

Aristotle's Four Because

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I. Introduction

What has traditionally been labelled 'Aristotle's theory of causes' would be more intelligible if construed as 'Aristotle's theory of explanations', where the term 'explanation' has substantially the sense of Hempel and Oppenheim, who construe explanations as deductions.¹ For Aristotle, specifying 'causes' is constructing demonstrations.

This interpretation has two virtues: unlike the theory of the 'four causes', it makes sense; and it shows what the logical theory of *aitia* in the *Posterior Analytics* has to do with the metaphysical treatment in the *Physics* and *Metaphysics*. On the assumption that Aristotle's metaphysics might be contaminated by his logic, Aristotle's metaphysics and logic have traditionally been kept scrupulously separate, as if they were by different men. The result of this separation is to make Aristotle's metaphysics seem illogical. I want here to go a little way towards showing that this is not necessarily so.²

II. Causes as Because

It has long been recognized that there is something wrong with translating the term *aition* by the term 'cause', but it is only recently that anyone has pointed out exactly what is wrong with it. In a well-known paper on Plato, Professor Gregory Vlastos argues that *aition* should be translated 'because', and points out that Aristotle speaks of the four *aitia* as 'all the ways of stating *to dia ti* (the *because*)'.³ As Vlastos shows, to translate the term as

¹ See their 'The Logic of Explanation', in *Readings in the Philosophy of Science*, edited by Feigl and Brodbeck (New York, 1953). As the reader will eventually discover, but as I now hasten to point out, I do not ascribe Hempel and Oppenheim's logical positivism to Aristotle, but only their deductive or covering law theory of explanation.

² An earlier version of this paper was on the programme of the Southern Society for Philosophy and Psychology in the Spring of 1970. I am grateful for helpful criticism from my colleagues Norvin Richards, Richard Baldes and J. B. McMinn.

³ 'Reasons and Causes in the *Phaedo*', *The Philosophical Review*, LXXVIII (3), 1969, p. 294.

'cause' is to make nonsense of Aristotle's talk about any but efficient *aitia*, since the English word 'cause' means productive agent or event, and nothing else. Thus, Aristotle has been made to say (a) that the material 'cause' of the statue's weight is its bronze, (b) that the formal 'cause' of the angle at a semi-circle being a right angle is its equality to the half of two right angles, and (c) that the final 'cause' of walking after dinner is health.⁴ As Vlastos points out, these statements have the grotesque implications (a') that the bronze *produces* the statue's weight as the sculptor produces the statue, (b') that the abstract entity 'equality to half of two right angles' *produces* the rectangularity of the right angle, and thus produces itself, and (c') that the health which does not yet exist *produces* the walking which does exist in order that the health eventually will. These are the very sorts of absurdities for which Aristotle chastizes his predecessors.

In 'The Secret of Aristotle' from Santayana's *Dialogues in Limbo*, Avicenna's ghost portrays the misinterpretation to which this translation has given rise in the following unkind words:

The ignorant . . . imagine that the four principles (which they call causes) are all equally forces producing change, and cooperative sources of natural things . . . thus these learned babblers would put nature together out of words, and would regard the four principles of interpretation as forces mutually supplementary, combining to produce natural things; as if perfection would be one of the sources of imperfection, or as if the forms which things happen to have could be one of the causes of their having it.⁵

Santayana's portrait is not a caricature. Almost verbatim accounts of Aristotle's doctrine have been written into most standard textbooks in the history of philosophy for several decades. Moreover, the writers of these textbooks have promulgated their interpretation on high authority. W. D. Ross concludes his discussion of 'causes' in his book, *Aristotle*, with the remark 'But for Aristotle none of the four causes is sufficient to *produce* an event; and speaking generally we may say that in his view all four are *necessary for the production* of any effect'.⁶ This statement describes all four *aitia* in terms befitting only efficient *aitia*, and then, trying to repair the damage thus done to the sense of the notion, compounds the error by making even efficient *aitia* merely partial efficient *aitia*, necessary but not

⁴ These examples are cited by Vlastos, *op. cit.*, pp. 293f.

⁵ George Santayana, *Dialogues in Limbo* (Ann Arbor, 1957), pp. 238f.

⁶ Meridian Books, New York, p. 75. Italics added. Ross makes equivalent remarks in his commentary on the *Physics* (Oxford, 1960), pp. 35–36. It should, however, be said in defence of this magnificent scholar that he sensed that something was wrong with the word 'cause'. No doubt, if he had had the advantage that contemporary work in the philosophy of science has given the rest of us, he would have figured out what it is.

sufficient to produce their effects. Just as bad is Mure's *vis a tergo* interpretation of the final cause, which portrays the non-existing end of an ongoing process as exerting some sort of mysterious pull from the future.⁷ If we agree that Aristotle himself is very unlikely to have been guilty of such solecisms, then we can agree with Vlastos that the term *aition* probably should not be translated 'cause'.

The main argument for translating the term as 'because' is that it would make sense of much that must otherwise remain incoherent. Aristotle explicitly presents causes as answers to the question 'Why?', a question which is normally answered by saying 'Because'.⁸ If the question is 'Why is the statue heavy?' an answer might be 'Because it is made of bronze'. This answer mentions the statue's matter. If the question is 'Why is the angle a right angle?' one answer is 'Because it is half of two right angles', an answer which invokes the form of the triangle. If the question is 'Why does a man walk?' the answer is 'Because he wants to be healthy', which refers to the purpose served, albeit in a referentially opaque way. In none of these cases is there any hint of 'productive agency' or 'necessary conditions for production'.

The trouble with 'because' is that it is awkward. There is an appearance of use-mention confusion in speaking of 'the four because's'. But this difficulty is common in Aristotle. Semantic descent⁹ is often necessary to gain an accurate appreciation of his point: he frequently refers to an ontological category indirectly by referring directly to the name of that category. As substance is to subject, and attribute is to predicate, so cause is to because. As Vlastos puts it, to call anything, X, the cause of Y, is merely to say that Y happens because of X.¹⁰ The point could be less misleadingly put by speaking, not of causes or of because's, but of *explanations*, the term which Professor Charlton uses in his excellent commentary on Aristotle's *Physics*. There he says 'The discussion of *aitia* . . . is a discussion of explanation, and the doctrine of "four causes" is an attempt to distinguish and classify different kinds of explanation. . .'.¹¹

In other words, for Aristotle the notion of cause is parasitical upon the notion of explanation, a notion which has both a linguistic and an ontological side: we speak of the *statement* 'Because of X' as the explanation of Y, and also of the *thing* (or event) X as the explanation of Y, a usage which evidently embodies the same use-mention ambiguity as does the term *aition*.

⁷ See G. R. G. Mure, *Aristotle* (New York, 1964), pp. 12f.

⁸ *Physics*, Bk. II, Ch. 3, 194b19.

⁹ By this term I mean the reverse of what Quine calls 'semantic ascent'. See W. V. Quine, *Word and Object* (Cambridge, Mass., 1960), pp. 271–276.

¹⁰ *Op. cit.*, p. 293.

¹¹ W. Charlton, *Aristotle's Physics* I, II (Oxford, 1971), p. 99. Charlton's entire discussion of this question (pp. 98–104) is masterful.

III. Causes as Demonstrations

For Aristotle, then, 'causes' are explanations. I want now to go further and argue that, for Aristotle, explanations are demonstrations. My evidence is the *Posterior Analytics*.

Incredibly, the *Posterior Analytics* is rarely cited in connection with Aristotle's theory of causes. Indeed, Ross dismisses it, especially the section on causes, as a muddleheaded and immature work.¹² More popular with commentators have been the passages on causes in the *Physics* and the *Metaphysics*. This is consistent with the long-standing emphasis on Aristotle's metaphysical views to the neglect of his logical doctrines. Yet the *Posterior Analytics* is the longest and most complete treatment of the notion of 'cause' in the Aristotelian corpus.

In the *Physics*, Aristotle defines 'cause' as an answer to the question 'Why?', points out that this question is asked 'in many senses', and then catalogues the various sorts of information for which it may be a request. In the *Metaphysics*, he merely repeats part of this and concentrates on distinguishing the four 'causes'. In the *Posterior Analytics*, on the other hand, he not only says everything he says in the *Physics*, and in greater detail, but he adds further important points. The most important new point in the *Posterior Analytics* is a new definition of 'cause': a cause is the middle term of a syllogism.¹³

What Aristotle has in mind here can be brought out by means of an example, which is not his, and not a strict example of a demonstrative syllogism, but which will enable us to make the main points conveniently. Let the question be 'Why did Socrates die?', and let the answer be 'Because he drank hemlock'. Aristotle's point is that what follows the 'because' here is the middle term of a syllogism which displays what follows the 'why' as conclusion; or, put otherwise, the explanation is an enthymeme, which, when all the suppressed parts are made fully explicit, reads:

Those who drink hemlock die;
Socrates drank hemlock;
Therefore, Socrates died.

This is not a strictly demonstrative syllogism because it contains singular statements.¹⁴ Consequently, if it is an explanation, it is one by courtesy and by an extended use of the term, being, at best, an explanation in *applied* science. But Aristotle himself never gives examples of strictly demonstrative

¹² See his *Aristotle*, p. 51, where he confesses inability to make head or tail of it. Of course Ross also did a commentary on the *Posterior Analytics*, but he still couldn't connect what is in it with the *Physics*.

¹³ Bk. II, Ch. 1, 90a5.

¹⁴ See Jan Lukasiewicz, *Aristotle's Syllogistic* (Oxford, 1951), Ch. 1.

sylogisms,¹⁵ the premises of which would, he says, be commensurately universal predications stating definitions.¹⁶ His own illustrations are demonstrations in a somewhat looser sense, and he too found it convenient to use illustrations which contain singular statements.¹⁷ Thus our use of this example is no more in violation of Aristotle's preaching than is his own practice.

A 'because', then, is an explanation, and is elliptical for a syllogism. That is, it is a demonstration. Thus Aristotle defines scientific knowledge in two ways which he evidently thought of as being equivalent: it is knowledge of causes, and it is demonstrated knowledge¹⁸. For all its neglect, the *Posterior Analytics* is not merely the most complete text on 'causes'; but, as an extended treatise on scientific knowledge, it is *the* definitive text. Aristotle's theory of 'causes' is simply an application of his theory of syllogistic to the analysis of scientific knowledge.

Several important results immediately follow. First, it follows that the criteria for appraising an explanation are exactly the same as those for appraising a sound syllogism: its premises must be true and the conclusion must necessarily follow.¹⁹ (The hemlock explains the 'necessity' of Socrates' death.) Moreover, as every valid syllogism requires a universal premise, so every explanation must invoke a general rule.²⁰ (If people did not as a rule die from drinking hemlock, we would not count it the cause of Socrates' death.)

In short, for Aristotle, a 'cause' is an *explanation* in substantially the sense in which Hempel and Oppenheim use that word in their famous paper 'The Logic of Explanation'. Hempel and Oppenheim also define an explanation as an answer to the question 'Why?',²¹ and argue that this question is answered by constructing a deductive argument which displays the fact to be explained (*explanandum*) as conclusion and the explaining facts (*explanans*) as premises.²² One of these premises, they emphasize, must be a universal law.²³

¹⁵ See Jonathan Barnes, 'Aristotle's Theory of Demonstrations', *Phronesis*, XIV (2), 1969, p. 124.

¹⁶ *Posterior Analytics*, Bk. I, Ch. 3, 73a25ff.

¹⁷ The defects of Aristotle's examples lead Charlton, *op. cit.*, p. 119, to pronounce them 'useless'. This, in turn, leads him to dismiss the 'promising' account of cause as middle term which these examples illustrate. The characterization seems to me too strong, and the dismissal unjustified. Only one example is entirely worthless, that of final cause, which we shall discuss later.

¹⁸ *Posterior Analytics*, Bk. I, Ch. 1, 71b1off.

¹⁹ *Ibid.*, Ch. 5, 74b10.

²⁰ *Ibid.*, Ch. 3, 73a26.

²¹ *Op. cit.*, p. 319.

²² *Ibid.*, p. 322.

²³ *Ibid.*, p. 324.

To be sure, there are differences. The most important is that Hempel and Oppenheim, under the influence of Hume, impose a condition on explanations which can be satisfied only by mechanistic explanations: they say that one premise must be a statement of antecedent conditions,²⁴ whereas Aristotle says that all ‘causes’ are simultaneous with their effects.²⁵ By requiring that explanations not be ‘empty of empirical content’, a term they would no doubt apply to definitions, they also specifically rule out formal explanations,²⁶ of which Aristotle was especially fond.

It is possible, but not likely, that these differences are more apparent than real. Hempel and Oppenheim are restricting themselves to empirical science, whereas Aristotle means to discuss explanations in all kinds of science, including especially formal science. But it seems unlikely that the difference is entirely the verbal one that Aristotle is discussing explanations in more senses than Hempel and Oppenheim. For one thing, Aristotle believes that formal explanations are as appropriate in empirical as in formal science, and he is right. Socrates’ death can also be demonstrated to be a consequence of his essential form ‘humanity’:

Humans are mortal;
Socrates is human;
Therefore, Socrates is mortal.

Indeed, there is much evidence that Aristotle thinks that all finally satisfactory explanations in every science—geometry, physics, biology, or whatever—are formal. Evidently, the strictly formal science of geometry is his model of science; and as we shall see in greater detail later, he says that the fundamental premises of scientific demonstration are definitions, statements of essence, commensurately universal predications. Of course, Aristotle would not, as do Hempel and Oppenheim, regard such premises as tautologies.²⁷ He means real, not nominal (stipulated) definitions; and he expects our knowledge of these fundamental premises to be the result of a process very much like induction from observed instances.²⁸ The differences here are real and philosophically important, and we shall return

²⁴ *Op. cit.*, p. 320.

²⁵ *Physics*, 195b18–21. This remark of his is perhaps best understood as a way of reminding us that the premises of a syllogism need to be in the same tense as the conclusion.

²⁶ *Op. cit.*, p. 321.

²⁷ A reasonable interpretation of them, however, would construe them as ‘analytic’.

²⁸ Peirce translated the term *apagoge* as ‘abduction’ or ‘retroduction’ and distinguished it from ordinary induction. C. S. Peirce, *Collected Papers*, Vol. I (Cambridge, Mass., 1960), p. 28.

to them; but they do not affect the present point that, concerning the definition of explanation as demonstration, there is complete unanimity.

For Aristotle, the notion of 'cause' is dependent upon this notion of explanation as deduction in a way which we can perhaps better appreciate if we seek a definition of 'effect'. The standard translations have Aristotle say that the premises are the 'cause' of their conclusion, which is presumably their effect. As Vlastos points out, this translation is a piece of nonsense.²⁹ In connection with premises and conclusions, better terms than 'cause' and 'effect' are Hempel and Oppenheim's '*explanans*' and '*explanandum*', whose referents are statements. 'Cause' and 'effect' refer to terms. But as Aristotle makes clear in the *Posterior Analytics*, what explanations explain are statements, not terms. In his words, we explain the inherence of an attribute in a subject, of one extreme term in another.³⁰ For example, we explain the inherence of death or mortality in Socrates—that is, we say why Socrates dies or why Socrates is subject to death. Put ontologically, what we explain are not things but facts and events—that is, states of affairs and changes in states of affairs. We do not explain Socrates or death, but rather we explain why Socrates is dead; we explain the death of Socrates. It is a solecism to speak of the statement 'Socrates is dead' as the 'effect' of the statements 'All who drink hemlock die' and 'Socrates drank hemlock'. If the term 'effect' is ever appropriate, it is only in connection with the predicate term of the conclusion, and then only if the syllogism is a mechanistic explanation whose middle term is an efficient *aition*. If we are explaining the fact that Socrates died, and the syllogism is

Socrates drank hemlock;
Those who drink hemlock die;
Therefore, Socrates is dead,

then we may say that death (meaning the death of Socrates) is the 'effect', drinking hemlock being the cause. But if the syllogism is

Socrates is a man;
Men are mortal;
Therefore, Socrates is mortal,

it makes no sense to speak of the attribute mortality as an effect of which the attribute manhood is the cause, although the fact that Socrates is human is an *explanation* of the fact that he is mortal.

In summary, an explanation is a syllogism, a demonstration in which an *explanandum*, a statement of inherence of an attribute in a subject, is the conclusion, and in which the premises are the *explanans*. Let the extreme terms be *A* and *C*. The request for an explanation is always of the form

²⁹ *Op. cit.*, p. 295.

³⁰ This is the language he uses throughout the *Posterior Analytics*.

'Why is *A*, *C*?' and is a request that the inherence of *C* in *A* be demonstrated through some middle term *B*. *B* can be called the 'cause' and *C* the 'effect' with strict accuracy only when the explanation is mechanistic, *B* being that which produces *C*. The criteria for assessing explanations in this sense are, obviously, exactly identical with the criteria by which we assess sound arguments: as an argument is sound when it is formally valid and contains premises known to be materially true, so we have got a good explanation when the *explanandum* has been shown to be the necessary consequence of known truths sufficiently general to cover all similar cases. Since our purpose here is not to detail Aristotle's theory of demonstration but only to point out that it and his theory of 'causes' are one and the same theory, we shall not here develop these criteria. Instead, we shall turn to the task of distinguishing one sort of explanation from another, so as to see what light the account of explanation as demonstration throws on these distinctions.

IV. The Four Because

The distinction between different sorts of explanation arises as follows. The question 'Why?' is systematically ambiguous, being used, in Aristotle's phrase, 'in several senses'.³¹ Aristotle distinguishes four main types of information for which it may be a request, and six sub-types.

The question 'Why is *A*, *C*?' may mean (1) 'What thing, *B*, made *C* inhere in *A*?' (2) 'By virtue of what attribute, *B*, does *C* inhere in *A*?' (3) 'By virtue of what material, *B*, does *C* inhere in *A*?' or (4) 'What end, *B*, does the inherence of *C* in *A* serve?' We may ask 'Why did Socrates die?' and mean either (1) 'What precipitated his death?' (2) 'Of what nature was Socrates that he was mortal?' (3) 'Of what material was he made that he was mortal?' or (4) 'What end or purpose did his execution serve?' An answer to the first might be that he drank hemlock; to the second, that he was a man; to the third, that he was made of living flesh; to the fourth, that it made his enemies happy.³² These answers represent the four main types of explanation: efficient, formalist, material, and final.

Each of these four admits of six sub-types. First, there is a distinction in each case between the generic and specific 'cause'. For example, if being human is the specific formal explanation of mortality, being animal is the generic. Second, there is a distinction between essential and coincidental

³¹ *Physics*, Bk. II, Ch. 3, 195a3–4.

³² The above paraphrases the *Physics*, Bk. II, Ch. 3, 194b23ff. I shall not go into the different characterizations of the 'material cause' to be found in Aristotle's *Physics* and *Posterior Analytics*, except to say that I think he had different sorts of explanation in mind.

'causes'. For example, if we count the executioner as efficient cause, and if he also happens to be a part-time gardener, we can say that an executioner was the essential efficient cause of death, while a gardener was the accidental efficient cause. Third, we may distinguish remote from proximate causes. Hemlock is a proximate efficient cause, while the executioner is a remote efficient cause of Socrates' death. These distinctions give us the six sub-types. Aristotle also notes that there is a distinction to be made between that which is actually and that which is potentially 'cause', as the executioner is potentially the efficient cause of death before the execution, actually so afterwards. But wisely recognizing that this distinction is of an entirely different order from the others, Aristotle does not count it as representing two further sub-types.³³ Thus there are fully twenty-four varieties of because, not counting the distinction between potential and actual.

Clearly, as Aristotle notes, to give only one of these twenty-four answers to the question 'Why?' is not to give all twenty-four.³⁴ Even to answer it in one of the four basic senses is to leave it unanswered in the other three. This does not mean that no sort of explanation is complete until it has been supplemented by every other sort. It only means that there are explanations of many different metaphysical types, explanations in many distinct senses. If an 'explanation' is incomplete (inadequate, partial), then it shouldn't be called an 'explanation'. An 'explanation' explains, or it is not an explanation. Adding a formalistic, materialistic, or teleological explanation to an incomplete mechanistic one will not make it a more complete explanation; it will merely make it an incomplete mechanistic explanation with a formalistic, materialistic, or teleological explanation tacked on.

Nor does one sort of explanation require supplementation by any other sort. In fact Aristotle points out that there are *explananda* which do not admit of explanations of all the four major types. He says, in particular, that events such as the eclipse of the moon lack material causes. This recognizes that one cannot meaningfully ask 'Of what material is the darkening of the moon made?'³⁵ He also says that events which happen by chance lack final causes, for otherwise they wouldn't be *chance* events.³⁶ And formal science, Aristotle's paradigm case of science, contains, in the nature of the case, *only* formal explanations. That is what makes it *formal* science. In geometry, one can ask 'By virtue of what other attribute does a triangle possess this attribute?' But since one is never discussing a particular existing triangle, one cannot sensibly ask 'Who made it to possess this attribute?' or 'What purposes does its possession of this attribute serve?' Only in empirical science is it even appropriate to ask for anything but

³³ *Physics*, Bk. II, Ch. 3, 195b15ff.

³⁴ *Ibid.*, 195a3ff.

³⁵ *Metaphysics*, Bk. XIII, Ch. 4, 1044b9–10.

³⁶ *Physics*, Bk. II, Ch. 6, 197b20.

formal explanations; and in empirical science it is not always sensible, much less necessary to do so.

V. Formal Because

Formal explanations are very dear to Aristotle and therefore deserve special comment. Not only are they the only sort of explanation found in geometry but there are indications that Aristotle thinks them fundamental in empirical science as well. It is his view that explanations form chains, there being *explanantia* which themselves admit of explanation by more fundamental facts. His famous thesis that there cannot be an infinite regress of causes means merely that the *explanandum* is never really (unconditionally) *explained* unless it is the last link of a chain whose first link is an *explanans* itself not in need of explanation, but instead self-evident or self-certifying, a thesis which is true, even given the possibility of infinite series.³⁷ Evidently feeling that only definitions, statements of essence, fulfil this requirement, he came to hold that the first principles of science, the basic laws of nature, must be definitional statements of the essential forms of things.³⁸

This reduction of all explanation to formal explanation is also a reduction of explanation to what we would call description. For Aristotle, formal explanation is description of the essence of things. To understand *what* something is is also to understand *why* it is what it is.³⁹ His favourite illustration of this thesis is the eclipse of the moon, which, he notes, can be explained as *due* to the interposition of the earth, and having been thus explained, subsequently described as *being* the interposition of the earth.⁴⁰

This identity of explanation with essential description or definition may have been suggested to Aristotle by the fact that the language which is descriptive of processes and actions usually mentions their beginning and termination as well as what goes on in between. For example, 'the action of going to the corner to mail a letter' and 'the dissolution of a lump of sugar in a glass of water' are descriptive phrases which make mention of efficient and final causes. Hence, Aristotle often identified the efficient and final causes with the formal.⁴¹

This identification is open to the objection that it makes explanations into empty tautologies, such as explaining the interposition of the moon in terms of the interposition of the moon. The objection presupposes what

³⁷ If this is correct, there is no support in Aristotle for the notion of a temporally first cause of motion, a notion which is inconsistent with his thesis that the universe is eternal.

³⁸ *Posterior Analytics*, Bk. II, Ch. 3, 90b3ff.

³⁹ *Ibid.*, Ch. 2, 90a32.

⁴⁰ *Ibid.*, 90a15.

⁴¹ e.g. *Generation of Animals*, Bk. I, Ch. 1, 715a4–9.

Quine calls the two dogmas of empiricism, the doctrine of an uninterpreted given and the related sharp dichotomy between analytic and empirical statements. Very possibly, however, Aristotle's own non-positivistic empiricism is closer to the actual practice of science. There is not in the actual language of science the sharp distinction between the empirical and the analytic which the positivists require. The descriptive language of an actual science is not empirically pure in Hume's sense, not a mere set of labels for given atomic sensory bits. On the contrary, it is empirically impure, having built into it implicit explanations which have got built into it as the science has developed. There are many ways to darken the moon, but only one of them counts as an eclipse; and to describe *that* sort of darkening as an eclipse is already to say how it happened. The descriptive language of any science carries, in the words of N. R. Hanson, a heavy theoretical burden;⁴² and the more developed the science, the heavier the theory.

Nevertheless, the doctrine does seem to invite such circular pseudo-explanations as that of the learned physician in Molière's play 'The Imaginary Invalid', who said that opium puts people to sleep because it has a soporific virtue. Since a soporific virtue can only be defined as a tendency to put people to sleep, this merely says that opium puts people to sleep because it puts people to sleep. Another illustration of the same sort would be the use of the notion of instinct, now abandoned by many psychologists as being empty. To explain the behaviour of a salmon returning to spawn by invoking an instinct (since this, at the present stage of our knowledge, merely means that it is in the salmon's nature to return) is to explain the behaviour of returning in terms of itself, and thus not to explain it at all.

An Aristotelian answer to this objection might go somewhat as follows: Aristotle frequently states that form and matter are relative. What counts as form and what counts as matter depends on the level of analysis and the stage of investigation. For example, wood is the matter of lumber; but lumber is the matter of a house. This illustrates what is meant by saying that the level of analysis determines whether any given explanation counts as formal or material, and it shows that what is an empty tautology at one level may be very informative at another. Consider another, more modern example. To explain a trait of an organism as the result of the transmission of a gene, where the gene is merely defined as that which transmits traits, is to give a purely formal explanation. Mendelian biology once gave such purely formal explanations. But to explain the same trait, as may become possible since the discoveries of Crick and Watson, by talking about the properties of molecules of deoxyribonucleic acid is to cash the formal explanation in material terms. This illustrates what is meant by speaking of relativity both to levels of analysis and to stages of investigation. What at

⁴² See his *Patterns of Discovery* (Cambridge, England, 1958), especially pp. 54ff.

the *molar* level and one stage of investigation counts as a formal cause (say 'He seeks food because he is hungry' or 'It attracts iron filings because it is magnetic' or 'It induces people to sleep because it has soporific virtue') is, at the *molecular* level and another stage, explained in terms of matter (the biology of hunger, the physics of magnets, the chemistry of drugs).

The point is that, if formal explanations seem to be definitional tautologies empty of content, it is perhaps because they are blank cheques for material explanations one level of analysis down and one stage of inquiry later. The question why salmon swim upstream to spawn is answered formally and tautologously by postulating an instinct only so long as we lack a definition of this instinct in terms of the metabolism of the salmon, and an understanding of its interaction with his surroundings, which would give the explanation content. Similarly, explaining sleep inducement in terms of 'soporific virtues' only marks a blank space where an explanation will be filled in when the chemistry of soporific drugs and sleep are better understood. This sort of answer is precisely the sort of thing which Aristotle seems to intend by his discussions of nature as a cause, where 'nature', as he explains, refers alternately to form and matter.⁴³

But let us resist the temptation to further speculation along these metaphysical lines. There is a more pressing problem.

VI. Final Because

Although they have not been discussed in any great detail, perhaps enough has been said about efficient, formal, and material causes to show how the account of explanation as syllogism and cause as middle term elucidates the distinctions and interrelations among them. We must now consider final causes.

Unhappily, we must begin the discussion of final causes by admitting that our account simply does not hold true of them. Normally, this would be sufficient to show the account false. But there is one saving fact: whether final causes can *in fact* be made middle terms of syllogisms, there is no doubt that Aristotle *thought* they could. But when, in the *Posterior Analytics*, Aristotle attempts to put his example of walking after supper for the sake of one's health in syllogistic terms, the best he can do is this: letting walking after supper be *C*, health be *A*, and non-regurgitation be *B*, he says that since *B* is predicable of *C*, and *A* is predicable of *B*, therefore *A* is predicable of *C*.⁴⁴ This achieves syllogistic form; but, as he immediately sees, it puts the wrong term in the middle. The term wanted there is *health*, but the term actually there is *non-regurgitation*. Labels removed, the argument

⁴³ *Metaphysics*, Bk. V, Ch. 4, 1014b27–1015a10.

⁴⁴ *Posterior Analytics*, Bk. II, Ch. 2, 94b10.

is that since walking after supper prevents regurgitation, which is healthy, therefore walking is healthy. Health is here the extreme, normally the position of the *explanandum*. Noticing this, Aristotle attempts to put things right by observing that since non-regurgitation is a 'sort of' definition of health, the two can be transposed. Evidently he has in mind substituting the *definiendum* for the *definiens* throughout, and vice versa. Thus, let our original syllogism be schematized as follows (where 'ε' is a symbol of predication):

Walking ε non-regurgitation;
 Non-regurgitation ε health;
 Therefore, walking ε health.

Substituting, we get

Walking ε health;
 Health ε non-regurgitation;
 Therefore, walking ε non-regurgitation.

This rewriting puts health in the middle, where it ought to be if teleological explanation is to have the same logical structure as other sorts of explanation.

But the rewriting is clearly required. Aristotle knew this, and it bothered him so much that he tried to defend it on the grounds that, since the premises of demonstrations are commensurately universal predications and convertible, it is legitimate. Besides, he remarks, the order of coming to be of a final cause is the reverse of the efficient cause. This defence is unsatisfactory. If unlimited convertibility is possible, then every demonstration is circular, proving only that *A* is *A*, although Aristotle himself objects to the notion that demonstrations are all circular. Aristotle promises that the solution will become clear as we look at the details, but he never looks at them in sufficient detail to make it clear.

What seems most likely is that Aristotle has confused *explanations* with *rationalizations*.⁴⁵ Final 'causes' are reasons. Health, for example, is the reason why we should walk; it may or may not be the explanation of why in fact we do. Thus, as one author has recently suggested,⁴⁶ the correct logical form of final causes is not the theoretical, but the *practical* syllogism:

Walking is healthy;
 You desire health;
 Therefore, (action) you walk.

⁴⁵ I use this term here to mean 'giving reasons', whether good or bad reasons, not in the psychologist's sense of giving *specious* reasons.

⁴⁶ See Gerasimos Santas, 'Aristotle on Practical Inference, the Explanation of Action, and Akrasia', *Phronesis*, XIV (2), 1969, pp. 162–189.

Here the final cause (health) comes in the middle. But here, of course, we have a practical syllogism, not a demonstration. For considered as being a theoretical demonstration, it is just fallacious, an example of undistributed middle.

Despite Aristotle's evident conviction that teleological 'explanations' are on a level with (have the same logical form as) other sorts of explanations, it seems that we must conclude that they represent a special case and have a different logical form. Why, then, did Aristotle believe them to be species of the same genus?

The answer seems to be that, like other types of explanation, 'explanations' in terms of final causes are answers to the question 'Why?', and can be answered by saying 'Because . . .'. Unfortunately, this is misleading. The trouble is that the word 'because' specifies the final 'cause' only in an indirect or referentially opaque way as a constituent of a motive or desire. For example, suppose I walk to the corner for the purpose of mailing a letter. If final causes fitted the required pattern, I could answer the question why I walk to the corner by saying 'Because . . .', filling in the dots by the mention of mailing a letter. Unfortunately, the best that I can do is to say I walked to the corner because I *wanted* to mail a letter. This invokes my *desire* to mail the letter, which, since it initiates my action, is an efficient cause of that action. The final cause is the actual *mailing of the letter*, this being what terminates the action, is its purpose, and exists only when it is completed. No doubt it is true, as Aristotle seems to say in various places, that ends are not causally efficacious until they become embodied in desires, but this is only to utter the tautology that ends do not become efficient causes until they become efficient causes. Thus, the end 'mailing a letter' will not result in my walking to the corner until I desire to mail a letter sufficiently to motivate my action. This doctrine leads Aristotle to go so far as to attribute to the acorn a sort of desire to become an oak, or generally to define nature in terms of drives towards ends⁴⁷—although he does not make the mistake of which he has often been accused of attributing *conscious* desires to the whole of nature.

In order, then, to specify final causes directly and transparently, we must make use of an expression other than 'because'. In English, we may use the locutions 'in order to' and 'for the sake of'. They correspond to the Greek *hou heneka*. For example, 'Why do we walk after supper?' may be answered 'In order to be healthy' or 'For the sake of one's health', both of which refer directly and transparently to the end which the behaviour serves.

Aristotle was aware, then, that teleological explanations present special difficulties. Evidently, he was inclined to disregard these as being merely verbal, resolvable by means of a little judicious rewording. Unfortunately, it cannot be claimed that he solved them by showing us how to manage the

⁴⁷ *Physics*, Bk. II, Ch. 8, 199b15.

rewording. If there is any solution to them, it is perhaps along an entirely different line. If, as Aristotle sometimes suggests, the final cause is really a constituent of, or identical with the formal cause, then the problem would be solved by the simple expedient of eliminating final causes as a special type. For example, to speak of 'walking for the sake of one's health' would be to define the activity in terms of the end for which it is done and thereby to make the end a constituent of the formal cause. Whether, however, Aristotle would agree that all final causes can be treated in this way is not clear.

VII. Conclusion

I have not here undertaken to give a comprehensive account of Aristotle's theory of 'causes', but only to show that it makes a great deal more sense than is generally thought to be the case. The doctrine has received much abuse which it does not deserve. This abuse is a result, if I am right, of a misunderstanding. The interpreters have unwittingly assimilated formal, final, and material 'causes' to efficient causes. This is especially ironical considering that Aristotle's principal objection to his predecessors on this score was that, unaware of the distinction between different sorts of explanation, they tended to take the account of their own favourite as being an account of every sort, or, worse, confused one sort with another. Thus, some of the Platonists made the mistake of attributing causal efficacy (productive power) to the forms.

Not only does Aristotle's theory not deserve contempt and abuse but, on the contrary, the account of scientific explanation in the *Posterior Analytics* contains much that is valuable today. We have seen that its main thesis is identical with that of the most famous contemporary discussions; and, in distinguishing various sorts of explanation, it may even be superior to the Hempel and Oppenheim account. To be sure, the syllogist theory of the *Posterior Analytics* is a very limited business, and more powerful logics are now available. Still, Aristotle's idea is right, and it is important not only to the history of philosophy but also to the philosophy of science that we acknowledge the fact.

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