

Aristotle – On the Heavens – Book Two, Chapter 14

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Let us first decide the question whether the earth moves or is at rest. For, as we said, there are some who make it one of the stars, and others who, setting it at the centre, suppose it to be ‘rolled’ and in motion about the pole as axis. That both views are untenable will be clear if we take as our starting-point the fact that the earth’s motion, whether the earth be at the centre or away from it, must needs be a constrained motion. It cannot be the movement of the earth itself. If it were, any portion of it would have this movement; but in fact every part moves in a straight line to the centre. Being, then, constrained and unnatural, the movement could not be eternal. But the order of the universe is eternal. Again, everything that moves with the circular movement, except the first sphere, is observed to be passed, and to move with more than one motion. The earth, then, also, whether it move about the centre or as stationary at it, must necessarily move with two motions. But if this were so, there would have to be passings and turnings of the fixed stars. Yet no such thing is observed. The same stars always rise and set in the same parts of the earth.

Further, the natural movement of the earth, part and whole alike, is the centre of the whole—whence the fact that it is now actually situated at the centre—but it might be questioned since both centres are the same, which centre it is that portions of earth and other heavy things move to. Is this their goal because it is the centre of the earth or because it is the centre of the whole? The goal, surely, must be the centre of the whole. For fire and other light things move to the extremity of the area which contains the centre. It happens, however, that the centre of the earth and of the whole is the same. Thus they do move to the centre of the earth, but accidentally, in virtue of the fact that the earth’s centre lies at the centre of the whole. That the centre of the earth is the goal of their movement is indicated by the fact that heavy bodies moving towards the earth do not move parallel but so as to make equal angles, and thus to a single centre, that of the earth. It is clear, then, that the earth must be at the centre and immovable, not only for the reasons already given, but also because heavy bodies forcibly thrown quite straight upward return to the point from which they started, even if they are thrown to an infinite distance. From these considerations then it is clear that the earth does not move and does not lie elsewhere than at the centre.

1 From what we have said the explanation of the earth's immobility is also apparent. If it is the nature
2 of earth, as observation shows, to move from any point to the centre, as of fire contrariwise to move
3 from the centre to the extremity, it is impossible that any portion of earth should move away from the
4 centre except by constraint. For a single thing has a single movement, and a simple thing a simple:
5 contrary movements cannot belong to the same thing, and movement away from the centre is the
6 contrary of movement to it. If then no portion of earth can move away from the centre, obviously
7 still less can the earth as a whole so move. For it is the nature of the whole to move to the point to
8 which the part naturally moves. Since, then, it would require a force greater than itself to move it, it
9 must needs stay at the centre. This view is further supported by the contributions of mathematicians
10 to astronomy, since the observations made as the shapes change by which the order of the stars is
11 determined, are fully accounted for on the hypothesis that the earth lies at the centre. Of the position
12 of the earth and of the manner of its rest or movement, our discussion may here end.

13 Its shape must necessarily be spherical. For every portion of earth has weight until it reaches the
14 centre, and the jostling of parts greater and smaller would bring about not a waved surface, but rather
15 compression and convergence of part and part until the centre is reached. The process should be
16 conceived by supposing the earth to come into being in the way that some of the natural philosophers
17 describe. Only they attribute the downward movement to constraint, and it is better to keep to the
18 truth and say that the reason of this motion is that a thing which possesses weight is naturally endowed
19 with a centripetal movement. When the mixture, then, was merely potential, the things that were
20 separated off moved similarly from every side towards the centre. Whether the parts which came
21 together at the centre were distributed at the extremities evenly, or in some other way, makes no
22 difference. If, on the one hand, there were a similar movement from each quarter of the extremity to
23 the single centre, it is obvious that the resulting mass would be similar on every side. For if an equal
24 amount is added on every side the extremity of the mass will be everywhere equidistant from its centre,
25 i.e. the figure will be spherical. But neither will it in any way affect the argument if there is not a similar
26 accession of concurrent fragments from every side. For the greater quantity, finding a lesser in front
27 of it, must necessarily drive it on, both having an impulse whose goal is the centre, and the greater
28 weight driving the lesser forward till this goal is reached. In this we have also the solution of a possible
29 difficulty. The earth, it might be argued, is at the centre and spherical in shape: if, then, a weight many
30 times that of the earth were added to one hemisphere, the centre of the earth and of the whole will
31 no longer be coincident. So that either the earth will not stay still at the centre, or if it does, it will be

1 at rest without having its centre at the place to which it is still its nature to move. Such is the difficulty.
2 A short consideration will give us an easy answer, if we first give precision to our postulate that any
3 body endowed with weight, of whatever size, moves towards the centre. Clearly it will not stop when
4 its edge touches the centre. The greater quantity must prevail until the body's centre occupies the
5 centre. For that is the goal of its impulse. Now it makes no difference whether we apply this to a clod
6 or common fragment of earth or to the earth as a whole. The fact indicated does not depend upon
7 degrees of size but applies universally to everything that has the centripetal impulse. Therefore earth
8 in motion, whether in a mass or in fragments, necessarily continues to move until it occupies the
9 centre equally every way, the less being forced to equalize itself by the greater owing to the forward
10 drive of the impulse.

11 If the earth was generated, then, it must have been formed in this way, and so clearly its generation
12 was spherical; and if it is ungenerated and has remained so always, its character must be that which
13 the initial generation, if it had occurred, would have given it. But the spherical shape, necessitated by
14 this argument, follows also from the fact that the motions of heavy bodies always make equal angles,
15 and are not parallel. This would be the natural form of movement towards what is naturally spherical.
16 Either then the earth is spherical or it is at least naturally spherical. And it is right to call anything that
17 which nature intends it to be, and which belongs to it, rather than that which it is by constraint and
18 contrary to nature. The evidence of the senses further corroborates this. How else would eclipses of
19 the moon show segments shaped as we see them? As it is, the shapes which the moon itself each
20 month shows are of every kind straight, gibbous, and concave—but in eclipses the outline is always
21 curved: and, since it is the interposition of the earth that makes the eclipse, the form of this line will
22 be caused by the form of the earth's surface, which is therefore spherical. Again, our observations of
23 the stars make it evident, not only that the earth is circular, but also that it is a circle of no great size.
24 For quite a small change of position to south or north causes a manifest alteration of the horizon.
25 There is much change, I mean, in the stars which are overhead, and the stars seen are different, as one
26 moves northward or southward. Indeed there are some stars seen in Egypt and in the neighbourhood
27 of Cyprus which are not seen in the northerly regions; and stars, which in the north are never beyond
28 the range of observation, in those regions rise and set. All of which goes to show not only that the
29 earth is circular in shape, but also that it is a sphere of no great size: for otherwise the effect of so
30 slight a change of place would not be quickly apparent. Hence one should not be too sure of the
31 incredibility of the view of those who conceive that there is continuity between the parts about the

1 pillars of Hercules and the parts about India, and that in this way the ocean is one. As further evidence
2 in favour of this they quote the case of elephants, a species occurring in each of these extreme regions,
3 suggesting that the common characteristic of these extremes is explained by their continuity. Also,
4 those mathematicians who try to calculate the size of the earth's circumference arrive at the figure
5 400,000 stades. This indicates not only that the earth's mass is spherical in shape, but also that as
6 compared with the stars it is not of great size.