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ARISTOTLE'S PHYSICS

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and Glossary by
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To Dr. Nathan Silberstein

Book A

1

184*a* 10 Since understanding and *knowing*[1] in every *inquiry* concerned with things having principles or causes or elements results from the knowledge of these (for we think that we know each thing when we know the first causes and the first principles and have reached the elements), 15 clearly, in the science of nature too we should first try to determine what is the case with regard to the principles.[2]

The natural way to proceed is from what is more known and *clearer* to us to what is by nature *clearer* and more known; for what is known to us and what is known without qualification are not the same.[3] So 20 we should proceed in this manner, namely, from what is less *clear* by nature, though *clearer* to us, to what is by its nature *clearer* and more known. Now the things that are at first plain and *clear* to us are rather mingled, and it is later that their elements and principles become known to those who distinguish them. Consequently, in the case of each thing, we should proceed from its entirety[4] to each of its constituents, for it is 25 the whole that is more known by sensation; and a thing in its entirety,[4] 184*b* 10 since it includes many constituents as parts, is a kind of a whole. In a sense, a name is related to its formula in the same way, for a name signifies some whole without distinguishing its parts, as in the case of "a circle"; but its definition analyzes the whole into its constituents. Children, too, at first call every *man* "papa" and every woman "mama", but later on they distinguish each of them.[5]

2

15 It is necessary that there be either one principle[1] or many; and if one, then either immovable, as Parmenides and Melissus say,[2] or in motion, as the physicists say—some of the latter asserting that the first principle is *Air*[3] and others that it is *Water*;[4] but if many, then either

finite or infinite. If finite, but more than one, then they are two[5] or three 20 or four[6] or some other number; but if infinite, then they are either generically one but differ in shape or kind, as Democritus says,[7] or even contrary.[8]

Also those who inquire into the number of things do so in a similar way; for they first inquire whether the constituents of things are one or 25 many, and if many, whether finite or infinite. Thus they inquire whether the principles or elements are one or many.[9]

Now to inquire whether being is one and immovable is not to inquire 185*a* about nature;[10] for just as the geometer has no arguments at all against one who rejects the principles of geometry, seeing that their discussion belongs to another science or to a science common to all others,[11] so too in the case of principles; for if being is only one and is one in this manner [immovable], no principle exists at all, seeing that a principle 5 is a principle of some thing or things.[12] Indeed, to inquire whether being is one in this manner is like arguing against any other paradox maintained for the sake of argument, such as that of Heraclitus[13] or the one which might assert that being is one man,[14] or it is like refuting an eristic argument, such as that of Melissus and that of Parmenides.[15] 10 (The latter two thinkers assume false premises, and the conclusions they draw do not follow from the premises; as for Melissus, his argument is rather crude and presents no problem, for once an absurd premise is granted, the rest follow, and there is no difficulty at all in this.)

We, on the other hand, make the assumption that things existing by nature[16] are in motion, either all or some of them; and this is clear by 15 induction.[17] In addition, we should refute only those conclusions which are falsely drawn from the principles of the science in question, and no others. For example, the task of refuting the squaring of the circle by means of segments belongs to the geometer,[18] but that of refuting the squaring of the circle by Antiphon's method does not belong to the geometer.[19] However, since these thinkers discuss problems in physics 20 even if their subject is not nature, perhaps it is well to go over their views somewhat; for such inquiry has philosophic value.

The most appropriate starting-point is to raise this question: In what sense are all things one? for "being" has many senses.[20] Are all things substances or quantities or qualities; and if substances, are they all one 25 substance, as, for example, one man or one horse or one soul, or are they one quality, as, for example, whiteness or hotness or some other thing of this sort? These alternative answers differ much and cannot all be true. If, on the one hand, [they say that] all things are substances and quantities and qualities, then whether these are detached from each other or not, things will be many.[21] But if [they say that] all things are 30 qualities or are quantities, then whether substances exist[22] or not, their

statement is absurd, if one is to call the impossible "absurd"; for none of these can exist separately (except substances), since all of them are said of substances as their subjects.

Now Melissus says that being is the *Infinite*; so, it is a quantity, for
185b the infinite exists in quantity.[23] But a substance or a quality or an affection cannot be infinite except in virtue of another attribute, that is, if each of them were at the same time a quantity;[24] for the formula of the infinite[25] uses "quantity" but not "substance" or "quality". So, if being is both a substance and a quantity, then it is two and not one; but if it is only a substance, then neither will it be infinite nor will it have any magnitude, since to have a magnitude it would have to be a quantity.[26]

Next, since the term "one" itself, like the term "being", also has many senses,[27] we should consider in what sense the totality [of things] is *One*.[28] Now to be one is to be (a) the continuous or (b) the indivisible or (c) things whose formula of their essence is the same and one, like what we call "vintage" and "wine".[29]

Accordingly, if (a) the totality is one by being continuous, then the *One* will be many; for the continuous is infinitely divisible.[30] We may add, there is a *difficulty* in the case of the part and the whole, perhaps not with respect to the expressions about them but with respect to the part and the whole themselves, namely, whether the part and the whole are one or many and how they are one or many and if many, how they are many, and the same applies to the parts and the whole if the latter is not continuous;[31] and further, if each part is one with the whole as if undivided from it, then so will the parts be from each other.[32]

Moreover, if (b) the totality is one in the sense of being indivisible, no thing will be a quantity or a quality, and so being will not be infinite, as Melissus says, nor limited, as Parmenides says;[33] for it is the limit that is [34] indivisible and not that which is limited.

Further, if (c) all things are one by having the same formula, like a dress and a garment, then what they are saying is what Heraclitus says; for to be good and to be bad will be the same, and to be not good and to be good, likewise, so that the same thing will be good and not good and a man and a horse. Indeed, what they will be saying is not that things are one but that they are not even one,[35] and that to be such-and-such will be the same as to be so-much.[36]

Even the later ancient thinkers were troubled lest the same thing should turn out to be both one and many. So some of them, like Lycophron, omitted the "is", and others changed the form of expression and used, for example, "man grayed" and not "man is gray", "walks" and not "is walking", lest by adding the "is" they should find themselves making what is one to be many, as if "one" and "being" had only one meaning. But beings are many, either in formula (for example, to be

white is distinct from to be musical, even if the same thing should turn out to be both white and musical; so the one may be many)[37] or by
186a division (like the whole and its parts). And in the latter cases they are even raising difficulties and admitting that the one is many, as if the same thing could not be one and also many (that is, one and many but not as opposites);[38] for what is one may be potentially one or actually one.

3

If we proceed in this manner, then, it appears that it is impossible for all things to be one, and the statements[1] from which these thinkers establish their doctrine are not difficult to refute. Both Melissus and Parmenides give eristic proofs, since the premises they introduce are false and the conclusions they draw do not follow from the premises; and in the case of Melissus, his argument is rather crude and presents no problem, for once something[2] absurd is granted, the rest follows, and there is no difficulty at all in this.

Clearly, Melissus draws conclusions falsely; for he thinks that from "every generated thing has a beginning" he can conclude "that which has not been generated has no beginning".[3] Then this too is absurd, namely, to grant a beginning to everything, but not to time,[4] and a beginning not [only] to an unqualified generation but also to an alteration, as if a change cannot occur all at once.[5]

Again, why is a thing immovable, if it is one? Like the part (e.g., a part of water) which is one and moves in itself, why cannot the whole too move?[6] Moreover, why should alteration be impossible? Further, being cannot be one in kind, although it may be one in that [e.g., in matter] of which things consist[7] (and even some physicists speak of things as being one in the latter sense,[8] but not in the former); for a man and a horse are distinct in species, and two contraries are distinct in species also.

The way of arguing against Parmenides, too, is the same, though other ways which are proper to him may also be used against him; and one may refute him by saying that this premise is false or that conclusion does not follow from the premises. Insofar as he assumes "being" to have a single meaning when it has many, he posits something false.[9] As for his conclusion not following from the premises, if "white" has one meaning and if only whites are posited, still there will be many whites and not one; for then neither by continuity nor in formula will there be one white. For to be white and to be that which receives whiteness will be distinct, even if nothing apart from the white will exist; for the white

and that to which it belongs are distinct not qua being separate but in essence.[10] Yet Parmenides did not perceive this.

Now Parmenides must grant not only that "being" signifies one thing, of whatever it might be predicated, but also that it signifies *just*[11] a being and what is *just* one.[12] For an attribute is predicated of some subject, and so that of which it is an attribute, being distinct from being, would not be [a being]; and then a nonbeing would exist [be a being]. Certainly, then, *just* being could not belong to something else, for the latter would not be a being unless "being" had many senses, in which case each might be some kind of being; but it was assumed that "being" has [only] one meaning.

If, on the other hand, *just* being is not an attribute of anything, but something else is an attribute of it, how does "*just* being" signify a being rather than a nonbeing? For if *just* being were to be itself and also white, the essence of white would still not be a *just* being (for even being could not be an attribute of white, since what is not a *just* being is not a being), and so it would be a nonbeing, and not in a qualified sense but entirely a nonbeing. So a *just* being would be a nonbeing, for it would be true to say "*just* being is white", and "white" was just shown to signify a nonbeing. So if "white" too were to signify a *just* being, then "being" would have many senses.[13]

Moreover, neither would "being" have a magnitude, if it were a *just* being, for it would then be distinct in essence from its two parts.[14]

That a *just* being will be divisible into another [kind of] *just* being is also evident from the formula. For example, if a man is a *just* being, also an animal and two-footedness must be *just* beings.[15] For if not, they will be attributes, and either in the man or in some other subject. But this is impossible; for an attribute is said to be either that which may or may not belong [to a subject], or that in whose formula is present the thing of which it is an attribute or that to which belongs the formula of the thing of which it is an attribute. For example, in the case of sitting, it is separable from a man,[16] while snubness has the formula of the nose to which snubness is said to belong as an attribute. Further, in the case of the parts which are present in the formula [of a thing] or of which that formula consists, the formula of the whole [of the thing] is not present in the formula of each part; for example, the formula of a man is not in that of two-footedness, and that of a white man is not in that of the white. Accordingly, if this is so and if two-footedness is an attribute of the man, then two-footedness must be separable from the man and so a man might not be two-footed; or else, the formula of the man will be present in the formula of two-footedness, which is impossible, for the converse is the case. If, however, two-footedness and animality were attributes of some other thing and each of them were not a *just* being,

then also the man would be an attribute of some other thing.[17] But let us grant (a) that *just* being is not an attribute of anything and (b) that if both of these two are said of something, also each of them and also the composite of the two will be said of it. Then the entire thing[18] [will be] composed of indivisibles.[19]

Some thinkers gave in to both arguments; so to meet (a) the argument that all things will be one if "being" has just one meaning, they posited that nonbeing exists,[20] and to meet (b) the argument proceeding from the dichotomy, they posited *indivisible* magnitudes.[21]

It is also evident that it is not true to say that nonbeing will not exist if "being" has just one meaning and contradictions are impossible; for nothing prevents nonbeing from being a qualified nonbeing and not an unqualified nonbeing.[22]

As for the statement that all things will be one if nothing else exists besides being itself, it is certainly absurd. For who would learn what being itself is if *just* being were not a kind of a thing?[23] And if this is so, then, as we said, nothing prevents things from being many.

It is clear, then, that being cannot be one in the manner it is claimed to be.

4

According to the statements of the physicists[1] there are two ways of proceeding [from principles].

Some of them posit being to be one underlying body—either one of the three[2] or something else which is denser than fire but thinner than air[3]—and generate the rest, making them many [in kind] by means of *Density* and *Rarity*,[4] which are contraries or which are excess and deficiency, if taken universally; and these are like Plato's *Great* and *Small*, except that he posits these as matter and the *One* as form,[5] while they posit the *One* as the underlying matter but the contraries as differentiae or forms.

Others say that things come out from the *One*, in which the contraries are present. And this is how Anaximander speaks, and also those who say that what exists is one and many, like Empedocles and Anaxagoras, for these too say that it is from the *Blend*[6] that the rest are generated by segregation. However, these thinkers differ from each other thus: One[7] of them posits a cycle of such changes, but the other[8] posits just one series of change; and one[9] of them posits an infinite number of homogeneous things and pairs of contraries, while the other posits only the so-called "elements".[10] Thus, Anaxagoras seems to regard the principles as infinite because he believes the common doctrine of the physicists,

that no thing is generated from nonbeing, to be true, for it is because of this that these thinkers use the expression "all things were together"; and some regard a generation of such-and-such a thing as being an alteration, while others regard it as being a combination or a separation.[11] Moreover, from the fact that one of two contraries comes to be from the other, these thinkers[12] conclude that the first contrary must have existed before; for, since that which is generated must be generated either from being or from nonbeing and generation from nonbeing is impossible (and all physicists are in agreement concerning this doctrine), they regard the other alternative as immediately following of necessity, namely, that things are generated from what are already present but are not sensible to us because of the smallness of their volume. And on account of this they say that everything is blended in everything because they observe everything coming to be from everything and that the different appearance and the different name given to each arises from that thing in the blend of innumerable things which exceeds all the others because of the great number of its particles; for they[12] say that nothing in its entirety is purely white or black or sweet or flesh or bone but that the nature of the thing is thought to be that which the thing has most.

Now if the infinite qua infinite is unknowable, then the infinite with respect to plurality or with respect to magnitude is an unknowable quantity, while the infinite in kind is an unknowable quality. Thus, if the principles are infinite with respect to plurality and in kind, that which is composed of them cannot be understood; for we believe that it is in this manner that we understand a composite, namely, when we understand what its parts are and how many they are.[13]

Again, if each part of a thing can be of any size in the direction of greatness and of smallness,[14] then[15] necessarily the thing itself can be of any size likewise (by "a part" I mean that which is present and into which the whole is divisible).[16] So if an animal or a plant cannot be of any size in the direction of greatness and of smallness, it is evident that neither can any part of it be of any size likewise (or else the whole would be of any size likewise). But flesh and bone and the like are parts of an animal, and fruits are parts of plants; clearly, then, it is impossible for flesh or bone or some other part to be of any size, whether in the direction of greatness or of smallness.[17]

Again, if all such things are present in each other and are not generable but are separable as consitituents and if a thing is named after that part which exceeds the other parts in the thing and if any thing may come to be from any other thing (for example, water from flesh or flesh from water, by segregation), then, since every finite body is exhausted by taking away from it repeatedly an [equal] finite magnitude,[18] it is

evident that not every thing can exist in every other thing. For if flesh be taken away from water and if this be done again from what remains even if what is taken away is always less, still it will not be smaller than some magnitude. Hence, if this process of separation comes to a stop, not every thing will be in every other thing (for there will be no flesh in the remaining water); but if it does not come to a stop but the removal of flesh continues indefinitely, there will be an infinite number of equal magnitudes in a finite magnitude—which is impossible.[19]

We may also add this: If every body decreases in magnitude when something is taken away from it and the quantity of flesh is bounded both in greatness and in smallness, it is evident that no body can be taken out of the least amount of flesh; for otherwise there would be flesh less than the least amount of it. And besides, in [each of] the infinite bodies there would already be infinite flesh and blood and brain, not[20] separate from each other but nevertheless existing, and each of them would be infinite; and this is unreasonable.

The statement that separation will never take place is made without being understood, but it is right; for the *attributes* are inseparable. If colors and possessions were in a blend, then when separated each would be, for example, a whiteness or health, but neither would each be something else also nor would it be predicated of a subject.[21] So *Intelligence* would be absurd in seeking to do the impossible, that is, if it [*Intelligence*] wishes to separate these but cannot do so[22] according to quantity or to quality; it can do so neither according to quantity, if there is no least magnitude,[23] nor according to quality, since *attributes* are inseparable.

Nor is Anaxagoras right in his view concerning the generation of homogeneous bodies. There is a sense in which mud is divisible into mud, but there is another sense in which it is not; and the manner in which bricks come from or exist in a house, or a house comes from or consists of bricks, is not similar to that in which water and air come from or consist of each other.[24] Also, it is better to posit a smaller or a finite number of principles, as Empedocles does.[25]

5

All thinkers posit contraries as principles, e.g., (a) those who say that the universe is one and motionless (even Parmenides posits the *Hot* and the *Cold* as principles[1] and calls them "*Fire*" and "*Earth*") and (b) those who speak of the *Rare* and the *Dense* and (c) Democritus, who posits the *Solid*[2] and the *Void*, calling them "*Being*" and "*Nonbeing*", respectively, and who uses [as differentiae] *Position*, *Shape*, and *Order* as

genera of contraries (for example, in the case of position, these are *up*
25 and *down*, and also *in front* and *behind;* but in the case of shape, they are the *angular* and the *non-angular*, and also the *straight* and the *circular*).

It is clear, then, that in a sense[3] all thinkers posit contraries as principles, and with good reason; for (a) neither must one principle be composed of another principle, (b) nor should they be composed of other things but the other things should be composed of them. Now the primary[4] contraries possess both these attributes: (b) They are not com-
30 posed of other things because they are primary, and (a) neither of them is composed of the other because they are contraries. However, we should attend to an argument as well in order to see how this turns out to be the case.

First we must grant that no thing by nature acts on, or is acted on by, any other chance thing, nor does any thing come to be from any other [chance] thing, unless one grants that this takes place in virtue of
35 of an attribute.[5] For how could the white come to be from the musical unless the musical were an accident of the not-white or the black? But the white does come to be from the nonwhite, not from any nonwhite[6] but from black or some intermediate color; and the musical comes to be from the nonmusical, not from any nonmusical but from the unmusical[7] or something between the musical and the unmusical, if there is such.

Nor again does any thing, when destroyed, change into any chance thing. For example, *the white is destroyed not into the musical,*[8] *unless*
5 it be in virtue of an attribute, but into the nonwhite, not into any chance nonwhite but into black or some other intermediate color; and the musical is similarly destroyed into the nonmusical, not into any chance nonmusical but into the unmusical or some intermediate between the two, if there is such.

It is likewise with all other cases, since the same formula applies even
10 to things which are not simple but composite; but we fail to notice this happening because no names have been given to the opposite dispositions. For the harmonious must come to be from the inharmonious,[9] and the inharmonious, from the harmonious; and the harmonious must be destroyed into something which is not harmonious, not into any chance
15 thing but into that which is opposed[10] to the harmonious. It makes no difference whether we speak of harmony or of order or of composition, for evidently it is the same formula which applies to them. Again, the generation of a house and of a statue and of any other thing takes place in a similar way. For a house is generated from objects which exist not in composition but are divided in a certain way, and likewise for a statue
20 or anything that has been shaped from shapelessness;[11] and what results in each of these are order in one case and a composition in the other.

If, then, all this is true, every thing that is generated or destroyed is so from or to a contrary or an intermediate. As for the intermediates, they are composed of contraries;[12] the other colors, for example, are composed
25 of white and black. Thus every thing which is generated by nature is a contrary or composed of contraries.

Up to this point most of the other thinkers were quite close in following this line of thinking, as we said before; for they all said that the elements, also called "principles" by them, are contraries, as if compelled by
30 truth itself even if they gave no reason. However, they differed from each other thus: Some of them used prior[13] contraries, while others used posterior, and some used contraries more known in formula, while others used contraries more known according to sensation; for some posited as causes of generation the *Hot* and the *Cold*, others, the *Moist* and the *Dry*, while others posited the *Odd* and the *Even*, and still others, *Strife*
35 and *Friendship;*[14] and these differ from each other in the way stated. So the principles which they used are in one way the same but in another distinct. They are distinct in the manner in which most thinkers took
189a them to be; but they are the same insofar as they are analogous, for they are taken from the same two sets of contraries, some of them being wider while others narrower in extent.[15] In this way, then, they spoke of them in the same and also in a distinct manner, some in a worse and others in a better way,[16] and, as we said, some posited them as more
5 known according to formula while others as more known according to sensation. For the universal is known according to formula but the individual according to sensation, since the formula is of the universal but sensation is of the part; for example, contrary principles according to formula are the *Great* and the *Small*,[17] those according to sensation are the *Dense* and the *Rare*.[18]
10 It is evident, then, that the principles should be contraries.

6

Next, we should consider whether the principles are two or three or more than three.

There cannot be just one principle, since there cannot be just one contrary,[1] nor can the principles be infinite, since otherwise being will not be *knowable*.[2] Also, in every genus there is just one contrariety, and
15 "substance"[3] is one genus. Besides, it is possible for things to be generated from a finite number of principles; and it is better if they come to be from a finite number, as Empedocles[4] says, than from an infinite number (for Empedocles thinks that from his finite principles he can give an account of all that Anaxagoras can from his infinite principles). Again,

some contraries are prior to others,[5] and some come to be from others, as in the case of the sweet and bitter and of the white and black, but the principles must always remain.[6] So it is clear from all these arguments that the principles are neither one nor infinite.

Since the principles, then, are finite, there is some reason in positing them to be not only two; for one might raise the problem as to how density can by nature act on rarity, or rarity on density, so as to produce something.[7] The problem is similar in the case of any pair of contraries; for it is not *Strife* that *Friendship* brings together and makes something out of, nor does *Strife* make something out of *Friendship*, but both act on a third and distinct object.[8] Some thinkers use even more such objects from which they construct the nature of things.[9]

In addition to the above, if no nature distinct from the contraries is assumed, one might also raise another *difficulty*, for among things, we observe no contrary as being a substance.[10] Now a principle should not be a predicate of any subject, since there would then be a principle of a principle; for the subject is a principle and is thought to be prior to what is a predicate of it.[11] Moreover, we maintain that no substance is contrary to a substance.[12] So how can there be a substance which is composed of nonsubstances? Or, how can a nonsubstance be prior to a substance?[13]

In view of all this, if we were to grant as true both the previous statement[14] and this [argument],[15] then, to preserve both, it would be necessary for us to assume a third [principle], like the one held by those who say that the universe is of one nature, i.e., of water or fire[16] or an intermediate between them. This principle seems to be rather an intermediate; for fire and earth and air and water are already composites with contraries.[17] And on account of this, those who posit as an underlying subject something distinct from these four elements do so not without good reason. Other thinkers choose air from the four elements; for of these, air has sensible differences to the least degree. Then water comes next. Yet all these thinkers regard this one principle [or, the *One*] as taking on a shape by means of contraries, i.e., by *Density* and *Rarity*, and in varying degrees. Now such contraries, considered universally, are clearly excess and deficiency, as stated previously.[18] And the doctrine that the *One*[19] and *Excess* and *Deficiency* are principles of things, we may add, seems to be an old one, except that it is not stated in the same manner; for the early thinkers said that the two [contraries] act but the *One* is acted upon, whereas some of the later thinkers[20] stated rather the contrary, namely, that the *One* acts while the two [contraries] are acted upon.

From a consideration of these and other such arguments, then, it would seem that there is some reason in maintaining that the elements

are three,[21] as we said before; but there is no reason in maintaining that they are more than three, for one element is sufficient [as a subject] to be acted upon. If with four [elements] there are two contrarieties, a distinct intermediate nature will be needed for each contrariety; and if, being two, they[22] can generate[23] from each other, one of the two contrarieties will be superfluous.[24] And along with this, the primary contrarieties cannot be many; for "substance" is a single genus of being, so the principles can differ in priority and posteriority and not in genus (for in a single genus there can be only one contrariety, and all other contrarieties [in that genus] are thought to be referred to one).[25]

It is evident, then, that there can be neither only one nor more than two or three elements; but, as we said before, there is much *difficulty* as to whether there are two or three.

7

We shall now give our own account by first going over generation universally, for in proceeding according to nature we should first investigate what is common and then what is proper in each case.[1]

We say that something comes to be[2] from something else or that some one thing is coming to be from some other thing by speaking either of simple or of composite things.[3] By this I mean the following: (a) A man becomes musical or the not-musical becomes musical, and (b) the not-musical man becomes a musical man. In (a), I call "simple" the man or the not-musical, which is becoming something else, and also the musical, which is what the former [the man or the musical] becomes; and in (b), when we say that the not-musical man becomes a musical man, we call "composite" both the thing generated and that which is in the process of becoming.[4]

Now of these, in some cases we say not only "A becomes B" but also "B comes to be from A", as in "the musical comes to be from the not-musical"; but we do not speak likewise in all cases, for we do not say "the musical came to be from the man" but "the man became musical".

Of simple things that come to be something, some of them persist throughout the generation but others do not. For when a man becomes musical, he persists during the generation and is still a man [at the end of it], but the not-musical or the unmusical does not so persist, whether as a simple thing or when combined with the subject.[5]

With these distinctions granted, then from all things which are being generated one may gather this, if he is to attend carefully to the manner of our statement—that there must always be something which underlies that which is in the process of becoming and that this, even if numeri-

cally one,[6] in kind[7] at least is not one (and by "in kind"[7] I mean the same thing as by "in formula", for "to be a man" and "to be unmusical" do not have the same meaning). And one part of that which is being generated persists but the other does not, that is, what is not an opposite persists[8] (for the man persists) but the musical[9] or the unmusical does not, and neither does the composite persist, i.e., the unmusical man.[10]

We say "B comes to be from A" rather than "A becomes B" of things which do not persist, i.e., we say "the musical is generated from the unmusical" but not "the musical is generated from the man"; but occasionally we do likewise also of things which persist, for we say "a statue comes to be from bronze" but not "bronze becomes a statue".[11] As for the generation from the opposite which does not persist, it is stated in both ways: We say both "B comes to be from A" and "A becomes B", for we say both "the musical comes to be from the unmusical" and "the unmusical becomes musical"; and in view of this, we do likewise in the case of the composite, for we say both "from being an unmusical man he becomes musical" and "the unmusical man becomes musical".

Now "becoming" has many senses: (a) In certain cases a thing is said to become a *this* in a qualified sense, while (b) a becoming without qualification exists only of substances.[12] And it is evident that in the former cases something underlies that which is in the process of generation; for in the generation of some quantity or some quality or some relation or sometime or somewhere, there is some underlying subject, because only a substance is not said of [predicated of] some other underlying subject whereas all others are said of substances. However, it will become evident on further examination that also substances and all other unqualified beings[13] are generated from some underlying subject,[14] for there is always some underlying subject from which the thing generated comes to be, e.g., plants and animals from seeds.[15]

Things in the process of generation without specification may be generated by the changing of shape, as a statue from bronze; or by addition, like things which increase; or by the removal of something, like the statue *Hermes* from stone; or by composition, like a house; or by alteration, like things which alter with respect to their matter. It is evident that all things which are being generated in this manner are generated from an underlying subject. So it is clear from what has been said that the thing in generation is always a composite, and there is that [say, A] which is generated, and what comes to be that [i.e., A] is something else, and this in two senses, either the subject or the opposite. By "the opposite" I mean, for example, the unmusical; by "the subject" I mean the man; and the shapelessness and the formlessness and the disorder are opposites, while the bronze and the stone and the gold are underlying subjects.[16]

Thus if, of things by nature, there are causes or principles[17] of which those things are composed primarily and from which they come to be not accidentally, but come to be what each of them is called according to its *substance*, then everything which is generated is generated from a subject and a *form;* for the musical man is composed, in a sense, of a man and the musical, since one would be analyzing the formula [of the musical man][18] by giving a formula of each of these two. Clearly, then, things in generation come to be from these [causes or principles].

Now the subject is in number one but in kind two;[19] for a man or gold or matter in general can be numbered, for it is rather this [the subject] which is a *this*, and it is not as from an attribute that the thing in generation comes to be from this, but what is an attribute is the privation or the contrary; and the form is one, as in the case of order or music or some other such predicate. So in a sense the principles may be spoken of as being two, but in another sense as being three;[20] and they may also be spoken of as being the contraries,[21] for example, if one were to say that they are the musical and the unmusical or the hot and the cold or the harmonious and the inharmonious; but in another sense they may not be so spoken of, for the contraries cannot be acted upon by each other. And this problem[22] is solved because there is a subject which is distinct [from the contraries], for it is not a contrary. So in some sense the principles are not more than the contraries but are two in number, so to speak; yet on the other hand, they are not entirely two but are three because in each of them there is a distinction in essence;[23] for the essence of a man is distinct from the essence of the unmusical,[24] and the essence of the unshaped is distinct from that of bronze.

We have stated, then, the number of the principles concerning the generation of physical objects and how they are so many, and it is clear that there must be something which underlies the contraries and that the contraries are two. Yet in another sense this is not necessary, for one of the contraries is sufficient to produce the change by its absence or presence.

As for the underlying nature,[25] it is *knowable* by analogy. Thus, as bronze is to the statue or the wood is to the bed or the matter or the formless object prior to receiving a *form* is to that which has a *form*, so is this [underlying nature] to a substance or to a *this* or to being. This then is one of the principles, though it is not one nor a being in the manner of a *this;* another [principle] is the formula, then there is the contrary of the latter, and this is the privation.

In what sense these [principles] are two and in what sense more than two has been stated above. First it was stated that only the contraries are principles, then it was stated that there must be something else, an underlying subject, and so the principles must be three. From the pre-

ceding statements it is evident how the contraries differ, how the principles are related to each other, and what the underlying subject is. As to whether it is the form or the underlying subject that is a substance, this is not yet clear.[26] But that the principles are three and how they are three and what their manner of existence is, this is clear.

Concerning the number of the principles and what they are, then, let the above be our investigation.

8

We will now proceed to state that the *difficulty* of the early thinkers, too, is solved only in this manner.

In seeking the truth and the nature of things from the philosophical point of view, the first thinkers, as if led astray by inexperience, were misled into another way of thinking by maintaining the following: No thing can be generated or be destroyed because a thing must be generated either from being or from nonbeing; but both of these are impossible, for being cannot become something since it already exists, and a thing generated cannot come to be from nonbeing since there must be some underlying subject [from which it is to be generated]. And exaggerating the consequences in this manner, they concluded by saying that there is no plurality of things, but that only *Being* itself exists. This is the doctrine they adopted, then, and for the *reasons* stated.

Our position, however, is that, in one way, the expressions "to be generated from being or from nonbeing" or "nonbeing or being acts upon or is acted upon by something, or becomes a *this*, whatever this[1] may be" do not differ from "a doctor acts upon or is acted upon by something" or "from a doctor something else is or comes to be"; hence, since each of these expressions has two senses, it is clear that also each of the expressions "from being [or nonbeing]" and "being [or nonbeing] acts upon or is acted upon" has two senses. Thus, the doctor builds [a house] not qua a doctor but qua a builder, and he becomes grey-haired not qua a doctor but qua black-haired; but he heals or becomes a nondoctor qua a doctor. So since, in saying "a doctor acts or is acted upon by something, or from a doctor he becomes something else", we do so mainly when it is qua a doctor that he acts upon or is acted upon by something or that he becomes something else; it is clear that also "to become something from nonbeing" means this, namely, to become something qua not-being.[2]

It is the failure to make this distinction that led those thinkers astray, and through their ignorance of this they added so much more as to think that nothing else is generated or exists [besides *Being*], thus doing away with every [kind of] generation. Now we too maintain, as they do,

that nothing is generated from unqualified nonbeing;[3] yet we do maintain that generation from nonbeing in a qualified sense exists, namely, with respect to an attribute;[4] for from the privation, which in itself is a not-being, something which did not exist is generated. Such generation from nonbeing, of course, is surprising and is thought to be impossible. In the same way, we maintain that being is not generated from being, except with respect to an attribute; so this generation too takes place in the same manner, as if an animal were to be generated from an animal, or an animal of one kind from an animal of another kind, i.e., if a dog were to come to be from a horse. For the dog would then come to be not only from an animal of another kind, but also from an animal, but not qua an animal since this is already there.[5] But if an object is to become an animal not with respect to an attribute, then it will do so not from an animal,[6] and if it is to become a being, then it will do so not from being, nor from nonbeing,[7] since we have stated that "from nonbeing" means qua not-being. And we may add here that [by this] we do not reject the truth of "everything either is or is not".[8]

This then is one way [of solving the difficulty]; but there is another, in view of the fact that we may speak of things with respect to their potentiality as well as with respect to their *actuality*, and we have settled this elsewhere with greater accuracy.[9]

As we said, then, the difficulties through which some thinkers are compelled to reject some of the things which we maintain are now solved; for it was because of these [*difficulties*] that earlier thinkers also deviated so much from the path which leads to the belief in generation, destruction, and change in general. If they had perceived this [underlying] nature, this would have released them from all their ignorance.

9

Other thinkers,[1] too, have perceived this nature, but not adequately. For, in the first place, they agree that there is unqualified generation from nonbeing, thus granting the statement of Parmenides as being right;[2] secondly, it appears to them that if this nature is numerically one, then it must be also one potentially,[3] and this makes the greatest difference.

Now we maintain that matter is distinct from privation and that one of these, matter, is nonbeing with respect to an attribute but privation is nonbeing in itself,[4] and also that matter is in some way near to a substance but privation is in no way such.[5]

These thinkers, on the other hand, maintain that the *Great* and the *Small* are alike nonbeing, whether these two are taken together as one

or each *is* taken separately.[6] And so they posit their triad in a manner which is entirely distinct from ours.[7] Thus, they have gone so far as to perceive the need of some underlying nature, but they posit this as being one; for even if someone [Plato] posits the *Dyad*, calling it "the *Great* and *Small*", he nevertheless does the same since he overlooks the other [nature].[8]

Now in things which are being generated, one of these [two natures] is an underlying joint cause with a *form*,[9] being like a mother, so to speak;[10] but the other part of the contrariety might often be imagined, by one who would belittle it, as not existing at all. For, as there exists an object[11] which is divine and good and something to strive after, we maintain that one of the principles is contrary to it, but that the other [principle],[12] in virtue of its nature, by nature strives after and desires that object. According to the doctrine of these thinkers, on the other hand, what results is that the contrary desires its own destruction.[13] Yet neither would the form strive after itself, because it does not lack it, nor does it strive after the contrary, for contraries are destructive of each other. Now this [principle] is matter, and it is like the female which desires the male and the ugly which desires the beautiful, but it is not by itself that the ugly or the female does this,[14] since these are only attributes.

In one way, this [principle] is destroyed or is generated, but in another way it is not. For, as that[15] which is in something [in the matter], it is this which in itself is being destroyed, since it is the privation in it [in the matter] that is being destroyed; but as that which exists in virtue of its potentiality,[16] this is not being destroyed in itself but is necessarily indestructible and ungenerable.[17] For (a) if the latter were to be generated, it would have to be generated from something else which is present and must be a primary underlying subject; yet its nature is to be just this, so it would then be existing prior to its generation[18] (for by "matter" here we mean the primary underlying subject in a thing, from which [matter], as something present but not as an attribute, something else is generated). And (b) if it were to be destroyed, it would ultimately arrive at this very thing, so it would then be destroyed prior to its destruction.[19]

Concerning the principle with respect to form, whether it is one or many and what it is or what they are, its accurate determination is a task belonging to first philosophy and will be laid aside till then;[20] but as regards the natural and destructible forms, we shall consider them in this treatise later.[21]

That there are principles, what these are, and how many they are, let the above as given so far be our account of them. Next, let us proceed from another starting-point.

Book B

1

192*b* Of things, some exist by nature, others through other causes. Animals and their parts exist by nature, and so do plants and the simple bodies, for example, earth, fire, air, and water; for we say[1] that these and other such exist by nature. Now all the things mentioned appear to differ from things which are composed not by nature. All things existing by nature appear to have in themselves a principle of motion[2] and of standstill,[3] whether with respect to place or increase or decrease or alteration.[4] But a bed or a garment or a thing in some other similar genus,[5] insofar as each of them is called by a similar predicate and in virtue of existing by art, has no natural tendency in itself for changing; but insofar as it happens to be made of stone or earth or to be a composite of these, it has such a tendency and only to that extent.[6] So nature is a principle and a cause of being moved or of rest in the thing to which it belongs primarily[7] and in virtue of that thing, but not accidentally. I say "not accidentally" in view of the fact that the same man may cause himself to become healthy by being a doctor; however, it is not in virtue of becoming healthy that he has the medical art, but it is an accident that the same man is both a doctor and becoming healthy,[8] and on account of this, the one is at times separate from the other.[9] Similarly, each of the other things produced has in itself no principle of producing, but in certain cases [in most cases] such a principle is in another thing or is *outside of the thing produced, as in the case of a house and other man*ufactured products,[10] while in the remaining cases it is in the thing itself but not in virtue of that thing, that is, whenever it is an accident in the thing that causes the production in it.[11]

We have stated, then, what nature is. Things which have such a principle are said to have a nature; and they are all substances, for each of them is a subject, and nature exists always in a subject.[12] And they and whatever essentially belongs to them are said to exist according to nature, as, for example, the upward locomotion of fire; for this

193a [locomotion] is not nature, nor does it have a nature, but it exists by nature or according to nature.[13]

We have stated, then, what nature is and what exists by nature and[14] according to nature. As far as trying to prove that nature exists, this would be ridiculous, for it is evident that there are many such things; and to try to prove what is evident through what is not evident is a mark of a man who cannot *judge* what is known through itself from what is known not through itself.[15] That this can take place is clear; for a man born blind may form syllogisms concerning colors, but such a man must be using mere names without conceiving the corresponding things.[16]

Some think that the nature or *substance* of a thing existing by nature is the first[17] constituent which is in the thing and which in itself is without shape, like wood in the case of a bed or bronze in a bronze statue. (According to Antiphon, a sign of this is the fact that if one plants a bed and the moistened wood acquires the power of sending up a shoot, what will result is not a bed but wood, thus showing that the arrangement of the parts according to custom or art belongs to the object planted by accident, but that the substance is that which persists while it is acted upon continuously.) And if each of these is also related to another object in the same way, say bronze and gold to water, bones and wood to earth, and similarly with any others, then it is that other object which is the nature and the *substance* of those things. It is in view of this that some say that the nature[18] of all things is earth; others, that it is fire; others, air; others, water; others, some of these; and others, all of them. For whatever each thinker believed to be of this sort, whether only one object or more than one,[19] he posited this or these as being all that is substance, but all other things as being affections or possessions or dispositions of substances, and also this or these as being eternal (for they said that there is no change from one of them to something else), but the other things [he posited] as being in generation and destruction a countless number of times.

In one way, then, nature is said to be the first underlying matter in things which have in themselves a principle of motion or of change, but in another it is said to be the *shape* or form according to formula;[20] for just as we call "art" that[21] which exists in virtue of art[22] and is artistic,[23] so we call "nature" that which exists in virtue of nature and is natural.[24] Neither in the former case would we say that a thing has something in virtue of art[25] or that there is art[26] if the thing is only potentially a bed but has not yet the form of a bed, nor is it so in things which are *composites* by nature; for that which is potentially flesh or bone has not yet its nature[27] or does not yet exist by nature until it acquires the form according to the formula by which [form] we state what flesh or bone is when we define it. Thus, in another way, the nature of things which

have in themselves a principle of motion would be the *shape* or form, which does not exist separately from the thing except according to formula.[28] As for the *composite* of the two, e.g., a man, this is not nature, but [we say] it exists by nature.

Indeed, the form is a nature to a higher degree than the matter; for each thing receives a name when it exists in actuality rather than when it exists potentially.[29] Moreover, it is from a man that a man is generated, but a bed is not generated from a bed (and in view of this they say that nature is not the shape but the wood, since, if it buds, what is generated is wood and not a bed); so if in the latter case it is the art,[30] in the former too it is the form that should be nature, for it is from a man that a man is generated.[31] Again, when we speak of nature as being a generation, this is a process toward nature [as a form]; for the term "nature" as signifying a process is not like the term "doctoring". The latter term signifies a process toward health, not toward the art of doctoring, for doctoring which begins from the art of doctoring cannot be a process toward the art of doctoring; but nature [as a process] is not related to nature [as a form] in the same way, for from something the growing object proceeds to something or grows into something. Into what does it grow? Not into that from which it begins but into that toward which it proceeds. Thus it is the *form* that is nature.[32] "*Form*" or "nature", it may be added, has two senses, for privation, too, is in a way a form;[33] but whether there is a privation or a contrary in an unqualified generation or not must be considered later.[34]

2

Having distinguished the various senses of "nature", we should next investigate how the mathematician and the physicist differ with respect to their objects, for physical bodies have also surfaces and solids and lengths and points, and these are the concern of the mathematician.[1] Moreover, is astronomy a distinct science or a part of physics?[2] For it is absurd that the physicist[3] should understand what the Sun or the Moon is but not what their essential attributes are, not to mention the fact that those who are concerned with nature appear to be discussing the shape of the Moon and of the Sun and to be raising the problem of whether the Earth and the universe are spherical or not.

Now the mathematician, too, is concerned with these, but not insofar as each is a limit of a physical body; nor does he investigate attributes qua existing in 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 occur in separating them [in thought].[4] Those who

posit Ideas, too, are doing the same but are unaware of it; for they are
194a separating the physical objects[5] [from motion], although these are less separable than the mathematical objects. This becomes clear if one tries to state the definitions in each [science], both of the subjects and of their attributes. For oddness and evenness and straightness and curva-
5 ture, and also a number and a line and a figure, will each be defined without reference to motion; but not so in the case of flesh and bone and a man, for these are defined like a snub nose and not like curvature.[6] This is also clear in those parts of mathematics which are more physical, such as optics and harmonics and astronomy, for these are related to geometry in a somewhat converse manner. On the one hand,
10 geometry is concerned with physical lines but not qua physical;[7] on the other, optics is concerned with mathematical lines not qua mathematical but qua physical.[8]

Since we speak of nature in two ways, as form as well as matter, we should investigate the whatness [of the objects of physics] as we would the whatness of snubness. Such objects, then, should be investigated
15 neither without matter nor with respect to matter [alone].[9] With regard to this we might also raise another problem. Since there are two natures, with which of them should the physicist be concerned? Or should he be concerned with that which has both natures? Of course, if with both natures, then also with each of the two natures. So should the same science be concerned with both natures, or one science with one and another with the other?

If we turn our attention to the ancients, physics would seem to be
20 concerned with matter, for even Empedocles and Democritus touched upon form or essence only slightly.[10] But if art imitates nature and the same science should understand the form and the matter to some extent (for example, the doctor should understand health, and also bile and phlegm in which health exists; the builder should likewise understand
25 the form of the house, and also the matter, namely, bricks and wooden materials; and similarly in each of the other arts), it should be the concern of physics, too, to know both natures.[11]

Moreover, it belongs to the same science to be concerned with the final cause or the end and also with whatever is needed for the sake of the final cause or the end. But nature is [also] an end and a final cause;
30 for if, in that which is in continuous motion, there is some end of that motion, this [end] is the last and the final cause.[12] And it is in view of this that the poet was carried away when he made the ridiculous statement "he has an end [death], for the sake of which he was born". For not every last thing tends to be an end, but only the best, seeing that in the case of the arts, too, some of them just make the matter but others

15 make it serviceable and that we use things as if they exist all for our own sake (since in a certain sense, we too are an end, for "final cause"
194b has two senses, as we stated in *"On Philosophy"*[13]). Indeed, there are two arts which rule over matter and have knowledge of it—the art which is concerned with the use of it and the art which directs the production of it. Thus the art which uses matter is also in a sense directive, but as directive it differs from the other insofar as it knows the form,
5 while the art which directs the production knows the matter; for the steersman knows what kind of form the rudder should have and orders its production, but the engineer knows from what kind of wood it should be produced and how it should move.[14] Now in objects produced according to art, it is we who produce the matter for the sake of some function,[15] but in natural objects it is there all along.[16]

Again, matter is relative to some thing, for distinct forms require distinct matter.[17]

10 To what extent should the physicist understand the form or the whatness? Up to a point, just as the doctor understands sinews and the smith understands bronze, for each of them [sinews and bronze] is for the sake of something, and the physicist is concerned with what is separable in kind but exists in matter; for both man and the Sun beget man.[18] As for a separate form, how it exists and what it is, this is a task to be
15 settled by first philosophy.[19]

3

Having made these distinctions, we should next examine the causes, their kinds and number. Since our *inquiry* is for the sake of understanding, and we think that we do not understand a thing until we have
20 acquired the *why* of it (and this is to acquire the first[1] cause), clearly we should do this as regards generation and destruction and every physical change so that, with an understanding of their principles, we may try to refer to them each of the things[2] we seek.

In one sense, "a cause" means (1) that from which, as a constituent,[3]
25 something is generated; for example, the bronze is a cause of the statue, and the silver, of the cup, and the genera of these[4] [are also causes].

In another, it means (2) the form or the pattern,[5] this being the formula of the essence,[6] and also the genera of this; for example, in the case of the octave, the ratio 2:1, and, in general, a number and the parts in the formula.[7]

30 In another, it means (3) that from which change or coming to rest[8] first begins; for example, the adviser is a cause, and the father is the

cause of the baby, and, in general, that which acts is a cause of that which is acted upon, and that which brings about a change is a cause of that which is being changed.

Finally, it means (4) the end, and this is the final cause [that for the sake of which]; for example, walking is for the sake of health.[9] Why does he walk? We answer, "In order to be healthy"; and having spoken thus, we think that we have given the cause. And those things which, after that which started the motion, lie between the beginning and the end, such as reducing weight or purging or drugs or instruments in the case of health, all of them are for the sake of the end;[10] and they differ in this, that some of them are operations while others are instruments.

The term "cause", then, has about so many senses. And since they [the causes] are spoken of in many ways, there may be many nonaccidental causes of the same thing; for example, in the case of a statue, not with respect to something else but qua a statue, both the art of sculpture and the bronze are causes of it, though not in the same manner, but the bronze as matter and the art as the source of motion. There may be also causes of each other; for example, exercise is a cause of good physical condition, and good physical condition is a cause of exercise, although not in the same manner, but good physical condition as an end, while exercise as a principle[11] of motion. Again, the same thing may be a cause of contraries, for if one thing, when present, is the cause of another, then the first, when absent, is sometimes also said to be the cause of the contrary of the second; for example, we say that the absence of the pilot was the cause of the capsizing, while his presence was the cause of safety.[12]

All of the causes just mentioned fall into four most evident types. For, the letters of the syllables, the matter of manufactured articles, fire and all such in the case of bodies, the parts of the whole, the hypotheses[13] of the conclusion[14]—in all of these there are causes in the sense that they are *that of which*[15] the latter[16] consists; and in these,[16] those first mentioned in each case are causes in the sense that they are the underlying subject, as in the case of the parts,[17] but each[18] of the others is a cause in the sense of essence, and this is the whole[19] or the composition or the form. As for the seed and the doctor and the adviser and, in general, that which acts, all these are causes in the sense of the source of change or of standstill or of motion. Finally, each of the rest is a cause as the end or the good of the others; for that for the sake of which the others exist or are done tends to be the best or their end. Let there be no difference here between calling this "the good" or "the apparent good".[20]

These, then, are the causes and their number in kind; but their modes are numerically many, although when summarized they too are fewer.

For causes are spoken of in many ways, and even within the same kind one cause may be prior[21] or posterior to another; for example, the cause of health is the doctor or the artist, and the cause of the octave is the ratio 2:1 or a number, and whatever includes[22] each is always a cause. Again, there are accidental causes and their genera; for example, Polyclitus as a cause of a statue is distinct from a sculptor as a cause, since the sculptor is by accident Polyclitus.[23] Also, whatever includes[24] the accident would be a cause; for example, a man, or, in general, an animal, would be a cause of the statue. Even of accidents, some are more remote or more near than others; for example, this would be the case if the white or the musical were to be called "a cause" of the statue.[25]

Of all causes, both those said to be *proper*[26] and those said to be accidental, some are said to be causes in the sense of being in potentiality, others in *actuality;* for example, the cause of the house to be built is the builder[27] and of the house that is being built the builder who is building. Similar remarks will apply to the things caused by the causes already listed; for example, the cause may be a cause of this statue or of a statue or of a portrait in general, and it may be a cause of this bronze or of bronze or of matter[28] in general.[29] Similar remarks may be made in the case of accidents. Again, both accidental and *proper* causes and also the objects caused may be spoken of in combination;[30] for example, not Polyclitus, nor the sculptor, but Polyclitus the sculptor.

However, all these are six in number, and each is spoken of in two ways. For as a cause or an object caused each may be stated as a particular[31] or as a genus of a particular; as an accident or as a genus of an accident; in combination or singly taken; and in each of these either in *actuality* or in virtue of its potentiality. And there is this difference, that causes which are in *actuality* and are taken as individuals exist, or do not exist, at the same time as the things of which they are the causes, for example, as in the case of this doctor who is healing and this man who is being healed, and this builder who is building and that building which is being built.[32] But with respect to potentiality this is not always so; for the house is not destroyed at the same time as the builder.

We should always seek the ultimate[33] cause of each thing, as in other cases; for example, a man builds in view of the fact that he is a builder, and a builder builds in virtue of his art of building; accordingly, this latter is the prior cause. It is likewise with all other cases. Moreover, causes generically given should be stated of effects generically given, and particular[31] causes, of particular effects; for example, a sculptor [in general] of a statue [in general], and this sculptor of this statue. Also potential causes should be stated of potential effects, and causes in *actuality* of effects in *actuality*.

Let this, then, be a sufficient description of the number of causes and the manner in which they are causes.

4

Luck and *chance*, too, are said to be causes, and many things are said to exist and to come to be through luck or *chance*. Accordingly, we must inquire (a) in what manner luck and *chance* are causes among those given, (b) whether luck and *chance* are the same or distinct, and, as a whole,[1] (c) what luck is and what *chance* is.

Some thinkers even raise the problem of whether luck and *chance* exist or not;[2] for they[3] say that nothing comes by luck, but that in every case in which we say that a thing comes to be by *chance* or luck there is a definite cause. For example, if a man came to the market and met by luck someone whom he wished but did not expect to meet, the cause of this meeting is the wish to come and buy something. Similarly, in the other cases which are said to happen by luck there is always a [definite] cause, and this is not luck; for it would indeed appear strange if luck were something, and one might even raise the question as to why not even one of the ancient wise men, in speaking of the causes of generation and of destruction, said anything definite about luck. So it seems that they, too, thought that nothing could exist by luck. Yet this too is surprising: Many things *come* to be and exist by luck or by *chance*. And although we know that each of these can be referred to some [definite] cause, like the old argument which eliminated luck, nevertheless all speak of some of these things as being by luck and others as being not by luck; and on this account, this fact should have been touched upon by them in some way or other.

Now none of the ancient thinkers thought that luck was some thing, such as *Friendship* or *Strife* or *Intelligence* or *Fire* or some other such thing. And this is certainly strange, whether they believed that luck does not exist or thought that it does but neglected to discuss it; for they sometimes used it, as in the case of Empedocles, who said that air is not always separated in the highest region but wherever it might chance. Anyway, he did say in his cosmology "it happened to run to that region at that time, but it often ran otherwise";[4] and he also said that most of the parts of animals came to be by luck.[5]

There are some[6] who say that chance[7] is a cause both of this heaven and of everything that is in the ordered universe; for they say that the vortex came to be by chance, and so did the motion which separated the parts and caused the present order of the universe. And this is very surprising; for they say, on the one hand, that animals and plants neither exist nor are generated by luck but that the cause is nature or intellect or some other such thing (for it is not any chance thing that is generated from a given seed, but an olive tree from this kind and a man from that kind), and, on the other, that the heavens and the most divine of the visible objects were generated by *chance*, which cause is not such as any of those in the case of animals or plants. Yet if such is the case, it deserves attention, and it is right that something should be said about it. For, besides the fact that the statement is absurd in other ways, it is more absurd to speak thus when they observe nothing generated by chance in the heavens but many things happening by luck among things which [according to them] neither exist nor are generated by luck, even if probability would have it the other way around.

There are also others who seem to think that chance is a cause but is not revealed to human *thought*, that it is something divine and rather godlike.

Let us inquire, then, what chance is and what luck is, whether they are the same or distinct, and how they fit into the causes already described.

5

To begin, then, since we observe that some things come to be always in the same way and others [come to be] for the most part,[1] it is evident that luck as a cause and what comes to be by luck[2] are none of those things, neither of what is necessary or eternal nor of what is for the most part. But since of things that come to be there exist, besides these, also others,[3] which all say exist by luck, it is evident that luck or chance does exist; for we grant that such things do come to be by luck and that things which come to be by luck are of such a kind.[4]

Of things that come to be, some do so for the sake of something [else] but others do not;[5] and of the former, some come to be according to *choice* and others not so, but both these are for the sake of something;[6] so it is clear that, besides things which exist necessarily or for the most part, there are also others[7] to which final cause may belong. Things to which final cause belongs may be done by *thought* or by nature. Now when such things come to be by accident, we say that they do so by luck;[8] for just as being exists either essentially or by accident, so may a cause exist.[9] In the case of a house, for example, a cause which is essential is the art of building, but one that is accidental is the white or the musical. Thus the essential cause of something is definite, but the accidental cause is indefinite,[10] for a great many accidents may belong to a thing.

As it was stated, then, when this happens in things for the sake of which there is generation, then it is said to happen by *chance*[11] or by luck. The difference between these two will be specified later,[12] but for the present it is evident that both belong to things for the sake of something. For example, a man engaged in collecting contributions would have gone to a certain place for the sake of getting the money,[13] had he known; but he went there not for the sake of this, and it is by accident that he got the money when he went there; and this happened neither for the most part whenever he went there, nor of necessity. And the end, which is getting the money, is not a cause present in him,[14] but it is something done by *choice* or by *thought*, and he is then said to have gone there by luck;[15] but if he had gone there by *choice* and for the sake of this, whether he was getting the money always or for the most part, then he would have done so not by luck.

It is clear, then, that luck is an accidental cause of things done according to *choice* and for the sake of something; and so both *thought* and luck are concerned with the same thing,[16] for *choice* is not without *thought*.

Now the causes of things which might come to be by luck are of necessity indefinite. In view of all this, (a) luck seems to be something indefinite or not revealed to man,[17] and (b) there is a sense in which nothing would seem to come to be by luck;[18] for both these opinions are right, since there is a good reason for them. For what comes to be by luck does so in a qualified sense, namely, in virtue of an accident, and it is as an accident that luck is a cause; but as a cause without qualification, it is a cause of no thing.[19] For example, of a house the builder is the cause, but accidentally it is the flute player; and in going to a place and getting the money, but not doing so for the sake of getting the money, the accidental causes might be a great many, such as wishing to see someone or following someone or avoiding someone or going to see a play. And it is right to say that luck is contrary to reason; for reason[20] is of what is always or for the most part, while luck is present in events which are outside of these. So, since such causes are indefinite, luck too is indefinite.

In some cases, however, one might raise the problem of whether a cause as luck may not be any chance thing whatever, as in the case of health, for example, whether the wind or the heat from the sun is such a cause but not the purge;[21] for, of accidental causes, some are nearer [to the effects] than others.

Luck is called "good" when the result is good, but "bad" when the result is bad; and it is called "good fortune" and "misfortune" when its goodness and badness, respectively, are of considerable magnitude. In view of this, even if great goodness or badness is missed by a little, we

are said to have been fortunate or unfortunate; for the small difference seems negligible, and so *thought* regards good fortune or misfortune as if attained. Further, it is with good reason that good fortune has no certainty, for luck has no certainy; for what comes to be by luck does so neither always nor for the most part.[22]

As we stated, both luck and *chance* are causes, but accidental; and they are among things[23] which come to be neither without qualification nor for the most part, and for the sake of something.

6

The term "chance" differs from "luck" by being a wider predicate; for every effect by luck is also an effect by chance, but not every effect by chance is an effect by luck. Luck and an effect by luck belong also to whatever good fortune and *action* in general belong.[1] It is for this reason, too, that luck is necessarily a cause of what may result by *action*. A sign of this is the fact that good fortune seems[2] to be either the same as happiness or close to it; and happiness is a kind of *action*, for it is a good *action*. Hence, whatever is incapable of *acting* is also incapable of doing anything by luck. And it is because of this that inanimate things and brutes and children, having no *choice*,[3] cannot do anything by luck; and neither good nor ill fortune can belong to them, except in virtue of some similarity, as in Protarchus' statement that the stones of which altars are made are fortunate, for they are honored, while those leading to the altar are walked upon. Of course, even these things[4] are affected by luck, but in a sense, that is, when one *acts* on them by luck, but in no other way.[5]

As for chance, it exists also in the other animals and in many inanimate things. For example, we say that the horse who came is a chance [cause],[6] that is, his coming saved him, but he did not come for the sake of being saved; and the tripod which fell [on its feet] is a chance [cause], for though its being on its feet is for the sake of being sat on, it did not fall for the sake of being sat on.[7]

Thus it is evident that in things which come to be without qualification for the sake of something, when the effects, whose causes are outside of them, do not come to be for their own sake, then we say that they come to be by chance; and of these, those *chosen* by those who have *choice* are said to come to be by luck.[8] A sign of this is the use of the phrase "in vain"[9] when that for the sake of which something is done does not result, as in walking which is for the sake of bowel movement; if the movement does not result after one has walked, we say that he has walked in vain and that the walking was futile, thus regarding as

futile that which was by nature for the sake of something that did not result, although by nature it does result (for it would be ridiculous to say that a man had bathed in vain if as a consequence the Sun was not eclipsed, seeing that the bathing was not for the sake of the Sun's eclipse). So chance, as its name also indicates, exists when something occurs in vain,[10] so to speak, for the stone that fell did so not for the sake of striking the man, but by chance, seeing that it might have been thrown by someone for the sake of striking the man.

Things occurring by *chance* are most distinct from those occurring by luck in things generated by nature; for when something has been generated contrary to nature, then we say that it did so not by luck but rather by *chance*. And there is another distinction, for in the one case the cause is outside, in the other it is inside.[11]

198*a* We have stated, then, what chance[12] is, what luck is, and in what they differ from each other. As for the manner in which they are causes, each of them is a source which begins motion; for each is always a cause of what results either by nature or by *thought*, and each of them as a cause may vary indefinitely in number.

Now, since *chance* and luck are causes of effects caused either by the intellect or by nature, when each of them comes to be an accidental cause of such an effect, then it is clear that, since nothing that is accidental is prior to what is essential, no accidental cause is prior to an essential cause. Thus *chance* and luck are posterior to intellect and nature.[13] Hence, however true it may be that chance is the cause of the heavens,[14] intellect or nature is of necessity a prior cause of many other things and of this [whole] universe.[14]

7

It is clear, then, that there are causes and that there are as many [in kind] as we have stated;[1] for the *why* of things includes just so many [in kind]. For the *why* in referred either (a) ultimately to the whatness[2] in the case of what is immovable, as in mathematics (for it is ultimately referred to the definition of a straight line or of commensurability or of something else[3]), or (b) to the first mover[4]—for example: Why did they declare war? Because they were raided—or (c) to a final cause:[5] [in declaring war] for the sake of ruling the enemy, or (d) to matter, as in things generated. Evidently, then, the causes are those stated and are as many in number.

Since the causes are four, it is the task of the physicist to understand all of them; and as a physicist he should state the *why* by referring it to all of them—the matter, the form, the mover, and the final cause. The

last three often amount to one; for both the whatness and the final cause are one, and the first[6] source of motion is the same in kind as these[7] (for man begets man), and, in general, this is so in the case of a movable mover. But a mover that is not movable is not a cause within physics,[8] for it moves without having in itself motion or a principle of motion[9] but is immovable. Accordingly, there are three disciplines: one concerning immovable things, a second concerning things which are in motion but are indestructible, and a third concerning destructible things.[10]

The *why*, then, is given by being referred to matter, to the whatness, and to the first mover,[11] for in generations causes are sought mostly in this manner: "What comes after what?",[12] "What was the first thing that acted or was acted upon?", and at each step always in this way. Now the principles that cause physical motion are two: One of these 198*b* is not physical, for it has no principle of motion in itself,[13] and such is that which moves another without itself being moved, as in the case of that which is completely immovable and primary among all;[14] and such is also the whatness or the *form*, for this is the end or final cause. So, since nature is a final cause, we should also understand this [cause]. So the *why* must be given in all [four] ways, namely, (1) that this must follow from that[15] (the phrase "this from that" to be taken either without qualification or for the most part[16]); (2) that if this is to be, then that[17] will be (as in the case of premises, from which conclusions follow); (3) that this was the essence; and (4) because it is better in this way (not without qualification, but relative to the *substance*[18] of each thing).[19]

8

We must discuss first (a) why nature is a cause for the sake of something;[1] then (b) how necessity exists in physical things,[2] for all thinkers make reference to this cause by saying, for example, that since the hot and the cold and each of such things are by nature of such-and-such a kind, certain other things must exist or come to be (for even if they mention some other cause—one of them mentions *Friendship* and *Strife*,[3] another mentions *Intelligence*[4]—they just touch upon it and let it go at that).

The following question arises: What prevents nature from acting, not for the sake of something or for what is better,[5] but by necessity, as in the case of rain, which does not fall in order that wheat may grow. For, one may say, what goes up must be cooled, and the resulting cold water must come down, and when this takes place, the growth of corn just happens; similarly, if a man's wheat is spoiled on the threshing floor, rain did not fall for the sake of spoiling the wheat, but this just hap-

pened.[6] So what should prevent the parts in nature, too, from coming to be of necessity in this manner, for example, the front teeth of necessity coming out sharp and so fit for tearing but the molars broad and useful for grinding food, not however for the sake of this but by coincidence? A similar question arises with the other parts in which final cause seems to exist. If so, then whenever[7] all the parts came together as if generated for the sake of something, the wholes which by *chance* were fitfully composed survived, but those which came together not in this manner,[8] like the man-faced offspring of oxen mentioned by Empedocles,[9] perished and still do so.[10]

This is the argument, then, or any other such, that might cause a *difficulty*. Yet it is impossible for things to come to be in this manner; for the examples cited and all things by nature come to be either always or for the most part, but none of those by luck or *chance* do so likewise.[11] It is not during the winter that frequent rain is thought to occur by luck or by coincidence, but during the summer, nor frequent heat during the summer, but during the winter. So if these be thought to occur either by coincidence or for the sake of something and if they cannot occur by coincidence or by chance, then they occur for the sake of something. Besides, those who use the preceding arguments, too, would admit that all such things exist by nature.[12] There is, then, final cause in things which come to be or exist by nature.[13]

Moreover, in that which has an end, a prior stage and the stages that follow are done for the sake of that end. Accordingly, these are done in the manner in which the nature of the thing disposes them to be done; and the nature of the thing disposes them to be done in the manner in which they are done at each stage, if nothing obstructs.[14] But they are done for the sake of something; so they are by nature disposed to be done for the sake of something.[15] For example, if a house were a thing generated by nature, it would have been generated in a way similar to that in which it is now generated by art.[16] So if things by nature were to be generated not only by nature but also by art, they would have been generated just as they are by nature disposed to be generated. So one stage is for the sake of the next.[17] In general, in some cases art completes what nature cannot carry out to an end,[18] in others, it imitates nature.[19] Thus, if things done according to art are for the sake of something, clearly also those according to nature are done for the sake of something; for the later stages are similarly related to the earlier stages in those according to art and those according to nature.

This is most evident in those of the other animals which make things neither by art nor by having inquired or deliberated about them; and from this latter fact arise discussions by some thinkers about the problem of whether spiders and ants and other such animals work by intellect or by some other power. If we go a little further in this direction,[20] we observe that in plants, too, parts appear to be generated which contribute to an end, for example, leaves for the sake of protecting the fruit. So if it is both by nature and for the sake of something that the swallow makes its nest and the spider its web and that plants grow leaves for the sake of fruit and send their roots not up but down for the sake of food, it is evident that there exists such a cause[21] in things which come to be or exist by nature. And since nature may be either matter or *form*, and it is the latter that may be an end while all the rest are for the sake of an end, it is *form* that would be a cause in the sense of a final cause.

Now error occurs even with respect to things produced according to art, for example, a grammarian did not write correctly and a doctor did not give the right medicine; so clearly this may occur also in things that come to be according to nature. If then there are (a) things produced according to art in which there is a right final cause and (b) also things done erroneously when the final cause has been aimed at but failed, a similar situation would exist also in natural things, and monstrosities in these would be failures of final causes. So too must have been the case in the original formation of the offspring of oxen, if they could not attain a certain limit or end; for there must have been some corruption in the source from which their generation started, like that in the seed nowadays.[22] We might add, too, that the seed must have come into being first and not the animals all at once, and the expression "first the whole-natured" meant the seed.[23] And final cause exists also in plants, though it is less capable of being articulated. So did olive-headed offspring of vines[24] come into being just as man-faced offspring did from oxen, or not? It would seem absurd; but they must have, if indeed this was also the case in animals. Again, any chance thing might otherwise be generated from a seed.

In general, he who asserts this rejects things existing by nature as well as nature itself.[25] For what exists by nature is a thing which, having started from some principle in itself, finally arrives by a continuous motion at a certain end; and neither is the end the same from every principle,[26] nor does any chance end come to be from a given principle,[27] but from the same principle the same end comes to be, if nothing obstructs. As for the final cause or what acts for the sake of the final cause, it might take place by luck. (For example, we say "the stranger came by luck and departed after paying the ransom" if he would have come for the sake of doing this [had he known], not that he came for the sake of this; and this happened by accident,[28] for luck is an accidental cause, as we stated earlier.[29]) But if it takes place always or for the most part, it is not an accident nor does it come to be by luck; and in natural things it takes place always, if nothing obstructs.

It is absurd to think that nothing comes to be for the sake of something if the moving cause is not observed deliberating (and we may add, even art does not deliberate [30]); and if the ship-building art were in the wood, it would have produced results similar to those produced by nature. So if there is a final cause in art,[31] so also in nature. This is most clearly seen in a doctor who heals himself; nature is like that.[32]

It is evident, then, that nature is a cause and that it is a cause also in this manner, namely, for the sake of something.

9

As for that which is necessary, does it exist by hypothesis or also simply?[1] Nowadays it is thought that what exists by necessity does so in generation, as if one were to consider the wall as having been constructed by necessity, since what is heavy travels down by its nature and what is light travels up by its nature, and so the stones and the foundations are down, then earth right above because it is lighter, and finally wood at the very top since it is the lightest. However, although a wall is not constructed without these, still it is constructed not because of these (except in the sense that they are causes as matter[2]) but for the sake of sheltering or preserving certain things. Similarly, in all other cases in which there is a final cause, although what is generated could not have been generated without a nature which is necessary for it, still it is not because of what is necessary (except as a material cause) but for the sake of something. For example, why is a saw such-and-such? So that this may come to be or for the sake of this. But this final cause cannot come to be unless the saw is made of iron. So if there is to be a saw capable of doing this work, it is necessary that it be made of iron. What is necessary, then, exists by hypothesis[3] and not as an end; for it exists in matter, while final cause is in the formula.[4]

The necessary in mathematics is in some way parallel to that in things generated according to nature. Since this is what a straight line is, it is necessary for a triangle to have its angles equal to two right angles, but the converse is not the case; but if the angles of a triangle were not equal to two right angles, neither would a straight line be what it is said to be. In things generated for the sake of something, this parallelism proceeds in a reverse manner. If the end will exist or exists, what precedes it also will exist or exists; but if what precedes the end will not or does not exist, then, just as in the other case the starting-point is not what it is posited to be if the conclusion is not true, so here, the end or final cause will not or does not exist if what precedes it will not or does not exist. The final cause here, we may add, is also a starting-point, not of *action*,

but of reasoning;[5] but in the other case [e.g., in mathematics], it is the whatness that is the starting-point of reasoning, for no *actions* exist there. Thus, if there is to be a house, certain things must be made or be available or exist (or the matter in general, which is for the sake of something, such as bricks and stones in the case of a house); but the end does not exist because of these things, except in the sense that they are a cause as matter, nor will the house come to be because of these. In general, then, if there are no stones, there can be no house, and if there is no iron, there can be no saw; whereas in mathematics, if the angles of the triangle are not equal to two right angles, the principles from which the equality to two right angles follows cannot be such as are posited.

It is evident, then, that the necessary in natural things is what we call "matter" and also the motions of matter.[6] We may also add that both causes must be stated by the physicist, and the final cause more so than the cause as matter, for it is the former which is the cause[7] of the latter, not the latter, of the end; and we may also add that the end is the final cause and that the starting-point is the definition or the formula, as in the case of things produced according to art. For example, if a house is such-and-such a thing, such other things must be produced or be available; and so in the case of a man: If he is such-and-such, then such other things must be or come to be, and if these, then such others likewise. Perhaps the necessary exists also in the formula; for, if one has defined the operation of sawing as being such-and-such an act of division, then this cannot take place unless the saw has teeth of such-and-such a kind, and these cannot be of such-and-such a kind unless they are made of iron. Indeed, even in formulas there are some parts which are parts as if they were the matter of these formulas.[8]

Book Γ

1

200*b* Since nature is a principle of motion or[1] of change and our *inquiry* is about nature, we should not neglect to inquire what a motion is; for
15 if we are ignorant of what a motion is, we are of necessity ignorant of what nature is. When we have explained motion,[2] then we shall try in the same manner to take up what follows.[3]

Now a motion is thought to be one of those things which are continuous, and it is in the continuous that the infinite first appears,[4] and for this reason, it often happens that those who define the continuous use
20 the formula of the infinite, that is, they say that the continuous is that which is infinitely divisible.[5] Again, a motion is thought to be impossible without place and void and time.[6] Clearly, then, because of all this and because of the fact that these[7] are common and belong universally to all the others, we must first undertake to inquire about each of these;
25 for the investigation of what is specific should come after that of what is common.[8]

As we said, then, our first inquiry is about motion. To begin, there is (a) that which exists in actuality only[9] and also (b) that which exists both potentially and in actuality,[10] and this may be a *this* or a *so-much* or a *such* or, likewise, any of the other categories of being. As for that
30 which is relative-to-something, it may be stated with respect to excess or deficiency or with respect to its being-able-to-act or be-acted-upon or, in general, with respect to its being-able-to-move or be-moved;[11] for that which-is-able-to-move is able-to-move that-which-can-be-moved, and that-which-can-be-moved can be moved by-that-which-can-move.

Now no motion exists apart from things; for that-which-changes always does so either with respect to substance or with respect to quantity
35 or with respect to quality or with respect to place, and there can be no thing common to these which-is-not, as is our manner of speaking, a *this*
201*a* or a quantity or a quality or some one of the other categories.[12] Thus

neither a motion nor a change can exist apart from these [categories] if nothing else exists but these.

In all cases, each of these [categories] may exist in two ways; for example, with respect to a *this*, it may be the *form* or the privation of
5 that *form*, with respect to quality it may be whiteness or blackness, and with respect to quantity it may be the complete or the incomplete. Similarly, with respect to locomotion the thing may be up or down or it may be heavy or light. Thus there are as many kinds of motion or of
10 change as there are kinds of being.[13] In view of this distinction between the actual and the potential in each genus, a motion is [defined as] the actuality of the potentially existing qua existing potentially.[14] For example, the actuality of the alterable qua alterable is an alteration; the actuality of what can be increased or (its opposite) what can be decreased [qua such] is an increase or decrease (no name exists which is a common predicate of both),[15] the actuality of the generable or de-
15 structible [qua such] is a generation or a destruction, and the actuality of the movable with respect to place [qua such] is a locomotion.

That a motion is what we have stated it to be is clear from the following. When the buildable, insofar as it is said to be such, exists in actuality, it is then [in the process of] being-built, and this is [the process of] building; and similarly in the case of learning, healing, rolling, leaping,
20 ripening, and aging.

Since, in some cases, the same things exist both potentially and actually, but not at the same time nor with respect to the same thing (as in the case of that which is potentially hot but actually cold), many of them will eventually both act and be acted upon by each other; for each of them has the potentiality both of acting and of being acted upon. Consequently, that which causes a motion physically[16] is also movable, for
25 every such thing which causes a motion is itself moved. There are some who think that every thing that moves another is itself moved; now what the situation is with respect to this will be made clear from other arguments (for there exists also something which causes a motion but is itself immovable),[17] but as for a motion, it is the actuality of that which exists potentially when it is in *actuality* not qua itself but qua movable.

30 By "qua" I mean the following. Bronze is potentially a statue, yet it is not qua bronze that the actuality of bronze is a motion; for to be bronze and to be movable by something are not the same, since if they were the same without qualification or according to formula, the actuality of bronze qua bronze would be a motion.[18] So they are not the same, as
35 stated. This is clear in the case of contraries; for to be capable of being
201*b* healthy and to be capable of being sick are distinct, for otherwise being sick and being healthy would be the same. It is the underlying subject,

be it moisture or blood, which is one and the same, whether in health or in sickness.[19] Since, then, to be bronze and to be potentially something else are not the same, just as to be a color and to be visible are not the same,[20] evidently it is the actuality of the potential qua potential that is a motion.

It is clear, then, that this is what a motion is and that an object happens to be in motion just when this actuality exists, and neither before nor after. For each [such] thing may be sometimes in *actuality* and sometimes not, as in the case of the buildable, and it is qua buildable that the *actuality* of the buildable is [the process of] building. For this *actuality* is either [the process of] building or the house. But when the house exists, it is no longer buildable; and it is the buildable that is being built. This *actuality*, then, must be [the process of] building, and [the process of] building is a [kind of] motion. Moreover, the same argument applies to the other motions.

2

That we have stated the facts well is also clear from (a) what the other thinkers are saying about motion and from (b) the fact that it is not easy to describe it in another way. For (b) one could not place motion or change in some other genus; and (a) an examination of the way in which some thinkers posit motion clearly shows them to be saying that it is otherness or inequality or nonbeing,[1] none of which (whether that which is other or that which is unequal or that which is nonbeing) need be in motion,[2] and besides, a change is no more into these or from these than into or from their opposites.[3]

The cause of positing motion as being some one of these is the fact that motion is thought to be something indefinite;[4] and the principles in one of the two columns of contraries are indefinite because they are privative, for none of them is a *this* or a *such* or any of the other categories.[5] And a motion is thought to be indefinite because of the fact that it cannot be placed in an unqualified way[6] either under the potentiality or under the *actuality* of things; for neither that which is potentially a quantity nor that which is *actually* a quantity is necessarily moved. And although a motion is thought to be an *actuality* of a sort, yet it is incomplete; and the cause of this is the fact that the potential, of which this is the *actuality*, is incomplete.[7] And it is indeed because of this that it is difficult to grasp its whatness; for it must be placed either under privation or under potentiality or under unqualified *actuality*, but none of these alternatives appears possible. What remains, then, is the manner in which we described it, namely, that a motion is a sort of an *actuality* —an *actuality* such as we have stated,[8] difficult to grasp but capable of existing.

The mover too is movable, as has been stated, that is, every mover which is potentially movable and whose absence of motion is rest; for the absence of motion in that which may be in motion is [said to be] rest. For to act on the movable qua such is precisely to move it. But it [i.e., the mover] acts on it by contact; so it is at the same time acted upon.[9] Thus it is of the movable qua movable that a motion is the actuality;[10] and this happens by contact with that which can move, so the latter too is at the same time acted upon. And the mover always has a form, whether a *this* or a *such* or a *so-much*,[11] which is a principle and a cause[12] of motion when the mover moves [something]; for example, a man in actuality begets a man from what is potentially a man.

3

Moreover, the solution to the problem[1] raised concerning a motion is now evident: A motion is in a movable [object], for it is of the movable that it [motion] is the actuality, and it [motion] is caused by that which can move [the movable]. And the *actuality* of that which can cause a motion is not distinct,[2] for there must be one actuality in both; for a thing can cause a motion by its potency, and it [the thing] causes a motion by *actualizing* that potency. But this *actuality* is in the movable, so it is alike one *actuality* [numerically] in both, just as it is the same interval from one to two and from two to one and the same interval from A going up to B and from B coming down to A. For these [two] intervals are [numerically] one, although their formula is not one;[3] and similarly with the mover and that which is moved.

However, there is a logical *difficulty*. Perhaps it is necessary for the *actuality* of that which can act to be distinct from the *actuality* of that which can be affected; in the one, it is [the process of] acting, in the other, it is [the process of] being affected, and the function or end of the first is an action, but that of the second is an affection. Now if both [*actualities*] are motions, in what [subject or subjects] do they exist if they are distinct? Either (a) both are in that which is affected or is moved, or (b) [the process of] acting is in that which acts and [the process of] being affected is in that which is being affected;[4] and if the latter motion, too, were to be called "an acting", then it would be equivocally so called.[5]

Now, if (b), then the motion will be in the mover, for the same argu-

ment applies to the mover and to the object moved;[6] so either every mover will be moved,[7] or, having motion, it will not be moved.[8] But in (a), if both motions are in the object which is being moved or is being affected, that is, both [the process of] acting and [the process of] being affected (for example, if both teaching and learning, which are two, are in the learner), then, first, the *actuality* of each will not be in each,[9] and second, it will be absurd for that object to have two motions at the same time (for what will be the two alterations of that which is proceeding toward one form?).[10] But this is impossible; so there will be one *actuality*. But it would be unreasonable for two [motions] which are distinct in kind to be one and the same *actuality;* for if indeed teaching and learning (and in general, acting and being affected) were the same, then also to teach and to learn (and in general, to act and to be affected) would be the same, and so it would be necessary for the teacher to learn everything that he teaches (and in general, for that which acts to be affected by every affection it causes).[11]

Nevertheless, neither is it absurd for the *actuality* of one thing to be in another thing (for teaching is the activity of a man who can teach but it is an activity *upon another man;* it is not cut off but is an activity of A upon B), nor can anything prevent one *actuality* from being the same for two things[12]—not in the sense that the essence is the same for both,[13] but in the sense in which potential being is related to being in *actuality*.[14] So it is not necessary for the teacher to learn, even if to act and to be affected are the same,[15] not however in the sense that the formula which states the essence is one (as in the case of the formula of clothing and of garment),[16] but in the sense that the road from Thebes to Athens and that from Athens to Thebes is the same, as it was stated before;[17] for things are in every way the same not if they are the same in any way whatsoever, but only if to be each [i.e., if their essence] is the same.[18] Nor is to learn the same as to teach, if teaching and learning are [numerically] the same, just as the direction from A to B is not one and the same as that from B to A, if the distance connecting A and B is one.[19] In general, however, neither are teaching and learning the same in the main sense,[20] nor are acting and being affected, but that to which they belong, which is motion, is the same;[21] for to be an *actuality* of A upon B and to be an *actuality* of B by A are distinct in formula.[22]

What motion is has been stated both universally and with respect to its parts, for it is not unclear how each of its species will be defined; for example, alteration is the actuality of the alterable qua alterable, or, in more known terms, it is the actuality of that which can act or that which can be affected qua such, whether without qualification or in each particular case[23] (as in [the process of] building and in [the process of]

healing). Each of the other motions will be defined in the same manner.

4

Since the science of nature is about magnitudes and motion and time —each of which is of necessity either finite or infinite,[1] even if not every thing is either finite or infinite (as for example an affection or a point, for perhaps it is not necessary for such things to be either finite or infinite)[2]—he who is concerned with nature should investigate whether the infinite exists or not; and if it exists, what it is.[3] A sign of the fact that the investigation of the infinite is *proper* to this science is this: All those who are thought to have touched upon this kind of philosophy in a worthy manner have discussed the infinite, and all of them have posited it as a principle[4] of things.

The Pythagoreans and Plato posit the infinite as a thing by itself,[5] not as an attribute existing in some other thing but as being itself a substance. But the Pythagoreans say that it exists in sensible things (for they do not posit numbers as existing apart from sensible things) and that the infinite exists also outside of the heaven;[6] whereas Plato holds that outside of the heavens no body exists, not even the Ideas, because these are not even in a place, but that the infinite exists in the sensible things as well as in the Ideas.[7] Moreover, the Pythagoreans posit the infinite as being the *Even;* for they say that it is this which, when cut off and limited by the *Odd*, provides [as matter] for the infinity[8] of things. A sign of this, they say, is what happens to numbers; for if gnomons are placed around the one, and apart,[9] in the latter case the form produced

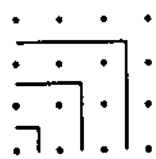

Fig. 1

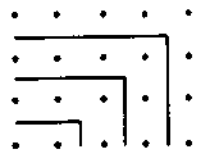

Fig. 2(a)

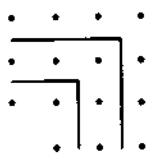

Fig. 2(b)

is always distinct, but in the former it is unique. Plato posits two infinites, the *Great* and the *Small*.[10]

On the other hand, all those who are concerned with nature always assign to the infinite a nature [a *substance*] which is distinct[11] from that of the so-called "elements", such as water or air or something between these. Of those who posit the elements to be finite, no one makes them infinite. But those who posit the elements to be infinite, like the various homogeneous elements in the case of Anaxagoras and the seeds of all

kinds of shapes in the case of Democritus, say that the infinite is a continuum by contact.

Now Anaxagoras adds that any part of a whole is a blend just like the whole because anything is observed to be generated from anything. It is from this that he seems to maintain that at one time all things were together, for example, this flesh and this bone and similarly any other thing, and so all of them, and at the same time too. For, according to him, there is a beginning of the separation not only of each thing but also of all; for since it is from such a body that a thing is generated and there is a generation of all things but not at the same time and, further, since there must be some principle of generation[12] (which is one and is called by him "*Intelligence*") and *Intelligence* works by thinking, which begins at some starting-point, it follows that at one time all things were necessarily together and started to be in motion at a certain time.

Democritus, on the other hand, says that of the primary things[13] no one comes from another; yet common body[14] as such is the principle of all of them, although they themselves differ in magnitude and shape.

It is clear from what has been said, then, that it is the task of the physicist to investigate the infinite. Now all thinkers have a good reason for positing the infinite as a principle.[15] For neither would they regard it as capable of existing in vain,[16] nor would they assign to it a power other than that of a principle; for every thing is either a principle or comes to be from a principle, but of the infinite there is no principle, since otherwise the infinite would have a limit.[17] Moreover, as a principle, it should be ungenerable and indestructible; for what is being generated must come to an end, and to every [process of] destruction there is a completion.[18] And so, as is our manner of saying, there is no principle of the infinite, but it itself is thought to be the principle of the other things, to contain all, to rule all (as is asserted by those who, besides the infinite, posit no other cause, such as *Intelligence* or *Friendship*), and to be divine[19] (for it is deathless and imperishable, as Anaximander and most of the natural philosophers say).

Conviction about the existence of the infinite might arise from the following five considerations:[20]

(1) From time, for this is regarded as infinite.

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

(3) If generation and destruction are not to come to an end, it will be only if there is an infinite source from which things to be generated can be taken.[21]

(4) From the view that what is finite always has its limits coincide with something [which contains it]; so if the finite is always limited by something, then there can be no ultimate limit.

(5) The greatest and most important point, which gives rise to a *difficulty* affecting everyone, is this: Numbers and mathematical magnitudes and [also] what is outside of the heaven are considered to be infinite because in thought they never come to an end.[22] And if that which is outside of the heaven is infinite, then it seems that there is also an infinite body and an infinity of universes; for why should mass be in one part of the void[23] rather than in another? So if indeed it is in one part, then it should be everywhere. Also, if void or place is infinite, then there must be an infinite body, too;[24] for, in the case of eternal things, that which may be does not differ from that which exists.[25]

Now the investigation of the infinite gives rise to a *difficulty;* for many impossibilities result whether it is posited to exist or not to exist. Moreover, if existing, how does it exist—as a substance or as an essential attribute of some nature?[26] Or does it exist in neither of these ways, but an infinity or an infinite plurality of things nevertheless exist?[27]

Now it belongs most of all to the physicist to inquire whether there exists a sensible magnitude which is infinite.[28] First, then, let us distinguish the various meanings of the term "infinite". The infinite is

(1) That which cannot be gone through, since it does not by nature admit of being gone through, as in the case of a voice, which is invisible.[29]

(2) That which admits of being traversed but without end, either (a) almost so [i.e., almost without end] or (b) when by nature it admits of being traversed but it cannot be traversed or it has no limit.[30]

Further, everything considered as infinite may be so either with respect to addition or with respect to division or with respect to both.[31]

5

Now the infinite, being itself just an infinite,[1] cannot exist as something separate from sensible things;[2] for if it is neither a magnitude nor a plurality[3] but is itself a substance and not an attribute, it will be indivisible,[4] for what is divisible is either a magnitude or a plurality; and if it is indivisible, it cannot be infinite, except in the sense in which the voice is invisible.[5] However, neither those who assert that the infinite exists speak of it as existing in this manner[6] nor do we inquire about it as such, but only as something which cannot be traversed.[7]

But if the infinite exists as an attribute, then just as invisibility is not an element of speech, even if voice is invisible, so the infinite qua infinite would not be an element[8] of things. Moreover, how can the infinite be itself something if it is not also a number or a magnitude, of which that infinite is an essential *attribute*?[9] And besides, the infinite will be of necessity less likely to exist than a number or a magnitude.[10]

It is also evident that the infinite cannot exist as a thing in *actuality*

and as a substance[11] and a principle; for, if it can have parts, each part that may be taken would be infinite. For to be infinite and the infinite would be the same[12] if the infinite were indeed a substance[11] and not an attribute of a subject; so it would be either indivisible or divisible into infinites. But the same thing cannot be [in actuality] many infinites;[13] and besides, just as a part of air is air, so a part of the infinite would be infinite, if it were a substance and a principle.[14] The infinite, then, must be without parts and indivisible. But the infinite as a thing in *actuality* cannot be so; for it must be a quantity. It exists, then, as an attribute; but if so, it was stated that it is not the infinite that can be truly called "a principle" but that of which it is an attribute, for example, air or the *Even*. So those who speak like the Pythagoreans do so absurdly, for they posit the infinite both as a substance and as divisible into parts.[15]

However, perhaps this is a more universal inquiry, that is, whether
204*b* the infinite can be in mathematical objects as well as in those which are intelligible and have no magnitude.[16] We are now examining the sensible objects and those with which our *inquiry* is concerned, and we are asking if there is among them a body which is infinite in the direction of increase.

If we consider the problem logically,[17] it would seem from the following that no such body can exist; for if the formula of a body is "that which is limited by a surface", no infinite body can exist, whether intelligible or sensible. Moreover, also a number cannot exist as something separate and infinite; for a number or that which has a number is numerable, so if the numerable may be numbered, it would also be possible to traverse the infinite.[18]

If we consider the problem rather from the point of view of physics, it would seem from what follows that no infinite body can be either (1) composite or (2) simple.

(1) If the [kinds of] elements[19] are finite in number, an infinite body cannot exist. For it is necessary that the elements be more than one, that the contraries always balance, and that no one of these be infinite; for however much one contrary in one body falls short in power relative to the other contrary in another body (for example, if fire is finite and air is infinite, but, volume for volume, the power of fire is any multiple m relative to that of air, as long as m is a number), still it is evident that the infinite body will overpower and destroy the finite body.[20] Nor is it possible for each element to be infinite; for (a) a body is that which is extended in all directions, (b) what is infinite would be infinitely extended, and so an infinite body would be infinitely extended in all directions.[21]

(2) Nor can there be an infinite body which is one and simple, whether

(a) as something which exists apart from the elements and from which the elements[22] are generated (as some thinkers say) or (b) as something without any qualification. For (a) there are some who posit the infinite in the first sense, and not as being air or water, since thus there would be no infinite element which might destroy the other finite elements. For these elements have contrarieties relative to each other (for example, air is cold, water is moist, and fire is hot); so if one of them were infinite, it would have already destroyed the others, and so they say that the infinite from which these elements are generated is distinct from them.[23] However, no such body can exist, not in view of its infiniteness (for, in connection with this, something common should be stated which applies to all alike, whether to air or water or whatever this may be), but in view of the fact that no such sensible body exists besides the so-called "elements". For, in all cases, a body is resolved into that of which it consists; so such a body would have existed besides air and fire and earth and water, but no such body appears to exist. Also,
205*a* it is not possible for fire or for any of the other elements to be infinite. For, in general, even apart from the problem of whether any of them can be infinite, it is impossible for the universe, even if it were finite, to be or to become one of them, as Heraclitus says that at times all things become fire; and the same argument applies to the one [element], which the physicists posit besides the elements; for all things are changing, from one contrary to another contrary, for example, from hot to cold.[24]

Whether an infinite sensible body can exist or not should also be examined from what follows.

That it is impossible, in general, for an infinite sensible body to exist is clear from the following. Every sensible body is by its nature somewhere, and for each such body there is a [proper] place, the same for the whole and for a part of it, for example, the same for all the Earth and a clod, for fire and a spark.[25] So if such an infinite body is alike in kind, either it will be motionless or it will always be in motion with respect to place. But this is impossible; for why should it travel up rather than down or to any other place or *rest* at one rather than at any other of these places?[26] For example, what I mean is that if there is a clod, where will it be moved or where will it rest? For its place is the infinite place of the body which is alike in kind and of which it is a part.[27] Will it[28] then occupy the whole place? And how? Which, then, or where will its [loco]motion or *rest* be?[29] It will either be *resting* everywhere, in which case it will not be in motion, or it will be moving everywhere, in which case it will not be at a standstill.[30]

But if the universe is composed of unlike parts,[31] there will also be unlike places;[32] then first, the body of the universe will not be one except by contact, and second, those parts will be either finite or infinite in

kind. They cannot be finite; for if the universe is infinite, some parts[33] will have to be infinite and others not, as in the case of fire and water, and in such a case there will be a destruction by a contrary, as it was stated earlier.[34] And it is because of this that none of the natural philosophers posited the *One* or the *Infinite*[35] to be fire or earth, but either water or air or something between these two,[36] seeing that the place of each of the former [fire, earth] is clearly definite,[37] while each of the latter lies in a place between [up and down].

On the other hand, if the parts are infinite [in kind] and simple, the places will also be infinite [in number], and the elements will be infinite.[38] So if this is impossible and the places are finite [in number], the whole too must be finite; for it is impossible for the places and the corresponding bodies not to fit each other exactly, since neither can each place be larger than the corresponding body it contains (and then the body will not be infinite) nor can the body be larger than its corresponding place[39] (otherwise, either void will exist,[40] or there will be a body whose nature is to be in no place).[41]

Anaxagoras speaks absurdly concerning the *Infinite* as being at *rest* with respect to place. He says the *Infinite* holds itself fixed, and it does this in view of the fact that it is in itself, for nothing else contains it, as if saying that wherever a thing is, it is there by its nature. But this is not true; for a thing might be somewhere by force and not by its nature.[42] So, however true it may be that the whole is not in motion (for that which holds itself fixed and is in itself cannot be in motion), still he should state why it is not its nature to be in motion; for it is not enough to make a statement in this manner and let it go at that. Other things, too, might not be in motion, but nothing would prevent them from being so and yet having a nature to be in motion. Thus the Earth does not move to any place, even if it were infinite; but it is held together at the Center. And it would *rest* at the Center not because there is no other place to which it might travel, but because it is not its nature to move to another place;[43] and we might still say in this case that the Earth holds itself fixed. So if the Earth, assumed infinite, holds itself fixed not because of its being infinite but by the fact that it is heavy, and *what is* heavy *rests* at the Center and the Earth is at the Center, then in a similar way the *Infinite* too would *rest* in itself through some other cause and not by the fact that it is infinite and holds itself fixed.

It is at the same time clear that any part, too, should remain at *rest*; for just as the *Infinite* keeps itself fixed at *rest*, so will any part of it. For the places of the whole and of a part are the same in kind (for example, the place of the whole earth and of a clod is down and that of the whole fire and of a spark is up); so if the place of the *Infinite* is to have what is in itself, so will the place of a part. Hence, the part will *rest* in itself.[44]

In general, if every sensible body is heavy or light and if it goes by nature towards the Center when heavy but up when light, it is evident that one cannot truly say both that an infinite body exists and that each body has a [proper] place. For this must be the case also with the infinite body, but neither all of it nor each of its halves can be affected in either way.[45] For how will one divide it,[46] or how will one part of the infinite be up and another down, or one part at the extreme and another at the Center?[47]

Further, every sensible body is in a place, and the species or differentiae of place are up, down, front, behind, right, and left, and these are specified not only relative to us or in position[48] but also in the whole[49] itself; yet these cannot exist in the infinite. And, without qualification, if no infinite place can exist and if every body is in a place, then no infinite body can exist. Moreover, that which is somewhere is in a place, and that which is in a place is somewhere.[50] So if the infinite cannot be a quantity (for if it were, it would have to be some quantity, e.g., two feet or three feet or the like, since it is these that "quantity" signifies), then likewise it cannot be in a place; for if it were, it would have to be somewhere, and this would be up or down or in some other of the six directions, each of which is a boundary.[51]

It is evident from what has been said, then, that no infinite body exists in *actuality*.

6

That many impossibilities result if the infinite, taken without qualification,[1] does not exist is clear from what will follow, namely, (a) there will be a beginning and an end of time, (b) magnitudes will not [always] be divisible into magnitudes, and (c) there will not be an infinite number.[2]

If no alternative appears possible when things are stated in this manner, then an arbiter is needed; and clearly there is a way in which the infinite exists and a way in whch it does not. Indeed, in one sense, "to be" *is used for what exists potentially, and in another, for what exists* actually; moreover, the infinite exists by addition and also by removal.[3] That the infinite does not exist in actuality has already been stated,[4] but it exists by division; and it is not hard to reject the hypothesis that *indivisible* lines exists.[5] Accordingly, we are left with the alternative that the infinite exists potentially.

However, the potential existence of the infinite must not be taken to be like that of a statue; for what is potentially a statue may come to be *actually* a statue, but this is not so for what is potentially infinite.[6] But

since "to be" has many senses, the infinite exists in the sense in which the day exists or games exist, namely, by always coming into being one after another; for these too exist both potentially and actually, e.g., Olympic games exist both in the sense that they *can* come to be and in the sense that they are *occuring*. However, it is clear that there is a distinction in the way in which the infinite exists in time and in men and in the division of magnitudes. For, although in general the infinite exists in the sense that one thing is always being taken after another, each thing so taken being always finite but always another and another (hence, the infinite should not be considered as being a *this*, e.g., a man or a house, but as we speak of a day or a game whose being, even if finite, is always in generation and destruction, not as something which became a *substance*, but always becoming one thing after another), yet in the case of magnitudes the parts taken persist, while in the case of time and of men they are destroyed but not exhausted.[7]

The infinite by addition is in a sense the same as that by division,[8] for in a finite magnitude the infinite by addition occurs in a way inverse to that by division; for as that magnitude is seen to be divided to infinity, the sum of the parts taken appears to tend toward something definite. For if in a finite magnitude one takes a definite part and then from what remains keeps on taking a part, not equal to the first part but always using the same ratio,[9] he will not traverse the original finite magnitude; but if he is to so increase the ratio that the parts taken are always equal, he will traverse it, because every finite magnitude is exhausted by any definite magnitude.[10] Thus it is in this and not in any other way that the infinite[11] exists, namely, potentially and by reduction. And it exists actually in the way in which a day and the games are said to exist,[12] and potentially in the way in which matter exists; and, unlike that which is limited, it exists not by itself.[13]

And the infinite by addition exists potentially in this manner,[14] which as we said is in a sense the same as that by division; for although there is always something outside of it that can be taken, it will not surpass every definite magnitude, unlike the infinite by division, which surpasses in smallness any given definite magnitude and remains smaller thereafter. As to surpassing every magnitude by addition, the infinite cannot do so even potentially if indeed it does not exist actually as an attribute;[15] and this is unlike what the natural philosophers say, namely, that the body which is outside of the world, whose *substance* is air or some other such thing, is infinite. But if no sensible body can be actually infinite in this manner,[16] it is evident that neither can it exist potentially by addition, except in a manner inverse to that by division, as already stated. It is because of this that Plato, too, posited two infinites,[17] namely, in view of the fact that it is thought possible to surpass all

magnitudes and proceed to infinity in the direction both of increase and of reduction. Yet though he posits two infinites, he does not make any use of them; for neither in numbers does the infinite exist in the direction of reduction, seeing that the unit is the smallest, nor in the direction of increase, seeing that he posits Numbers up to Ten only.[18]

Now the infinite turns out to be the contrary of what they say it is; for it is not that outside of which there is nothing, but that outside of which there is always something. A sign of this is the following: People say that rings without a bezel are infinite [endless] as there is always some-

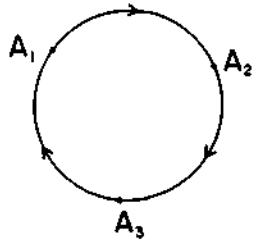

Fig. 3

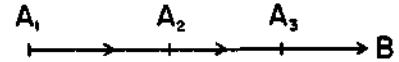

Fig. 4

thing outside [beyond] that may be taken. But they say this in virtue of some similarity and not in the main sense;[19] for both (a) this[20] must be the case and (b) the same thing must not be taken again, while in the circle this is not what happens but [only] (a) the succeeding part is always distinct.[21] Thus the infinite is that outside of which, with respect to taking a quantity, there is always some part [yet] to be taken.[22] On the other hand, that of which there is no part outside is complete or a whole; for this is how we define a whole,[23] namely, that from which no part is absent, as in the case of a whole man or a whole box. And as in the case of each individual, so it is when the term "whole" is considered in the main sense,[24] that is, the whole is that outside of which no part exists; but, in every case, that from which there is a part absent (whatever that part may be) is not a whole. The whole and the complete are either entirely the same or quite close in their nature.[25] Nothing is complete which has no end, and the end is a limit.

In view of this, Parmenides must be considered to have spoken better than Melissus; for the latter says that the whole is infinite,[26] while the former says that the whole is finite and equally balanced from the middle. For to attach the infinite to the universe or the whole is not *to tie a string to a string*,[27] although it is because of some similarity to the whole that they attribute dignity to the infinite (namely, that of containing all things and of having in itself the universe). For the infinite is the matter of the completeness of a magnitude and is potentially the

whole and not actually,[28] and it is distinguishable as proceeding in the direction of both reduction and its inverse, which is addition; and as for its being a whole and finite, it is not so in itself but in virtue of something else.[29] And qua infinite it does not contain but is contained; and because of this, it is unknowable qua infinite, for matter has no form.[30] So it is evident that the infinite is in the formula of a part rather than in that of a whole; for the matter [of a whole thing] is a part of the whole, just as the bronze in the case of a bronze statue, since if, we might add, in both sensible and intelligible things the *Great* and *Small* does indeed act as a container, it should contain the intelligibles.[31] But it is absurd and impossible for the unknowable and the indefinite to contain or to limit [something else].

7

It is according to reason, too, to think that no infinite by addition is such as to surpass every magnitude, but that every magnitude may be surpassed in smallness by an infinite by division; for, like matter, the infinite too is contained inside, while it is the form which contains.[1] It is also reasonable to think that (a) in numbers there is a limit in the direction of the least, but in the direction of the greater every plurality can always be surpassed, (b) while in magnitudes, on the contrary, every given magnitude can be surpassed in the direction of the less, but in the direction of the greater there can be no infinite magnitude.

The *reason* for this is the fact that the one[2] is indivisible, whatever it is that is just one; for example, a man is one man and not many; but a number is many ones or a quantity of things. Hence, in numbers, there must be a stop in the direction of the indivisible, for "two" and "three" are derivative terms,[3] and the same applies to each term which signifies a number. In the direction of the greater, however, it is always possible to think of a greater number, for the bisections of a magnitude may be infinite, so [in this direction] an infinite number exists potentially and not actually.[4] But this number will always surpass any definite plurality as the parts are taken one after another; yet neither is it separable from that bisection,[5] nor does its infiniteness *rest* but is in the process of becoming, as in the case of time and the number of time.[6]

With magnitudes, the contrary is the case, for the continuous is infinitely divisible; but there is no infinite in the direction of the greater, for whatever size a [sensible] magnitude may be potentially, it may also be *actually*. Hence, since no sensible magnitude can be infinite, it is not possible to exceed every definite magnitude; otherwise, something greater than the heaven would be possible.[7]

The infinite is not the same in magnitude and in motion and in time in the sense that it is one nature, but the infinite which is posterior is named according to the infinite which is prior; for example, the motion of a thing is called "infinite" in view of the fact that the magnitude over which the thing is being moved or is being altered or is growing is infinite, and time is infinite because motion is infinite. At present, these are taken for granted, but later we shall try to state what each of them is and why every magnitude is divisible into magnitudes.[8]

Our account, which rejects the infinite as existing in *actuality* and as being untraversible in the direction of increase, does not deprive the mathematicians from investigating their objects; for neither do they need it nor do they use it in this way,[9] but only in the way in which, for example, they extend a finite line as far as they wish, and any magnitude may be divided in the same ratio as that in which the greatest magnitude may.[10] Thus, as far as proofs are concerned, an infinite of this sort makes no difference, but as for the existence of an infinite, it is in existing magnitudes.

As there are four senses of "cause", it is evident that the infinite is a cause as matter and that its being is a privation,[11] and the subject in virtue of which it exists is that which is continuous and sensible.[12] All the other thinkers who use the infinite appear likewise to use it as matter;[13] and for this reason, too, it is absurd that they should posit it as containing and not as being contained.

8

It remains to meet the arguments according to which the infinite is thought to exist not only potentially but as something definite, for some of them are not necessary, and there are true replies for the others.[1]

(1) If generation is to come to an end, it is not necessary that an infinite sensible body exist in *actuality*; for the destruction of one thing may be the generation of another, while the whole universe remains finite.[2]

(2) To touch and to be limited are distinct. The first is related to something else or is of something else (for every thing that touches does touch something else) and is an accident of something which is finite;[3] but neither is that which is limited [necessarily] related to something else (since its limit is only in itself), nor is it possible for any chance thing to touch any other chance thing.

(3) To base our convictions on [just] thinking is absurd, for excess and deficiency here are not in the things but in thinking. For one might think that each of us is becoming many times greater than our [actual]

size and that we might continue doing so to infinity. But because of this, that is, of the fact that one so thinks, it does not follow that we are beyond the city or that we exceed our own size; we are as great as we are, and that one is thinking about it is an accident.[4]

(4) Concerning time and motion, they are infinite, and so is thinking, but each part that is taken does not remain.[5]

(5) As for a magnitude, it cannot be infinite [in *actuality*], whether by way of reduction or by increase through thought.[6]

We have stated, then, how the infinite exists, how it does not exist, and what it is.

Book Δ

1

208*a* As in the case of the infinite, so in that of place the physicist must know if it exists or not, how it exists, and what it is; for all believe[1] that existing things are somewhere (nonbeing, on the other hand, is nowhere; for where is a goat-stag or a sphinx?) and that the most common and most independent[2] motion, which we call "locomotion", is a motion with respect to place.

As to what a place is, there are many problems that arise; for if a place is viewed from all [the attributes] that belong to it, it does not appear to be the same. Moreover, nothing is available to us from the previous thinkers by way of a statement of the *difficulties* about it or of a solution.

208*b* That a place exists seems clear from the replacement of one thing by another, for where water is at one time, at a later time air will be there after the water has gone out as from a vessel; and since it is the same place that is occupied by different bodies, that place is then thought to be distinct from all the bodies which come to be in it and replace each other. For *that* in which air is now, in *that* there was water earlier; so, clearly the place or space[3] into which these came and out of which they went would be distinct from each of them.

Moreover, the locomotions of physical bodies and of simple bodies (e.g., of fire, earth, and the like) make it clear not only that a place is some thing, but also that it has some power. For each of those bodies, if not prevented, travels to its own place, some of them up and others down;[4] and these (up and down and the rest of the six directions) are parts and species of place. Now such directions (up, down, right, left, etc.) do not exist only relative to us; for to us a thing is not always the same in direction but changes according as we change our position, whichever way we may happen to turn, and so the same thing often is now to the right, now to the left, now up, now down, now ahead, now behind. By nature, on the other hand, each of these is distinct and exists