Some Issues in Aristotelian Causation

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Of the four kinds of causes which Aristotle sees as jointly necessary to comprehensive explanation of the observed phenomena of the world, it is final causes, with the integral involvement of ends or goals, which seem to be most difficult to reconcile with contemporary conceptions. This paper explores some of the issues arising and takes some initial steps towards such reconciliation. The aim is to develop a coherent picture built upon an Aristotelian foundation, rather than establish a definitive interpretation or critique.

1. Ontology

Aristotle says his four causes are necessary and sufficient to explain anything that needs to be explained.[1] For Aristotle, those things which are in need of explanation are the empirical data provided by perception; the "phainomena". Such empirical data are the starting point for properly scientific inquiry, and the material through which explanatory results are tested and confirmed (Bolton & Code, 2012:54). As he says, "The senses do not give the reasons for anything e.g. the why a fire is hot, but merely indicate that it is hot" (*Metaphysics,* Alpha*,* 981b). "The experienced know the 'that' but not the 'because', where the skilled have a grasp of 'the because', the cause..." (*Metaphysics,* Alpha*,* 981a).

Perception gives generally reliable knowledge of the ontological structure of the world as a world of substances and their properties. We perceive individual things as instantiations of real kinds, with their individual properties as instantiations of particular (shared) universals.[2] Primary substances are complexes of matter and form;

[1] As Shields summarises his position, "A complete and adequate explanation must cite all four causes. And there are no kinds of causes beyond the four" (Shields, 2007:44).

[2] The foundations of our knowledge of the world seem to lie in a deep attuning of our perceptual and cognitive systems with elements of the kinds-based structure of the world. Some primitive assessments of similarity thereby serve to ground reliable inductive inferences on the basis of one or a few instances. See Hilary Kornblith, 1993, chapters 4 and 5.

matter is what underlies the acquisition or loss of a form; form is a positive attribute gained or lost by matter in the process of change. Matter is the material of which something is made; form is the mode of organisation of the matter which makes it an instance of a particular kind of thing, rather than of another such kind. Certain sorts or aspects of organisation of underlying matter (aspects of form) are essential to a thing being the kind of thing it is.[3]

One of Aristotle's own examples here is that of a house: the matter of the house is bricks and beams. Initially, they have the form of a pile of bricks and a stack of beams. Later, through the action of a builder, they have the form of a house, with walls and a roof. This example illustrates the hierarchical structure of matter and form. The bricks themselves have their own matter and form: the matter is clay, the form is the brick shape, and so on. Complex structures are built up out of simpler ones — or at least smaller ones.

Primary substances have some properties whose loss involves the destruction of the substance; transformation of one kind of substance (one essential form) to another. Aristotle distinguishes such essential properties, essential to the identity of a thing as an instance of a particular kind, from accidental ones, which can come and go in the course of a things existence as a particular type of thing. We probably need to qualify this distinction by reference to variable properties, where some value of the variable — within a particular range — is essential to the thing being a particular kind of thing. A population of such things at a given time, or an individual over a period of time, exhibits variations within that range, but outside of that range there is a change of form, the substance is destroyed. [4]

2. The four causes

Turning to Aristotle's four causes, we see how they are related to the ontology, and how they are related to each other. A mover (or "maker") of some kind, an "efficient cause", acts upon — directs some force upon — some pre-existing matter/form system, some substance, to change one or more properties of the substance (e.g. temperature)

[3] In the *Metaphysics* Aristotle actually identifies primary substance as basic constituent of reality with essential form or structure in this sense rather than with particular complexes of matter and form. A possible reason for this is his identification of matter as potentiality and form as actuality. The matter of a particular form is potentially the matter of another form (Zeta). But insofar as such essential form is a particular organisation of matter, then there is no such essential form without its particular (actual) matter. Some aspects of form are immediately apparent, e.g. external shape. Some less so, e.g. the internal structures and processes within the body of a substance, or the tendencies or potentialities of that substance for particular actions or responses, which need to be liberated or triggered into operation by particular sorts of circumstances.

[4] In *Metaphysics* (Iota 9), Aristotle says that differences of species involve differences of form, while differences within a species — as e.g. of gender — have to do with matter. More helpfully (in Lambda 2), he notes that change is "from contraries", both in the case of a "change of quality" (or location or size) — as e.g. from green to brown colour (rather than from green colour to loud sound), and in the case of "generation or destruction" of substance — as e.g. from wood to ash.

or to change the form, the essential pattern of the thing, sufficiently, to bring a new kind of substance into existence in and through destruction or transformation of an existing substance.

In the *Metaphysics,* Aristotle speaks of the matter, the material cause, as that which undergoes change; he speaks of form, the formal cause, as that into which the matter changes. He speaks of the efficient cause as that which produces the change (Lambda 3). Matter is the potential for new form, through re-arrangement of its components under the pressure of the efficient cause. Form is the actuality of accomplished transformation. In the case of house construction the final cause, defined in the *Physics* as "that for the sake of which a thing is done" (*Physics,* 194b23–35), relates to the intention of the builder, their reason for building the house; to provide shelter for themselves, for example.[5]

But Aristotle extends the concept of final cause beyond instances of intelligent agency to include natural things "acting for the sake of something" (*Physics,* 198b1 6–23). As he says, "if ... things coming to be in accordance with a craft are for something, clearly so too are things coming to be in accordance with nature. For later stages are related to earlier (amongst things coming to be in accordance with nature) just as they are amongst things coming to be in accordance with a craft" (*Physics,* 198b 1 6–23).

3. Problems with final causes

The final cause is the major problem for contemporary thinkers. It is not so clear as Aristotle thinks that natural things "are for something". Questions arise of why Aristotle extends the concept as he does and of whether any such extension is really defensible.

We can recognise agency (of a moving cause) without teleology; the simple fact of entity A in some way impinging or impacting upon some part of entity B. The moving cause is an active agent exercising a power. The thing acted upon — or its matter — has the potential to respond to such a power in a particular way. Typically powers are triggered into action by "releasers" or "triggers" of various kinds. This could be as simple as the impact of moving billiard ball A on static billiard ball B,

[5] So, in terms of explanation, we know how the house came into existence by reference to the motivation and skill of the maker, the availability of, and potentiality inherent in, the appropriate raw materials. We know that things with the form of a sturdy, well-constructed brick house have the property of being able to protect human inhabitants, including the capacity to do this for a long period — to persist, in part because of what they are made of, sturdy water-proof, long lasting bricks, and in part because of the new properties emerging out of the particular complex arrangement of such components — with walls supporting roof, roof stabilising walls, mortar, arches, etc.

The house retains its character as a house in face of some changes of its properties — some external forces producing such changes. Forms have particular conditions of existence; a range of conditions of external environment and internal arrangement compatible with their continued existence, so change of such conditions beyond such limits destroys the form in question (creating a different form, or more than one). So part of the explanation of why individual X persisted (as an instance of kind Y) is because such limits were not exceeded.

setting B in motion towards static ball C. In the case of an intelligent agent, the trigger can include intentional elements of belief, desire and perception. They desire a particular result, believe that a particular action can produce that result, perceive that they are in a situation where such action is possible, they command the resources necessary to engage in the action in question, they see no strong enough reasons for not engaging in the action.[6] And, in the case of house building, a representation of the finished product guides the construction process. So part of the explanation of why or how a constructed thing came to be as it is, is a reference to the goal of the action that produced it.[7]

But it is far from clear how reference to a goal can figure in explaining the coming into being of things, where that process involves no such intentional action. There are various sorts of considerations which could have influenced Aristotle here.

4. Form and function

In relation to the house building, a part of the belief that drives the action is the idea of the thing in question, a particular house design, being able to serve a human purpose by virtue of the particular matter and form of the finished product. A perfectly legitimate form of explanation is one which shows how a thing can, effectively, serve a particular human purpose by virtue of its particular matter and form, including the role of such matter and form in sustaining particular kinds of efficient causation. At least some of the useful properties of the house, its ability to provide shelter, are explicable by reference to the intrinsic properties of the bricks (as matter), as rigid, weight-bearing, water-proof, etc. They have these properties as isolated bricks (in piles) and they carry them through into their role as house components. Other such new, emergent, useful properties of the house are explicable by reference to the arrangement of the bricks and beams (as form), the house has a roof which protects its occupants from rain and snow.[8]

But so can a cave serve a similar function by virtue of its particular matter and form. Legitimate explanation can, again, relate matter and form to function.[9] Humans can see everything in the world, both natural and human-made, in relation to the actuality or possibility of its serving some useful human purpose. Everything can, potentially, be drawn into this sort of purposive explanation, whether or not there has been any involvement of intention in the creation of a thing's particular form.

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6 Philosopher John Searle has explored such intentional causation in detail. See e.g. Searle, 1983:112–140.

7 This is only a part of the explanation. We also need to refer to how they came to have access to relevant tools, skills, raw materials, etc.

8 This is a change of form, from pile of bricks to house shape. The change is explicable both by reference to the motivation of the builder and their ability (skills, access to resources) to usefully re-arrange the bricks to create a new form, and to the suitability of the bricks to such a re-arrangement, their capacity for house formation.

9 It keeps out the rain by virtue of its structure and composition.

Beyond this point so can we make a moral judgement about the best possible (or at least morally defensible) human uses of particular kinds of things. And the analysis of the function of matter and form then focuses upon the potential of particular kinds of things for such ethically optimum usage. Clearly such usage depends upon appropriate action by people, preparing and/or using the thing in the right way. So, to say, as Aristotle does, that the rain falls in order to make the crops grow, is really to say that the rain should not be wasted by the responsible farmer.

5. Two sorts of teleology

Both of these modes of explanation integrally involve reference to the intentions, goals or purposes of humans. On the one hand, there is explanatory reference to the role of intention in directing action as efficient causation of transformation of pre-existing materials. This could be called type one teleology. On the other hand, there is reference to the functional capacity of particular configurations of matter and form to be able to fulfil particular intentional goals or purposes of human agents by virtue of their particular matter and form. This could be called type two teleology.

Both are actually forms of efficient causation in the sense that the first deals with the role of intention in the efficient causation of action, the second with the efficient causative role, or potential role, of particular configurations of matter and form in contributing to the fulfilment of particular human intentions.

In his comprehensive investigation of *Aristotle on Teleology*, Monte Ransom Johnson argues that Aristotle's teleology is not confined, or even centrally focussed upon, these two principles, but rather upon an idea of "every natural substance" being "an end ... identified as the beneficiary of its own parts and motions" (Johnson, 2005:4). As he says,

> it would be a grave mistake to infer from Aristotle's discussion of the instrumental value of plants and animals that Aristotle therefore holds that such natural substances do not at the same time have intrinsic ends independent of their instrumental value to humans. (2005:4)

Some animals, at least, have their own desires, beliefs and perceptions, combined in intentions, which drive actions in pursuit of particular goals of their own. So type one teleology, of efficient causation, in part through intentional action, is applicable in this sort of case. Johnson refers here to animals' "pursuit of pleasurable perception through various kinds of locomotion" to summarise Aristotle's position, with survival and reproduction as, at least partially, unintended consequences of such action.

Aristotle recognises that plants have no such faculties of perception, cognition and desire. Nonetheless, it remains possible to identify the functional contribution of elements of their particular matter and form, and the characteristic actions or responses associated with such matter and form, to the survival and reproduction of

the organism in question, in a type two teleological explanation, parallel to that of the function of such elements in contributing to the realisation of particular human intentions, but without any such reference to intention. And so can we identify the parallel, non-intentional contribution of elements of matter and form of animal species in contributing to survival and reproduction of the animals in question.

As Johnson notes, both natural theology and evolutionary theory start out with consideration of how particular organs, e.g. function within particular bodily structures or patterns of behaviour to facilitate survival and reproduction. The former approaches rely upon a divine creator, presumably conceived along the lines of Aristotle's house-builder, putting together the total system of the organism in question — a process of intentional efficient causation at some past time — with such structures thereafter reproduced through natural biological processes. The latter refer instead to a model of non-intentional efficient causation based upon random mutations in pre-existing structures, improving survival chances of individuals (and groups) in particular environmental circumstances, again, with biological transmission of such changes across the generations.

Johnson highlights the "common ground" of both such approaches in identifying "only that which promotes the survival and reproduction of an individual" as "explanatory of a part ... or pattern of behaviour"(Johnson, 2005:204). Aristotle is not a natural theologian or an evolutionary theorist. But he is in line with both in placing survival and reproduction at the heart of his teleological explanation.

6. Guiding plan

This leaves Aristotle without any clear explanation of the phylogenetic origins of such functionality. On the other hand, it is possible that the builder analogy points the way towards possible ontogenetic causal explanation of the biological reproduction of individual organisms. Such an analogy can be developed to model the unseen — internal — mechanisms through which biological systems develop "by nature" along predictable paths from small and apparently simple to large and obviously complex, from acorn to oak tree for example. Just as the house-builder is guided by an image or plan of the finished structure, so is it easy to imagine that such a plan plays a part in guiding the relevant natural processes.

It seems even more appropriate to say that the acorn somehow embodies the potential for becoming an oak tree than that the bricks embody the potential to become a house. In the case of the bricks, the guiding representation of the final structure necessary for realisation of such a potential has to come from outside, from the mind of the builder. But in the case of the acorn, both representation and capacity to be guided by the representation in assembling relevant components seem to be internal to the acorn, having been bequeathed by the parent tree.

This is possibly the kind of thing Aristotle is thinking of when he speaks of "later stages [being] related to earlier amongst things coming to be in accordance with

nature just as they are amongst things coming to be in accordance with a craft" (*Physics,* 198b 1 6–23).

In recent times, the genome has been believed by some to provide just such a "blueprint" to guide processes of biological generation, maintenance and repair. People have found it difficult to see how complex biological structures could be built up out of simpler molecules without any such blueprint to guide the process. So it would be hardly surprising if Aristotle's thinking was, at some level, guided by this kind of idea.

The view of DNA as "guiding" blueprint, in anything like the way a house blueprint provides a picture of the finished construction seems to be radically mistaken. On the other hand, the DNA molecule does seem to include what are in some sense "representations" of elements, of protein structures, along with means to guide the "automated" nano-machinery of the cell in assembling such proteins.[10]

7. Homeostasis

Johnson argues that,

> Aristotle's teleology is less successful at the level of complexity below and above the organism. ... His theory of the teleological movement of the elements ... has as little import for modern physics and chemistry as his notion that the stars are alive does for astronomy. And his application of teleology to political organisations ... likewise has little to teach contemporary sociologists and political scientist. (2005:288)

But all stable systems — all substances — continue to exist only so long as they effectively resist internal and external forces that threaten to destroy them, e.g. to break down complex structures into simpler more intrinsically stable component parts. Such resistance involves feedback processes of mutual support of such constituent elements and ongoing interaction with elements of the ambient environment, counteracting or neutralising the potentially destructive tendencies of that environment.

Such ongoing existence, therefore, provides the basis for a kind of functional explanation of the operation of subsystems of many different kinds of things. This applies at the lower level of inanimate physical systems and, more so, at the upper level of complex human social systems.

8. Complex structures

When we look into the structure of any particular substance, we find a hierarchy of components, with the form of the lower order components becoming matter for the

[10] Genes turn out to be groups of DNA sequences separated by non-coding sequences, stitched together in different ways and activated by cellular mechanisms during development, and in the course of life. Particular sequences of DNA are turned on or off in the course of development by multiple signalling molecules, generated within particular cells where they operate or diffusing from other regions of the developing foetus. But all such processes combine to give a direction to development, seemingly towards a pre-determined goal.

next higher order.[11] And Aristotle operates a practical principle of the explanatory priority of higher orders of structure; higher order subsystems.

There is a methodological individualist tradition in social theory, which can be traced from the work of Thomas Hobbes, through to contemporary sociobiology and neoclassical economics, which sees human individuals, and intentional actions, as the primary sub-systems for social explanation. Hobbes and the sociobiologists try to explain all social phenomena by reference to biologically programmed capacities and tendencies of individual humans, including reasoning powers, leading them into forms of conflict, competition and co-operation.

Aristotle seems to have recognised the incoherence of such reductionism. This is part of what he is concerned with when he refers to the "temporal priority" of substance or of species over individuals (theta 8). A fully formed member of a complex species or kind is needed to produce the "seed" of a new individual of the kind in question.

While attributing the creation of humans as biological systems to processes of biological reproduction, he recognises that the creation of humans as people, as essentially political animals, able to function as elements of social organisation, is a product of the action of pre-existing social organisation. In the *Politics* he identifies a certain necessary minimum of such social organisation, in the form of family or village structure, integrating different sorts of necessary human actions (including care and education of children), while recognising that in practice, in his day, most people were produced by more complex social structures (of city states).

He specifically identifies social structures as existing by nature, meaning that they have their own autonomous developmental dynamic, with new social forms emerging from pre-existing social forms — rather than as artifacts created by people, with no such autonomous life. Human intentional action is certainly integral to the maintenance and operation of such systems. But it always operates within such structures, which direct and empower it. Outside of such a system, a human could only be (as Aristotle says) "a beast or a god" (*Politics,* 1253a18–29).

J. L. Ackrill argues that higher order structures of living things and social systems pose major problems for the matter/form model, insofar as this model requires that the matter of any particular composite "be capable of existing ... as the same matter when in-formed by another form" (Ackrill, 1978:69–70). It is not the case that the higher order components of a human — or animal — body, or the components of a nation state, can exist outside of the body or the nation state in some other form. So such components can neither be assembled into the complex structure by external agency nor assemble themselves. And the stability of the complex structures concerned cannot be explained by reference to the intrinsic stability of their higher order components.

The first point in answer to this is that there is an ontogenetic or phylogenetic carry-over of matter in some such complex cases; bacteria and archaea reproduce

[11] Perhaps this should be qualified to apply to substances above the level of basic leptons and quarks. But some argue for significant structure even at this level.

through division; in higher organisms maternal mitochondria are handed on to the developing foetus. Aristotle focuses upon the carry-over of pre-existing family and village structures into more complex political and economic forms of city states. Here, indeed, is the beginning of a kind of evolutionary phylogeny in Aristotle's social theory.

Identifying the higher order structures of contemporary capitalist society as institutions of state; imposing binding rules and regulations over a territory, economy; producing and distributing goods and services, and civil society; including such voluntary associations as clubs, political parties, labour unions and neighbourhood associations, social theorist Erik Olin Wright looks forward to a future in which "the voluntary associations in civil society directly organise various aspects of economic activity" (Wright, 2010:140). He foresees both continuity and radical change in civil society structures in course of such a transformation.

It is certainly true that outside of the complex structures of which they are integral parts, some such higher order components break down into simpler (relatively stable) sub-components. Such higher order components can exist only within the complex structure in the sense that they are protected — by some barrier — and that they ongoingly supply each other with necessary inputs, or remove toxic waste materials. But such subsystems still play a central explanatory role in understanding the complex systems of which they are parts.

Just as blood is pumped by the heart to the other organs via the lungs and back again, so does money flow from corporations to working families as wages and then back from families — as consumers — to corporations in exchange for consumption goods.

In contributing to each other's continued operation, so are such higher order subsystems thereby contributing to the maintenance of the total system. Form is no more than the arrangement of highest order subsystems. Such relations between components are characterised by negative feedbacks, with one — efficient — cause triggered by a variable value falling below a given value to push it up and another triggered when the variable reaches a given high value to push it down again. Or more broadly what could be called causal loops whereby action of agents contributes either to their own stability or that of other elements within complex systems of which they are parts.

In a social context, high order subsystem A, e.g. government, of a complex system B, a liberal nation state, triggered by a condition of another such subsystem, C, a slump in the national economy, acts upon C to change its properties from slump to boom through deficit spending, in such a way as to maintain the stability of the total system.

In this case, such stability is a goal of intentional action (on the part of particular groups). But it need not be. One model of the business cycle sees employment increasing above a certain level leading to labour becoming scarce, allowing workers bargaining power to increase, leading to a greater share of wages in the value of output and declining profits. Beyond a particular point of increased wages employment suffers

as investment tails off, businesses collapse, unemployment rises. As employment falls below a particular level, workers declining bargaining power leads to falling wages, boosting employment with more investment, Once it reaches that level again wages increase again (and so on). Scarcity of labour functions to increase wages and falling wages function to restore profitability without these being goals of action. But governments can engineer such slumps through interest rate rises and professional groups can sometimes restrict entry to keep skilled labour in short supply.

9. Ecology

Moving down into simpler physical systems, we see ongoing interaction of components as integral to the maintenance of structures, as for example, with the interaction of atoms, sharing electrons in molecular structures.

But it seems clear that some have run into problems in seeking to extend ideas of homeostasis beyond the level of structures of individual organisms and social systems and into the ecology of the planet. James Lovelock, in particular, went too far in his claims about homeostasis in the biosphere of the Earth.

There are some well-established large-scale feedbacks or causal loops contributing to maintaining the conditions necessary for complex life on the planet, including the atmospheric carbon dioxide thermostat in the stable geologic carbon cycle. More co2 (e.g. from big volcanoes) leads to more greenhouse warming, leads to more rain, leads to removal of co2 by weathering of igneous rocks (which absorb the co2 as calcium carbonate), washed into ocean sediments, incorporated into the bodies of planktonic creatures and subducted beneath the crust, leading to cooling, leading to less rain, leading to less weathering, less removal of co2, more heating and so on. Unfortunately, this process operates much too slowly to save the human species from human-induced global warming (Archer, 2010:56).

The social examples show how human intentional action can play a part within such subsystem interactions with or without the final state in question actually being a goal of any such action. The climate example shows such a cycle operating without any such intentional input, for millions of years.

Certain sorts of components of complex systems are found together in particular natural or social kinds because such components are attuned to contributing to each other's conditions of existence — to keeping relevant variables within particular ranges.

The atmospheric co2 thermostat example nicely illustrates a coincidence of function and feedback, insofar as humans have a special and obvious interest in the maintenance of a stable surface temperature of the earth.

10. Conclusion

In a sense, then, this perspective on Aristotelian final causation vindicates the contemporary prioritisation of efficient causation, in terms of capacities or powers of

particular structures to act to produce particular sorts of changes in particular sorts of situations, with other, appropriately receptive objects to work upon. Type one teleology is essentially concerned with the role of human or animal intention in the efficient causation of action. Type two teleology is concerned with the role of elements of a stable structures in fulfilling some human or animal purpose, or in contributing to the stability, survival or reproduction of that structure.

But in contrast to contemporary reductionist models, particularly in the social sciences, so does Aristotle highlights the emergent efficient causative powers of complex structures, including social institutional structures, to influence their own component elements and other structures or systems around them. He recognises that such higher order powers are products of the ongoing functional integration of higher order constituent components of such complex structures.

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