# Causation and Movement

Aristotle (384-322 BC)

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The twentieth century philosopher and mathematician, A. N. Whitehead, claimed that Western intellectual history was one extended footnote to Plato. In terms of his influence on the development of scientific ideas and practices, it is arguable that Aristotle was at least the equal of his distinguished teacher. Aristotle developed a systematic philosophy that he applied to the central questions of his day. His system was distinguished by the extent to which it engaged empirical investigation. Aristotle's central ideas acquired a canonical status during the middle ages. If not the final word on any subject, his words were invariably taken to be the starting point for any investigation. In the natural sciences, his central doctrines were assailed during the seventeenth century, but his system of logic and his emphasis on purposefulness persisted until well into the twentieth century.

This reading, which is taken from Aristotle's *Physics*, addresses the issue of causation. The notion of causation has historically stood front and center in accounts of the aims of science and the character of scientific explanation. For Aristotle, 'to know' was to know by means of four causes — the material, formal, efficicient, and the final cause. The material cause deals with the substrate, such as the bronze of a statue, while the formal cause is concerned with its shape. The final cause is its end or purpose for the sake of which the process of making the status was commenced, and the efficient cause is that which initiates the process of change. Each of these four causes can be identified in the writings of Plato (*c.* 427 to 347 BC), but they did not make up a system for Plato, as they did for Aristotle.

Many of the revolutionary episodes in the history of scientific ideas have been associated with the rejection of one or other of Aristotle's four causes.

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Now that we have determined the different senses in which 'nature' may be understood (as signifying either 'material' or 'form'), we have next to consider how the mathematician differs from the physicist or natural philosopher; for natural bodies have surfaces and occupy spaces, have lengths and present points, all which are subjects of mathematical study. And then there is the connected question whether astronomy is a separate science from physics or only a special branch of it; for if the student of nature is concerned to know what the Sun and Moon are, it would be strange if he avoided inquiry into their essential properties; especially as we find that writers on nature have, in fact, discoursed on the shape of the Moon and Sun and raised the question whether the Earth, or the cosmos, is spherical or otherwise.

Physicists, astronomers, and mathematicians, then, all have to deal with lines, figures and the rest. But, the mathematician is not concerned with these concepts *qua* boundaries of natural bodies, nor with their properties as manifested in such bodies. Therefore, he abstracts them from physical conditions; for they are capable of being considered in the mind in separation from the motions of the bodies to which they pertain, and such abstraction does not affect the validity of the reasoning or lead to any false conclusions.

Now the exponents of the philosophy of 'Ideas'* also make abstractions, but in doing so they fall unaware into error; for they abstract physical entities, which are not really susceptible to the process as mathematical entities are. And this would become obvious if one should undertake to define, respectively, the mathematical and the 'ideal' entities, together with their properties; for the concepts 'odd,' 'even,' 'straight,' 'curved,' will be found to be independent of movement; and so too with 'number,' 'line,' and 'figure.' But of 'flesh' and 'bone' and 'man' this is no longer true, for these are in the same case as a 'turned-up nose,' not in the same case as 'curved.' The point is further illustrated by those sciences which are rather physical than mathematical, though combining both disciplines, such as optics, harmonics, and astronomy; for the relations between them and geometry are, so to speak, reciprocal; since the geometer deals with physical lines, but not *qua* physical, whereas optics deals with mathematical lines, but *qua* physical not *qua* mathematical.

Since 'nature' is used ambiguously, either for the form or for the matter, nature, as we have seen, can be regarded from two points of view; and therefore, our speculations about it may be likened to an inquiry as to what 'snubnosed-ness' is; that is to say, it can neither be isolated from the material subject in which it exists, nor is it constituted by it.

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* This passage refers is to the views of Plato (c. 428 BC – 347 BC) and his disciples. [B.]

At this point, in fact, we may again raise two questions: Which of the two aspects of nature is it that claims the attention of the physicist? Or is his subject the *compositum* that combines the two? In that case, if he is concerned with the *compositum*, he must also inquire into its two factors; and then we must ask further whether this inquiry is the same for both factors or different for each.

In reading the ancients one might well suppose that the physicist's only concern was with the material; for Empedocles* and Democritus† have remarkably little to say about kinds of things and what is the constituent essence of them. But if art imitates nature, and if in the arts and crafts it pertains to the same branch of knowledge both to study its own distinctive aspect of things and likewise (up to a point) the material in which the same is manifested (as the physician, for instance, must study health and also bile and phlegm, the state of which constitutes health; and the builder must know what the house is to be like and also that it is built of bricks and timber; and so in all other cases), it seems to follow that physics must take cognizance both of the formal and of the material aspect of nature.

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* Empedocles of Acragas (*c.* 490 BC - *c.* 430 BC) is remembered as the author of the four element theory of matter (earth, air, fire, and water), which was authoritative until the rise of modern chemistry in the eighteenth century [B.]

† Democritus of Abdera (*c.* 460 BC - *c.* 370 BC) is remembered, chiefly through the writings of Aristotle, as the leading exponent in antiquity of the theory of atoms (from the Greek *atomos*) and the void. [B.]

And, further, the same inquiry must embrace both the purpose or end and the means to that end. And the 'nature' is the goal for the sake of which the rest exist; for if any systematic and continuous movement is directed to a goal, this goal is an end in the sense of the purpose to which the movement is a means. (A confusion on this point betrayed the poet into the unintentionally comic phrase in reference to a man's death: 'He has reached his end for the sake of which he was born.' For the 'goal' does not mean any kind of termination, but only the best.) For in the arts, too, it is in view of the end that the materials are either made or suitably prepared, and we make use of all the things that we have at our command as though they existed for our sake; for we too are, in some sort, a goal ourselves. For the expression 'that for the sake of which' a thing exists or is done has two senses (as we have explained in our treatise *On Philosophy*). Accordingly, the arts which control the material and possess the necessary knowledge are two: the art which uses the product, and the art of the master-craftsman who directs the manufacture. Hence, the art of the user also may in a sense be called the master-art; the difference is that this art is concerned with knowing the form, the other, which is supreme as controlling the manufacture, with knowing the material. Thus, the helmsman knows what are the distinctive characteristics of the helm as such, that is to say, its form, and gives his orders accordingly; while what the other knows is out of what wood and by what manipulations the helm is produced. In the crafts, then, it is we who prepare the material for the sake of the function it is to

fulfill, but in natural products nature herself has provided the material. In both cases, however, the preparation of the material is commanded by the end to which it is directed.

And again, the conception of 'material' is relative, for it is different material that is suited to receive the several forms.

How far then, is the physicist concerned with the form and identifying essence of things and how far with their material? With the form primarily and essentially, as the physician is with health; with the material up to a certain point, as the physician is with sinew and the smith with bronze. For his main concern is with the goal, which is formal; but he deals only with such forms as are conceptually, but not factually, detachable from the material in which they occur. In nature man generates man; but the process presupposes and takes place in natural material already organized by the solar heat and so forth. But how we are to take the subject and what it is, is a question for First Philosophy to determine …

We have next to consider in how many senses 'because' may answer the question 'why.' For we aim at understanding, and since we never reckon that we understand a thing until we can give an account of its 'how and why,' it is clear that we must look into the 'how and why' of things coming into existence and passing out of it, or more generally into the essential constituents of physical change, in order to trace back any object of our study to the principles so ascertained.

Well then, (1) the existence of *material* for the generating process to start from specifically or generically considered is one of the essential factors we are looking for. Such is the bronze for the statute or the silver for the phial. (Material cause.) Then, naturally, (2) the thing in question cannot be there unless the material has actually received the *form* or characteristics of the *type*, conformity to which brings it within the definition of the thing we say it is, whether specifically or generically. Thus the interval between two notes is not an octave unless the notes are in the ratio of 2 to 1; nor do they stand at a musical interval at all unless they conform to one or other of the recognized ratios. (Formal cause.) Then again (3), there must be something to initiate the process of the change or its cessation when the process is completed, such as the act of a voluntary agent (of the smith, for instance) or the father who begets a child; or more generally the prime, conscious or unconscious, *agent* that produces the effect and starts the material on its way to the product, changing it from what it was to what it is to be. (Efficient cause.) And lastly, (4) there is the *end* or purpose for the sake of which the process is initiated as when a man takes exercise for the sake of his health. "Why does he take exercise?" we ask. And the answer: "Because he thinks it good for his health" satisfies us. (Final cause.) Then there are all the intermediary agents, which are set in motion by the prime agent and make for the goal, as means to the end. Such are the reduction of superfluous flesh and purgation, or drugs and surgical instruments, as means to health. For

both actions and tools may be means or *'media*,' through which the efficient cause reaches the end aimed at.

This is a rough classification of the causal determinants of things; but it often happens that, when we specify them we find a number of them coalescing as joint factors in the production of a single effect, and that not merely incidentally; for it is *qua* statue that the statue depends for its existence alike on the bronze and on the statuary. The two, however, do not stand on the same footing for one is required as the material and the other as initiating the change.

Also it can be said of certain things indifferently that either of them is the cause or the effect of the other. Thus, we may say that a man is in fine condition 'because' he has been in training or that he has been in training 'because' of the good condition he expected as the result. But one is the cause as aim (final) and the other as initiating the process (efficient).

Again, the same cause is often alleged for precisely opposite effects. For if its presence causes one thing we lay the opposite to its account if it is absent. Thus, if the pilot's presence would have brought the ship safe to harbor, we say that he caused its wreck by his absence.

But in all cases the essential and causal determinants we have enumerated fall into four main classes. For letters are the causes of syllables, and the material is the cause of manufactured articles, and fire and the like are causes of physical bodies, and the parts are causes of the whole, and the premises are causes of the

conclusion, in the sense of that [premise, or design] out of which these [final outcomes] are respectively made; but of these things some are causes in the sense of the *substratum* (e.g. the parts stand in this relation to the whole), others in the sense of the *essence* — the whole or the synthesis or the form. And again, the fertilizing sperm, or the physician, or briefly the voluntary or involuntary *agent* sets going or arrests the transformation or movement. And finally, there is the goal or end in view which animates all the other determinant factors as the best they can attain to; for the attainment of that 'for the sake of which' anything exists or is done is its final and best possible achievement (though of course 'best' in this connection means no more than 'taken to be the best').

These are the main classes of determinant factors and causes …

Since nature is the principle of movement and change and it is nature that we are studying, we must understand what 'movement' is; for if we do not know this, neither do we understand what nature is. When we have defined the meaning of movement or progress from this to that, we must attempt in the same way a discussion of the associated conceptions to which it leads. Now, movement is clearly one of the things we think of as 'continuous,' and it is in connection with continuity that we first encounter the concept of the 'unlimited.' And this is why in definitions of continuity this concept of the 'illimitable' frequently occurs, as when we say that the continuous is that which is susceptible of division without limit. Further,

movement (it is said*) cannot occur except in relation to place, void, and time. Evidently, then, for these reasons and because these four things — movement, place, void, and time — are universal conditions common to all natural phenomena, we must consider each of them on the threshold of our inquiry; for the treatment of peculiar properties must come after that of properties common to all natural things.

We must begin, then, as already said, with movement in general or progress from this to that. Now, some potentialities never exist apart, but always reveal themselves as actualized; others, while they are something actually, are capable of becoming something else than they are, that is to say, have potentialities not realized at the moment; and these potentialities may concern their substantive being (what they are) or their quantity or their qualities; and so on with the other categories of existence. And under the category of 'relation' may be relations between the 'more' and the 'less,' or between that which is active and that which is acted on, and generally between that which 'moves' (or changes) something as the agent and that which is moved (or changed) by it as the patient. For that which has the power of producing a change can only act in reference to a thing capable of being changed; and that which is capable of being changed can only suffer change under the action of that which has the power to change it.

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* The reference is to the followers of Democritus and the doctrine of atoms and the void. [B].

Now, motion and change cannot exist in themselves apart from what moves and changes. For, wherever anything changes it always changes either from one thing to another, or from one magnitude to another, or from one quality to another, or from one place to another; but there is nothing that embraces all these kinds of change in common, and is itself neither substantive nor quantitative nor qualitative nor pertaining to any of the other categories, but existing in detachment; so neither can movement or change exist independently of these, for there is nothing independent of them.

Again, in each of these four cases, there are two poles between which the change moves; in substantive existence, for example, [the poles are] form and shortage from form; in quality, white and black; in quantity, the perfectly normal and an achievement short of perfection; and so, too, in the case of vection, up and down, or the action of levity and gravity. So there are as many kinds of change as there are categories of existence.

Reverting, therefore, to the universal distinction already established between 'being-at-the-goal' in actuality and being in potentiality 'such-as-is-capable-of-attaining-the-goal,' we can now define motion or change as the progress of the realizing of a potentiality, *qua* potentiality, e.g. the actual progress of qualitative modification in any modifiable thing *qua* modifiable; the actual growing or shrinking (for we have no single word to include them both) of anything capable of expanding or contracting; the process of coming into existence or passing out of that which is

capable of so coming and passing; the actual moving of the physical body capable of changing its place. That this is what we really mean by motion or change may be shown thus: building material is actualizing the potentialities in virtue of which we call it 'building material' when it is in the act of being built into a structure, and this act is the process or 'movement' of 'building'; and so too with other processes: learning, healing, rolling, jumping, maturing, aging.

And since in certain cases the same thing may have both an actuality and a potentiality (not indeed at the same time or not in the same respect, but potentially hot, for instance, and actually cold) it follows that many things act on and are acted on by, each other; for anything will be at once capable of acting and of being acted upon. And so it happens that every physical body which causes motion must be capable of being moved; for whenever it causes motion it is itself under the action of some other body which is keeping it in motion.* But the inference that has sometimes been drawn, that there is *no* cause of a thing being in motion, which cause is not itself in motion, is false. The truth in this matter will be explained later on; suffice it now to say that there is a cause of things being in motion, which cause is itself immovable; but motion is the functioning of a movable thing, all the time that it is bringing its potentiality into act, not *qua* itself, but *qua* movable.

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* Aristotle did not have the modern concept of inertia as the convervation of a body's state of motion or rest, and so he could not offer an explanation for the motion of projectiles; e.g., why a javelin keeps moving once it leaves the hand that is throwing it. [B.]

To illustrate what I mean by '*qud* this or ['*qud*] that: The bronze is potentially the statue, but neither to be the statue nor to move or change in any respect is the self-realization of the bronze *qua* bronze; for it is not the same thing to be bronze and to be potentially movable or changeable. Were it the same thing, absolutely and by definition, then indeed moving would be its self-realization; but it is not the same. (It is clear in the case of opposites the potentiality of health and the potentiality of disease are different things, otherwise being diseased and being healthy would be identical, but whatever it is, humor or blood, to be subject to the healthy or unhealthy condition is one and the same thing in both cases.) And since it is not the same (any more than color and visibility, for instance, are the same), it is clear that motion must be the realization of the specific potentiality in question and of the subject only *qua* seat of this specific potentiality.

Clearly, then, this is the nature of movement, and a thing is moving just as long as it is actually functioning in this particular way, and neither before nor after. For anything capable of this special kind of functioning may be exercising it at one time, but not at another; for instance, the building materials are functioning *as materials for building only* so long as they are in process of being built with; for as soon as the edifice itself is actually raised, the functioning of what were materials for a house is merged in the functioning of the house itself; but as long as they are being built with, they are functioning as materials for a house. The act of building, then, is the energizing or bringing into actuality of the potentiality of the materials *qua*

materials; and the passage of the materials of a house into the texture of the house itself, so long as it is in progress, is their 'movement' *qua* materials of building. And this is the theory of all the other 'movements' equally.

**Source:**

Aristotle, *The Physics*, trans. P. H. Wicksteed and F. M. Cornford. London: William Heinemann Ltd., pp. 116-125; 129-134; 91-201.

**Further Reading:**

Judson, Linsay, ed. 1995. *Aristotle's Physics: A Collection of Essays*. Oxford: Clarendon Press.

Lennox, James G. 2001. *Aristotle's Philosophy of Biology: Studies in the Origins of Life Science*. Cambridge: Cambridge University Press.