wanes show for the most part a crescent-shaped or gibbous figure, and only at one moment a half-moon? And astronomical arguments[1] give further confirmation; for no other hypothesis accounts for the crescent shape of the sun's eclipses. One, then, of the heavenly bodies being spherical, clearly the rest will be spherical also.

12 There are two difficulties, which may very reasonably here be raised, of which we must now attempt to state the probable solution:[2] for we regard the zeal of one whose thirst after philosophy leads him to accept even slight indications where it is very difficult to see one's way, as a proof rather of modesty than of over-confidence.

Of many such problems one of the strangest is the problem why we find the greatest number of movements in the intermediate bodies, and not, rather, in each successive body a variety of movement proportionate to its distance from the primary motion. For we should expect, since the primary body shows one motion only, that the body which is nearest to it should move with the fewest movements, say two, and the one next after that with three, or some similar arrangement. But the opposite is the case. The movements of the sun and moon are fewer than those of 292^{a}
some of the planets. Yet these planets are farther from the centre and thus nearer to the primary body than they, as observation has itself revealed. For we have seen the moon, half-full, pass beneath the planet Mars, which vanished on its shadow side and came forth by the bright and shining part.[3] Similar accounts of other stars are

[1] See note on 291^{a} 32.
[2] See note on 288^{a} 2.
[3] Brandis (Berlin Aristotle, vol. IV, 497^{b} 13) quotes a scholium to the effect that Alexander in his Commentary said it was Mercury, not Mars. Both Simpl. and Them., however, give Mars without question. If it was Mars, a calculation of Kepler's (*Astronomia Nova*, 1609, p. 323) fixes the date. 'Inveni,' he writes, 'longissima inductione per annos L, ab anno quindecimo ad finem vitae Aristotelis, non potuisse esse alio die, quam in vespera diei IV Aprilis, anno ante CHRISTI vulgarem epocham CCCLVII, cum Aristoteles XXI annorum audiret

[redacted]

given by the Egyptians and Babylonians, whose observations have been kept for very many years past, and from whom much of our evidence about particular stars is derived.[1]

A second difficulty which may with equal justice be raised is this. Why is it that the primary motion includes such a multitude of stars that their whole array seems to defy counting, while of the other stars[2] each one is separated off, and in no case do we find two or more attached to the same motion?[3]

On these questions, I say, it is well that we should seek to increase our understanding, though we have but little to go upon, and are placed at so great a distance from the facts in question. Nevertheless there are certain principles on which if we base our consideration we shall not find this difficulty by any means insoluble. We may object that we have been thinking of the stars as mere bodies, and as units with a serial order indeed but entirely inanimate; but should rather conceive them as enjoying life and action. On this view the facts cease to appear surprising. For it is natural that the best-conditioned of all things should have its good without action, that that which is nearest to it should achieve it by little and simple action, and that which is farther removed by a complexity of actions, just as with men's bodies one is in good condition without exercise at all, another after a short walk, while another requires running and wrestling and hard training,[4] and there are yet

Eudoxum, ut ex Diogene Laërtio constat.' Diogenes' date for Aristotle's birth is in fact Ol. 99, 1 (384–3 B.C.): Aristotle would therefore be 27 at the date arrived at. The calculation for Mercury does not appear to have been made.

[1] See note on 270b 14.

[2] i.e. the planets.

[3] The term φορά (motion) is transferred from the motion itself to the sphere which imparts the motion.

[4] There seems to be no parallel for the use of the word *κόνισις* (tr. 'hard training') in connexion with the exercises of the palaestra, though *κονίστρα* is used in post-Aristotelian writers for the arena. Simpl. says the term stands for the training of the wrestler, *διὰ τὸ ἐν κόνει γυμνάζεσθαι τὰ παλαιστρικά*. Bywater (*J. of Phil.* xxviii, p. 241) objects that the third term in the phrase should be a distinct form of exercise from running or wrestling, and suggests *κἀκοντίσεως*. Perhaps it is best to keep the text, though there can be no certainty that it is right.

others who however hard they worked themselves could never secure this good, but only some substitute for it. To succeed often or in many things is difficult. For instance, to throw ten thousand Coan throws with the dice would be impossible, but to throw one or two is comparatively easy.[1] In action, again, when *A* has to be done to get *B*, *B* to get *C*, and *C* to get *D*, one step or two present little difficulty, but as the series extends the difficulty grows. 292b
We must, then, think of the action of the lower stars as similar to that of animals and plants. For on our earth it is man that has the greatest variety of actions—for there are many goods that man can secure; hence his actions are various[2] and directed to ends beyond them—while the perfectly conditioned has no need of action, since it is itself the end, and action always requires two terms, end and means. The lower animals have less variety of action than man; and plants perhaps have little action and of one kind only.[3] For either they have but one attainable good (as indeed man has), or, if several, each contributes directly to their ultimate good.[4] One thing then has and enjoys the

[1] Prantl's Κῴους rests on one MS. (H) and was known as an alternative reading to Simpl. Two MSS. (EL) give Χίους, two others (FM) χίους ἢ κῴους. J has χιλίους χωλούς, with χίους ἢ κωίους in the margin. Simpl. thinks the point is the size of the dice (ὡς μεγάλων ἀστραγάλων ἐν ἀμφοτέραις γινομένων ταῖς νήσοις). Prantl takes the impossibility to be a succession of good throws or 'sixes', and therefore prefers 'Coan' to 'Chian', which according to Pollux was used for the worst throw. The impossibility is clearly the same whether the worst throw or the best is intended; but, since success is implied by the context, I have followed Prantl. The double reading Χίους ἢ Κῴους may however be right.

[2] Reading πράττει, with FHMJ and Bekker, for Prantl's πράττειν (EL).

[3] The long parenthesis (l. 3 πολλῶν γάρ to l. 7 ἕνεκα) in Prantl's text breaks the structure of the sentence and should be removed. The succession of colons which results (for a colon must be marked after πράξεις in l. 3) is best broken by placing full-stops after φυτῶν (l. 2), ἕνεκα (l. 4), ἕνεκα (l. 7).

[4] If there is more than one good, e.g. nutriment and propagation, each is a constituent of the plant's 'good' in the final sense. To be able to accept something merely as a means to something else, i.e. as indirectly good, is a distinctive mark of a higher development. Thus the variety here indicated as characteristic of human action lies not so much in the superior range of human desires (though that also is a fact) as in the variety and complexity of the means by which man effects their satisfaction.

ultimate good, other things attain to it, one immediately[1] by few steps, another by many, while yet another does not even attempt to secure it but is satisfied to reach a point not far removed from that consummation. Thus, taking health as the end, there will be one thing that always possesses health, others that attain it, one by reducing flesh, another by running and thus reducing flesh, another by taking steps to enable himself to run, thus further increasing the number of movements, while another cannot attain health itself, but only running or reduction of flesh, so that one or other of these is for such a being the end.[2] For while it is clearly best for any being to attain the real end, yet, if that cannot be, the nearer it is to the best the better will be its state. It is for this reason that the earth moves not at all and the bodies near to it with few movements. For they do not attain the final end, but only come as near to it as their share in the divine principle permits.[3] But the first heaven finds it immediately with a single movement, and the bodies intermediate between the first and last heavens attain it indeed, but at the cost of a multiplicity of movement.[4]

As to the difficulty that into the one primary motion is crowded a vast multitude of stars, while of the other stars each has been separately given special movements of its own, there is in the first place this reason for regarding the arrangement as a natural one. In thinking of the life

[1] Reading εὐθὺς for ἐγγύς. Cf. l. 20 below. ἐγγύς is in all the MSS., but is quite intolerable in view of the general contrast between attainment and approximation made here and repeated below. The influence of ἐγγύς in the following line may be supposed to have caused its substitution for εὐθὺς here. Simpl. paraphrases τὸ δὲ δι' ὀλίγων κινήσεων ἀφικνεῖται πρὸς τὸ ἑαυτοῦ τέλος, and therefore appears not to have had ἐγγύς in his text. Them., however, has it: 'ad illud prope per pauca accedit.'

[2] Place a full-stop after ἐλθεῖν (l. 13), delete bracket, comma after ἰσχνανθῆναι (l. 17). 'Running' or 'reduction of flesh' becomes in such a case the 'end', i.e. the content of purpose, as soon as the true end or good is recognized as unattainable.

[3] Simpl. finds this sentence difficult. He did not see that Aristotle here, as frequently elsewhere, uses ἀλλά where ἀλλ' ἤ would be expected. See Bonitz, *Ind. Ar.* 33^{b} 15.

[4] The upshot of the argument seems to be this, that the earth and the bodies nearest to it move simply, or not at all, because they are content with little, and perfection is beyond their reach.

and moving principle of the several heavens one must regard the first as far superior to the others. Such a superiority would be reasonable. For this single first motion has to move many of the divine bodies, while the numerous other motions move only one each, since each 293a
single planet moves with a variety of motions. Thus, then, nature makes matters equal and establishes a certain order, giving to the single motion many bodies and to the single body many motions. And there is a second reason why the other motions have each only one body, in that each of them except the last, i. e. that which contains the one star,[1] is really moving many bodies. For this last sphere moves with many others, to which it is fixed, each sphere being actually a body; so that its movement will be a joint product. Each sphere, in fact, has its particular natural motion, to which the general movement is, as it were, added. But the force of any limited body is only adequate to moving a limited body.[2]

The characteristics of the stars which move with a circular motion, in respect of substance and shape, movement and order, have now been sufficiently explained.

13 It remains to speak of the earth, of its position, of the question whether it is at rest or in motion, and of its shape.

I. As to its *position* there is some difference of opinion. Most people—all, in fact, who regard the whole heaven as finite—say it lies at the centre. But the Italian philosophers known as Pythagoreans take the contrary view. At the centre, they say, is fire, and the earth is one of the stars, creating night and day by its circular motion about the

[1] The movements of each planet are analysed into the combination of a number of simple spherical motions each contributed by a single sphere. The 'last' sphere or motion means the outermost, viz. that to which the planet is actually attached. The inner spheres have really bodies to move even though they carry no planet: for they have to communicate their motion to the sphere or spheres in which they are included.

[2] Prantl seems to find unnecessary difficulty in this sentence. These spheres, says Aristotle, have only a limited force, and they have enough to do to impart their motion to the outer spheres, and through it to the planet: the burden of several planets would be too much for them.

centre. They further construct another earth in opposition to ours to which they give the name counter-earth.[1] In all this they are not seeking for theories and causes to account for observed facts, but rather forcing their observations and trying to accommodate them to certain theories and opinions of their own. But there are many others who would agree that it is wrong to give the earth the central position, looking for confirmation rather to theory than to the facts of observation. Their view is that the most precious place befits the most precious thing: but fire, they say, is more precious than earth, and the limit than the intermediate, and the circumference and the centre are limits. Reasoning on this basis they take the view that it is not earth that lies at the centre of the sphere, but rather

293b fire. The Pythagoreans have a further reason. They hold that the most important part of the world, which is the centre, should be most strictly guarded, and name it, or rather the fire which occupies that place, the 'Guard-house of Zeus', as if the word 'centre' were quite unequivocal, and the centre of the mathematical figure were always the same with that of the thing or the natural centre. But it is better to conceive of the case of the whole heaven as analogous to that of animals, in which the centre of the animal and that of the body are different. For this reason they have no need to be so disturbed about the world, or to call in a guard for its centre: rather let them look for the centre in the other sense and tell us what it is like and where nature has set it. That centre will be something primary and precious; but to the mere position we should give the last place rather than the first. For the middle is what is defined, and what defines it is the limit, and that which contains or limits is more precious than that which is limited, seeing that the latter is the matter and the former the essence of the system.

II. As to the position of the earth, then, this is the view which some advance, and the views advanced concerning its *rest or motion* are similar. For here too there is no general agreement. All who deny that the earth lies at

[1] ὄνομα is omitted by FHMJ, but is probably right.

the centre think that it revolves about the centre,[1] and not the earth only but, as we said before, the counter-earth as well. Some of them even consider it possible that there are several bodies so moving, which are invisible to us owing to the interposition of the earth. This, they say, accounts for the fact that eclipses of the moon are more frequent than eclipses of the sun: for in addition to the earth each of these moving bodies can obstruct it. Indeed, as in any case the surface of the earth is not actually a centre but distant from it a full hemisphere, there is no more difficulty, they think, in accounting for the observed facts on their view that we do not dwell at the centre, than on the common view that the earth is in the middle.[2] Even as it is, there is nothing in the observations to suggest that we are removed from the centre by half the diameter of the earth. Others, again, say that the earth, which lies at the centre, is 'rolled', and thus in motion, about the axis of the whole heaven. So it stands written in the *Timaeus*.[3]

III. There are similar disputes about the *shape* of the earth. Some think it is spherical, others that it is flat and drum-shaped. For evidence they bring the fact that, as the 294a

[1] μηδ' in l. 18 appears to prove that the comma should be put after κεῖσθαι instead of after αὐτήν, and that φασιν governs both infinitives.

[2] Prantl's insertion of μή in the last clause rests on a misunderstanding of the passage. The text is quite sound.—Dreyer (*Planetary Systems*, p. 45) thinks that the supposed movement would seriously affect observations of the sun and the moon.

[3] *Timaeus*, 40 B. For a discussion of this vexed passage see Heath, *Aristarchus*, pp. 174–8. J has εἰλεῖσθαι καὶ κινεῖσθαι (in 296a 26, however, where the same pair of words recur, it has εἴλλεσθαι κ. κ.), which decreases the probability, not antecedently very great, that the words καὶ κινεῖσθαι are an insertion. Unless the idea of movement is contained in the phrase, the quotation would seem to be out of place here. It seems plain that Aristotle considered the word ἴλλεσθαι ('rolled' in the text) obscure or ambiguous, and added the words καὶ κινεῖσθαι to indicate his interpretation of it. Alex. (*apud* Simpl.) says that the word used in the *Timaeus* means 'pressed' (βιάζεσθαι), but that it is difficult to contradict Aristotle on a point on which he was so much better informed. Simpl. says that, spelt with the diphthong ει and a single λ, the word does connote rotation. He points out that Aristotle promised to speak of the earth's motion *and rest*; and suggests that, taking καὶ κινεῖσθαι to be a later insertion, one might suppose that Aristotle passes in this sentence to the consideration of the view that the earth is at rest. But this will hardly do.

sun rises and sets, the part concealed by the earth shows a straight and not a curved edge, whereas if the earth were spherical the line of section would have to be circular. In this they leave out of account the great distance of the sun from the earth and the great size of the circumference, which, seen from a distance on these apparently small circles appears straight. Such an appearance ought not to make them doubt the circular shape of the earth. But they have another argument. They say that because it is at rest, the earth must necessarily have this shape. For there are many different ways in which the movement or rest of the earth has been conceived.

The difficulty must have occurred to every one. It would indeed be a complacent mind that felt no surprise that, while a little bit of earth, let loose in mid-air, moves and will not stay still, and the more there is of it the faster it moves, the whole earth, free in mid-air, should show no movement at all. Yet here is this great weight of earth, and it is at rest. And again, from beneath one of these moving fragments of earth, before it falls, take away the earth, and it will continue its downward movement with nothing to stop it. The difficulty then, has naturally passed into a commonplace of philosophy; and one may well wonder that the solutions offered are not seen to involve greater absurdities than the problem itself.

By these considerations some have been led to assert that the earth below us is infinite, saying, with Xenophanes of Colophon, that it has 'pushed its roots to infinity',[1]—in order to save the trouble of seeking for the cause. Hence the sharp rebuke of Empedocles, in the words 'if the deeps of the earth are endless and endless the ample ether—such is the vain tale told by many a tongue, poured from the mouths of those who have seen but little of the whole'.[2]

[1] Diels, *Vorsokratiker*[3], 11 A 47 (53, 38 ff.), B 28 (63, 8). Ritter and Preller, 103 b. Simpl. cannot find the quotation in the writings of Xenophanes, and doubts whether τὸ κάτω τῆς γῆς means 'the under-parts of the earth' or 'the ether under the earth'. A fragment corroborating the former interpretation survives (no. 28 in Diels). Cf. Burnet, E.G.P.[2] § 60.

[2] Diels, *Vors.*[3] 21 B 39 (241, 16). Ritter and Preller, 103 b. Burnet, E.G.P.[2] p. 212.

Others say the earth rests upon water. This, indeed, is the oldest theory that has been preserved, and is attributed to Thales of Miletus. It was supposed to stay still because it floated like wood and other similar substances, which are so constituted as to rest upon water but not upon air. As if the same account had not to be given of the water which carries the earth as of the earth itself! It is not the nature of water, any more than of earth, to stay in mid-air: it must have something to rest upon. Again, as air is lighter 294b
than water, so is water than earth: how then can they think that the naturally lighter substance lies below the heavier? Again, if the earth as a whole is capable of floating upon water, that must obviously be the case with any part of it. But observation shows that this is not the case. Any piece of earth goes to the bottom, the quicker the larger it is. These thinkers seem to push their inquiries some way into the problem, but not so far as they might. It is what we are all inclined to do, to direct our inquiry not by the matter itself, but by the views of our opponents: and even when interrogating oneself one pushes the inquiry only to the point at which one can no longer offer any opposition. Hence a good inquirer will be one who is ready in bringing forward the objections proper to the genus, and that he will be when he has gained an understanding of all the differences.[1]

Anaximenes and Anaxagoras and Democritus give the flatness of the earth as the cause of its staying still. Thus, they say, it does not cut, but covers like a lid, the air beneath it. This seems to be the way of flat-shaped bodies: for even the wind can scarcely move them because of their power of resistance. The same immobility, they say, is produced by the flatness of the surface which the earth presents to the air which underlies it; while the air,

[1] The objections must be 'proper to the kind' or class to which the subject of investigation belongs, i.e. scientific, not dialectical or sophistical. These thinkers, as Simpl. observes, have failed to investigate the peculiar characteristics of wood and earth in the genus 'body', and therefore think that, because wood floats, earth may. For the importance of a study of the 'differences' Simpl. refers to *Top.* I. xviii.

not having room enough to change its place because it is underneath the earth, stays there in a mass, like the water in the case of the water-clock.[1] And they adduce an amount of evidence to prove that air, when cut off and at rest, can bear a considerable weight.

Now, first, if the shape of the earth is not flat, its flatness cannot be the cause of its immobility. But in their own account it is rather the size of the earth than its flatness that causes it to remain at rest. For the reason why the air is so closely confined that it cannot find a passage, and therefore stays where it is, is its great amount: and this amount is great because the body which isolates it, the earth, is very large. This result, then, will follow, even if the earth is spherical, so long as it retains its size. So far as their arguments go, the earth will still be at rest.

In general, our quarrel with those who speak of movement in this way cannot be confined to the parts[2]; it concerns the whole universe. One must decide at the outset whether bodies have a natural movement or not, whether there is no natural but only constrained movement. Seeing,
295a however, that we have already decided this matter to the best of our ability, we are entitled to treat our results as representing fact. Bodies, we say, which have no natural movement, have no constrained movement; and where there is no natural and no constrained movement there will be no movement at all. This is a conclusion, the necessity of which we have already decided,[3] and we have seen further that rest also will be inconceivable, since rest, like

[1] Reading ὥσπερ with the MSS. Diels (*Vors.*[3] 25, 32) inserts τοῦ before μεταστῆναι (l. 19), a conjecture which has some support in L, which has που in that place.—Experiments with the water-clock are frequently mentioned. See esp. Emped. fr. 100 (Diels), Arist. *Probl.* 914b 26, Burnet, E.G.P.[3] Index I s.v. Klepsydra. 'The water-clock', says Simpl., 'is a vessel with a narrow mouth and a flattish base pierced with small holes, what we now call a *hydrarpax*. If this vessel is dipped in water while the mouth at the top is kept closed, no water runs in through the holes. The massed air inside resists the water and prevents its ingress, being unable to change its own place. When the mouth at the top is opened the water runs in, the air making way for it.' The position of the water beneath the water-clock is analogous to that of the air beneath the earth.

[2] i.e. to the single element earth or to earth and air.

[3] I. ii–iv.

movement, is either natural or constrained. But if there is any natural movement, constraint will not be the sole principle of motion or of rest. If, then, it is by constraint that the earth now keeps its place, the so-called 'whirling' movement by which its parts came together at the centre was also constrained. (The form of causation supposed they all borrow from observations of liquids and of air, in which the larger and heavier bodies always move to the centre of the whirl. This is thought by all those who try to generate the heavens to explain why the earth came together at the centre. They then seek a reason for its staying there; and some say, in the manner explained, that the reason is its size and flatness, others, with Empedocles, that the motion of the heavens, moving about it at a higher speed, prevents movement of the earth, as the water in a cup, when the cup is given a circular motion, though it is often underneath the bronze, is for this same reason prevented from moving with the downward movement which is natural to it.[1]) But suppose both the 'whirl' and its flatness (the air beneath being withdrawn[2]) cease to prevent the earth's motion, where will the earth move to then? Its movement to the centre was constrained, and its rest at the centre is due to constraint; but there must be some motion which is natural to it. Will this be upward motion or downward or what? It must have some motion; and if upward and downward motion are alike to it, and the air above the earth does not prevent upward movement, then no more could air below it prevent downward movement. For the same cause must necessarily have the same effect on the same thing.[3]

Further, against Empedocles there is another point which might be made. When the elements were separated off by

[1] Simplicius seems to be right in considering the portion included within brackets in the text as a parenthetic note on δίνησις, interrupting Aristotle's argument.

[2] The sense required is 'withdrawn', as above, but there is no parallel to the use of ὑπελθεῖν in this sense. The MSS. offer no variant, and Simpl. paraphrases ἐκστάντος. In the absence of a better suggestion I should read ὑπεξελθόντος.

[3] The suggestion clearly is that, consciously or unconsciously, these thinkers attributed a natural motion downward to the earth, since they gave it a reason for not moving in that direction only.

Hate, what caused the earth to keep its place? Surely the 'whirl' cannot have been then also the cause. It is absurd too not to perceive that, while the whirling movement may have been responsible for the original coming together of the parts of earth at the centre, the question remains, why *now* do all heavy bodies move to the earth. For the whirl
295b surely does not come near us. Why, again, does fire move upward? Not, surely, because of the whirl. But if fire is naturally such as to move in a certain direction, clearly the same may be supposed to hold of earth. Again, it cannot be the whirl which determines the heavy and the light.[1] Rather that movement caused the pre-existent heavy and light things to go to the middle and stay on the surface respectively. Thus, before ever the whirl began, heavy and light existed; and what can have been the ground of their distinction, or the manner and direction of their natural movements? In the infinite chaos there can have been neither above nor below, and it is by these that heavy and light are determined.

It is to these causes that most writers pay attention: but there are some, Anaximander, for instance, among the ancients, who say that the earth keeps its place because of its indifference.[2] Motion upward and downward and sideways were all, they thought, equally inappropriate to that which is set at the centre and indifferently related to every extreme point; and to move in contrary directions[3] at the same time was impossible: so it must needs remain still. This view is ingenious but not true. The argument would prove that everything, whatever it be, which is put at the

[1] Read *καὶ τὸ κοῦφον* with all MSS. except E.

[2] Literally 'likeness'. Kranz, Index to Diels, *Vors.*, s.v. *ὁμοιότης*, translates 'gleichmässige Lage'. Burnet (who formerly took a different view) now accepts 'indifference' as the equivalent of *ὁμοιότης* in this passage. (E.G.P.[3] p. 66, n. 1.) Cf. Burnet's note on Plato, *Phaedo*, 109 A 2, where he proposes the translation 'equiformity', and the phrase *πρὸς ὁμοίας γωνίας* below (296b 20). From Aristotle's wording it seems probable that he had the *Phaedo* in mind here. The full phrase there is: *τὴν ὁμοιότητα τοῦ οὐρανοῦ αὐτοῦ ἑαυτῷ πάντῃ καὶ τῆς γῆς αὐτῆς τὴν ἰσορροπίαν.* It is to be observed that Plato makes *ὁμοιότης* an attribute of the whole heaven or universe, not of the earth.

[3] Prantl's *ἐναντίον* is a misprint for *ἐναντίαν*.

centre, must stay there. Fire, then, will rest at the centre; for the proof turns on no peculiar property of earth. But this does not follow. The observed facts about earth are not only that it remains at the centre, but also that it moves to the centre. The place to which any fragment of earth moves must necessarily be the place to which the whole moves; and in the place to which a thing naturally moves, it will naturally rest. The reason then is not in the fact that the earth is indifferently related to every extreme point: for this would apply to any body, whereas movement to the centre is peculiar to earth. Again it is absurd to look for a reason why the earth remains at the centre and not for a reason why fire remains at the extremity. If the extremity is the natural place of fire, clearly earth must also have a natural place. But suppose that the centre is not its place, and that the reason of its remaining there is this necessity of indifference—on the analogy of the hair which, it is said, however great the tension, will not break under it, if it be evenly distributed, or of the man who, though exceedingly hungry and thirsty, and both equally,[1] yet being equidistant from food and drink, is therefore bound to stay where he is—even so, it still remains to explain why fire stays at the extremities. It is strange, too, to ask 296a
about things staying still but not about their motion,—why, I mean, one thing, if nothing stops it, moves up, and another thing to the centre. Again, their statements are not true. It happens, indeed, to be the case that a thing to which movement this way and that is equally inappropriate is obliged to remain at the centre.[2] But so far as their argument goes, instead of remaining there, it will move, only not as a mass but in fragments. For the argument applies equally to fire. Fire, if set at the centre, should stay there, like earth, since it will be indifferently related to every point on the extremity. Nevertheless it will move, as in fact it always does move when nothing stops it, away from the centre to the extremity. It will not, however, move in a

[1] The structure of the sentence would be made clearer if commas were placed after μέν and after δέ in l. 33.

[2] The principle is in fact true, if it is properly understood, i.e. seen to apply, as explained in what follows, only to indivisible bodies.

mass to a single point on the circumference—the only possible result on the lines of the indifference theory—but rather each corresponding portion of fire to the corresponding part of the extremity, each fourth part, for instance, to a fourth part of the circumference. For since no body is a point, it will have parts. The expansion, when the body increased the place occupied, would be on the same principle as the contraction, in which the place was diminished. Thus, for all the indifference theory shows to the contrary, earth also would have moved in this manner away from the centre, unless the centre had been its natural place.

We have now outlined the views held as to the shape, position, and rest or movement of the earth.

Let us first decide the question whether the earth moves 14
or is at rest. For, as we said, there are some who make it one of the stars, and others who, setting it at the centre, suppose it to be 'rolled' and in motion about the pole as axis.[1] That both views are untenable will be clear if we take as our starting-point the fact that the earth's motion, whether the earth be at the centre or away from it, must needs be a constrained motion. It cannot be the movement of the earth itself. If it were, any portion of it would have this movement; but in fact every part moves in a straight line to the centre. Being, then, constrained and unnatural, the movement could not be eternal. But the order of the universe is eternal. Again, everything that moves with the circular movement, except the first sphere, is observed to
296b be passed, and to move with more than one motion. The earth, then, also, whether it move about the centre or as stationary at it, must necessarily move with two motions. But if this were so, there would have to be passings and turnings of the fixed stars. Yet no such thing is observed. The same stars always rise and set in the same parts of the earth.[2]

[1] For ἴλλεσθαι J has εἴλλεσθαι. See note on 293b 31.

[2] This passage is examined in Heath, *Aristarchus*, pp. 240–1. The necessity for two motions appears to rest only on the analogy of the planets, which are 'passed' or left behind by the motion of the sphere of the fixed stars. The consequence, that there would be variety in

Further, the natural movement of the earth, part and whole alike, is to the centre of the whole—whence the fact that it is now actually situated at the centre—but it might be questioned, since both centres are the same, which centre it is that portions of earth and other heavy things move to. Is this their goal because it is the centre of the earth or because it is the centre of the whole? The goal, surely, must be the centre of the whole. For fire and other light things move to the extremity of the area which contains the centre. It happens, however, that the centre of the earth and of the whole is the same. Thus they do move to the centre of the earth, but accidentally, in virtue of the fact that the earth's centre lies at the centre of the whole. That the centre of the earth is the goal of their movement is indicated by the fact that heavy bodies moving towards the earth do not move parallel but so as to make equal angles,[1] and thus to a single centre, that of the earth. It is clear, then, that the earth must be at the centre and immovable, not only for the reasons already given, but also because heavy bodies forcibly thrown quite straight upward return to the point from which they started, even if they are thrown to an infinite distance.[2] From these considerations then it is clear that the earth does not move and does not lie elsewhere than at the centre.

From what we have said the explanation of the earth's immobility is also apparent. If it is the nature of earth, as observation shows, to move from any point to the centre, as

the places of rising and setting of the fixed stars, follows from the assumption of a second motion, if the second is taken to be oblique to the first (Heath, *loc. cit.*).

[1] i.e. at right angles to a tangent: if it fell otherwise than at right angles, the angles on each side of the line of fall would be unequal. Cf. *inf.* 311^b 34, where the argument is repeated. The phrase *πρὸς ὁμοίας γωνίας*, 'at *like* angles', appears to strike Simpl. as a rather strange equivalent for *πρὸς ἴσας γωνίας*, 'at *equal* angles', borrowed, as he says, from those who referred 'angle' to the category of quality—*ὁμοίας δὲ ἐκάλουν τὰς ἴσας γωνίας οἱ τὴν γωνίαν ὑπὸ τὸ ποιὸν ἀνάγοντες* (538, 22). Cf. Burnet's remarks on *ὁμοιότης* in *Phaedo*, 109 A 2, quoted in part above in note on 295^b 11.

[2] It seems plain that the words *κατὰ στάθμην* ('quite straight') refer to the line of the throw, not, as Simpl. supposes, to the line of return. But it is difficult to see what independent test Aristotle had of the straightness of the throw.

[redacted]

of fire contrariwise to move from the centre to the extremity, it is impossible that any portion of earth should move away from the centre except by constraint. For a single thing has a single movement, and a simple thing a simple: contrary movements cannot belong to the same thing, and movement away from the centre is the contrary of movement to it. If then no portion of earth can move away from the centre, obviously still less can the earth as a whole so move. For it is the nature of the whole to move to the point to
297a which the part naturally moves. Since, then, it would require a force greater than itself to move it, it must needs stay at the centre. This view is further supported by the contributions of mathematicians to astronomy, since the observations made as the shapes change by which the order of the stars is determined,[1] are fully accounted for on the hypothesis that the earth lies at the centre. Of the position of the earth and of the manner of its rest or movement, our discussion may here end.

Its shape must necessarily be spherical. For every portion of earth has weight until it reaches the centre, and the jostling of parts greater and smaller would bring about not a waved surface, but rather compression and convergence[2] of part and part until the centre is reached. The process should be conceived by supposing the earth to come into being in the way that some of the natural philosophers describe.[3] Only they attribute the downward movement to constraint, and it is better to keep to the truth and say that the reason of this motion is that a thing which possesses

[1] The sense of the sentence is, clearly, 'the phenomena are accounted for on the present hypothesis: why change it?' But the precise relevance of (apparent) changes of shape does not seem clear. Simpl. illustrates by changes which would be necessitated by the hypothesis of a moving earth; but his own paraphrase of Aristotle's words implies that the changes in question are *observed* changes. The Greek implies (1) that the order of the stars is settled by the apparent shapes or patterns which they make in combination; (2) that the changes of these shapes are accounted for on the hypothesis of a stationary earth.

[2] *συγχωρεῖν* is clearly used here of 'convergence', not, as Prantl translates, of 'making way'. So Simpl. paraphrases, *συμπλάττεται ἢ συγχωρεῖ ἕτερον ἑτέρῳ*.

[3] The cosmogony which follows is in principle that of Anaxagoras (Burnet, E.G.P.^{3} § 133).

weight is naturally endowed with a centripetal movement. When the mixture, then, was merely potential, the things that were separated off moved similarly from every side towards the centre. Whether the parts which came together at the centre were distributed at the extremities evenly, or in some other way, makes no difference. If, on the one hand, there were a similar movement from each quarter of the extremity to the single centre, it is obvious that the resulting mass would be similar on every side. For if an equal amount is added on every side the extremity of the mass will be everywhere equidistant from its centre, i.e. the figure will be spherical. But neither will it in any way affect the argument if there is not a similar accession of concurrent fragments from every side. For the greater quantity, finding a lesser in front of it, must necessarily drive it on, both having an impulse whose goal is the centre, and the greater weight driving the lesser forward till this goal is reached. In this we have also the solution of a possible difficulty. The earth, it might be argued, is at the centre and spherical in shape: if, then, a weight many times that of the earth were added to one hemisphere, the centre of the earth and of the whole will no longer be coincident. So that either the earth will not stay still at the centre, or if it does, it will be at rest without having its centre at the 297b
place to which it is still its nature to move.[1] Such is the difficulty. A short consideration will give us an easy answer, if we first give precision to our postulate that any body endowed with weight, of whatever size, moves towards the centre. Clearly it will not stop when its edge touches the centre. The greater quantity must prevail until the body's centre occupies the centre. For that is the goal of its impulse. Now it makes no difference whether we apply

[1] The words 'at the centre' in the first clause seem intrusive at first sight; and logically they are indefensible. 'Either the earth will not stay still at the centre, or, if it does stay still at the centre, it will not have its (new) centre at the centre which is its natural goal!' The words ἐπὶ τοῦ μέσου, then, may be an insertion. They are, however, more probably due to the desire for a direct contradictory. The view is μένει ἐπὶ τοῦ μέσου: the contradictory is therefore οὐ μένει ἐπὶ τοῦ μέσου: and the εἴπερ recalls only the μένει. 'Either it does not *stay still* at the centre or it doesn't stay still *at the centre*.'

this to a clod or common fragment of earth or to the earth as a whole. The fact indicated does not depend upon degrees of size but applies universally to everything that has the centripetal impulse. Therefore earth in motion, whether in a mass or in fragments, necessarily continues to move until it occupies the centre equally every way, the less being forced to equalize itself by the greater owing to the forward drive of the impulse.[1]

If the earth was generated, then, it must have been formed in this way, and so clearly its generation was spherical; and if it is ungenerated and has remained so always, its character must be that which the initial generation, if it had occurred, would have given it. But the spherical shape, necessitated by this argument, follows also from the fact that the motions of heavy bodies always make equal angles,[2] and are not parallel. This would be the natural form of movement towards what is naturally spherical. Either then the earth is spherical or it is at least naturally spherical.[3] And it is right to call anything that which nature intends it to be, and which belongs to it, rather than that which it is by constraint and contrary to nature. The evidence of the senses further corroborates this. How else would eclipses of the moon show segments shaped as we see them? As it is, the shapes which the moon itself each month shows are of every kind—straight, gibbous, and concave—but in eclipses the outline is always curved: and, since it is the interposition of the earth that

[1] The argument is quite clear if it is understood that 'greater' and 'less' here and in ^{a} 30 and in ^{b} 5 stand for greater and smaller portions of one body, the line of division passing through the centre which is the goal. Suppose the earth so placed in regard to the centre. The larger and heavier division would 'drive the lesser forward', i.e. beyond the centre (^{a} 30); it would 'prevail until the body's centre occupied the centre' (^{b} 5); it would 'force the less to equalize itself', i.e. to move on until the line passing through the central goal divided the body equally. Simpl. fails to see this.—Alex. (*ap.* Simpl. 543, 15) raises the difficulty that the final movement of the 'less' will be away from the centre, or upward, and hence unnatural. But this is to make a perverse abstraction of part from whole. The desire of earth to reach the centre can never be fully satisfied, since the centre is a geometrical point.

[2] See note on 296^b 20.

[3] Allowing for scruples due to the evident inequalities of the earth's surface.

makes the eclipse, the form of this line will be caused by the form of the earth's surface, which is therefore spherical. Again, our observations of the stars make it evident, not only that the earth is circular, but also that it is a circle of no great size. For quite a small change of position to south or north causes a manifest alteration of the horizon. There is much change, I mean, in the stars which are over- 298a
head, and the stars seen are different, as one moves northward or southward. Indeed there are some stars seen in Egypt and in the neighbourhood of Cyprus which are not seen in the northerly regions; and stars, which in the north are never beyond the range of observation, in those regions rise and set. All of which goes to show not only that the earth is circular in shape, but also that it is a sphere of no great size: for otherwise the effect of so slight a change of place would not be so quickly apparent. Hence one should not be too sure of the incredibility of the view of those who conceive that there is continuity between the parts about the pillars of Hercules and the parts about India, and that in this way the ocean is one. As further evidence in favour of this they quote the case of elephants, a species occurring in each of these extreme regions, suggesting that the common characteristic of these extremes is explained by their continuity. Also, those mathematicians who try to calculate the size of the earth's circumference arrive at the figure 400,000 stades.[1] This indicates not only that the earth's mass is spherical in shape, but also that as compared with the stars it is not of great size.

[1] Simpl. gives, for the benefit of 'those who doubt the wisdom of the ancients', a summary account of the methods by which this result was attained.—This appears to be the oldest recorded estimate of the size of the earth. 400,000 stades = 9,987 geographical miles. Other estimates (in miles) are: Archimedes, 7,495; Eratosthenes and Hipparchus, 6,292; Poseidonius, 5,992 or 4,494; present day, 5,400. (These figures are borrowed from Prantl's note on the passage in his translation, p. 319.)

BOOK III

298a WE have already discussed the first heaven and its parts, 1
the moving stars within it, the matter of which these are composed and their bodily constitution, and we have also shown that they are ungenerated and indestructible. Now things that we call natural are either substances or functions and attributes of substances. As substances I class the simple bodies—fire, earth, and the other terms of the series—and all things composed of them; for example, the heaven as a whole and its parts, animals, again, and plants and their parts. By attributes and functions I mean the movements of these and of all other things in which they have power in themselves to cause movement, and
298b also their alterations and reciprocal transformations. It is obvious, then, that the greater part of the inquiry into nature concerns bodies: for a natural substance is either a body or a thing which cannot come into existence without body and magnitude. This appears plainly from an analysis of the character of natural things, and equally from an inspection of the instances of inquiry into nature. Since, then, we have spoken of the primary element, of its bodily constitution, and of its freedom from destruction and generation, it remains to speak of the other two.[1] In speaking of them we shall be obliged also to inquire into generation and destruction. For if there is generation anywhere, it must be in these elements and things composed of them.

This is indeed the first question we have to ask: is generation a fact or not? Earlier speculation was at variance both with itself and with the views here put forward as to the true answer to this question. Some removed generation and destruction from the world altogether.

[1] Aristotle speaks of the four sublunary elements as two, because generically they are two. Two are heavy, two light: two move up and two down. Books III and IV of this treatise deal solely with these elements.

Nothing that is, they said, is generated or destroyed, and our conviction to the contrary is an illusion. So maintained the school of Melissus and Parmenides. But however excellent their theories may otherwise be, anyhow they cannot be held to speak as students of nature. There may be things not subject to generation or any kind of movement, but if so they belong to another and a higher inquiry than the study of nature. They, however, had no idea of any form of being other than the substance of things perceived; and when they saw, what no one previously had seen, that there could be no knowledge or wisdom without some such unchanging entities, they naturally transferred what was true of them to things perceived. Others, perhaps intentionally, maintain precisely the contrary opinion to this. It had been asserted that everything in the world was subject to generation and nothing was ungenerated, but that after being generated some things remained indestructible while the rest were again destroyed. This had been asserted in the first instance by Hesiod and his followers, but afterwards outside his circle by the earliest natural philosophers.[1] But what these thinkers maintained was that all else has been generated and, as they said, 'is flowing away', nothing having any solidity, except one single thing which persists as the basis of all these transformations. So we may interpret the statements of Heraclitus of Ephesus and many others.[2] And some[3] subject all bodies whatever to generation, by means of the composition and separation of planes. 299a

Discussion of the other views may be postponed.[4] But this last theory which composes every body of planes is, as

[1] The reference, according to Simplicius, is to Orphic writings ('the school of Orpheus and Musaeus').

[2] e.g. Thales, Anaximander, Anaximenes.

[3] 'The view of Timaeus the Pythagorean, recorded by Plato in the dialogue named after him' (Simpl.). The theory criticized is certainly that advanced in the *Timaeus*, and is usually attributed to Plato, as by Zeller, *Ph. d. Gr.*[4] II. i, p. 804, but Aristotle probably has also in mind certain members of the Academy, particularly Xenocrates (*ib.*, pp. 1016 ff.).

[4] The promised discussion is not to be found in the *De Caelo* nor in its sequel, the *De Generatione et Corruptione*. But Aristotle has already devoted some attention to these views at the beginning of the *Physics*, and there is also the discussion of *Met.* A.

the most superficial observation shows, in many respects in plain contradiction with mathematics. It is, however, wrong to remove the foundations of a science unless you can replace them with others more convincing. And, secondly, the same theory which composes solids of planes clearly composes planes of lines and lines of points, so that a part of a line need not be a line. This matter has been already considered in our discussion of movement, where we have shown that an indivisible length is impossible.[1] But with respect to natural bodies there are impossibilities involved in the view which asserts indivisible lines, which we may briefly consider at this point. For the impossible consequences which result from this view in the mathematical sphere will reproduce themselves when it is applied to physical bodies, but there will be difficulties in physics which are not present in mathematics; for mathematics deals with an abstract and physics with a more concrete object. There are many attributes necessarily present in physical bodies which are necessarily excluded by indivisibility; all attributes, in fact, which are divisible.[2] There can be nothing divisible in an indivisible thing, but the attributes of bodies are all divisible in one of two ways. They are divisible into kinds, as colour is divided into white and black, and they are divisible *per accidens* when that which has them is divisible. In this latter sense attributes which are simple[3] are nevertheless divisible. Attributes of this kind will serve, therefore, to illustrate the impossibility of the view. It is impossible, if two parts of a thing have no weight, that the two together should have weight. But either all perceptible bodies or some, such as earth and water, have weight, as these thinkers would themselves admit. Now if the point has no weight, clearly the lines have not either, and, if they have not, neither have the planes. Therefore no body has weight. It is, further, manifest that their point cannot have

[1] *Phys.* VI. i.

[2] The reading διαιρετόν, though preserved only in one rather inferior manuscript, must be preferred on grounds of sense to the ἀδιαίρετον of the other manuscripts. The silence of Simplicius seems to corroborate the reading διαιρετόν. Possibly the clause is a gloss.

[3] i. e. not divisible into kinds.

weight. For while a heavy thing may always be heavier than something and a light thing lighter than something, 299b a thing which is heavier or lighter than something need not be itself heavy or light, just as a large thing is larger than others, but what is larger is not always large. A thing which, judged absolutely, is small may none the less be larger than other things. Whatever, then, is heavy and also heavier than something else, must exceed this by something which is heavy. A heavy thing therefore is always divisible. But it is common ground that a point is indivisible. Again, suppose that what is heavy is a dense body, and what is light rare. Dense differs from rare in containing more matter in the same cubic area. A point, then, if it may be heavy or light, may be dense or rare. But the dense is divisible while a point is indivisible. And if what is heavy must be either hard or soft, an impossible consequence is easy to draw. For a thing is soft if its surface can be pressed in, hard if it cannot; and if it can be pressed in it is divisible.

Moreover, no weight can consist of parts not possessing weight. For how, except by the merest fiction, can they specify the number and character of the parts which will produce weight? And, further, when one weight is greater than another, the difference is a third weight; from which it will follow that every indivisible part possesses weight. For suppose that a body of four points possesses weight. A body composed of more than four points[1] will be superior in weight to it, a thing which has weight. But the difference between weight and weight must be a weight, as the difference between white and whiter is white. Here the difference which makes the superior weight heavier[2] is the single point which remains when the common number, four, is subtracted. A single point, therefore, has weight.

Further, to assume, on the one hand, that the planes can

[1] Prantl's conjecture ᾗ τουδί is unsatisfactory. The alternatives are (1) to keep the reading of the manuscripts (ᾗ τοδί), (2) to read τουδί, omitting ᾗ. In the latter case the sense remains the same but the construction becomes rather easier.

[2] Prantl's conjectural duplication of the words μιᾷ στιγμῇ, though harmless, is unnecessary.

only be put in linear contact[1] would be ridiculous. For just as there are two ways of putting lines together, namely, end to end and side by side, so there must be two ways of putting planes together. Lines can be put together so that contact is linear by laying one along the other, though not by putting them end to end.[2] But if, similarly, in putting the planes together, superficial contact is allowed as an alternative to linear, that method will give them bodies which are not any element nor composed of elements.[3] Again, if it is the number of planes in a body[4] that makes 300a one heavier than another, as the *Timaeus*[5] explains, clearly the line and the point will have weight. For the three cases are, as we said before, analogous.[6] But if the reason of differences of weight is not this, but rather the heaviness of earth and the lightness of fire, then some of the planes will be light and others heavy (which involves a similar distinction in the lines and the points); the earth-plane, I mean, will be heavier than the fire-plane. In general, the result is either that there is no magnitude at all, or that all magnitude could be done away with. For a point is to a line as a line is to a plane and as a plane is to a body. Now the various forms in passing into one another will each be resolved into its ultimate constituents. It might happen therefore that nothing existed except points, and that there was no body at all. A further consideration is that if time is similarly constituted, there would be, or might be, a time at which it was done away with. For the indivisible now is like a point in a line. The same consequences follow from composing the heaven of numbers, as some of the Pythagoreans do who make all nature out of numbers. For natural bodies are manifestly endowed with weight and lightness, but an assemblage of units can neither be composed to form a body nor possess weight.

[1] i. e. so as to form pyramids, cubes, &c.

[2] Grammar requires the readings ἐπιτιθεμένη, προστιθεμένη instead of the ἐπιτιθεμένην, προστιθεμένην of all manuscripts but one (M).

[3] Because they will not be pyramids or instances of any other recognized figure.

[4] Omitting the τά before τῶν ἐπιπέδων, which got into E by a simple dittography and is found in no other manuscript.

[5] Plato, *Tim.* 56 B.

[6] i. e. point : line :: line : plane :: plane : body (as below).

2 The necessity that each of the simple bodies should have a natural movement may be shown as follows. They manifestly move, and if they have no proper movement they must move by constraint: and the constrained is the same as the unnatural. Now an unnatural movement presupposes a natural movement which it contravenes, and which, however many the unnatural movements, is always one. For naturally a thing moves in one way, while its unnatural movements are manifold.[1] The same may be shown from the fact of rest. Rest, also, must either be constrained or natural, constrained in a place to which movement was constrained, natural in a place movement to which was natural. Now manifestly there is a body which is at rest at the centre. If then this rest is natural to it, clearly motion to this place is natural to it. If, on the other hand, its rest is constrained, what is hindering its motion? Something, perhaps, which is at rest: but if so, we shall simply repeat the same argument; and either we shall come to an ultimate something to which rest where it is is natural, or we shall 300b
have an infinite process, which is impossible. The hindrance to its movement, then, we will suppose, is a moving thing—as Empedocles says that it is the vortex which keeps the earth still—: but in that case we ask, where would it have moved to but for the vortex?[2] It could not move infinitely; for to traverse an infinite is impossible, and impossibilities do not happen. So the moving thing must stop somewhere, and there rest not by constraint but naturally. But a natural rest proves a natural movement

[1] This is in verbal contradiction with the doctrine of Book I, which asserts that the unnatural movement is single since it is the contrary of the natural, which is single. But it is not difficult to conceive of all movements of a body divergent from the one natural path as unnatural according to the degree of their divergence, even though, strictly construed, the unnatural path is also one.

[2] This question, though relevant to the general problem, is not *specially* relevant to the hypothesis that the obstacle is in movement. There is therefore something to be said for an interpretation which, like that attributed by Simplicius to Alexander, makes the question refer to the supposed moving obstacle instead of to the earth. But Alexander's interpretation turns out on examination to create more difficulties than it removes: and there is no great objection, after all, to supposing that Aristotle refutes the second alternative by an argument which refutes both.

to the place of rest. Hence Leucippus and Democritus, who say that the primary bodies are in perpetual movement in the void or infinite, may be asked to explain the manner of their motion and the kind of movement which is natural to them. For if the various elements are constrained by one another to move as they do, each must still have a natural movement which the constrained contravenes, and the prime mover must cause motion not by constraint but naturally. If there is no ultimate natural cause of movement and each preceding term in the series is always moved by constraint, we shall have an infinite process. The same difficulty is involved even if it is supposed, as we read in the *Timaeus*,[1] that before the ordered world was made the elements moved without order. Their movement must have been due either to constraint or to their nature. And if their movement was natural, a moment's consideration shows that there was already an ordered world. For the prime mover must cause motion in virtue of its own natural movement,[2] and the other bodies, moving without constraint, as they came to rest in their proper places, would fall into the order in which they now stand, the heavy bodies moving towards the centre and the light bodies away from it. But that is the order of their distribution in our world. There is a further question, too, which might be asked. Is it possible or impossible that bodies in unordered movement should combine in some cases into combinations like those of which bodies of nature's composing are composed, such, I mean, as bones and flesh? Yet this is what Empedocles asserts to have occurred under Love. 'Many a head', says

[1] Plato, *Tim.* 30 a.

[2] Taking the reading for which Alexander argued—*κινεῖν αὐτὸ κινούμενον κατὰ φύσιν*. I should put a comma after *κινεῖν* and take *κατὰ φ.* with *κινούμενον*. The hypothesis is that the elements have their natural movements; and the dependent clause *αὐτὸ κιν. κ. φ.* applies this hypothesis to the prime mover, as *τὰ κινούμενα μὴ βίᾳ* applies it to the other bodies. Aristotle shows that, on this hypothesis, the present world-order would exist: the prime mover would be imparting movement to the bodies within it, as it does now, and the four elements would be moving towards or resting in their proper places, as now. If *αὐτό* is read, we have a more disputable description of this *κόσμος* and less use for the words *κινούμενον κατὰ φύσιν*. *αὐτό* is said to be the reading of the manuscripts, but neither copyists nor collators are to be trusted with a breathing. J has *αυτό* (*sic*).

he, 'came to birth without a neck.'[1] The answer to the view that there are infinite bodies moving in an infinite is that, if the cause of movement is single, they must move with a single motion, and therefore not without order; and if, on the other hand, the causes are of infinite variety, their 301^a motions too must be infinitely varied. For a finite number of causes would produce a kind of order, since absence of order is not proved by diversity of direction in motions: indeed, in the world we know, not all bodies, but only bodies of the same kind, have a common goal of movement. Again, disorderly movement means in reality unnatural movement, since the order proper to perceptible things is their nature. And there is also absurdity and impossibility in the notion that the disorderly movement is infinitely continued. For the nature of things is the nature which most of them possess for most of the time. Thus their view brings them into the contrary position[2] that disorder is natural, and order or system unnatural. But no natural fact can originate in chance. This is a point which Anaxagoras seems to have thoroughly grasped; for he starts his cosmogony from unmoved things. The others, it is true, make things collect together somehow before they try to produce motion and separation. But there is no sense in starting generation from an original state in which bodies are separated and in movement. Hence Empedocles begins after the process ruled by Love: for he could not have constructed the heaven by building it up out of bodies in separation, making them to combine by the power of Love, since our world has its constituent elements in separation, and therefore presupposes a previous state of unity and combination.[3]

These arguments make it plain that every body has its natural movement, which is not constrained or contrary to its nature. We go on to show that there are certain bodies[4]

[1] Emped. fr. 57, l. 1 (Diels, *Vors.*[3] 245, 20).

[2] Reading συμβαίνει, with HMJ, for συμβαίνειν.

[3] Putting a comma instead of a full-stop after στοιχείων (l. 19).

[4] The proposition to be proved is that *some* bodies have *necessarily* this kind of impetus. The introduction of necessity shows that we are dealing with a universal. Below in 301^b 16, and again in 301^b 30, we

whose necessary impetus is that of weight and lightness. Of necessity, we assert, they must move, and a moved thing which has no natural impetus cannot move either towards or away from the centre. Suppose a body A without weight, and a body B endowed with weight. Suppose the weightless body to move the distance CD, while B in the same time moves the distance CE, which will be greater since the heavy thing must move further. Let the heavy body then be divided in the proportion $CE : CD$ (for there is no reason why a part of B should not stand in this relation to the whole). Now if the whole moves the whole distance CE, the part must in the same time move the distance CD. A weightless body, therefore, and one which has weight
301b will move the same distance, which is impossible. And the same argument would fit the case of lightness. Again, a body which is in motion but has neither weight nor lightness, must be moved by constraint, and must continue its constrained movement infinitely. For there will be a force which moves it, and the smaller and lighter a body is the further will a given force move it. Now let A, the weightless body, be moved the distance CE, and B, which has weight, be moved in the same time the distance CD. Dividing the heavy body in the proportion $CE : CD$, we subtract from the heavy body a part which will in the same time move the distance CE, since the whole moved CD: for the relative speeds of the two bodies will be in inverse ratio to their respective sizes. Thus the weightless body will move the same distance as the heavy in the same time. But this is impossible. Hence, since the motion of the weightless body will cover a greater distance than any that is suggested,[1] it will continue infinitely. It is therefore obvious that every body must have a definite[2] weight or

are told that *every* body is either light or heavy. Aristotle's readers would of course understand that the disjunction only applied universally 'beneath the moon'. The more cautious statement in this passage allows for the exception of the heavenly body.

[1] Reading προστεθέντος, which is given by all manuscripts except M and by Simplicius.

[2] i.e. not infinite. διωρισμένον is here equivalent to ὡρισμένον. A similar tendency is observable in other derivatives of διορίζειν, e.g. ἀδιόριστος. Alexander and Simplicius made great, but not very

lightness. But since 'nature' means a source of movement within the thing itself, while a force is a source of movement in something other than it or in itself *quâ* other,[1] and since movement is always due either to nature or to constraint, movement which is natural, as downward movement is to a stone, will be merely accelerated by an external force, while an unnatural movement will be due to the force alone.[2] In either case the air is as it were instrumental to the force. For air is both light and heavy, and thus *quâ* light produces upward motion, being propelled and set in motion by the force, and *quâ* heavy produces a downward motion. In either case the force transmits the movement to the body by first, as it were, impregnating the air.[3] That is why a body moved by constraint continues to move when that which gave the impulse ceases to accompany it. Otherwise, i. e. if the air were not endowed with this function, constrained movement would be impossible. And the natural movement of a body may be helped on in the same way. This discussion suffices to show[4] (1) that all bodies are either light or heavy, and (2) how unnatural movement takes place.

From what has been said earlier[5] it is plain that there

successful, efforts to interpret the word as qualifying 'body': they do not consider the possibility of its qualifying βάρος ἢ κουφότητα. Probably their manuscripts, like FHMJ, had τό before διωρισμένον, which would make it difficult or impossible to take διωρισμένον in that way.

[1] Reading ἢ ᾗ ἄλλο. It looks as if Simplicius had this reading (see critical note to Heiberg's edition, p. 595, 22): his interpretation requires it.

[2] Reading θάττω in l. 20, with all manuscripts except F and with Simplicius. αὐτή in 22 is somewhat vague in reference, but must stand for ἡ δύναμις αὐτή.

[3] ll. 23–5, πέφυκε . . . βαρύς, are grammatically a parenthesis, and should be so printed, with a colon in 23 after βαρύς. For the doctrine cf. *Phys.* IV. 8 and VIII. 10.

[4] Simplicius and Alexander, with three of our manuscripts (FHM), have ἐν τούτοις for ἐκ τούτων. ἐν τούτοις would go with ἔχουσι rather than with φανερόν, qualifying the application of the second clause. The qualification, however, cannot be made very precise, and it is best to follow the other three manuscripts.

[5] The γάρ which introduces the next sentence shows that the justification of the statement is to come. The thesis follows from what was 'said earlier', because in *Phys.* IV. 6–9 the hypothesis of a void was investigated and refuted, and it is here shown that absolute generation, or generation of body out of not-body, requires a void.

cannot be generation either of everything or in an absolute sense of anything. It is impossible that everything should 302a be generated, unless an extra-corporeal[1] void is possible. For, assuming generation, the place which is to be occupied by that which is coming to be, must have been previously occupied by void in which no body was.[2] Now it is quite possible for one body to be generated out of another, air for instance out of fire, but in the absence of any pre-existing mass generation is impossible. That which is potentially a certain kind of body may, it is true, become such in actuality. But if the potential body was not already in actuality some other kind of body, the existence of an extra-corporeal void must be admitted.

It remains to say what bodies are subject to generation, 3
and why. Since in every case knowledge depends on what is primary, and the elements are the primary constituents of bodies, we must ask which of such bodies[3] are elements, and why; and after that what is their number and character. The answer will be plain if we first explain what kind of substance an element is. An element, we take it, is a body into which other bodies may be analysed, present in them potentially or in actuality (which of these, is still disputable), and not itself divisible into bodies different in form. That, or something like it, is what all men in every case mean by element. Now if what we have described is an element, clearly there must be such bodies. For flesh and wood and all other similar bodies contain potentially fire and earth, since one sees these elements exuded from them; and, on the other hand, neither in potentiality nor in actuality does fire contain flesh or wood, or it would exude them.

The nature of the heavenly body and the views of Parmenides and Melissus, referred to by Simplicius, are not here in point.

[1] i.e. a void outside bodies, as distinct from the fragments of void which are supposed to be distributed throughout the texture of every body. Simplicius attributes the distinction of two kinds of void to the authors of the theory themselves.

[2] Reading in l. 2 τὸ γινόμενον, εἰ ἐγένετο with Bekker. The manuscripts are confused, and offer many variants.

[3] viz. bodies subject to generation. We read ποῖα τῶν τοιούτων with the manuscripts. taking τῶν τοιούτων as a partitive genitive (after Simplicius).

Similarly, even if there were only one elementary body, it would not contain them. For though it will be either flesh or bone or something else, that does not at once show that it contained these in potentiality: the further question remains, in what manner it becomes them. Now Anaxagoras opposes Empedocles' view of the elements. Empedocles says that fire and earth and the related bodies are elementary bodies of which all things are composed; but this Anaxagoras denies. His elements are the homoeomerous things,[1] viz. flesh, bone, and the like. Earth and 302b
fire are mixtures, composed of them and all the other seeds, each consisting of a collection of all the homoeomerous bodies, separately invisible; and that explains why from these two bodies all others are generated. (To him fire and *aither* are the same thing.[2]) But since every natural body has its proper movement, and movements are either simple or mixed, mixed in mixed bodies and simple in simple, there must obviously be simple bodies; for there are simple movements. It is plain, then, that there are elements, and why.

4 The next question to consider is whether the elements are finite or infinite in number, and, if finite, what their number is. Let us first show reason for denying that their number is infinite, as some suppose. We begin with the view of Anaxagoras that all the homoeomerous bodies are elements.[3] Any one who adopts this view misapprehends the meaning of element. Observation shows that even mixed bodies are often divisible into homoeomerous parts; examples are flesh, bone, wood, and stone. Since then the composite

[1] 'Homoeomerous' means 'having parts like one another and like the whole of which they are parts'. Some confusion is here caused by the fact that Aristotle sometimes uses 'homoeomerous' as an attribute of the parts of a homoeomerous whole, i.e. as meaning 'like one another and like the whole of which they are parts'. That is what he means when he says of a body (302^b 16) that it is 'divisible into homoeomerous parts' or (*ib.* 25) that it is 'composed of homoeomerous bodies'. The use of the term λεπτομερές (= μικρομερές) is complicated by a similar transference from whole to part (cp. 304^b 9, note).

[2] Cp. Book I, 270^b 24.

[3] τοὺς . . . ποιοῦντας must be construed (by a kind of zeugma) with θεωρητέον.

[redacted]

cannot be an element, not every homoeomerous body can be an element; only, as we said before,[1] that which is not divisible into bodies different in form.[2] But even taking 'element' as they do, they need not assert an infinity of elements, since the hypothesis of a finite number will give identical results. Indeed even two or three such bodies serve the purpose as well, as Empedocles' attempt shows. Again, even on their view it turns out that all things are not composed of homoeomerous bodies. They do not pretend that a face is composed of faces, or that any other natural conformation is composed of parts like itself.[3] Obviously then it would be better to assume a finite number of principles. They should, in fact, be as few as possible, consistently with proving what has to be proved. This is the common demand of mathematicians, who always assume as principles things finite either in kind or in number.[4] Again, if body is distinguished from body by the appropriate qualitative difference, and there is a limit to
303a the number of differences (for the difference lies in qualities apprehended by sense, which are in fact finite in number, though this requires proof[5]), then manifestly there is necessarily a limit to the number of elements.

There is, further, another view—that of Leucippus and Democritus of Abdera—the implications of which are also

[1] Above, 302a 18.

[2] 'Divisible into homoeomerous parts' = 'homoeomerous wholes' (cp. note on 'homoeomerous' at 302a 31). The argument is therefore as follows: 'homoeomerous' includes mixed as well as simple bodies; but any one who understood the meaning of the term 'element' would have seen that a mixed body cannot be an element: instead of regarding all homoeomerous bodies as elements, he would have confined the term to such homoeomerous bodies as are simple.—As an argument against Anaxagoras this is ineffective; for he (*a*) denied that flesh, bone, &c., are mixed; (*b*) denied that earth, air, fire, and water—cited by Simplicius as simple and homoeomerous—are simple. Aristotle is content to argue from what he regards as established fact, whether Anaxagoras admits it or not. Anaxagoras would have claimed that the suggested criterion of indivisibility κατ' εἶδος was satisfied by his ὁμοιομερῆ, and could therefore plead not guilty to the charge of misapprehending the meaning of 'element'.

[3] All bodies should be either elements or composed of elements. But Anaxagoras, though he makes his elements infinite, is still not able to show that every whole is composed of parts like itself.

[4] Reading τὰ πεπερασμένα (so J, as well as three of Bekker's manuscripts).

[5] The proof of the proposition is given in *De Sensu*, 6 (445b 20 ff.).

unacceptable. The primary masses, according to them, are infinite in number and indivisible in mass: one cannot turn into many nor many into one; and all things are generated by their combination and involution. Now this view in a sense makes things out to be numbers or composed of numbers.[1] The exposition is not clear, but this is its real meaning. And further, they say that since the atomic bodies differ in shape, and there is an infinity of shapes, there is an infinity of simple bodies. But they have never explained in detail the shapes of the various elements, except so far as to allot the sphere to fire. Air, water, and the rest they distinguished by the relative size of the atom, assuming that the atomic substance was a sort of master-seed for each and every element. Now, in the first place, they make the mistake already noticed. The principles which they assume are not limited in number, though such limitation would necessitate no other alteration in their theory. Further, if the differences of bodies are not infinite, plainly the elements will not be an infinity.[2] Besides, a view which asserts atomic bodies must needs come into conflict with the mathematical sciences, in addition to invalidating many common opinions and apparent data of sense perception. But of these things we have already spoken in our discussion of time and movement.[3] They are also bound to contradict themselves. For if the elements are atomic, air, earth, and water cannot be differentiated by the relative sizes of their atoms, since then they could not be generated out of one another. The extrusion of the largest atoms is a process that will in time exhaust the supply; and it is by such a process that they account for the generation of water, air, and earth from one another.[4] Again, even on their own presuppositions it does

[1] Because the atom is practically a mathematical unit, out of which bodies are formed by simple addition. Cp. *Met.* Z. 13, 1039a 3 ff.

[2] Cp. 303a 1.

[3] Esp. *Phys.* VI. 1-2 (231a 18 ff.).

[4] Suppose water is being formed out of air; and suppose that the water-atom is larger than the air-atom: what is required on this theory is the extrusion from the air of the larger atoms. Conversely, if air were being formed out of water, the smaller atoms would be extruded from the water. But the supply of large (or small) atoms will soon run out, and air not reducible to water (or water not reducible to air) will be left.

not seem as if the elements would be infinite in number. The atoms differ in figure, and all figures are composed of 303b pyramids, rectilinear in the case of rectilinear figures, while the sphere has eight pyramidal parts.[1] The figures must have their principles,[2] and, whether these are one or two or more, the simple bodies must be the same in number as they. Again, if every element has its proper movement, and a simple body has a simple movement, and the number of simple movements is not infinite, because the simple motions are only two and the number of places is not infinite,[3] on these grounds also we should have to deny that the number of elements is infinite.

Since the number of the elements must be limited, it 5
remains to inquire whether there is more than one element. Some assume one only, which is according to some[4] water, to others[5] air, to others[6] fire, to others[7] again something finer than water and denser than air, an infinite body—so they say—embracing all the heavens.

Now those who decide for a single element, which is either water or air or a body finer than water and denser than air, and proceed to generate other things out of it by use of the attributes density and rarity, all alike fail to observe the fact that they are depriving the element of its priority. Generation out of the elements is, as they say, synthesis, and generation into the elements is analysis,

[1] The pyramids are tetrahedrons; and those produced by triple section of a sphere are irregular, having a spherical base.

[2] i. e. there must be a limited number of primary figures to which all other figures are reducible.

[3] There are only two places to which movement can be directed, viz. the circumference and the centre. By the two simple motions Aristotle probably here means motions towards these two places, motion up and motion down. Circular motion is not possible beneath the moon.

[4] Thales and Hippon.

[5] Anaximenes and Diogenes of Apollonia.

[6] Heracleitus and Hippasus: but see below, 304a 18, note.

[7] Anaximander. This identification has been rejected by many modern scholars. See Bonitz, *Ind.* 50a 33, Diels, *Vors.*[3] 18, 10 and 416, 1, Burnet, *E.G.P.*[2] § 15. Diels follows Zeller in attributing the view to a certain Idaios of Himera, whom Aristotle never mentions by name and of whom hardly anything is known. Burnet refers the passage to Anaximander.

so that the body with the finer parts must have priority in the order of nature. But they say that fire is of all bodies the finest. Hence fire will be first in the natural order. And whether the finest body is fire or not makes no difference; anyhow it must be one of the other bodies that is primary and not that which is intermediate.[1] Again, density and rarity, as instruments of generation, are equivalent to fineness and coarseness, since the fine is rare, and coarse in their use means dense. But fineness and coarseness, again, are equivalent to greatness and smallness, since a thing with small parts is fine and a thing with large parts coarse. For that which spreads itself out widely is fine, and a thing composed of small parts is so spread out. In the end, then, they distinguish the various other substances from the element by the greatness and smallness of their parts. This method of distinction makes all judgement relative. There will be no absolute distinction between fire, water, and air, but one and the same body will be relatively to this fire, relatively to something else air.[2] The same 304a
difficulty is involved equally in the view which recognizes several elements and distinguishes them by their greatness and smallness. The principle of distinction between bodies being quantity, the various sizes will be in a definite ratio, and whatever bodies are in this ratio to one another must be air, fire, earth, and water respectively. For the ratios of smaller bodies may be repeated among greater bodies.[3]

Those who start from fire as the single element, while avoiding this difficulty, involve themselves in many others. Some of them give fire a particular shape, like those who make it a pyramid, and this on one of two grounds. The reason given may be—more crudely—that the pyramid is the most piercing of figures as fire is of bodies,[4] or—more

[1] i.e. the rarest or finest body is the true element, as being the true starting-point of the process of generation or synthesis; and a body denser than fire and rarer than earth, like air or water, or finer than water and denser than air, like Anaximander's infinite, will not do.

[2] For the attributes great and small belong to the category of relation (*Cat.* 5^b 10 ff.).

[3] i.e. what is really asserted is a ratio, and ratio is independent of size.

[4] Simplicius observes that the argument is justly called crude, since

ingeniously—the position may be supported by the following argument. As all bodies are composed of that which has the finest parts, so all solid figures are composed of pyramids: but the finest body is fire, while among figures the pyramid is primary and has the smallest parts;[1] and the primary body must have the primary figure: therefore fire will be a pyramid.[2] Others, again, express no opinion on the subject of its figure, but simply regard it as the body of the finest parts, which in combination will form other bodies, as the fusing of gold-dust produces solid gold. Both of these views involve the same difficulties. For (1) if, on the one hand, they make the primary body an atom, the view will be open to the objections already advanced against the atomic theory. And further the theory is inconsistent with a regard for the facts of nature. For if all bodies are quantitatively commensurable, and the relative size of the various homoeomerous masses and of their several elements are in the same ratio, so that the total mass of water,[3] for instance, is related to the total mass of air as the elements of each are to one another, and so on, and if there is more air than water and, generally, more of the finer body than of the coarser, obviously the element of water will be smaller than that of air.[4] But the lesser quantity is contained in the greater. Therefore

it involves an undistributed middle: 'fire is piercing', 'the pyramid is piercing': they attempt to draw an affirmative conclusion in the second figure.

[1] Reading *μικρομερέστατον* with FHMJ. The word is used as equivalent to *λεπτομερέστατον*, which is the reading of EL and (probably) of Simplicius.—The pyramid is presumably said to have the smallest parts because it contains fewer of the primary triangles than any other regular solid. But the assertion is not thereby justified. Given a certain size of triangle, the pyramid would be the smallest of the solids in cubic content; thus the body composed of pyramids would be the body with the smallest parts. The epithet *λεπτομερές*, in short, seems to be transferred from the whole to the part, just as *ὁμοιομερές* was (above, 302a 31, note).

[2] To whom is this 'more ingenious' version to be attributed? 'Heracleitus made fire the universal element but did not say it was a pyramid, and the Pythagoreans, who said that fire was composed of pyramids, did not make it the universal element' (Simpl.).

[3] Perhaps *οἷον τό* should be read for *οἷον τά*.

[4] The ascertained fact on which this argument is based is that when (e.g.) water turns into air, the volume of the resultant air is

the air element is divisible. And the same could be shown of fire and of all bodies whose parts are relatively fine. 304^b (2) If, on the other hand, the primary body is divisible, then (*a*) those who give fire a special shape will have to say that a part of fire is not fire, because a pyramid is not composed of pyramids,[1] and also that not every body is either an element or composed of elements, since a part of fire will be neither fire nor any other element. And (*b*) those whose ground of distinction is size will have to recognize an element prior to the element, a regress which continues infinitely, since every body is divisible and that which has the smallest parts is the element.[2] Further, they too will have to say that the same body is relatively to this fire and relatively to that air, to others again water and earth.

The common error of all views which assume a single element is that they allow only one natural movement, which is the same for every body. For it is a matter of observation that a natural body possesses a principle of movement. If then all bodies are one, all will have one movement. With this motion the greater their quantity the more they will move, just as fire, in proportion as its quantity is greater, moves faster with the upward motion which belongs to it. But the fact is that increase of quantity makes many things move the faster downward. For these reasons, then, as well as from the distinction already established[3] of a plurality of natural movements, it is impossible that there should be only one element. But if the elements are not an infinity and not reducible to one, they must be several and finite in number.

greater than that of the original water. This increase of volume can only be accounted for (since the hypothesis of a void has been refuted) by supposing an increase in the volume of the atom proportionate to the observed increase in the volume of the total mass. But the enlarged atom would be divisible, and therefore no atom.

[1] i.e. a pyramid cannot be divided so that *every* part is a pyramid.

[2] If every body is infinitely divisible, it is difficult to give a precise meaning to 'that which has the smallest parts'. Further, the phrase, as used, is somewhat illogical; for the argument would point to the smallest part of any body, rather than the body with the smallest parts, as the element. But the use of λεπτομερές (and μικρομερές) as an epithet of the part instead of the whole occurs elsewhere (cf. note on 304^a 16).

[3] Book I, c. ii.

[redacted]

First we must inquire whether the elements are eternal 6
or subject to generation and destruction; for when this question has been answered their number and character will be manifest. In the first place, they cannot be eternal. It is a matter of observation that fire, water, and every simple body undergo a process of analysis, which must[1] either continue infinitely or stop somewhere. (1) Suppose it infinite. Then the time occupied by the process will be infinite, and also that occupied by the reverse process of synthesis. For the processes of analysis and synthesis succeed one another in the various parts. It will follow that there are two infinite times which are mutually exclusive, the time occupied by the synthesis, which is infinite, being preceded by the period of analysis. There are thus
305a two mutually exclusive infinites, which is impossible. (2) Suppose, on the other hand, that the analysis stops somewhere. Then the body at which it stops will be either atomic or, as Empedocles seems to have intended, a divisible body which will yet never be divided. The foregoing arguments[2] show that it cannot be an atom; but neither can it be a divisible body which analysis will never reach. For a smaller body is more easily destroyed than a larger; and a destructive process which succeeds in destroying, that is, in resolving into smaller bodies, a body of some size, cannot reasonably be expected to fail with the smaller body. Now in fire we observe a destruction of two kinds: it is destroyed by its contrary when it is quenched, and by itself when it dies out.[3] But the effect is produced by a greater quantity upon a lesser, and the more quickly the smaller it is. The elements of bodies must therefore be subject to destruction and generation.

Since they are generated, they must be generated either from something incorporeal or from a body, and if from a body, either from one another or from something else. The theory which generates them from something in-

[1] Reading ἀνάγκη δέ with the MSS. [2] c. iv.
[3] i.e. it may die out 'of itself'. Aristotle does not develop this, but his point is only the simple one that the smaller the fire is, the sooner, by either process, it is destroyed.

corporeal requires an extra-corporeal void.[1] For everything that comes to be comes to be in something,[2] and that in which the generation takes place must either be incorporeal or possess body; and if it has body, there will be two bodies in the same place at the same time, viz. that which is coming to be and that which was previously there, while if it is incorporeal, there must be an extra-corporeal void. But we have already shown[3] that this is impossible. But, on the other hand, it is equally impossible that the elements should be generated from some kind of body. That would involve a body distinct from the elements and prior to them. But if this body possesses weight or lightness, it will be one of the elements; and if it has no tendency to movement, it will be an immovable or mathematical entity, and therefore not in a place at all. A place in which a thing is at rest is a place in which it might move, either by constraint, i.e. unnaturally, or in the absence of constraint, i.e. naturally. If, then, it is in a place and somewhere,[4] it will be one of the elements; and if it is not in a place, nothing can come from it, since that which comes into being and that out of which it comes must needs be together. The elements therefore cannot be generated from something incorporeal nor from a body which is not an element, and the only remaining alternative is that they are generated from one another.

7 We must, therefore, turn to the question, what is the manner of their generation from one another? Is it as Empedocles and Democritus say, or as those who resolve bodies into planes say, or is there yet another possibility? 305b

[1] γεννώμενον is found only in EL, and the other four manuscripts offer no substitute. It was clearly not in Simplicius' text. κεχωρισμένον, or another word of similar meaning, must be read.

[2] The words ἔν τινι γίνεται καί are a conjectural addition suggested by Simplicius (after Alexander). They occur (without the καί) in one of our manuscripts, M, whose original readings are mostly either errors or conjectures. Without these words it is almost impossible to make any sense of the passage; but they are not intrinsically a probable conjecture and are only accepted because a better remedy remains to be suggested.

[3] *Phys.* IV. 8.

[4] Placing the comma after που (l. 29) instead of after τόπῳ (l. 28). To be 'somewhere' is to be 'in a place'.

(1) What the followers of Empedocles do, though without observing it themselves, is to reduce the generation of elements out of one another to an illusion. They make it a process of excretion from a body of what was in it all the time—as though generation required a vessel rather than a material—so that it involves no change of anything. And even if this were accepted, there are other implications equally unsatisfactory. We do not expect a mass of matter to be made heavier by compression. But they will be bound to maintain this, if they say that water is a body present in air and excreted from air, since air becomes heavier when it turns into water.[1] Again, when the mixed body is divided, they can show no reason why one of the constituents must by itself take up more room than the body did: but when water turns into air, the room occupied is increased. The fact is that the finer body takes up more room, as is obvious in any case of transformation. As the liquid is converted into vapour or air the vessel which contains it is often burst because it does not contain room enough. Now, if there is no void at all, and if, as those who take this view say, there is no expansion of bodies,[2] the impossibility of this is manifest: and if there is void and expansion, there is no accounting for the fact that the body which results from division occupies of necessity a greater space. It is inevitable, too, that generation of one out of another should come to a stop, since a finite quantum cannot contain an infinity of finite quanta. When earth produces water something is taken away from the earth, for the process is one of excretion. The same thing happens again when the residue produces water. But this can only go on for ever, if the finite body contains an infinity, which is impossible. Therefore the generation of elements out of one another will not always continue.[3]

[1] More accurately, becomes heavy, since air rises and water falls. Lightness is treated here as a low degree of heaviness.

[2] The words *καθάπερ φασὶν οἱ τ. λ.* must be taken to refer only to expansion, since Democritus of course believed in a void.

[3] In the end the elements will be sorted out, and there will remain several homogeneous masses between which no interchange is possible.

(2) We have now explained that the mutual transformations of the elements cannot take place by means of excretion. The remaining alternative is that they should be generated by changing into one another. And this in one of two ways, either by change of shape, as the same wax takes the shape both of a sphere and of a cube, or, as some assert, by resolution into planes. (*a*) Generation by change of shape would necessarily involve the assertion of atomic bodies. For if the particles were divisible there would be a part of fire which was not fire and a part of earth which was not earth, for the reason that not every part of a pyramid is a pyramid nor of a cube a cube. But if 306a
(*b*) the process is resolution into planes, the first difficulty is that the elements cannot all be generated out of one another. This they are obliged to assert, and do assert. It is absurd, because it is unreasonable that one element alone should have no part in the transformations, and also contrary to the observed data of sense, according to which all alike change into one another. In fact their explanation of the observations is not consistent with the observations. And the reason is that their ultimate principles are wrongly assumed: they had certain predetermined views, and were resolved to bring everything into line with them. It seems that perceptible things require perceptible principles, eternal things eternal principles, corruptible things corruptible principles; and, in general, every subject matter principles homogeneous with itself. But they, owing to their love for their principles, fall into the attitude of men who undertake the defence of a position in argument. In the confidence that the principles are true they are ready to accept any consequence of their application. As though some principles did not require to be judged from their results, and particularly from their final issue! And that issue, which in the case of productive knowledge[1] is the product, in the knowledge of nature is the unimpeachable evidence of the senses as to each fact.

The result of their view is that earth has the best right to the name element, and is alone indestructible; for that

[1] i. e. in the case of art.

[redacted]

which is indissoluble is indestructible and elementary, and earth alone cannot be dissolved into any body but itself. Again, in the case of those elements which do suffer dissolution, the 'suspension' of the triangles is unsatisfactory. But this takes place whenever one is dissolved into another, because of the numerical inequality of the triangles which compose them.[1] Further, those who hold these views must needs suppose that generation does not start from a body. For what is generated out of planes cannot be said to have been generated from a body. And they must also assert that not all bodies are divisible, coming thus into conflict with our most accurate sciences, namely the mathematical, which assume that even the intelligible is divisible, while they, in their anxiety to save their hypothesis, cannot even admit this of every perceptible thing. For any one who gives each element a shape of its own, and makes this the ground of distinction between the substances, has to attribute to them indivisibility; since division of a pyramid or a sphere must leave somewhere at least a residue which is not a sphere or a pyramid. Either, then, a part of fire is not fire, so that
306b there is a body prior to the element—for every body is either an element or composed of elements—or not every body is divisible.

In general, the attempt to give a shape to each of the 8
simple bodies is unsound, for the reason, first, that they will not succeed in filling the whole. It is agreed that there are only three plane figures which can fill a space, the triangle, the square, and the hexagon, and only two solids, the pyramid and the cube.[2] But the theory needs more than these because the elements which it recognizes are more in number. Secondly, it is manifest that the simple bodies are often given a shape by the place in which they are included, particularly water and air. In such a case the shape of the element cannot persist; for, if it did, the

[1] e.g. the εἰκοσάεδρον of water, with its twenty triangles, has to be converted into the ὀκτάεδρον of air, with eight triangles. Four of the twenty component triangles of the water-particle will be 'suspended'.

[2] Only regular figures are included.

contained mass would not be in continuous contact with the containing body; while, if its shape is changed, it will cease to be water, since the distinctive quality is shape. Clearly, then, their shapes are not fixed.[1] Indeed, nature itself seems to offer corroboration of this theoretical conclusion. Just as in other cases the substratum must be formless and unshapen—for thus the 'all-receptive', as we read in the *Timaeus*,[2] will be best for modelling—so the elements should be conceived as a material for composite things; and that is why they can put off their qualitative distinctions and pass into one another. Further, how can they account for the generation of flesh and bone or any other continuous body? The elements alone cannot produce them because their collocation cannot produce a continuum. Nor can the composition of planes; for this produces the elements themselves, not bodies made up of them. Any one then who insists upon an exact statement of this kind of theory,[3] instead of assenting after a passing glance at it, will see that it removes generation from the world.

Further, the very properties, powers, and motions, to which they paid particular attention in allotting shapes, show the shapes not to be in accord with the bodies. Because fire is mobile and productive of heat[4] and combustion, some made it a sphere, others a pyramid. These shapes, they thought, were the most mobile because they offer the fewest points of contact and are the least stable of 307a
any; they were also the most apt to produce warmth and combustion, because the one is angular throughout[5] while the other has the most acute angles, and the angles, they say, produce warmth and combustion. Now, in the first place, with regard to movement both are in error. These may be the figures best adapted to movement; they are

[1] Reading αὐτῶν for αὐτοῦ, with LMJ.

[2] Plato, *Tim.* 51 A. At Mr. Ross's suggestion, I have altered the stopping of the sentence. Delete comma after ἄλλοις (l. 17), and enclose the words μάλιστα γὰρ . . . τὸ πανδεχές (ll. 18-19) within brackets.

[3] Reading τοὺς τοιούτους with FHMJ.

[4] Prantl's text (presumably by accident) omits the καί before θερμαντικόν.

[5] Cf. below, 307a 16.

not, however, well adapted to the movement of fire, which is an upward and rectilinear movement, but rather to that form of circular movement which we call rolling. Earth, again,[1] they call a cube because it is stable and at rest. But it rests only in its own place, not anywhere; from any other it moves if nothing hinders, and fire and the other bodies do the same. The obvious inference, therefore, is that fire and each several element is in a foreign place a sphere or a pyramid, but in its own a cube. Again, if the possession of angles makes a body produce heat and combustion, every element produces heat, though one may do so more than another. For they all possess angles, the octahedron and dodecahedron as well as the pyramid; and Democritus makes even the sphere a kind of angle, which cuts things because of its mobility.[2] The difference, then, will be one of degree: and this is plainly false. They must also accept the inference that the mathematical solids produce heat and combustion, since they too possess angles and contain atomic spheres[3] and pyramids, especially if there are, as they allege, atomic figures.[4] Anyhow if these functions belong to some of these things and not to others, they should explain the difference, instead of speaking in quite general terms as they do. Again, combustion of a body produces fire, and fire is a sphere or a pyramid. The body, then, is turned into spheres or pyramids. Let us grant that these figures may reasonably be supposed to cut and break up bodies as fire does; still it remains quite inexplicable that a pyramid must needs produce pyramids or a sphere spheres. One might as well postulate that a knife or a saw divides things into knives or saws. It is also ridiculous to think only of division when allotting fire its shape. Fire is generally thought of as combining and connecting rather than as separating.

[1] Prantl has εἴπειτ' for ἔπειτ' by a misprint.

[2] Though it has a low degree of angularity, it is highly mobile and therefore extremely piercing. But the double ὡς is awkward, and perhaps the tradition is at fault. (J has τέμνει ὡς εὐκίνητον, supporting E against the other MSS.)

[3] Prantl's σφαῖρα is a misprint for σφαῖραι.

[4] i. e. indivisible units of line, of which the geometrical figures are composed.

For though it separates bodies different in kind, it combines 307b those which are the same; and the combining is essential to it, the functions of connecting and uniting being a mark of fire, while the separating is incidental. For the expulsion of the foreign body is an incident in the compacting of the homogeneous. In choosing the shape, then, they should have thought either of both functions or preferably of the combining function. In addition, since hot and cold are contrary powers, it is impossible to allot any shape to the cold. For the shape given must be the contrary of that given to the hot, but there is no contrariety between figures. That is why they have all left the cold out, though properly either all or none should have their distinguishing figures. Some of them, however, do attempt to explain this power, and they contradict themselves. A body of large particles, they say, is cold because instead of penetrating through the passages it crushes. Clearly, then, that which is hot is that which penetrates these passages, or in other words that which has fine particles. It results that hot and cold are distinguished not by the figure but by the size of the particles. Again, if the pyramids are unequal in size, the large ones will not be fire, and that figure will produce not combustion but its contrary.

From what has been said it is clear that the difference of the elements does not depend upon their shape. Now their most important differences are those of property, function, and power; for every natural body has, we maintain, its own functions, properties, and powers. Our first business, then, will be to speak of these, and that inquiry will enable us to explain the differences of each from each.

[redacted]

BOOK IV

307b We have now to consider the terms 'heavy' and 'light'. 1

We must ask what the bodies so called are, how they are constituted, and what is the reason of their possessing these powers. The consideration of these questions is a proper part of the theory of movement, since we call things heavy and light because they have the power of being moved naturally in a certain way. The activities corresponding to these powers have not been given any name, unless 308a it is thought that 'impetus' is such a name. But because the inquiry into nature is concerned with movement,[1] and these things have in themselves some spark (as it were) of movement, all inquirers avail themselves of these powers, though in all but a few cases without exact discrimination. We must then first look at whatever others have said, and formulate the questions which require settlement in the interests of this inquiry, before we go on to state our own view of the matter.

Language recognizes (*a*) an absolute, (*b*) a relative heavy and light. Of two heavy things, such as wood and bronze, we say that the one is relatively light, the other relatively heavy. Our predecessors have not dealt at all with the absolute use of the terms, but only with the relative. I mean, they do not explain what the heavy is or what the light is, but only the relative heaviness and lightness of things possessing weight. This can be made clearer as follows. There are things whose constant nature it is to move away from the centre, while others move constantly towards the centre; and of these movements that which is away from the centre I call upward movement and that which is towards it I call downward movement. (The view, urged by some,[2] that there is no up and no down in the heaven, is absurd. There can be, they say, no up and no down, since

[1] Read φυσικὴν μὲν εἶναι (E alone omits μέν).

[2] The digression is directed against Plato, *Tim.* 62 E; but the view was held by others besides Timaeus.

the universe is similar every way, and from any point on the earth's surface a man by advancing far enough will come to stand foot to foot with himself. But the extremity of the whole, which we call 'above', is in position above and in nature primary. And since the universe has an extremity and a centre, it must clearly have an up and down. Common usage is thus correct,[1] though inadequate. And the reason of its inadequacy is that men think that the universe is not similar every way. They recognize only the hemisphere which is over us. But if they went on to think of the world as formed on this pattern all round, with a centre identically related to each point on the extremity, they would have to admit that the extremity was above and the centre below.) By absolutely light, then, we mean that which moves upward or to the extremity, and by absolutely heavy that which moves downward or to the centre. By lighter or relatively light we mean that one, of two bodies endowed with weight and equal in bulk, which is exceeded by the other in the speed of its natural downward movement.[2]

2 Those of our predecessors who have entered upon this inquiry have for the most part spoken of light and heavy things only in the sense in which one of two things both 308b
endowed with weight is said to be the lighter. And this treatment they consider a sufficient analysis also of the notions of absolute heaviness and absolute lightness, to which their account does not apply. This, however, will become clearer as we advance. One use of the terms 'lighter' and 'heavier' is that which is set forth in writing in the *Timaeus*,[3] that the body which is composed of the greater number of identical parts is relatively heavy, while that which is composed of a smaller number is relatively

[1] Read *ὥσπερ* with FHMJ.

[2] Accepting Prantl's first correction, *οὗ* (for *ὅ*), which seems to be necessary to the sense. His second correction, *ἴσων* (for *ἴσον*), is to be rejected as unnecessary. Bywater (*J. of Phil.* xxviii, p. 242) suggests *θατέρου*, keeping *ὅ* and *ἴσον*; but the phrase, so emended, seems to be descriptive of the heavy rather than of the light.

[3] 63 C.

light. As a larger quantity of lead or of bronze is heavier than a smaller—and this holds good of all homogeneous masses, the superior weight always depending upon a numerical superiority of equal parts—in precisely the same way, they assert, lead is heavier than wood.[1] For all bodies, in spite of the general opinion to the contrary, are composed of identical parts and of a single material. But this analysis says nothing of the absolutely heavy and light. The facts are that fire is always light and moves upward, while earth and all earthy things move downwards or towards the centre. It cannot then be the fewness of the triangles (of which, in their view, all these bodies are composed)[2] which disposes fire to move upward. If it were, the greater the quantity of fire the slower it would move, owing to the increase of weight due to the increased number of triangles. But the palpable fact, on the contrary, is that the greater the quantity, the lighter the mass is and the quicker its upward movement: and, similarly, in the reverse movement from above downward, the small mass will move quicker and the large slower. Further, since to be lighter is to have fewer of these homogeneous parts and to be heavier is to have more, and air, water, and fire are composed of the same triangles, the only difference being in the number of such parts, which must therefore explain any distinction of relatively light and heavy between these bodies, it follows that there must be a certain quantum of air which is heavier than water. But the facts are directly opposed to this. The larger the quantity of air the more readily it moves upward, and any portion of air without exception will rise up out of the water.

So much for one view of the distinction between light and heavy. To others[3] the analysis seems insufficient; and their views on the subject, though they belong to an older generation than ours, have an air of novelty. It is apparent

[1] I put a colon in l. 6 after ἐλαττόνων and mark ll. 8–9, ὁμοίως δὲ . . . ἐστιν, as parenthetical. This leaves an asyndeton at ὥσπερ in l. 7, but it seems to give the sequence of thought better than the stopping of Bekker and Prantl does.

[2] There should be a comma after τριγώνων in l. 15.

[3] The atomists, Democritus and Leucippus.

that there are bodies which, when smaller in bulk than others, yet exceed them in weight. It is therefore obviously insufficient to say that bodies of equal weight are composed of an equal number of primary parts: for that would give equality of bulk. Those who maintain that the primary or atomic parts, of which bodies endowed with weight are composed, are planes, cannot so speak without absurdity;[1] 309a but those who regard them as solids are in a better position to assert that of such bodies the larger is the heavier. But since in composite bodies the weight obviously does not correspond in this way to the bulk, the lesser bulk being often superior in weight (as, for instance, if one be wool and the other bronze), there are some who think and say that the cause is to be found elsewhere. The void, they say, which is imprisoned in bodies, lightens them and sometimes makes the larger body the lighter. The reason is that there is more void. And this would also account for the fact that a body composed of a number of solid parts equal to, or even smaller than, that of another is sometimes larger in bulk than it. In short, generally and in every case a body is relatively light when it contains a relatively large amount of void. This is the way they put it themselves, but their account requires an addition. Relative lightness must depend not only on an excess of void, but also on a defect of solid: for if the ratio of solid to void exceeds a certain proportion, the relative lightness will disappear. Thus fire, they say, is the lightest of things just for this reason that it has the most void. But it would follow that a large mass of gold, as containing more void than a small mass of fire, is lighter than it, unless it also contains many times as much solid. The addition is therefore necessary.

Of those who deny the existence of a void some, like Anaxagoras and Empedocles, have not tried to analyse the notions of light and heavy at all; and those who, while still denying the existence of a void, have attempted this,[2] have

[1] For, since the planes have no weight, their number cannot affect the weight of a body.
[2] Plato, in the *Timaeus*.

failed to explain why there are bodies which are absolutely heavy and light, or in other words why some move upward and others downward. The fact, again, that the body of greater bulk is sometimes lighter than smaller bodies is one which they have passed over in silence, and what they have said gives no obvious suggestion for reconciling their views with the observed facts.

But those who attribute the lightness of fire to its containing so much void are necessarily involved in practically the same difficulties. For though fire be supposed to contain less solid than any other body, as well as more void, yet there will be a certain quantum of fire in which the amount of solid or plenum is in excess of the solids contained in some small quantity of earth. They may reply that there is an excess of void also. But the question is, how will they discriminate the absolutely heavy? Presumably, either by its excess of solid or by its defect
309b of void. On the former view there could be an amount of earth so small as to contain less solid than a large mass of fire. And similarly, if the distinction rests on the amount of void, there will be a body, lighter than the absolutely light, which nevertheless moves downward as constantly as the other moves upward. But that cannot be so, since the absolutely light is always lighter than bodies which have weight and move downward, while, on the other hand, that which is lighter need not be light, because in common speech we distinguish a lighter and a heavier (viz. water and earth) among bodies endowed with weight. Again, the suggestion of a certain ratio between the void and the solid in a body is no more equal to solving the problem before us. This manner of speaking will issue in a similar impossibility. For any two portions of fire, small or great, will exhibit the same ratio of solid to void; but the upward movement of the greater is quicker than that of the less, just as the downward movement of a mass of gold or lead, or of any other body endowed with weight, is quicker in proportion to its size. This, however, should not be the case if the ratio is the ground of distinction between heavy things and light. There is also an absurdity in attributing

the upward movement of bodies to a void which does not itself move. If, however, it is the nature of a void to move upward and of a plenum to move downward, and therefore each causes a like movement in other things,[1] there was no need to raise the question why composite bodies are some light and some heavy; they had only to explain why these two things are themselves light and heavy respectively, and to give, further, the reason why the plenum and the void are not eternally separated. It is also unreasonable to imagine a place for the void, as if the void were not itself a kind of place.[2] But if the void is to move, it must have a place out of which and into which the change carries it. Also what is the cause of its movement? Not, surely, its voidness: for it is not the void only which is moved, but also the solid.[3]

Similar difficulties are involved in all other methods of distinction, whether they account for the relative lightness and heaviness of bodies by distinctions of size, or proceed on any other principle, so long as they attribute to each the same matter, or even if they recognize more than one matter, so long as that means only a pair of contraries. If there is a single matter, as with those who compose things of triangles, nothing can be absolutely heavy or light: and if there is one matter and its contrary—the void, for 310a
instance, and the plenum—no reason can be given for the relative lightness and heaviness of the bodies intermediate between the absolutely light and heavy when compared either with one another or with these themselves.[4] The

[1] Read φορᾶς ἑκατέρας. ἑκατέρας is in all MSS. except E, and is implied in Simplicius' paraphrase.

[2] Read αὐτό with FHMJ and the corrector of E. The construction is certainly loose, but the other reading (αὐτῷ) does not give the required sense. To give void a motion is to give it a 'place', i.e. a natural place to which it moves. But it is itself nothing but a place where no body is (cf. *Phys.* IV. 7): and, as Simplicius punningly remarks, 'it is out of place to give a place a place' (τοῦ δὲ τόπου τόπον ποιεῖν τῶν ἀτοπωτάτων ἐστίν).

[3] If mover ent is natural to both void and solid, the cause of movement must lie in something common to both and not in the peculiar nature of either, i.e. not in voidness or solidity.

[4] Aristotle's argument is that the observed diversity of movement necessarily involves a corresponding diversity of bodies: hence any view which makes the four elements one in substance fails to account

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view which bases the distinction upon differences of size is more like a mere fiction than those previously mentioned, but, in that it is able to make distinctions between the four elements, it is in a stronger position for meeting the foregoing difficulties. Since, however,[1] it imagines that these bodies which differ in size are all made of one substance, it implies, equally with the view that there is but one matter, that there is nothing absolutely light and nothing which moves upward (except as being passed by other things or forced up by them);[2] and since a multitude of small atoms are heavier than a few large ones, it will follow that much air or fire is heavier than a little water or earth, which is impossible.

These, then, are the views which have been advanced by 3
others and the terms in which they state them. We may begin our own statement by settling a question which to some has been the main difficulty—the question why some bodies move always and naturally upward and others downward, while others again move both upward and downward. After that we will inquire into light and heavy and the explanation of the various phenomena connected with them.[3] The local movement of each body into its own place must be regarded as similar to what happens in connexion with other forms of generation and change. There

for the facts of movement. He here adds that it is not enough to recognize two kinds of substance or two contrary attributes. For there are four bodies to be accounted for. A single pair of opposites may yield an account of fire and earth, but they cannot account also for the 'intermediate bodies', water and air. Two pairs of opposites will be required, such as those which he uses himself (warm, cold: dry, moist).—In l. 3 *τῶν ἁπλῶν* must refer to the things also called *τῶν ἁπλῶς βαρέων καὶ κούφων*. Simplicius tells us that Alexander read *τῶν ἁπλῶν*, but found in some MSS. *τῶν ἁπλῶς*. *ἁπλῶς* is tempting, but *ἁπλῶν* may be allowed to stand: for (*a*) the absolutely heavy and light are, on the theory criticized, pure solid and pure void respectively: thus *τὰ ἁπλῶς* are *τὰ ἁπλᾶ*: (*b*) all other bodies whatever will be composed of these in combination, and may therefore be opposed to them as composite to simple.

[1] Reading *τῷ* with HMLJ. Simplicius' paraphrase supports this.

[2] i.e. upward movement is either (*a*) illusory: as all things race downward, some, moving slower, are left behind, and thus appear to move up: or (*b*) unnatural: due to pressure applied from without by other bodies pushing downward.

[3] Prantl misprints *γένεται* for *γίνεται*.

are, in fact, three kinds of movement, affecting respectively the size, the form, and the place of a thing, and in each it is observable that change proceeds from a contrary to a contrary or to something intermediate: it is never the change of any chance subject in any chance direction, nor, similarly, is the relation of the mover to its object fortuitous: the thing altered is different from the thing increased, and precisely the same difference holds between that which produces alteration and that which produces increase. In the same manner it must be thought that that which produces local motion and that which is so moved are not fortuitously related. Now,[1] that which produces upward and downward movement is that which produces weight and lightness, and that which is moved is that which is potentially heavy or light, and the movement of each body to its own place is motion towards its own form. (It is best to interpret in this sense the common statement of the older writers that 'like moves to like'. For the words are not in every sense true to fact. If one were to remove the earth to where the moon now is, the various fragments of earth would each move not towards it but to the place in which it now is. In general, when a number of similar and undifferentiated bodies are moved with the same motion this result is necessarily produced, viz. that the place which is the natural goal of the movement of each single part is also that of the whole.[2] But since the place of a thing is the boundary of that which contains it, and the continent of all things that move upward or downward is the extremity and the centre, and this boundary comes to be, in a sense, the form of that which is contained, it is to its like that a body moves when

[1] Reading *εἰ οὖν εἰς* with EL (Simplicius' MSS. had, some *εἰ μὲν εἰς*, and some *εἰ μέν*. J has *εἰς οὖν*). The apodosis does not begin till 310^b 16 *τὸ δὲ ζητεῖν*, the argument being interrupted by a long note on the meaning of the saying *ὅμοιον πρὸς ὅμοιον*, which should be marked as a parenthesis.

[2] *ὥσθ' ὅπου . . . τὸ πᾶν* is explanatory of *τοῦτο συμβαίνειν*. Grammatically the predicate to be supplied to *τὸ πᾶν* is *πέφυκε φέρεσθαι*, though this in the context creates a slight illogicality. Aristotle's point is that a fragment of earth moves to the mass called the earth, not because it loves its like, but *per accidens* in the effort to reach the centre. It is the effort of numberless such fragments to reach the centre which has formed the mass, not the presence of the mass at the centre which causes the effort.

it moves to its own place. For the successive members of the series[1] are like one another: water, I mean, is like air and air like fire, and between intermediates the relation may be converted, though not between them and the extremes; thus air is like water, but water is like earth:[2] for the relation of each outer body to that which is next within it is that of form to matter.[3]) Thus[4] to ask why fire

[1] *ἐφεξῆς* should be read, with the other MSS. and Simplicius, rather than E's *ἑξῆς*. Cf. *de Gen. et Corr.* 331b 4, 26, 34.

[2] i.e. though air is like fire, fire is not like air; and though water is like earth, earth is not like water. See next note. Prantl proposes to take *μέσοις* and *ἄκροις* in l. 13 to mean inner and outer respectively, i.e. to make the former stand for earth and water, the latter for fire and air. His reason is grammatical: *μέσοις* is in the dative and so are *ὕδατι* and *γῇ*. Thus a construction is provided for *μέσοις*. He omits to observe that *τοῖς δ' ἄκροις οὔ* becomes meaningless: which, with the admitted difficulty of taking the terms in this sense, is sufficient reason for rejecting the proposal. It is no doubt due to *ὅμοια* that *μέσοις* is in the dative: *likeness to* a *μέσον* is convertible, *likeness to* an *ἄκρον* not.

[3] The connexion is difficult, and may be explained as follows. Aristotle's argument is formally concluded at *φέρεσθαι* in l. 11 ('to its own place'). The 'place' (centre and extremity, as explained) gives form to the body, and the body in reaching its place attains its form, i.e. completes the transition from potentiality to actuality. In a sense, then, if the potential is like the actual, it moves 'to its like'. The *γάρ* in l. 11 forestalls an objection. 'There remain the intermediate bodies: what of them?' These are given form or determined by the extreme bodies, and thus mediately determined by the 'place'. Instead of saying 'are given form' or 'are determined' Aristotle says 'are like'; being entitled to do so by the meaning just given to 'like'. The like to which earth moves is that from which it receives its form, and the like to which water and air move is the extreme body—earth in the one case, fire in the other—from which each receives its form. Thus 'like' means 'receptive of form from'. In this sense water is like air which is like fire, and air is like water which is like earth; but the extremes themselves, earth and fire, are like nothing but their places. The relation of likeness is reciprocal (i.e. determination is mutual) only between the intermediates; and the chain of resemblance breaks off in each direction short of the extreme. Starting from the centre, we find in the three terms, water, air, fire, a gradual approximation (*ἀεὶ τὸ ἀνώτερον . . .*) to the form realized in fire; starting from the extremity, we find in the terms air, water, earth, a gradual approximation to the form realized in earth. (Of these two complementary statements Aristotle gives only the first; but the second is necessary to complete the argument.) Therefore the intermediate bodies, as well as the extremes, may be said in moving to their places to attain their form.—The above account agrees in principle with that of Simplicius, who, however, is not very clear. Alexander, he tells us, took another view, based on a different interpretation of *ἀεὶ τὸ ἀνώτερον κτλ.* As reported the view is not easy to fit into the context.—For the relation of upper to lower bodies, cf. 312a 15 and *De Gen. et Corr.* 335a 18.

[4] Alexander's *δή* for *δέ* here, like his *τῶν ἄλλων* for *τούτων* in l. 22,

moves upward and earth downward is the same as to ask why the healable, when moved and changed *quâ* healable, attains health and not whiteness; and similar questions might be asked concerning any other subject of alteration. Of course the subject of increase, when changed *quâ* increasable, attains not health but a superior size. The same applies in the other cases. One thing changes in quality, another in quantity: and so in place, a light thing goes upward, a heavy thing downward. The only difference is that in the last case, viz. that of the heavy and the light, the bodies are thought to have a spring of change within themselves, while the subjects of healing and increase are thought to be moved purely from without. Sometimes, however, even they change of themselves, i.e. in response to a slight external movement reach health or increase, as the case may be. And since the same thing which is healable is also receptive of disease, it depends on whether it is moved *quâ* healable or *quâ* liable to disease whether the motion is towards health or towards disease. But the reason why the heavy and the light appear more than these things to contain within themselves the source of their movements is that their matter is nearest to being. This is indicated by the fact that locomotion belongs to bodies only when isolated from other bodies,[1] and is generated last of the several kinds of movement; in order of being then it will be first. Now whenever air comes into being 311a
out of water, light out of heavy, it goes to the upper place. It is forthwith light: becoming is at an end, and in that place it has being.[2] Obviously, then, it is a potentiality,

was advanced as a conjecture unsupported by MSS. None of our MSS. have either. The apodosis to the protasis introduced by *εἰ* in 310a 31 begins here. *δή* is therefore attractive, but *δέ in apodosi* is easily excused in view of the long intervening parenthesis.

[1] The use of *ἀπολελυμένων* ('isolated') is interesting, as Prantl points out, because of its later technical use (= *absolutus*, absolute). Simplicius here takes it to stand for complete substances (*ὁλοκλήρων κατ' οὐσίαν ὄντων*) not involved in any process of *γένεσις*, *αὔξησις*, or *ἀλλοίωσις*. Prantl says *ἀπολελυμένα* means 'independent beings' (unabhängige Wesen). Bonitz, *Ind.* 84a 26, says '*idem fere ac ἀποκεκριμένον, χωριστόν*'. The 'independence' intended is rather physical than metaphysical.

[2] Read *ἐκεῖ ἔστιν*.

which, in its passage to actuality, comes into that place and quantity and quality which belong to its actuality.[1] And the same fact explains why what is already actually fire or earth moves, when nothing obstructs it, towards its own place. For motion is equally immediate in the case of nutriment, when nothing hinders, and in the case of the thing healed, when nothing stays the healing. But the movement is also due to the original creative force and to that which removes the hindrance or off which the moving thing rebounded, as was explained in our opening discussions, where we tried to show how none of these things moves itself.[2] The reason of the various motions of the various bodies, and the meaning of the motion of a body to its own place, have now been explained.

We have now to speak of the distinctive properties of 4
these bodies and of the various phenomena connected with them. In accordance with general conviction we may distinguish the absolutely heavy, as that which sinks to the bottom of all things, from the absolutely light, which is that which rises to the surface of all things. I use the term 'absolutely', in view of the generic character of 'light' and 'heavy',[3] in order to confine the application to bodies which do not combine lightness and heaviness. It is apparent, I mean, that fire, in whatever quantity, so long as there is no external obstacle, moves upward, and earth downward; and, if the quantity is increased, the movement is the same, though swifter. But the heaviness and lightness of bodies which combine these qualities is different from this, since while they rise to the surface of some bodies they sink to the bottom of others. Such are air and water. Neither of them is absolutely either light or heavy. Both are lighter than earth—for any portion of either rises to the surface of it—but heavier than fire, since a portion of either, whatever its quantity, sinks to the bottom of fire; compared together, however, the one has absolute weight, the other

[1] Omitting, with F, the words καὶ ὅπου, which I assume to have been inserted by some one who mistook οὗ = *ubi* for the genitive of the relative.

[2] *Phys.* VII. 1, 241b 24; VIII. 4, 254b 7.

[3] i. e. because there are distinct species of light and heavy.

absolute lightness, since air in any quantity rises to the surface of water, while water in any quantity sinks to the bottom of air. Now other bodies are severally light and heavy, and evidently in them the attributes are due to the difference of their uncompounded parts: that is to say, according as the one or the other happens to preponderate the bodies will be heavy and light respectively. Therefore we need only speak of these parts, since they are primary and all else consequential: and in so doing we shall be following the advice which we gave[1] to those who attribute heaviness to the presence of plenum and lightness to that of void. It is due to the properties of the elementary bodies that a body which is regarded as light in one place is regarded as heavy in another, and vice versa. In air, for instance, a talent's weight of wood is heavier than a mina of lead, but in water the wood is the lighter. The reason is that all the elements except fire have weight and all but earth lightness. Earth, then, and bodies in which earth preponderates, must needs have weight everywhere, while water is heavy anywhere but in earth, and air is heavy when not in water or earth. In its own place each of these bodies has weight except fire, even air. Of this we have evidence in the fact that a bladder when inflated weighs more than when empty. A body, then, in which air preponderates over earth and water, may well be lighter than something in water and yet heavier than it in air, since such a body does not rise in air but rises to the surface in water.

The following account will make it plain that there is an absolutely light and an absolutely heavy body. And by absolutely light I mean one which of its own nature always moves upward, by absolutely heavy one which of its own nature always moves downward, if no obstacle is in the way. There are, I say, these two kinds of body,[2] and it is not the case, as some[3] maintain, that all bodies have weight.

[1] Above, 309^b 20: if they would only give an account of the simple bodies, their questions as to the composite would answer themselves.

[2] Read ἐστί τινα (E and Simpl. omit τινα).

[3] This view is maintained in its most unqualified form by those (atomists, probably) who distinguish the four elements by the size of their particles (cf. c. ii. 310^a 9).

Different views are in fact agreed that there is a heavy body, which moves uniformly towards the centre. But there is also similarly a light body.[1] For we see with our eyes, as we said before,[2] that earthy things sink to the bottom of all things and move towards the centre. But the centre is a fixed point. If therefore there is some body which rises to the surface of all things—and we observe fire to move upward even in air itself, while the air remains at rest[3]—clearly this body is moving towards the extremity. It cannot then have any weight. If it had, there would be another body in which it sank: and if that had weight, there would be yet another which moved to the extremity and thus rose to the surface of all moving things.[4] In fact, however, we have no evidence of such a body. Fire, then, has no weight. Neither has earth any lightness, since it sinks to the bottom of all things, and that which sinks moves to the centre. That there is a centre[5] towards which the motion of heavy things, and away from which that of light things is directed, is manifest in many ways. First, because no movement can continue to infinity. For what cannot be can no more come-to-be than be, and movement is a coming-to-be in one place from another. Secondly, like the upward movement of fire, the downward movement of earth and all heavy things makes equal angles on every side with the earth's surface[6]: it must therefore be directed
312^{a} towards the centre. Whether it is really the centre of the earth and not rather that of the whole to which it moves, may be left to another inquiry, since these are coincident.[7]

[1] It cannot be right to print ll. 14-19, λέγω δ' . . . κοῦφον, as a parenthesis, with Prantl. The sentences are not sufficiently self-contained nor closely enough inter-connected to justify such treatment. The argument which begins in l. 19 with ὁρῶμεν γάρ is a justification of the statement last preceding: as there is, by general admission and by the evidence of observation, a heavy body, so there is a light body.

[2] Above, 311^{a} 20.

[3] Since the air is at rest, the explanation that the fire is 'forced up' (ἐκθλιβόμενον, 310^{a} 10) is inadmissible.

[4] Reading ὅ with the MSS. Prantl's conjecture, οὗ, is unnecessary.

[5] Read ἔστι for ἐστί.

[6] i.e. the line of movement is at right angles to any tangent. Cf. above, 296^{b} 20, 297^{b} 19.

[7] The question is discussed in II. xiv, 296^{b} 9.

But since that which sinks to the bottom of all things moves to the centre, necessarily that which rises to the surface moves to the extremity of the region in which the movement of these bodies takes place. For the centre is opposed as contrary to the extremity, as that which sinks is opposed to that which rises to the surface. This also gives a reasonable ground for the duality of heavy and light in the spatial duality centre and extremity. Now there is also the intermediate region to which each name is given in opposition to the other extreme. For that which is intermediate between the two is in a sense both extremity and centre.[1] For this reason there is another heavy and light; namely, water and air. But in our view the continent pertains to form and the contained to matter: and this distinction is present in every genus.[2] Alike in the sphere of quality and in that of quantity there is that which corresponds rather to form and that which corresponds to matter. In the same way, among spatial distinctions, the above belongs to the determinate, the below to matter. The same holds, consequently, also of the matter itself of that which is heavy and light: as potentially possessing the one character, it is matter for the heavy, and as potentially possessing the other, for the light. It is the same matter, but its being is different, as that which is receptive of disease is the same as that which is receptive of health, though in being different from it, and therefore diseasedness is different from healthiness.[3]

5 A thing then which has the one kind of matter is light and always moves upward, while a thing which has the

[1] Read ἔστι γὰρ ὡς, omit ἐστί after ἀμφοτέρων, and put a colon after μεταξύ. (J has an erasure in the position of the second ἐστί.)

[2] i.e. in every category. For this use of γένος see Bonitz, *Ind.* 152a 16.

[3] The doctrine here expressed is the same as that expressed in the last chapter (310b 15, note). A single matter is receptive of two opposed forms, weight and lightness or health and disease. But Aristotle here adds the new point that of two such alternative forms one is always more formal and the other more material. Weight and lightness, disease and health, are not true coordinates. *A* form, we may say, is realized in disease, in weight, in the female; but *the* form is realized in health, in lightness, and in the male. The principle is stated in the *Metaphysics* in the form τῶν ἐναντίων ἡ ἑτέρα συστοιχία στέρησις (1004b 27).

opposite matter is heavy and always moves downward. Bodies composed of kinds of matter different from these but having relatively to each other the character which these have absolutely, possess both the upward and the downward motion.[1] Hence air and water each have both lightness and weight, and water sinks to the bottom of all things except earth, while air rises to the surface of all things except fire. But since there is one body only which rises to the surface of all things and one only which sinks to the bottom of all things, there must needs be two other bodies which sink in some bodies and rise to the surface of others. The kinds of matter, then, must be as numerous as these bodies, i. e. four, but though they are four there must be a common matter of all—particularly if they pass into one another—which in each is in being different. There
312b is no reason why[2] there should not be one or more intermediates between the contraries, as in the case of colour; for 'intermediate' and 'mean' are capable of more than one application.[3]

Now in its own place every body endowed with both weight and lightness has weight—whereas earth has weight everywhere—but they only have lightness among bodies to whose surface they rise. Hence when a support is withdrawn such a body moves downward until it reaches the body next below it, air to the place of water and water to that of earth. But if the fire above air is removed, it will not move upward to the place of fire, except by constraint; and in that way water also may be drawn up, when the upward movement of air which has had a common surface with it is swift enough to overpower the downward impulse of the water. Nor does water move upward to the place of air, except in the manner just described. Earth is not so affected at all, because a common surface is not possible to

[1] In l. 24 put the comma *after*, not before, ἁπλῶς. (The correction is due to Mr. Ross.) The intermediates, air and water, are only relatively light and heavy. In the absolute sense these characters belong only to fire and water.

[2] οὐδὲ in Bekker and Prantl must surely be a misprint for οὐδὲν (so J).

[3] 'Intermediate' stands for a region, not a point, and includes as a rule a variety of things.

it.[1] Hence water is drawn up into the vessel to which fire is applied, but not earth. As earth fails to move upward, so fire fails to move downward when air is withdrawn from beneath it: for fire has no weight even in its own place, as earth has no lightness. The other two move downward when the body beneath is withdrawn because, while the absolutely heavy is that which sinks to the bottom of all things,[2] the relatively heavy sinks to its own place or to the surface of the body in which it rises, since it is similar in matter to it.[3]

It is plain that one must suppose as many distinct species of matter as there are bodies. For if, *first*, there is a single matter of all things, as, for instance, the void or the plenum or extension or the triangles, either all things will move upward or all things will move downward, and the second motion will be abolished. And so, either there will be no absolutely light body, if superiority of weight is due to superior size or number of the constituent bodies or to the fullness of the body: but the contrary is a matter of observation, and it has been shown that the downward and upward movements are equally constant and universal: or, if the matter in question is the void or something similar, which moves uniformly upward, there will be nothing to move uniformly downward.[4] Further, it will follow that

[1] The surface of earth is too rough to allow of the necessary *σύμφυσις* (Simpl.), or continuity of surface, with another body.

[2] Read *ἐστιν ὃ* (not *ἐστιν, ὃ* with Bekker). Prantl's ingenious conjecture, *εἰς τὴν ὑπό*, is not quite convincing.

[3] The downward movement of earth (absolute weight) is quite determinate, having its limit at the centre. But the downward movement of air and water (relative weight) is not equally determinate: it is limited only by the surface of the body next beneath, air by that of water, water by that of earth, the upper body being attracted to the lower by similarity of matter. This admission inflicts some damage on the doctrine of 'places'—for where a body has weight it cannot be said to 'rest naturally' or to 'be in its place'—and also on the symmetry of the elements—for if the fire above air were removed the air would not move upward, but if the earth below water were removed the water would move downward.—In l. 18 *εἰς* must be construed with *φέρεται*, and in l. 19 *ἢ οἷς*, more fully expressed, would be *ἢ εἰς τὴν ἐκείνων οἷς*. The construction is difficult, and the passage may be corrupt.

[4] The stopping of this sentence requires alteration. *ἐὰν δέ* in l. 27 is an irregular second limb to the disjunction introduced by *ἢ κοῦφον* in l. 23. Put a colon at *πλήρη* (l. 25) and at *ἄνω* (l. 27), and delete the comma after *πλειόνων* (l. 25).

the intermediate bodies move downward in some cases quicker than earth: for air in sufficiently large quantity will contain a larger number of triangles or solids or particles. It is, however, manifest that no portion of air whatever moves downward.[1] And the same reasoning applies to lightness, if that is supposed to depend on superiority of quantity of matter.[2] But if, *secondly*, the kinds of matter are two, it will be difficult to make the intermediate bodies behave as air and water behave.
313a Suppose, for example, that the two asserted are void and plenum. Fire, then, as moving upward, will be void, earth, as moving downward, plenum; and in air, it will be said, fire preponderates, in water, earth.[3] There will then be a quantity of water containing more fire than a little air, and a large amount of air will contain more earth than a little water: consequently we shall have to say that air in a certain quantity moves downward more quickly than a little water. But such a thing has never been observed anywhere. Necessarily, then, as fire goes up because it has something, e.g. void, which other things do not have, and earth goes downward because it has plenum, so air goes to its own place above water because it has something else, and water goes downward because of some special kind of body. But if the two bodies[4] are one matter, or two matters both present in each,[5] there will be a certain quantity of each at which water will excel a little air in the upward movement and air excel water in the downward movement, as we have already often said.

The shape of bodies will not account for their moving 6
upward or downward in general, though it will account for their moving faster or slower. The reasons for this

[1] *sc.* in earth.

[2] On the somewhat absurd theory that the universal 'matter' is void or absolute lightness.

[3] 312b 33—313a 3, οἷον . . . γῆς, is a parenthesis and should be so printed, with a colon, instead of a full-stop, at πλῆρες and at κάτω. This is proved by the infinitive ἔχειν (after φαίη) in l. 3, as well as by the γάρ which follows.

[4] viz. air and water.

[5] Prantl's ἑκατέρω is a misprint for ἑκατέρῳ.

are not difficult to see. For the problem thus raised is why a flat piece of iron or lead floats upon water, while smaller and less heavy things, so long as they are round or long—a needle, for instance—sink down; and sometimes a thing floats because it is small, as with gold dust and the various earthy and dusty materials which throng the air. With regard to these questions, it is wrong to accept the explanation offered by Democritus. He says that the warm bodies moving up[1] out of the water hold up heavy bodies which are broad, while the 313b narrow ones fall through, because the bodies which offer this resistance are not numerous. But this would be even more likely to happen in air—an objection which he himself raises. His reply to the objection is feeble. In the air, he says, the 'drive' (meaning by drive the movement of the upward moving bodies) is not uniform in direction. But since some continua are easily divided and others less easily, and things which produce division differ similarly in the ease with which they produce it, the explanation must be found in this fact. It is the easily bounded,[2] in proportion as it is easily bounded, which is easily divided; and air is more so than water, water than earth. Further, the smaller the quantity in each kind, the more easily it is divided and disrupted. Thus the reason why broad things keep their place is because they cover so wide a surface and the greater quantity is less easily disrupted. Bodies of the opposite shape sink down because they occupy so little of the surface, which is therefore easily parted. And these considerations apply with far greater force to air, since it is so much more easily divided than water. But since there are two factors, the force responsible for the downward motion of the heavy body and the disruption-resisting force of the continuous surface, there must be some ratio between the two. For in proportion as the force applied by the heavy thing

[1] ἀναφερόμενα is the better-attested reading (ELMJ Simpl.) and should be preferred to ἄνω φερόμενα. The word is elsewhere used of upward movement by Aristotle.

[2] i.e. the fluid or moist. Cp. *de Gen. et Corr.* 329b 30.

towards disruption and division exceeds that which resides in the continuum, the quicker will it force its way down; only if the force of the heavy thing is the weaker, will it ride upon the surface.

We have now finished our examination of the heavy and the light and of the phenomena connected with them.

INDEX I. English

[The sign + following a reference means that many other references could be given.]

68–13 = 268–313.

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INDEX II. Greek

[The reference is to the foot-note in which the word is cited.]

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