



# PHYSICS

BY ARISTOTLE

## Book 3

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### 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.

To begin then, as we said, with motion.

We may start by distinguishing (1) what exists in a state of fulfilment only, (2) what exists as potential, (3) what exists as potential 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 what can move and what can be moved. For 'what can cause movement' is relative to 'what can be moved', and vice versa.

Again, 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 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, 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'.

We have now before us the distinctions in the various classes of being between what is full 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 building. Similarly, learning, doctoring, rolling, leaping, ripening, ageing.

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. It is possible for a thing to cause motion, though it is itself incapable of being moved.

It is the fulfilment of what is potential when it is already fully real and operates not as itself but as movable, that is motion. What I mean by 'as' is this: Bronze is potentially a

statue. But it is not the fulfilment of bronze as bronze which is motion. For 'to be bronze' and 'to be a certain potentiality' are not the same.

If they were identical without qualification, i.e. in definition, the fulfilment of bronze as bronze would 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 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 it is evident that motion is an attribute of a thing just when it is fully real in this way, and neither before nor after. For each thing of this kind is capable of being at one time actual, at another not. Take for instance the buildable as buildable. 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.

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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.

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 or 'inequality' or 'not being'; but such things are not necessarily moved, whether they are 'different' or 'unequal' or 'non-existent'; Nor is change either to or from these rather than to or from their opposites.

The reason why they put motion into these genera is that it is thought to be something indefinite, and the principles in the second column are indefinite because they are privative: none of them is either 'this' or 'such' or 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 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 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. 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 so that the mover is also acted on. The mover or agent will always be the vehicle of a form, either a ‘this’ or ‘such’, 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.

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The 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 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’. Since then they are both motions, we may ask: in what are they, if they are different? Either (a) both are in what is acted on and moved, or (b) the agency is in the agent and the patiency in the patient. (If we ought to call the latter also ‘agency’, the word would be used in two senses.)

Now, in alternative (b), the motion will be in the mover, for the same statement will hold of 'mover' and 'moved'. 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 in one subject towards one definite quality? The thing is impossible: the actualization will be one.

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 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, provided the actualizations are not described in the same way, but are related as what can act to what is acting.

(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. 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 its types will be defined-alteration is the fulfillment 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.

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The science of nature is concerned with spatial magnitudes 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 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, in the one construction the figure that results is always different, in the other it is always the same. But Plato has two infinities, 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-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 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 the common body is a source of all things, differing 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 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.

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

- (1) What is incapable of being gone through, because it is not in 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 what scarcely admits of being gone through.
- (3) 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.

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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 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.

Further, 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 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 discussion, however, involves the more general question whether the infinite can be present in mathematical objects and things which are intelligible and do not have

extension, 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 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. 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, 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*.

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

(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 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 proof can be given which applies equally to all, air, water, or anything

else-but 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. For generally, and apart from the question of 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 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 be moved; or it will be moved everywhere-then it will not come to rest.

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.)

But (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 (and then the body would no longer be infinite), nor is the body larger than the place; for either there would be an empty space or a body whose nature it is to be nowhere.

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.

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 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. 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 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 half the other. For how should you divide it? or how can the infinite have the one part up and the other down, or an extremity and a centre?

Further, every sensible body is in place, and the kinds or differences of place are up-down, before-behind, right-left; and these distinctions hold not only in relation to us and by 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.

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, 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.

Now, as we have seen, magnitude is not actually infinite. But by division it is infinite. (There is no difficulty in refuting the theory of indivisible lines.) The alternative then remains that the infinite has a potential existence.

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, so that we must not regard the infinite as a 'this', such as a man or a horse, but must suppose it to exist in the sense in which we speak of the day or the games as existing things whose being has not come to them like that of a substance, but consists in a process of coming to be or passing away; definite if you like at each stage, yet always different.

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), 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 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 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 infinities 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 infinities 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, but what always has something outside it. This is indicated by the fact that rings also that have no bezel are described as 'endless', 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 (teleion) which has no end (telos); 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, but the former describes it as limited, 'equally balanced from the middle'. For to connect the infinite with the all and the whole is not like joining two pieces of string; for it is from this they get the dignity they ascribe to the infinite-its containing all things and holding the 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, 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, 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 and the infinite are contained inside what contains them, while it is the form which contains. It is natural too to suppose that 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.

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

8

It remains to dispose of the arguments which are supposed to support the view that the infinite exists not only potentially but as a separate thing. Some have no cogency; others can be met by fresh objections that are 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 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.