



# PHYSICS

BY ARISTOTLE

## Book 7

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### 1

EVERYTHING that is in motion must be moved by something. For if it has not the source of its motion in itself it is evident that it is moved by something other than itself, for there must be something else that moves it. If on the other hand it has the source of its motion in itself, let AB be taken to represent that which is in motion essentially of itself and not in virtue of the fact that something belonging to it is in motion. Now in the first place to assume that AB, because it is in motion as a whole and is not moved by anything external to itself, is therefore moved by itself-this is just as if, supposing that KL is moving LM and is also itself in motion, we were to deny that KM is moved by anything on the ground that it is not evident which is the part that is moving it and which the part that is moved. In the second place that which is in motion without being moved by anything does not necessarily cease from its motion because something else is at rest, but a thing must be moved by something if the fact of something else having ceased from its motion causes it to be at rest. Thus, if this is accepted, everything that is in motion must be moved by something. For AB, which has been taken to represent that which is in motion, must be divisible since everything that is in motion is divisible. Let it be divided, then, at G. Now if GB is not in motion, then AB will not be in motion: for if it is, it is clear that AG would be in motion while BG is at rest, and thus AB cannot be in motion essentially and primarily. But ex hypothesi AB is in motion essentially and primarily. Therefore if GB is not in motion AB will be at rest. But we have agreed that that which is at rest if something else is not in motion must be moved by something. Consequently, everything that is in motion must be moved by something: for that which is in motion will always be divisible, and if a part of it is not in motion the whole must be at rest.

Since everything that is in motion must be moved by something, let us take the case in which a thing is in locomotion and is moved by something that is itself in motion, and that again is moved by something else that is in motion, and that by something else, and

so on continually: then the series cannot go on to infinity, but there must be some first movent. For let us suppose that this is not so and take the series to be infinite. Let A then be moved by B, B by G, G by D, and so on, each member of the series being moved by that which comes next to it. Then since *ex hypothesi* the movent while causing motion is also itself in motion, and the motion of the moved and the motion of the movent must proceed simultaneously (for the movent is causing motion and the moved is being moved simultaneously) it is evident that the respective motions of A, B, G, and each of the other moved movents are simultaneous. Let us take the motion of each separately and let E be the motion of A, Z of B, and H and O respectively the motions of G and D: for though they are all moved severally one by another, yet we may still take the motion of each as numerically one, since every motion is from something to something and is not infinite in respect of its extreme points. By a motion that is numerically one I mean a motion that proceeds from something numerically one and the same to something numerically one and the same in a period of time numerically one and the same: for a motion may be the same generically, specifically, or numerically: it is generically the same if it belongs to the same category, e.g. substance or quality: it is specifically the same if it proceeds from something specifically the same to something specifically the same, e.g. from white to black or from good to bad, which is not of a kind specifically distinct: it is numerically the same if it proceeds from something numerically one to something numerically one in the same period of time, e.g. from a particular white to a particular black, or from a particular place to a particular place, in a particular period of time: for if the period of time were not one and the same, the motion would no longer be numerically one though it would still be specifically one.

We have dealt with this question above. Now let us further take the time in which A has completed its motion, and let it be represented by K. Then since the motion of A is finite the time will also be finite. But since the movents and the things moved are infinite, the motion EZHO, i.e. the motion that is composed of all the individual motions, must be infinite. For the motions of A, B, and the others may be equal, or the motions of the others may be greater: but assuming what is conceivable, we find that whether they are equal or some are greater, in both cases the whole motion is infinite. And since the motion of A and that of each of the others are simultaneous, the whole motion must occupy the same time as the motion of A: but the time occupied by the motion of A is finite: consequently the motion will be infinite in a finite time, which is impossible.

It might be thought that what we set out to prove has thus been shown, but our argument so far does not prove it, because it does not yet prove that anything impossible results

from the contrary supposition: for in a finite time there may be an infinite motion, though not of one thing, but of many: and in the case that we are considering this is so: for each thing accomplishes its own motion, and there is no impossibility in many things being in motion simultaneously. But if (as we see to be universally the case) that which primarily is moved locally and corporeally must be either in contact with or continuous with that which moves it, the things moved and the movents must be continuous or in contact with one another, so that together they all form a single unity: whether this unity is finite or infinite makes no difference to our present argument; for in any case since the things in motion are infinite in number the whole motion will be infinite, if, as is theoretically possible, each motion is either equal to or greater than that which follows it in the series: for we shall take as actual that which is theoretically possible. If, then, A, B, G, D form an infinite magnitude that passes through the motion EZHO in the finite time K, this involves the conclusion that an infinite motion is passed through in a finite time: and whether the magnitude in question is finite or infinite this is in either case impossible. Therefore the series must come to an end, and there must be a first movent and a first moved: for the fact that this impossibility results only from the assumption of a particular case is immaterial, since the case assumed is theoretically possible, and the assumption of a theoretically possible case ought not to give rise to any impossible result.

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That which is the first movement of a thing-in the sense that it supplies not ‘that for the sake of which’ but the source of the motion-is always together with that which is moved by it by ‘together’ I mean that there is nothing intermediate between them). This is universally true wherever one thing is moved by another. And since there are three kinds of motion, local, qualitative, and quantitative, there must also be three kinds of movent, that which causes locomotion, that which causes alteration, and that which causes increase or decrease.

Let us begin with locomotion, for this is the primary motion. Everything that is in locomotion is moved either by itself or by something else. In the case of things that are moved by themselves it is evident that the moved and the movent are together: for they contain within themselves their first movent, so that there is nothing in between. The motion of things that are moved by something else must proceed in one of four ways: for there are four kinds of locomotion caused by something other than that which is in motion, viz. pulling, pushing, carrying, and twirling. All forms of locomotion are reducible to these. Thus pushing on is a form of pushing in which that which is causing motion away

from itself follows up that which it pushes and continues to push it: pushing off occurs when the movent does not follow up the thing that it has moved: throwing when the movent causes a motion away from itself more violent than the natural locomotion of the thing moved, which continues its course so long as it is controlled by the motion imparted to it. Again, pushing apart and pushing together are forms respectively of pushing off and pulling: pushing apart is pushing off, which may be a motion either away from the pusher or away from something else, while pushing together is pulling, which may be a motion towards something else as well as the puller. We may similarly classify all the varieties of these last two, e.g. packing and combing: the former is a form of pushing together, the latter a form of pushing apart. The same is true of the other processes of combination and separation (they will all be found to be forms of pushing apart or of pushing together), except such as are involved in the processes of becoming and perishing. (At same time it is evident that there is no other kind of motion but combination and separation: for they may all be apportioned to one or other of those already mentioned.) Again, inhaling is a form of pulling, exhaling a form of pushing: and the same is true of spitting and of all other motions that proceed through the body, whether secretive or assimilative, the assimilative being forms of pulling, the secretive of pushing off. All other kinds of locomotion must be similarly reduced, for they all fall under one or other of our four heads. And again, of these four, carrying and twirling are to pulling and pushing. For carrying always follows one of the other three methods, for that which is carried is in motion accidentally, because it is in or upon something that is in motion, and that which carries it is in doing so being either pulled or pushed or twirled; thus carrying belongs to all the other three kinds of motion in common. And twirling is a compound of pulling and pushing, for that which is twirling a thing must be pulling one part of the thing and pushing another part, since it impels one part away from itself and another part towards itself. If, therefore, it can be shown that that which is pushing and that which is pushing and pulling are adjacent respectively to that which is being pushed and that which is being pulled, it will be evident that in all locomotion there is nothing intermediate between moved and movent. But the former fact is clear even from the definitions of pushing and pulling, for pushing is motion to something else from oneself or from something else, and pulling is motion from something else to oneself or to something else, when the motion of that which is pulling is quicker than the motion that would separate from one another the two things that are continuous: for it is this that causes one thing to be pulled on along with the other. (It might indeed be thought that there is a form of pulling that arises in another way: that wood, e.g. pulls fire in a manner different from that described above. But it makes no difference whether that which pulls is in motion or is stationary when it is pulling: in the

latter case it pulls to the place where it is, while in the former it pulls to the place where it was.) Now it is impossible to move anything either from oneself to something else or something else to oneself without being in contact with it: it is evident, therefore, that in all locomotion there is nothing intermediate between moved and movent.

Nor again is there anything intermediate between that which undergoes and that which causes alteration: this can be proved by induction: for in every case we find that the respective extremities of that which causes and that which undergoes alteration are adjacent. For our assumption is that things that are undergoing alteration are altered in virtue of their being affected in respect of their so-called affective qualities, since that which is of a certain quality is altered in so far as it is sensible, and the characteristics in which bodies differ from one another are sensible characteristics: for every body differs from another in possessing a greater or lesser number of sensible characteristics or in possessing the same sensible characteristics in a greater or lesser degree. But the alteration of that which undergoes alteration is also caused by the above-mentioned characteristics, which are affections of some particular underlying quality. Thus we say that a thing is altered by becoming hot or sweet or thick or dry or white: and we make these assertions alike of what is inanimate and of what is animate, and further, where animate things are in question, we make them both of the parts that have no power of sense-perception and of the senses themselves. For in a way even the senses undergo alteration, since the active sense is a motion through the body in the course of which the sense is affected in a certain way. We see, then, that the animate is capable of every kind of alteration of which the inanimate is capable: but the inanimate is not capable of every kind of alteration of which the animate is capable, since it is not capable of alteration in respect of the senses: moreover the inanimate is unconscious of being affected by alteration, whereas the animate is conscious of it, though there is nothing to prevent the animate also being unconscious of it when the process of the alteration does not concern the senses. Since, then, the alteration of that which undergoes alteration is caused by sensible things, in every case of such alteration it is evident that the respective extremities of that which causes and that which undergoes alteration are adjacent. Thus the air is continuous with that which causes the alteration, and the body that undergoes alteration is continuous with the air. Again, the colour is continuous with the light and the light with the sight. And the same is true of hearing and smelling: for the primary movent in respect to the moved is the air. Similarly, in the case of tasting, the flavour is adjacent to the sense of taste. And it is just the same in the case of things that are inanimate and incapable of sense-perception. Thus there can be nothing intermediate between that which undergoes and that which causes alteration.

Nor, again, can there be anything intermediate between that which suffers and that which causes increase: for the part of the latter that starts the increase does so by becoming attached in such a way to the former that the whole becomes one. Again, the decrease of that which suffers decrease is caused by a part of the thing becoming detached. So that which causes increase and that which causes decrease must be continuous with that which suffers increase and that which suffers decrease respectively: and if two things are continuous with one another there can be nothing intermediate between them.

It is evident, therefore, that between the extremities of the moved and the movent that are respectively first and last in reference to the moved there is nothing intermediate.

3

Everything, we say, that undergoes alteration is altered by sensible causes, and there is alteration only in things that are said to be essentially affected by sensible things. The truth of this is to be seen from the following considerations. Of all other things it would be most natural to suppose that there is alteration in figures and shapes, and in acquired states and in the processes of acquiring and losing these: but as a matter of fact in neither of these two classes of things is there alteration.

In the first place, when a particular formation of a thing is completed, we do not call it by the name of its material: e.g. we do not call the statue 'bronze' or the pyramid 'wax' or the bed 'wood', but we use a derived expression and call them 'of bronze', 'waxen', and 'wooden' respectively. But when a thing has been affected and altered in any way we still call it by the original name: thus we speak of the bronze or the wax being dry or fluid or hard or hot.

And not only so: we also speak of the particular fluid or hot substance as being bronze, giving the material the same name as that which we use to describe the affection.

Since, therefore, having regard to the figure or shape of a thing we no longer call that which has become of a certain figure by the name of the material that exhibits the figure, whereas having regard to a thing's affections or alterations we still call it by the name of its material, it is evident that becomings of the former kind cannot be alterations.

Moreover it would seem absurd even to speak in this way, to speak, that is to say, of a man or house or anything else that has come into existence as having been altered.

Though it may be true that every such becoming is necessarily the result of something's being altered, the result, e.g. of the material's being condensed or rarefied or heated or cooled, nevertheless it is not the things that are coming into existence that are altered, and their becoming is not an alteration.

Again, acquired states, whether of the body or of the soul, are not alterations. For some are excellences and others are defects, and neither excellence nor defect is an alteration: excellence is a perfection (for when anything acquires its proper excellence we call it perfect, since it is then if ever that we have a thing in its natural state: e.g. we have a perfect circle when we have one as good as possible), while defect is a perishing of or departure from this condition. So as when speaking of a house we do not call its arrival at perfection an alteration (for it would be absurd to suppose that the coping or the tiling is an alteration or that in receiving its coping or its tiling a house is altered and not perfected), the same also holds good in the case of excellences and defects and of the persons or things that possess or acquire them: for excellences are perfections of a thing's nature and defects are departures from it: consequently they are not alterations.

Further, we say that all excellences depend upon particular relations. Thus bodily excellences such as health and a good state of body we regard as consisting in a blending of hot and cold elements within the body in due proportion, in relation either to one another or to the surrounding atmosphere: and in like manner we regard beauty, strength, and all the other bodily excellences and defects. Each of them exists in virtue of a particular relation and puts that which possesses it in a good or bad condition with regard to its proper affections, where by 'proper' affections I mean those influences that from the natural constitution of a thing tend to promote or destroy its existence. Since then, relatives are neither themselves alterations nor the subjects of alteration or of becoming or in fact of any change whatever, it is evident that neither states nor the processes of losing and acquiring states are alterations, though it may be true that their becoming or perishing is necessarily, like the becoming or perishing of a specific character or form, the result of the alteration of certain other things, e.g. hot and cold or dry and wet elements or the elements, whatever they may be, on which the states primarily depend. For each several bodily defect or excellence involves a relation with those things from which the possessor of the defect or excellence is naturally subject to alteration: thus excellence disposes its possessor to be unaffected by these influences or to be affected by those of them that ought to be admitted, while defect disposes its possessor to be affected by them or to be unaffected by those of them that ought to be admitted.

And the case is similar in regard to the states of the soul, all of which (like those of body) exist in virtue of particular relations, the excellences being perfections of nature and the defects departures from it: moreover, excellence puts its possessor in good condition, while defect puts its possessor in a bad condition, to meet his proper affections. Consequently these cannot any more than the bodily states be alterations, nor can the processes of losing and acquiring them be so, though their becoming is necessarily the result of an alteration of the sensitive part of the soul, and this is altered by sensible objects: for all moral excellence is concerned with bodily pleasures and pains, which again depend either upon acting or upon remembering or upon anticipating. Now those that depend upon action are determined by sense-perception, i.e. they are stimulated by something sensible: and those that depend upon memory or anticipation are likewise to be traced to sense-perception, for in these cases pleasure is felt either in remembering what one has experienced or in anticipating what one is going to experience. Thus all pleasure of this kind must be produced by sensible things: and since the presence in any one of moral defect or excellence involves the presence in him of pleasure or pain (with which moral excellence and defect are always concerned), and these pleasures and pains are alterations of the sensitive part, it is evident that the loss and acquisition of these states no less than the loss and acquisition of the states of the body must be the result of the alteration of something else. Consequently, though their becoming is accompanied by an alteration, they are not themselves alterations.

Again, the states of the intellectual part of the soul are not alterations, nor is there any becoming of them. In the first place it is much more true of the possession of knowledge that it depends upon a particular relation. And further, it is evident that there is no becoming of these states. For that which is potentially possessed of knowledge becomes actually possessed of it not by being set in motion at all itself but by reason of the presence of something else: i.e. it is when it meets with the particular object that it knows in a manner the particular through its knowledge of the universal. (Again, there is no becoming of the actual use and activity of these states, unless it is thought that there is a becoming of vision and touching and that the activity in question is similar to these.) And the original acquisition of knowledge is not a becoming or an alteration: for the terms 'knowing' and 'understanding' imply that the intellect has reached a state of rest and come to a standstill, and there is no becoming that leads to a state of rest, since, as we have said above, change at all can have a becoming. Moreover, just as to say, when any one has passed from a state of intoxication or sleep or disease to the contrary state, that he has become possessed of knowledge again is incorrect in spite of the fact that he was previously incapable of

using his knowledge, so, too, when any one originally acquires the state, it is incorrect to say that he becomes possessed of knowledge: for the possession of understanding and knowledge is produced by the soul's settling down out of the restlessness natural to it. Hence, too, in learning and in forming judgements on matters relating to their sense-perceptions children are inferior to adults owing to the great amount of restlessness and motion in their souls. Nature itself causes the soul to settle down and come to a state of rest for the performance of some of its functions, while for the performance of others other things do so: but in either case the result is brought about through the alteration of something in the body, as we see in the case of the use and activity of the intellect arising from a man's becoming sober or being awakened. It is evident, then, from the preceding argument that alteration and being altered occur in sensible things and in the sensitive part of the soul, and, except accidentally, in nothing else.

## 4

A difficulty may be raised as to whether every motion is commensurable with every other or not. Now if they are all commensurable and if two things to have the same velocity must accomplish an equal motion in an equal time, then we may have a circumference equal to a straight line, or, of course, the one may be greater or less than the other. Further, if one thing alters and another accomplishes a locomotion in an equal time, we may have an alteration and a locomotion equal to one another: thus an affection will be equal to a length, which is impossible. But is it not only when an equal motion is accomplished by two things in an equal time that the velocities of the two are equal? Now an affection cannot be equal to a length. Therefore there cannot be an alteration equal to or less than a locomotion: and consequently it is not the case that every motion is commensurable with every other.

But how will our conclusion work out in the case of the circle and the straight line? It would be absurd to suppose that the motion of one in a circle and of another in a straight line cannot be similar, but that the one must inevitably move more quickly or more slowly than the other, just as if the course of one were downhill and of the other uphill. Moreover it does not as a matter of fact make any difference to the argument to say that the one motion must inevitably be quicker or slower than the other: for then the circumference can be greater or less than the straight line; and if so it is possible for the two to be equal. For if in the time A the quicker (B) passes over the distance B' and the slower (G) passes over the distance G', B' will be greater than G': for this is what we took

‘quicker’ to mean: and so quicker motion also implies that one thing traverses an equal distance in less time than another: consequently there will be a part of A in which B will pass over a part of the circle equal to G’, while G will occupy the whole of A in passing over G’. None the less, if the two motions are commensurable, we are confronted with the consequence stated above, viz. that there may be a straight line equal to a circle. But these are not commensurable: and so the corresponding motions are not commensurable either.

But may we say that things are always commensurable if the same terms are applied to them without equivocation? e.g. a pen, a wine, and the highest note in a scale are not commensurable: we cannot say whether any one of them is sharper than any other: and why is this? they are incommensurable because it is only equivocally that the same term ‘sharp’ is applied to them: whereas the highest note in a scale is commensurable with the leading-note, because the term ‘sharp’ has the same meaning as applied to both. Can it be, then, that the term ‘quick’ has not the same meaning as applied to straight motion and to circular motion respectively? If so, far less will it have the same meaning as applied to alteration and to locomotion.

Or shall we in the first place deny that things are always commensurable if the same terms are applied to them without equivocation? For the term ‘much’ has the same meaning whether applied to water or to air, yet water and air are not commensurable in respect of it: or, if this illustration is not considered satisfactory, ‘double’ at any rate would seem to have the same meaning as applied to each (denoting in each case the proportion of two to one), yet water and air are not commensurable in respect of it. But here again may we not take up the same position and say that the term ‘much’ is equivocal? In fact there are some terms of which even the definitions are equivocal; e.g. if ‘much’ were defined as ‘so much and more’, ‘so much’ would mean something different in different cases: ‘equal’ is similarly equivocal; and ‘one’ again is perhaps inevitably an equivocal term; and if ‘one’ is equivocal, so is ‘two’. Otherwise why is it that some things are commensurable while others are not, if the nature of the attribute in the two cases is really one and the same?

Can it be that the incommensurability of two things in respect of any attribute is due to a difference in that which is primarily capable of carrying the attribute? Thus horse and dog are so commensurable that we may say which is the whiter, since that which primarily contains the whiteness is the same in both, viz. the surface: and similarly they are commensurable in respect of size. But water and speech are not commensurable in respect of clearness, since that which primarily contains the attribute is different in the

two cases. It would seem, however that we must reject this solution, since clearly we could thus make all equivocal attributes univocal and say merely that that contains each of them is different in different cases: thus 'equality', 'sweetness', and 'whiteness' will severally always be the same, though that which contains them is different in different cases. Moreover, it is not any casual thing that is capable of carrying any attribute: each single attribute can be carried primarily only by one single thing.

Must we then say that, if two things are to be commensurable in respect of any attribute, not only must the attribute in question be applicable to both without equivocation, but there must also be no specific differences either in the attribute itself or in that which contains the attribute—that these, I mean, must not be divisible in the way in which colour is divided into kinds? Thus in this respect one thing will not be commensurable with another, i.e. we cannot say that one is more coloured than the other where only colour in general and not any particular colour is meant; but they are commensurable in respect of whiteness.

Similarly in the case of motion: two things are of the same velocity if they occupy an equal time in accomplishing a certain equal amount of motion. Suppose, then, that in a certain time an alteration is undergone by one half of a body's length and a locomotion is accomplished the other half: can we say that in this case the alteration is equal to the locomotion and of the same velocity? That would be absurd, and the reason is that there are different species of motion. And if in consequence of this we must say that two things are of equal velocity if they accomplish locomotion over an equal distance in an equal time, we have to admit the equality of a straight line and a circumference. What, then, is the reason of this? Is it that locomotion is a genus or that line is a genus? (We may leave the time out of account, since that is one and the same.) If the lines are specifically different, the locomotions also differ specifically from one another: for locomotion is specifically differentiated according to the specific differentiation of that over which it takes place. (It is also similarly differentiated, it would seem, accordingly as the instrument of the locomotion is different: thus if feet are the instrument, it is walking, if wings it is flying; but perhaps we should rather say that this is not so, and that in this case the differences in the locomotion are merely differences of posture in that which is in motion.) We may say, therefore, that things are of equal velocity in an equal time they traverse the same magnitude: and when I call it 'the same' I mean that it contains no specific difference and therefore no difference in the motion that takes place over it. So we have now to consider how motion is differentiated: and this discussion serves to show that the genus

is not a unity but contains a plurality latent in it and distinct from it, and that in the case of equivocal terms sometimes the different senses in which they are used are far removed from one another, while sometimes there is a certain likeness between them, and sometimes again they are nearly related either generically or analogically, with the result that they seem not to be equivocal though they really are.

When, then, is there a difference of species? Is an attribute specifically different if the subject is different while the attribute is the same, or must the attribute itself be different as well? And how are we to define the limits of a species? What will enable us to decide that particular instances of whiteness or sweetness are the same or different? Is it enough that it appears different in one subject from what appears in another? Or must there be no sameness at all? And further, where alteration is in question, how is one alteration to be of equal velocity with another? One person may be cured quickly and another slowly, and cures may also be simultaneous: so that, recovery of health being an alteration, we have here alterations of equal velocity, since each alteration occupies an equal time. But what alteration? We cannot here speak of an 'equal' alteration: what corresponds in the category of quality to equality in the category of quantity is 'likeness'. However, let us say that there is equal velocity where the same change is accomplished in an equal time. Are we, then, to find the commensurability in the subject of the affection or in the affection itself? In the case that we have just been considering it is the fact that health is one and the same that enables us to arrive at the conclusion that the one alteration is neither more nor less than the other, but that both are alike. If on the other hand the affection is different in the two cases, e.g. when the alterations take the form of becoming white and becoming healthy respectively, here there is no sameness or equality or likeness inasmuch as the difference in the affections at once makes the alterations specifically different, and there is no unity of alteration any more than there would be unity of locomotion under like conditions. So we must find out how many species there are of alteration and of locomotion respectively. Now if the things that are in motion—that is to say, the things to which the motions belong essentially and not accidentally—differ specifically, then their respective motions will also differ specifically: if on the other hand they differ generically or numerically, the motions also will differ generically or numerically as the case may be. But there still remains the question whether, supposing that two alterations are of equal velocity, we ought to look for this equality in the sameness (or likeness) of the affections, or in the things altered, to see e.g. whether a certain quantity of each has become white. Or ought we not rather to look for it in both? That is to say, the alterations are the same or different according as the affections are the same or different, while they are equal or unequal according as the things altered are equal or unequal.

And now we must consider the same question in the case of becoming and perishing: how is one becoming of equal velocity with another? They are of equal velocity if in an equal time there are produced two things that are the same and specifically inseparable, e.g. two men (not merely generically inseparable as e.g. two animals). Similarly one is quicker than the other if in an equal time the product is different in the two cases. I state it thus because we have no pair of terms that will convey this 'difference' in the way in which unlikeness is conveyed. If we adopt the theory that it is number that constitutes being, we may indeed speak of a 'greater number' and a 'lesser number' within the same species, but there is no common term that will include both relations, nor are there terms to express each of them separately in the same way as we indicate a higher degree or preponderance of an affection by 'more', of a quantity by 'greater.'

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Now since wherever there is a movent, its motion always acts upon something, is always in something, and always extends to something (by 'is always in something' I mean that it occupies a time: and by 'extends to something' I mean that it involves the traversing of a certain amount of distance: for at any moment when a thing is causing motion, it also has caused motion, so that there must always be a certain amount of distance that has been traversed and a certain amount of time that has been occupied). then, A the movement have moved B a distance G in a time D, then in the same time the same force A will move  $\frac{1}{2}B$  twice the distance G, and in  $\frac{1}{2}D$  it will move  $\frac{1}{2}B$  the whole distance for G: thus the rules of proportion will be observed. Again if a given force move a given weight a certain distance in a certain time and half the distance in half the time, half the motive power will move half the weight the same distance in the same time. Let E represent half the motive power A and Z half the weight B: then the ratio between the motive power and the weight in the one case is similar and proportionate to the ratio in the other, so that each force will cause the same distance to be traversed in the same time. But if E move Z a distance G in a time D, it does not necessarily follow that E can move twice Z half the distance G in the same time. If, then, A move B a distance G in a time D, it does not follow that E, being half of A, will in the time D or in any fraction of it cause B to traverse a part of G the ratio between which and the whole of G is proportionate to that between A and E (whatever fraction of AE may be): in fact it might well be that it will cause no motion at all; for it does not follow that, if a given motive power causes a certain amount of motion, half that power will cause motion either of any particular

amount or in any length of time: otherwise one man might move a ship, since both the motive power of the ship-haulers and the distance that they all cause the ship to traverse are divisible into as many parts as there are men. Hence Zeno's reasoning is false when he argues that there is no part of the millet that does not make a sound: for there is no reason why any such part should not in any length of time fail to move the air that the whole bushel moves in falling. In fact it does not of itself move even such a quantity of the air as it would move if this part were by itself: for no part even exists otherwise than potentially.

If on the other hand we have two forces each of which separately moves one of two weights a given distance in a given time, then the forces in combination will move the combined weights an equal distance in an equal time: for in this case the rules of proportion apply.

Then does this hold good of alteration and of increase also? Surely it does, for in any given case we have a definite thing that cause increase and a definite thing that suffers increase, and the one causes and the other suffers a certain amount of increase in a certain amount of time. Similarly we have a definite thing that causes alteration and a definite thing that undergoes alteration, and a certain amount, or rather degree, of alteration is completed in a certain amount of time: thus in twice as much time twice as much alteration will be completed and conversely twice as much alteration will occupy twice as much time: and the alteration of half of its object will occupy half as much time and in half as much time half of the object will be altered: or again, in the same amount of time it will be altered twice as much.

On the other hand if that which causes alteration or increase causes a certain amount of increase or alteration respectively in a certain amount of time, it does not necessarily follow that half the force will occupy twice the time in altering or increasing the object, or that in twice the time the alteration or increase will be completed by it: it may happen that there will be no alteration or increase at all, the case being the same as with the weight.