

Aristotle's Categories of Cause

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Abstract

It is widely believed that Aristotle originally defined 4 categories of cause. But in one of the two surviving notes, 5 categories of cause were defined: the name **proximal** cause for the fifth category is proposed. The recent restricting by *e.g.* Dawkins of causality in evolution theory to only two categories of cause is disputed.

Keywords

aitia, categories of cause, evolution theory, emergent properties, explanation in biology, neo-Darwinism, scientism.

Introduction

As a scientist seeking help from philosophers in clarifying the theory of evolution, I wish to suggest reasons for renewed study of the categories of cause originally proposed by Aristotle.

Even within science, little attention has been directed this past century or so to the question of what the term explanation should mean. (I distinguish here between philosophers of science, some of whom have arguably been obsessed with it, and practising scientists uneducated in philosophy.) The categories of cause proposed by Aristotle, although little challenged for 2.3 millennia, have rarely been taught to science students.

One use of this extremely important concept is in the theory of evolution, which has lately concentrated on only two of the categories of cause.

Categories of Cause

Margaret Taylor (1924, 120-21) introduces Aristotle's causes thus:-

The aim of wisdom, he says, is to arrive at knowledge of causes and principles. A 'cause' gives the answer to the question 'Why?'. Generally speaking, the cause of anything is the coming to be of a particular form in the appropriate matter: 'matter' and 'form' are then 'causes' of a thing's existence. But for a complete account of the reason why anything comes to be what it is, a further analysis of form is required, and the original two causes become four.

Evidently, 'the answer' would better read 'an answer'.

Aristotle's own statements are found in the series 'Aristotle' in the Loeb Classical Library. The definitions of the Causes are in two different versions, in different 'books', *Physics* (Wicksteed & Cornford 1957) and *Metaphysics* (Tredennick 1933). The differences have been deemed, for most purposes, minor. But here I wish to emphasise the neglected fact that the *Physics* version actually proposes 5 causes.

Loeb editors Wicksteed & Cornford, and Antony Flew (1989) whose abbreviated translation is transcribed below, point out that in normal English we would not apply the word 'cause' to every one of what Aristotle calls the *aitia*. The Greek word *aitia* evidently had wider meanings than the English word cause which may for present purposes be taken to mean 'a thing or condition required for the item of interest to come into existence'.

The *Metaphysics* definitions

1013A24 - 1013B9, *trans.* Flew (1989, 159)

Cause means:

- (1) that from which, as its constitutive material, something comes, e.g. the bronze of the statue ... ;
- (2) the form or pattern, that is, the account of the-what-is-to-be ... ;
- (3) the source of the first beginning of change or rest, e.g. the man who resolves is a cause, ... ; and
- (4) the end, that for the sake of which, e.g. as health is of walking around. ('Why is he walking around?', we say; 'In order to be healthy', and having said this we think we have given the cause ...

These are just about all the senses of the word cause, and since the term is multiply ambiguous there are regularly several causes of the same thing; for instance, the making of a statue and the bronze are causes of the statue ... They are not, however, causes in the same sense, since the one is material and the other efficient.

Although Flew does not put the respective labels directly on the causes, the names generally used have been (1) Material (2) Formal (3) Efficient (4) Final.

Two or three of the 4 labels which have long been standard are less than self-explanatory, or are even confusing - notably efficient. It is probably too late to change these traditional names; but consistent usage is highly desirable,

and has not always been achieved.

Causes in Biology

The biologist John Morton (1972 Ch.1), noting that at Aristotle's period in the development of science he was in no position to understand chemical process, offered a more modern version of the 4 causes which I précis, taking account of other unpublished comments by Morton, and of Broom's (2010) correction:

What are the causes of the bottle of claret I'm now decanting?

The **material** causes include the grape juice and the yeast, materials transformed by the efficient cause into this peculiar substance claret.

The **efficient** cause is a person (named Babich) who willed to organise suitable vessels & conditions for the substances which are the material cause, and planned a sequence of operations, for the purpose (**final** cause) of making claret by maximising the likelihood that the particular biochemical action of the yeast would operate on the grape juice, leading to claret.

Aristotle's **formal** cause is in this example the pre-existing 'claret idea' in Babich's mind.

Wicksteed & Cornford in their translation of the *Physics* divide the final section of the list into two:

(d) The same as "end"; *i.e.* the final cause; *e.g.* as the "end" of walking is health. For why does a man walk? "To be healthy," we say, and by saying this we consider that we have supplied the cause.

(e) All those means towards the end which arise at the instigation of something else; as *e.g.* fat-reducing, purging, drugs and instruments are causes of health; for they all have the *end* as their object, although they differ from each other as being some instruments, others actions.

It is surprising that there has been little notice taken of the 5 Causes as in Aristotle's *Physics*, as distinct from the more famous 4 as in *Metaphysics*. The fifth Cause I propose to call **Proximal cause** – any process in matter &/or energy leading to a new state of the universe.

Doyle (2011) has stated that elsewhere in the *Physics* Aristotle defined **chance** as a further cause.

Some rationalisation for the label final is offered by Temple (1923):

This is the essence of "intellection" or science, that it asks "why" perpetually; as soon as it is answered, it asks "Why?" again ... But if from some other department of Mind's activity an answer is suggested, the intellect (if not impeded by "intellectualist" dogmatism) will gladly accept it. And Mind does accept as final an explanation in terms of Purpose and Will; for this (and, so far as our experience goes, this alone) combines efficient and final causation. "Why is this canvas covered with paint?" "Because I painted

it." "Why did you do that?" "Because I hoped to create a thing of beauty for the delight of myself and others."

Causes in Evolution

The term evolution means the appearance over time (Margulis & Schwartz 1998) of new life-forms - new species, and larger taxa (genus, family, order, class, phylum, kingdom). Science has inferred from a large body of observations that life appeared on our planet as blue-green algae 4×10^9 year BP; later emergences include complex animals 1×10^9 y, mammals 2×10^8 y, and humans in the region 10^6 - 10^5 y BP. Thus, evolution has certainly occurred, in the sense that new life-forms have appeared (mostly in bursts) over billions of years. However, evidence for descent from one to another has been difficult to come by and is sparser, at least to date, than sometimes assumed. The rarity of the processes which can form fossils, and the severe limits on sampling such fossils as have been formed, make inevitable the absence, in the record as we glimpse it, of most intermediate forms.

Gradualism remains a dominant principle in orthodox neo-Darwinism, although hardly a major characteristic of the known record of evolution, which is dominated by discontinuities ('saltations').

This proliferation over time of increasingly complex life-forms requires explanation - ascription of causes - beyond what has become standard evolution theory *viz.* random mutation, genetics, natural selection, and population dynamics, the four strands of scientific ideas which have been synthesised into neo-Darwinism.

We are here concerned with the causes of evolution, and more widely, the need to clarify explanation and cause in biology - what will count as a thorough explanation *i.e.* a full attribution of causes?

The origin of life, as distinct from evolution which afterwards occurred, similarly requires logical explanation.

One point not at issue is that **emergent properties** are real & important. As matter takes more complex forms, new properties emerge which are absent in less complex forms. In an extremely simple example, the molecular substance H_2 (ordinary hydrogen) has more properties than does atomic hydrogen H, and science (mainly quantum mechanics) has gone some considerable way toward explaining such emergent properties of molecules (*e.g.* vibrations & rotations seen by infra-red & Raman spectroscopy; nuclear magnetic resonance spectra; etc). But a phenomenon such as the emergence of the first seed-plant (a sequoia, 3×10^8 y BP), with no known 'proto-sequoia' precursor, represents a scale & co-ordination of emergence requiring some different kind(s) of explanation. The *methodological* assumption that there are no Final causes should not be viewed

as a fact. It is an axiom for the purposes of scientific method, to be carefully distinguished from a *philosophical* assumption let alone a fact. Étienne Gilson (1984) insists on the relevance of final cause in biology:

... the modern biologist ... [declares] that it is scientific to exclude final causality from the explanation of organized living beings ... [t]he pure mechanist in biology is a man whose entire activity has as its end the discovery of the "how" of the vital operations in plants and animals. Looking for nothing else, he sees nothing else ...

In stating objections to Dawkins's neo-Darwinian approach which alludes to only Material causation and one other category (clarified & named above), Broom (1998) asks why Dawkins always uses goal-laden accounts of the process. *Can* evolution actually be described in purpose-free language? If not, that fact might suggest that evolution theory should somehow include, rather than ignore, the concept of Final cause. Not even the discipline of anatomy, much less physiology, has been conducted without recourse to the language of purpose. This is one place where Final cause impinges on science. The language of purpose that suffuses biology is not merely paraphrases for brevity, nor slang; it reflects broadly the need for Final cause in biology.

In order to promote consideration of causes in biology, let us go back to W^m Paley's 1802 scenario of finding, during a stroll on a heath, a watch. The evident order of this mechanism would - Paley argued - force the finder who studied it to infer the existence of a purposive design, and therefore a purposeful designer. (This conclusion would seem especially warranted if the watch was running when found.) He then argued that the living mechanisms of nature - the complex machinery so evident in biology - must similarly be inferred to have been designed. This argument, which seems to me to have been unduly neglected, might be interpreted as a vague insistence on *all* causes in biology. In the last two decades' revival of Paley's argument - including a pocket of recent natural theology labelled 'intelligent design theory' - the need becomes more acute to bring up to date the definitions of causes.

What can be said to explain - ascribe the causes of - an organism? DNA is a Material cause of all (so far as is known) organisms, and operates as parts of Proximal causes through the several types of RNA and the many enzymes essential for biosynthesis of proteins & other biochemicals; but DNA is surely not an Efficient cause. As Morton recently put it, DNA is not the kind of thing that can cause other things as if paints could leap from tubes to create a Turner, or vibrations & percussions form themselves into a work of Mozart. A person implementing a plan - an Efficient cause, like Aristotle's prototypical 'the man who resolves' - is a prerequisite for such things to come into existence.

The extent to which the blueprints encoded in DNA are Formal causes is debated (Denton, Marshall & Legge 2002).

The neo-Darwinist approach simply *assumes* that Proximal causes (with of course the Material causes entailed in them) suffice to explain evolution.

Emergent properties are assumed to be entailed in these impersonal processes of nature, to whatever arbitrary extent may seem desirable in the attempt to evade Final cause and, above all, Efficient cause.

The main exception is obviously technology - and more widely, all human acts willed to modify the universe. The only type of Efficient cause - person acting with a purpose - is, in this 'Enlightenment' approach, human will. Thus "who designed this watch?" would be an allowed question, but "who designed this frog?" disallowed. This assumption - an implied denial, rather than any reasoning - appears not to have been subjected to much scrutiny. And of course biologists find themselves using the language of logic-based mechanism despite their denial that the frog with all its 'mechanisms' needs a higher level of causation.

Can the origin of life, &/or evolution, be explained by only Material and Proximal causes? They are necessary but - I suggest - not sufficient for the task. The chemical materials are necessary, as are the processes of metabolic pathways within organisms and ecochemical cycles amongst them, and the concomitant fluxes of energy (mainly, on current knowledge, of the one kind - electromagnetic - though gravity is also significant). But can it be imagined how the patterns of evolution could have been produced by the mere outworkings of the laws of physics & chemistry? Ecological order, the most complex mechanism (entailing the complexities within each organism and also inter-organismal complexities), implies design and therefore Final cause. Megatime is no substitute for purpose in the creation of coordinated working ecological order. Final cause is involved in explaining any given physiological or ecological regime and most of all the evolutionary responses of ecosystems to changes in imposed conditions. Bolides e.g. the 'Yucatan' iridium-rich meteorite ending the Mesozoic era, and major ice ages ending earlier eras by exterminating most species extant at the respective times, have normally been followed soon (within a few dozen My) by an explosion of novel taxa. This, the broad outline of evolution, will require more than just two categories of cause to explain it.

The popularisation of neo-Darwinist theory has amounted to little better than the issuing of an endless series of promissory notes; its actual achievements in explaining life remain extremely slender. It is not just that neo-Darwinism has made slower progress than it had hoped - though this sluggishness might be widely admitted. The inadequacy of explanation is not merely quantitative. The more important point is the qualitative distinction: Paley's point that (stated in modern terms) no amount of explanation in the categories of Material & Proximal causes can suffice to explain life.

The reasoning so far leaves many options open. The character, and number, of efficient cause(s) in biology remain to be explored, beginning logically with the sceptical attitude exemplified by Hume in his *Dialogues on Natural Theology* quoted by Temple (1934):

This world, for aught [any man] knows, is very faulty and imperfect compared to a superior standard; and was only the first rude essay of some infant deity, who afterwards abandoned it, ashamed of his lame performance.

Natural theology has come some distance since Hume, reaching a peak by the 1930s in Temple's Gifford Lectures (pubd 1934) surveying the history of attempts to infer causes in nature without recourse to special revelation. The strand of philosophy represented by Morton (1972), Rupert Sheldrake (1990) and Broom (2001, 2010), traceable through Gilson, Sir Alister Hardy (1965), Temple, Grosseteste, Aquinas, etc., back to Aristotle, does not suggest a biology devoid of Final or Efficient cause. Neo-Darwinism fails to explain evolution fully. How is a modern biology to deal with Final cause?

The question is of course far from novel. Gilson's answer in 1984 began by refusing to discuss

... scientism ... the resolve not to admit, in any discipline, any solution to any problem which cannot be rigorously demonstrated by reason and is not verifiable to observation. The object of the present essay is not to make of final causality a scientific notion, which it is not, but to show that it is a philosophical inevitability and, consequently, a constant of biophilosophy, or philosophy of life.

A conservative answer today could be to continue the methodological convention that science will pursue only Proximal (and Material) causes, but also to advocate that science should be taught & practised in a context of philosophy acknowledging all the categories of Cause. Introducing the English edition of Gilson's *From Aristotle to Darwin and Back Again*, Jaki remarked (*in* Gilson 1984, xviii)

The infatuation of the English-speaking world with an evolutionary philosophy disdainful of purpose is hardly something to cheer about or something that would be cured by a book however excellent.

This present small essay is a further attempt towards curing what Jaki (*ibid*, xix) called

... the hostility toward the notion of final causality ... one of the principal reasons [of this hostility] is [final causality's] long association with the notions of a creator God and providence.

If science consists in discovering materials (*e.g.* chemical elements & compounds), energies (so far just 4), and forms (*e.g.* species of organism), and elucidating qualitatively & quantitatively the proximal processes - including energy conversions - which result in new physical situations, then one might suppose Material and Proximal causes are the only causes science can study. But if science discovers *e.g.* new species on the basis of studying say form & physiological function which clearly require more than Material and Proximal causes then this methodological restriction surely cannot be continued! We cannot say, therefore, that no Final causes operate in evolution. How much

science can hint about these final causes remains to be seen, but may perhaps not amount to much, if only because natural theology is only a small part of comprehensive theology. May we look to philosophy and theology for the revival of metaphysics needed to study final and formal, and even efficient, causes in evolution?

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This paper was much helped by discussions with J E Morton, J R Ravetz, N D Broom, and J Owens; P McKechnie kindly clarified Greek.

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