

## Chapter 16

# Teleology: Inorganic and Organic

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The banishment of teleology from the natural world during the early modern period is something from which philosophy has still not fully recovered. This period saw the almost wholesale rejection of Aristotelian metaphysics, and with it the ‘final causes’ that are a central part of that worldview. It is not merely that final causes were replaced by a mechanistic picture of nature bolstered by Newtonian physics and general corpuscularianism, but that final causes and the Aristotelian ‘baggage’ associated with them were shunned with an almost visceral distaste bordering, it seems to me, on the pathological.

One need only look at the hostility shown by Thomas Hobbes, at the end of *Leviathan*, to the ‘barbarisms’, ‘ignorance’ and ‘darkness’ of the ‘vain philosophy’ that allegedly permeated the schools, serving no other purpose than to maintain and enhance the power of the ‘Roman clergy’ and the Pope at the expense of the civil government.<sup>1</sup> No less hostility, though expressed in slightly more measured tones, is found in Locke, Hume and Descartes. ‘Occult’ qualities and mysterious ‘substantial forms’ are out; law-governed mechanism is in.<sup>2</sup> The idea that all objects have a natural tendency to some kind of motion or behaviour characteristic of their essence is interpreted as illicit mentalism: material objects do not ‘endeavour’ to go to the centre of the earth when dropped, ‘as if stones and metals had a desire, or could discern the place they would be at, as man does’.<sup>3</sup> That this was an egregious misreading of Aristotle did nothing to dampen the fire of animosity towards all things teleological.<sup>4</sup>

Contemporary philosophy has, one may note with justified relief, moved some way from the sort of blind antagonism, coupled with almost wilful misinterpretation of Aristotle and Aristotelianism, that characterized the heyday of mechanism. Teleology has never been wholly eradicated from biological explanation. Though the standard view is still that reference to final causes, purposes, ends, goals and related notions is unnecessary for evolutionary theory to explain what we need to

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<sup>1</sup> T. Hobbes, *Leviathan*, ed. R. Tuck (Cambridge, 1991; orig. pub. 1651), ch. 46, ‘Of Darknesse from Vain Philosophy, and Fabulous Traditions’.

<sup>2</sup> Hostility to substantial forms and other key concepts of Scholastic metaphysics goes back further than the early empiricists, of course, to the many of the late Scholastics themselves.

<sup>3</sup> *Leviathan*, ch. 46, pp. 467–8.

<sup>4</sup> No one reading, for instance, *Physics* or *On the Heavens* (*De Caelo*), will find it easy to interpret Aristotle as holding that moving objects ‘seek’ the place to which their movement naturally tends. See, for example, *Physics* II, 192b ff., and *On the Heavens* III.2, 300a ff. Nor does one find it in Aquinas’s *Commentary on Aristotle’s Physics*.

know about the behaviour and development of living things,<sup>5</sup> there is a respectable minority of philosophers who insist that such concepts are required.<sup>6</sup>

Moreover – and more interestingly – there are a few philosophers who are prepared to countenance at least the coherence, if not the plausibility, of some form of teleology in the *non-living* world as well – where by ‘non-living’ I exclude artefacts because of their necessary connection to living creatures. In his extended discussion of powers, George Molnar invokes what he calls ‘physical intentionality’ to explain the directedness of a thing’s powers towards their fulfilment, and he models it on intentionality as understood by Brentano.<sup>7</sup> John Hawthorne and Daniel Nolan argue that teleological causation in the inorganic world is at least metaphysically possible, if interpreted in terms of what they call ‘end velocity laws’, where such laws are characterized as involving a notion of distance from a privileged end state, and where distance need not be physical.<sup>8</sup> Their outline is sketchy, but it seems to be inspired by a principle such as the Principle of Least Action, according to which all of the equations of motion can be derived, using the equations of Hamilton and Lagrange, from the assumption that moving objects minimize a certain quantity of action, such as the difference between kinetic and potential energy in classical mechanics, and its analogue (the path integral approach) in quantum mechanics. Furthermore, the revival of essentialist thinking itself has helped to make teleology in general more respectable. For the very concept of an essence or nature, whether that of a living or a non-living thing, carries with it the idea of a characteristic tendency towards a certain kind of operation or behaviour, and resistance to other kinds of behaviour or causes contrary to the thing’s nature.

Teleology has, of course, never disappeared from moral philosophy, but the majority of ethicists still resist the idea that it can be found in human or other living creatures in a way that enables it to be characterized independently of human goals or purposes. Natural law theorists dissent from this view, insisting – at least when natural law theory is formulated in its traditional form rather than the novel form advocated by John Finnis, Germain Grisez and others<sup>9</sup> – that without a robust conception of teleology in nature, ontologically independent of the purposes and

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<sup>5</sup> For a sample of the majority view, see C. Allen, M. Bekoff and G. Lauder (eds) *Nature’s Purposes: Analyses of Function and Design in Biology* (Cambridge, Mass., 1998).

<sup>6</sup> See Mark Bedau, ‘Where’s the Good in Teleology?’, *Philosophy and Phenomenological Research*, 52 (1992): 781–806, and the citations he gives in note 1 (reprinted in Allen, Bekoff and Lauder, *Nature’s Purposes*, pp. 261–91); also see his ‘Can Biological Teleology Be Naturalized?’, *The Journal of Philosophy*, 88 (1991): 647–55.

<sup>7</sup> G. Molnar, *Powers* (Oxford, 2003), ch. 3.

<sup>8</sup> J. Hawthorne and D. Nolan, ‘What Would Teleological Causation Be?’, in Hawthorne, *Metaphysical Essays* (Oxford, 2006), ch. 15, pp. 265–83.

<sup>9</sup> See, as exemplars of the ‘new natural law’, such works as J. M. Finnis, *Natural Law and Natural Rights* (Oxford, 1980); G. Grisez, *The Way of the Lord Jesus, Volume I: Christian Moral Principles* (Chicago, 1983); G. Grisez, J. Boyle and J. Finnis, ‘Practical Principles, Moral Truth, and Ultimate Ends’, *American Journal of Jurisprudence*, 32 (1987): 99–151.

valuations made by agents, morality has no secure footing.<sup>10</sup> I have argued for this traditional position at length elsewhere.<sup>11</sup>

In this essay I assume, rather than argue for, teleology in the organic world. I will briefly characterize it, but only for the main purpose of this discussion, which is to examine the extent to which teleology can also be found in the inorganic world. I think it can, though it is essential to mark the differences between organic and inorganic teleology so as to bring both into relief. It was the mistaken assumption (rooted in an erroneous interpretation of the tradition) that teleology as found in the organic world was transferable holus-bolus to the world of the non-living, that played such a large part in sparking the anti-teleological revolt. The tradition was a little more nuanced than that. I propose that by examining some select phenomena of the inorganic world, one can find teleology there as well. It is no part of my argument that it is widespread. Maybe it is. But if we can find it in at least some places, we do more than uncover something of metaphysical interest in itself. We also add some stones to the foundation upon which organic teleology itself is built, and the ethical theory which reposes on that. For if some sort of teleology can be found in the world of the non-living, how much more likely is it that the teleology of the living world is no mere projection of human interests, but a real, mind-independent, objective phenomenon?

### Organic Teleology

Before going on to consider whether there is inorganic teleology, I want to give a brief characterization of organic teleology, having assumed its existence for the purpose of the discussion. Philosophers do not spend nearly enough time examining the nature of life from the metaphysical perspective, but it is one of the phenomena of which we must have a good metaphysical grasp if we are to understand the material universe. My general definition of life is that it is the natural capacity of an object for self-perfective *immanent* activity. Living things act *for* themselves in order to *perfect* themselves, where by perfection I mean that the entity acts so as to produce, conserve and repair its proper functioning as the kind of thing it is – not to reach a state of absolute perfection, which is of course impossible for any finite being.

Speaking now in causal terms, living things, unlike non-living things, exercise *immanent* causation: this is a kind of causation that begins *with* the agent and terminates *in* the agent for the sake *of* the agent. *Transient* causation, on the other

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<sup>10</sup> Here confusion must be avoided. Even on the traditional natural law theory, human teleology is not independent of human goals and purposes, since they enter into the analysis of human nature that makes moral theory possible. What the traditional theorist denies, by contrast, is that human nature, including all human activities connected with the formulation of goals, plans, projects and so on, is revealed to us exclusively or even primarily by reflection on the structure of our practical reasoning as opposed to reflection informed by metaphysical anthropology. It is this that primarily separates traditional theorists from the Grisez-Finnis school of 'new natural law'.

<sup>11</sup> See my 'The Metaphysical Foundations of Natural Law', forthcoming in Holger Zaborowski (ed.), *Natural Law and Contemporary Society* (Washington, DC). For a recent defence of natural teleology as the foundation of morality, see Philippa Foot, *Natural Goodness* (Oxford, 2001).

hand, is the causation of one thing or event (or state, process and so on) by another where the effect terminates in the former.<sup>12</sup>

All exercises of immanent causation involve transient causal relations as effects and/or instruments. When a person eats food (immanent), they use transient instrumental causes that are both conscious (placing the food in the mouth, maybe consciously tasting or chewing it and so on) and unconscious (swallowing, secreting gastric acids and so on). There are also transient causal results or effects of the immanent nutritive and eliminative process (expelling waste, perhaps emitting wind!). ‘Transient’ in this context does not mean ‘fleeting’ or ‘short lived’: a transient causal process can be long lasting. What makes it transient is that the process terminates in something other than the cause itself.<sup>13</sup> All living things essentially engage in immanent activity for the sake of their own natures, whether conscious of it or not. It’s just the way they are constituted.

What about the parts of a living thing? Don’t they carry out their operations merely transiently, since these operations are not for their own sake but for that of the living thing of which they are parts? It might be thought that this cannot be characterized as mere transient causation since the part – a heart, to use the paradigm example – acts for the *sake* of the organism whose heart it is, whereas I have defined transient causation without reference to such a sake, as it were.<sup>14</sup> All I have said is that transient causation terminates in the distinct thing on which the cause operates. Now if we speak, as teleologists typically do, of ‘final causes’, we should say that the heart’s operation is still teleological because although the effect terminates in the whole organism, the heart’s operation is for the sake of the organism, that is, what is really happening is that the organism’s final cause of staying alive is what regulates the merely efficient cause involved in pumping blood.

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<sup>12</sup> A useful discussion of immanent and transient causation is in Roderick Chisholm, ‘Human Freedom and the Self’ (lecture given in 1964), in G. Watson (ed.), *Free Will* (Oxford, 1982), pp. 24–35. Note that he emphasizes human agency as the paradigm of immanent causation without extending it explicitly to causation by other biological agents, and without underscoring the nature of the process as one beginning with and terminating in the agent. A good discussion of immanent causation in Aristotle’s natural teleology is John Cooper, ‘Aristotle on Natural Teleology’, in M. Schofield and M.C. Nussbaum (eds) *Language and Logos: Studies in Ancient Greek Philosophy Presented to G. E. L. Owen* (Cambridge, 1982), pp. 197–222.

<sup>13</sup> Of course there are complexities that would need spelling out in a longer treatment. When I throw a ball at a window I engage in both immanent and transient causation. Transiently, I break the window: the causal process begins with me and terminates in the window. Immanently, I exercise free will: I do something for some reason that belongs to me and so the transient process is an instrument to the fulfilling of my purpose, satisfaction of my desire and so on. All of which, note, is not only compatible with altruistic behaviour but is presupposed by it. When I help a person in need because they are in need, I transiently do something for them, but immanently perfect my own nature by conforming to morality – even if I am not thinking about this at the time. Altruism does not even make sense if this basic self-perfection is not presupposed in the action. When I act immorally, I still act immanently, though I do not perfect but rather damage myself as a moral agent by not conforming to the demands of morality.

<sup>14</sup> So much for Quine’s thought that ‘sake’ does not refer to anything.

Although I do not object to talk of ‘final causes’, and believe we can understand organic teleology in this way, I prefer to stick to the language of immanent causation. This is partly because of the inherent preferability of the latter. Immanent causation is a preferable way of talking about the phenomenon of life because final causation does not of itself import the notion of *self*-directedness. There can be a goal (or purpose, or final cause) of a thing without that goal being one whose satisfaction does anything *for* the object that acts to satisfy it. Artefacts have purposes that do nothing for them, only for the persons who impose the purposes upon them. Parts of organisms, such as the heart, have purposes whose satisfaction does something for the wholes of which they are parts rather than for themselves. Note that the heart also carries out self-repairing and self-maintaining activities, just as any living entity does things for itself. That is why, when the heart is separated from the organism and kept alive, say, by a machine, it continues to exercise immanent causation.

The point, however, is that the heart also has purposes that are not for its benefit but for that of the organism that has the heart. Moreover, its own self-directed purposes are wholly derivative from the purposes whose satisfaction does something for the organism of which it is a part. Thus I want to characterize the immanent causation involved in the heart’s pumping blood for the sake of an organism in the following way. It is the *organism* that exercises immanent causation by *means* of the heart’s pumping blood. Needless to say, this does not imply conscious activity, or any idea to the effect that the organism *tries* or *seeks* to keep itself alive by using the heart as a means. Nevertheless, it does use the heart as a means of keeping itself alive. So leaving aside the heart’s own self-repairing and self-maintaining operations and the like, which are directed towards its own continued existence (again, for the sake of the continued existence of the organism) and hence are truly immanent, still this takes place within the context of immanent activity by the whole organism. Within that context the heart is a mere means to the continued existence of the organism, and as such it operates only transiently. It is thus no counter-example to the thesis that organic teleology is immanent in character.<sup>15</sup>

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<sup>15</sup> Mark Bedau, in his illuminating discussion of teleology, distinguishes between three grades (‘Where’s the Good in Teleology?’). Grade 1 teleology involves the performance of a function that happens to be good (for the thing performing it or for the whole to which the thing performing the function belongs). In grade 2 teleology, a thing performs a function *because* the function contributes to some result and the result happens to be good. In grade 3 teleology, a thing performs a function *both* because the function contributes to a result that happens to be good *and* because that result is good (again, for the thing performing it for the whole to which it belongs). Bedau does not believe any biological teleology amounts to grade 3 teleology but is only ever at grade 2, since ‘[n]atural selection is blind to the goodness that supervenes on a biological creature’s survival’ (802). On my account, organisms *use* their parts to contribute to what is good for them (or at least in some cases to what they think is good for them, what they perceive as good for them, what appears to be good for them and so on; the complications can be left to one side). Hence the heart does not merely beat because nature has selected such an organ and the organ contributes to something good for the organism (if natural selection is a true theory, which I assume for the purpose of argument). But it does not follow that nature has selected such an organ *because* it is good for the organism. Nevertheless, the *organism* uses the heart to contribute to its own survival *because* it makes such a contribution.

My claim, then, is that while final causation is characteristic of the living world, it is not just any final causation, but the self-directed kind – a special kind of teleology. As a corollary, conceptual space is thus left open for another kind of teleology that is not self-directed. Whether we use the term ‘final causation’ in such cases as well, or whether we restrict it to immanent causation only, depends on what we mean by final causation – about which more shortly. In any case, it is the burden of the present essay to establish whether this other kind of teleology exists.

### Distinguishing Inorganic From Organic Teleology

If there were such a thing as inorganic teleology, what differences would we expect to see between it and the organic case? They should be derived from our prior understanding of what is characteristic of the living and the non-living. In fact, this understanding is based on our grasp of the essence of life and its difference from the essence of non-life, but although I prefer to frame the issue in essentialist terms and have defended essentialism at length elsewhere,<sup>16</sup> what I have to say will not depend on it. Given that, four principal differences should be noted.

First, we do not find any immanent causation in the inorganic world. Nothing inorganic does anything for itself. All inorganic causation is transient – and here I include efficient causation of course, but also the causation involved in material constitution and that which, for an Aristotelian essentialist, invokes the notion of form (these latter two traditionally called material and formal causation).

What about final causation? This brings me to the second difference. Since final causation is the kind around which the issue being examined here revolves, it would be question-begging simply to assert or deny the existence of final causes in the non-living world. Rather, the question of final causation needs, in my view, to be refined and disambiguated if we are to get a better grip on what is at stake. A large part of the present discussion is, explicitly or implicitly, about the status of final causes in the non-living world, so the first refinement I want to make is to deny the existence

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The use is not conscious, there is no intention: it is just that the organism does things for itself because they are good for it, that is, this is the *explanation* of why its heart beats, whatever the selection process. That is what immanent causation amounts to. One way of highlighting the implausibility of Bedau’s account is by asking: why should we even say that the heart pumps blood *because* it contributes to the organism’s survival if it doesn’t do so because survival is good (which itself implies, in my view, that it is the *organism* which is using its heart *for* its own survival)? The appeal to natural selection will not help, since nature is supposed to work blindly – not only with no good end states in view, but with *nothing* in view, not even a contribution by anything to anything. Bedau’s account, then, seems to threaten the collapse of grade 2 biological teleology into grade 1 teleology, which on his view is teleology in name only. On my view, while there is a genuine kind of teleology at the inorganic level, as I will argue, the fact that there are goods to be had at the organic level means they need to form part of the explanation of why organisms and organs do what they do. And this pushes teleology in biology to grade 3, which Bedau reserves only for ‘teleology traceable to the mind’ (802). (I have learned, in correspondence, that Bedau now does not accept the position he once advocated, which I have outlined above, and that he concedes the force of my objection.)

<sup>16</sup> See my *Real Essentialism* (London, 2007), esp. ch. 8.

of inorganic final causes *if* this means that there is anything non-living which is capable of flourishing. By this is meant that no inorganic entity has an intrinsic *telos*, a principle of natural fulfilment, such that it characteristically behaves in such a way as to achieve or seek to achieve that fulfilment. This is not because the notion of 'seeking' already implies conscious purpose: as already asserted, there need be no conscious purpose by which an organism seeks to fulfil its nature. Bacteria seek to flourish every bit as much as human beings. Rather, the point is one about the absence of purpose altogether, where purpose invokes the idea of natural fulfilment.

Now it might be tempting for an inorganic teleologist to argue that even non-living things seek to achieve purposes, the most basic one being simply to stay in existence. Material objects by nature resist certain destructive forces: once in existence, they persist unless and until they are overcome by forces that destroy them, for example by disintegration. Indeed the very term 'persistence', which philosophers (though not the so-called 'folk') apply indiscriminately to all things having diachronic identity, connotes just such an idea. But what should we say about very short-lived entities such as the 'virtual particles' of quantum theory, some of which (as in pair creation) are said to pop into existence only to annihilate each other almost immediately? Can we not at least imagine the existence of an entity that begins to decay or disintegrate within moments of coming into existence? It might be replied that such an object still persists, if only for a short time, and would continue in existence like any other entity but for the forces that destroy it. Yet there is nothing impossible in the idea of an object that by its very nature is so unstable and liable to destruction that to speak of its somehow seeking to remain in existence is an empty form of words. Whatever the refinements that could be made to this line of thought, I suggest it be left to one side for present purposes.

If we accept that there is no intrinsic *telos*, in the sense of a principle of natural fulfilment, existing in the inorganic world, then we are bound to say that when a non-living entity behaves, acts or operates in a certain way, it does so only transiently. Yet this does not of itself rule out the possibility of some kind of *instrumental* causation in the inorganic world, as long as we do not interpret instrumental causation as necessarily involving an intrinsic purpose on the part of the entity towards which the instrumental causation is directed.

And this leads to the third difference. A further refinement to the notion of inorganic final causation is to deny not only the existence of an internal principle of natural fulfilment on the part of any non-living thing, that is the existence of an intrinsic *telos*, but also the existence of intrinsic purpose altogether. In the organic world, some things have purposes that are either directly or indirectly aimed at the flourishing of some other thing. When one animal feeds another, this is a case of acting with a purpose directly aimed at the second animal's flourishing. The beating of the heart is also directly aimed at the flourishing of the animal to which it belongs, but since, as I have noted, organs also carry out operations directed at their own self-maintenance and self-repair, the purposes involved in such operations are indirectly aimed at the animal's flourishing. The indirect purposes are wholly explained by, and subsumed under, the direct purposes. In the non-living world, we do not find any entity operating for the purpose of doing anything for some other, any more than we find one operating for its own purposes, that is immanently. Again, this only rules out instrumental causation to the extent that such causation is interpreted as involving

an intrinsic purpose, this time on the part of the object acting as instrumental cause rather than on that of the object towards which the instrumental cause is directed.

Fourth, *if* there were inorganic instrumental causation, it might involve something organic as beneficiary of the instrument, though it need not. In other words, instrumental causation, if it exists in the non-living, could be directed either at the non-living or at the living. I will come to the former case shortly, but the latter case would be exemplified by the existence of inorganic objects as food for organisms (for example minerals as nutrition for plants). By contrast, it is hard (maybe not impossible, about which more later) to see how anything organic could be instrumental for anything inorganic, not simply because there are no intrinsic purposes in the inorganic world, but for reasons to do with my interpretation of inorganic teleology itself, which I will shortly sketch. My claim, then, is that inorganic entities, if they can be instrumental causes, are able to be such both for other inorganic entities and for organic entities. On the other hand living things are never, or at least hardly ever, instrumental causes for non-living things, only for each other.

### Systems and Cycles

Having established some significant presumptive differences between inorganic and organic teleology, one might wonder what is left that could even be called inorganic teleology. If there is in the inorganic world no immanent causation, no flourishing, no intrinsic purpose, and a distinction in the applicability of instrumental causation as between the living and the non-living (assuming there is any such causation at all in the case of the latter), hasn't any notion of inorganic teleology been evacuated of all meaningful content? Or at the very least, isn't it so thin and etiolated as to be of no metaphysical interest?

I think there is still something in the inorganic world that deserves the name of teleology even in a stripped-down form. It is present when there are inorganic entities that play what can alternatively be called a *part*, *role* or *function* with respect to other entities and the processes in which they are involved. What I have in mind are the natural processes that are properly thought of as *systems* – more particularly a certain kind of system that is most sharply illustrated by those that are *cycles*.

Consider two such wholly inorganic cycles – the rock cycle and the water cycle.<sup>17</sup> These are recognized as cycles by the scientists whose business it is to study them, and have a clearly delineated structure. Slimmed down to the essentials, the rock cycle involves the following two sub-cycles. First, exposure, sedimentation and pressure cause igneous rock to form into sedimentary rock. Heat and pressure cause the sedimentary rock to form into metamorphic rock. Heat and pressure then cause the metamorphic rock to melt into magma. The magma then cools and hardens into igneous rock, and the sub-cycle recommences. In the second sub-cycle, heat and pressure cause igneous rock to change into metamorphic rock. Exposure, sedimentation and pressure cause the metamorphic rock to change into sedimentary

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<sup>17</sup> On the rock cycle, see R. J. Foster, *General Geology*, 2nd edn (Columbus, OH, 1973), pp. 49–50. On the water cycle, see G. M. Hornberger, J. P. Raffensperger, P. L. Wiberg, and K. N. Eshleman, *Elements of Physical Hydrology* (Baltimore, Md., 1998), pp. 5–6.

rock. Heat and pressure cause the sedimentary rock to melt into magma. The magma cools and hardens into igneous rock, and the sub-cycle recommences.

Again, with details omitted, the water cycle involves the following. In precipitation, condensation causes water vapour in the air to fall to the surface of the Earth. Surface water then evaporates into the air, where it condenses again and precipitation occurs. Included in this cycle are such sub-processes as snowmelt, produced as one might guess by melting snow; surface runoff into streams, lakes and oceans; infiltration by surface water into the ground, where it becomes soil moisture or groundwater; advection by water in all of its states through the atmosphere, without which the precipitation over land of ocean evaporation would be impossible; and canopy interception by plants of precipitation that does not make land but evaporates back into the atmosphere.

What is it about the rock cycle and the water cycle that might lead one to give a teleological interpretation, at least in a thin sense? One thought might be that the phenomenon of *order* is what could motivate teleological talk. Synchronically, for each of the rock cycle and the water cycle, that cycle is always in a state very similar to any of its other states; at a high enough level of generality, it is in the *same* state at any time at which one, as it were, takes a snapshot of the cycle. Diachronically, events and processes within each cycle happen in the same order: condensation is always followed by evaporation, which is always followed by precipitation, which is always followed by condensation. Exposure, sedimentation and pressure on igneous rock is always followed by the production of sedimentary rock, on which heat and pressure always produce metamorphic rock, on which heat, pressure and the subsequent cooling of magma always produce igneous rock and so on.

There is something important in the appeal to order, but it is not order *per se* that necessarily motivates teleological talk, at least of the kind I will advocate. There is order in the solar system, but while there may be arguments for a teleological interpretation in this case, they do not appeal to phenomena that are quite the same as in the rock and water cycles. There is order in the perfect geometrical shapes one finds in, say, crystals or atomic structures (think of the cubic structure of gold); but again, if one wanted to argue for teleology here one would need to appeal to something different from what one finds in the rock and water cycles. Further, nature can throw up all sorts of one-off patterns and ordered arrangements, but unless one wants to build teleology into the concept of the mere existence of patterns and ordered arrangements, one will not get very far in justifying teleological talk as far as order pure and simple goes.

Second, one might appeal to the existence of some kind of *complexity* as the basis for the attribution of teleology to the rock and water cycles. True, both cycles are complex, involving large numbers of interdependent variables, but that is not enough on its own for moving to a teleological vocabulary. We find all sorts of complexity in nature, but that does not of itself license teleological talk. Moreover, complexity is a concept covering a wide range of other concepts, and one would need to know a lot more about the type of complexity appealed to before knowing what, if any, metaphysical interpretation could be put on it. If there is genuine randomness in nature (which I doubt<sup>18</sup>), then there might be complex random processes, such as

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<sup>18</sup> For a brief discussion, see 'The Metaphysical Foundations of Natural Law'.

in radioactive decay; but doesn't randomness make teleological talk less warranted than where randomness is absent?

Third, one might simply appeal to the fact that the water and rock cycles are systems. I think that systematicity has something to do with teleology, but not mere systematicity. A binary star system, in which each orbits around their common centre of mass due to the gravitational attraction of the stars on each other, plausibly should not evoke teleological thoughts. Nor should the system of plate tectonics or the earthquake fault system. In the case of binary stars, there is what one might call a lack of process: we just have two stars orbiting about their centre of mass. In the case of plate tectonics and fault systems, the processes are open-ended: continents come together and drift apart, followed by others coming together and drifting apart, plates grind against each other and recede, yet there is what I would call a lack of convergence of the processes on any specific end-state.

Now I do not want to deny categorically that my approach to inorganic teleology could not work for the sorts of phenomena that I am using as foils. The physical details are, as always, complex and multi-faceted. But as long as it were metaphysically possible for there to be an inorganic system, phenomenon, series of events and so on that did not display enough characteristics to warrant a teleological description, that would be enough for the contrast to be made.

Finally, one might appeal to the regularity or periodicity of the rock and water cycles to ground teleological vocabulary. Again, like order and system, this phenomenon is relevant, though not decisive. But mere regularity or periodicity is still not enough to warrant teleological talk. Consider a ping pong ball sucked up by a tornado and then dropped some place. It hits the ground, and with system, order and regularity continues to bounce according to Newton's laws until it comes to rest. There is no obvious reason for appealing to teleology in such a phenomenon.<sup>19</sup> Or consider the well-known example, of which I will make substantial use, of the stick that floats downstream, is pinned against a rock and creates a backwash that keeps the stick pinned to the rock.<sup>20</sup> There is order in the phenomenon: the stick creates a backwash, the backwash keeps the stick pinned, which causes it to maintain the backwash, which continues to keep it pinned. The order is repeating, whatever the general disorder in the flow of the water. Is there a system? Perhaps it is stretching the notion to apply the term 'system' to such a scenario, but if we mean by 'system' the presence of a number of interrelated elements working together to produce a unified whole, and given that fluid mechanics analyses systems of water flow, we could perhaps call the phenomenon a system. But even if we did, there would be no good reason to attribute any teleology to it.

## Roles and Functions

So what *does* give us license to speak of teleology in respect of the rock cycle and the water cycle? I submit that the answer lies in the concept of a function. In the

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<sup>19</sup> Whether an argument for teleology can be based on the existence of the laws themselves is another matter. See 'The Metaphysical Foundations of Natural Law'.

<sup>20</sup> The example comes from Robert van Gulick, and is well discussed in Bedau, 'Where's the Good in Teleology?', pp. 786 ff.

broadest sense, a function is any natural specific activity of a power or capacity of a thing. And when Aristotle begins his discussion of nature in *Physics* II – where so many anti-teleologists have found reason to object to what is in fact a caricature of Aristotle's views concerning final causation in nature – he speaks in terms of a 'natural principle', and applies it not only to living things but to the 'simple bodies' of earth, air, fire and water, out of which material bodies were thought to be composed. The same goes for *On the Heavens* III.2, when he discusses the natural movements of the sublunary bodies.<sup>21</sup>

My case does not, though, depend on any essentialist thesis about the behaviour of things. It does not require that any natural movement or behaviour of anything be essential to it – only that some things behave in a sufficiently regular and predictable way for their behaviour to be called functional. In particular, I am focusing on how certain things behave in respect of other things to which they stand in a causal relationship. For when we think about the rock and water cycles, we can see that certain objects and processes within each *contribute* to, play a *role* or *function* in, the existence and occurrence of other objects and processes.<sup>22</sup> What is the function of condensation in the water cycle? It is the function of causing precipitation. What is the role played by precipitation in the water cycle? It brings about later evaporation. What function do igneous rocks perform in the rock cycle? They become sedimentary rock with the aid of exposure, sedimentation and pressure, and in addition through heat and pressure they become metamorphic rock. What role do heat and pressure play in the rock cycle? Together they contribute to the existence of magma, which then cools into igneous rock; and they also contribute together to the existence of metamorphic rock. And pressure without heat functions to bring about sedimentary rock.

This is just how a geologist or a hydrologist talks about the cycles that are the object of their study. 'How does evaporation function in the water cycle?' 'It does such-and-such.' 'What role does sedimentation play in the rock cycle?' 'It functions in such-and-such a way.' The locutions are natural, plausible and do not smack of illicit anthropomorphism or closet panspsychism. It just *looks* like certain inorganic processes have functional components. And if they have functional components, the components perform functions. Yet function talk is a kind of teleological talk. In this highly attenuated sense, then, we can find teleology in the inorganic realm. Moreover, this sort of stripped-down teleology only serves to bring into sharp relief the stronger teleology we find in the organic world, which then contrasts with what we might call the most extreme teleology as located in the world of conscious agents with conscious purposes.

So far so quick, of course. I need to say more about this concept of function applicable to the inorganic world. First, it is divorced from the idea of any intrinsic purpose, immanence or principle of flourishing, as stated earlier. There is nothing good for a rock that happens during the rock cycle, and nothing good for water during the water cycle. It is useful here to mark a distinction between saying that

<sup>21</sup> In *Physics* II.1, 192b14–15, he speaks of the '*archē kinēseōs kai staseōs*', the principle of movement/change and rest, and in *On the Heavens* III.2, 301a21, he refers to the '*phūsikē kinēsis*', the natural movement of things.

<sup>22</sup> I have come across a book whose title reflects just the sort of talk I am defending: *The Role of Snow and Ice in Hydrology: Proceedings of the Banff Symposia, Sept. 1972* (Geneva, 1973).

something *performs* a function and that something *has* a function, a distinction noted by Bedau.<sup>23</sup> There is a way of hearing ‘X has the function of doing Y’ that makes it equivalent to saying either that X has a purpose for which it does Y, or that the thing in respect of which Y is done has a purpose for which X does Y in respect of it. If that is what one means by having a function, nothing in the rock and water cycles has a function. But one can also read ‘has a function’ as equivalent to ‘performs a function’, and this is what I mean when I say that condensation has a function in the water cycle: it performs the function of producing precipitation. Now Bedau, like virtually all teleologists, goes on to limit performing a function to doing something that has a good consequence, his example being a person who swims for pleasure, not for fitness, but who gets fit none the less. Such a person does not swim in order to get fit, but his swimming performs the function of making him fit. In the non-living case, however, there is no intrinsic good consequence for anything in the rock and water cycles following from anything that happens within them. There are good consequences (and bad ones) for living things such as us, of course, but that is beside the point. The question concerns whether there is teleology within the cycle.

Second, the rock and water cycles can be distinguished from other inorganic events and processes in such a way as to heighten the plausibility of using functional talk in one case but not the other. Recall the example of the stick and the backwash. What function does the stick play in creating the backwash? What role does the backwash play in respect of the stick? It is plausible to say none. Again, there is a way of reading ‘X has the function of doing Y’ that takes it to be equivalent, not this time to talk of purposes or flourishing or goodness, but to simple causal talk. One billiard ball smacks into another. Someone asks, ‘What function did the white ball have?’ Interpreting charitably, the questioner has merely used high-flown function talk to ask, ‘What did the white ball do?’, to which the answer is, ‘It hit the red ball.’ Similarly, asking what function the stick has can be taken to be no more than asking what the stick does when it is pinned against the rock: it creates a backwash which continues to pin it against the rock. This is all that Bedau means when, criticizing Larry Wright’s aetiological analysis of teleology, he says that ‘the stick creates the backwash because doing so *contributes* [my emphasis] to keeping it pinned on the rock’.<sup>24</sup> There is no genuine role-playing here, no contribution of a function to anything, over and above a mere causal role.

<sup>23</sup> ‘Where’s the Good in Teleology?’, p. 788.

<sup>24</sup> ‘Where’s the Good in Teleology?’, p. 786. Wright’s aetiological approach is spelled out in his ‘Functions’, *The Philosophical Review*, 82 (1973): 139–68, reprinted in Allen, Bekoff and Lauder, *Nature’s Purposes*, pp. 51–78. The problem with Wright’s analysis, as Bedau rightly points out, is that it implies there is teleology in the case of the stick and the backwash. Because Wright’s account is in terms of causal history and purely causal explanation (how the function got there, what its causal role is), teleology ends up being present wherever such a history exists, which is far broader than even my account would tolerate. Moreover, his analysis gives no place to immanent causation as found in the organic realm, lacking any account of goodness or of what organisms do for themselves. Hence Wright’s approach neither identifies what is teleological about organic teleology, nor does it capture what – if the present theory is correct – is teleological about inorganic teleology. Bedau’s theory, on the other hand – as I have already indicated – is wrong in its account of organic teleology, and

But what is a genuine function? Note the following simple fact: whole books are written about the water and rock cycles. They are an established object of systematic scientific investigation. No one writes books about sticks pinned against rocks. To be sure, scientists study fluid mechanics, and the behaviour of a stick pinned against a rock in a stream might be one example used to instantiate general fluid-mechanical principles. But no one studies sticks pinned against rocks per se. Yet many people study the rock and water cycles per se. Is it because the latter are systems? I said earlier that one could perhaps stretch the concept of a system so as to treat the stick pinned against the rock as part of a system. If so, then there is something more to the rock and water cycles' being systems that makes them fit objects for independent investigation.

I contend it has something to do, not so much with their cyclicity pure and simple, but with what that cyclicity indicates. Aristotle believed that the world and all the processes within it were eternally stable, from the behaviour of the stars and planets to the processes occurring in the sublunary world, organic and inorganic. As John Cooper puts it, according to Aristotle 'our world is a self-maintaining system, with a built-in tendency to preserve fundamentally the same distribution of air, land and water and the same balance of animal and plant populations as it had in his own time', and Cooper refers, for example, to the 'annual cycle of warm and cold periods' and other recurring features of nature that impressed Aristotle, and that seemed to him to be 'permanent structural facts – as it were, part of the given framework of the world, over and above that provided by the celestial movements'.<sup>25</sup>

Now it is not necessary to accept Aristotelian cosmology in order to grasp the kernel of what he is saying. In particular, one need not – nor, I think, should one – accept the eternity of the universe. Whatever the prior states of the universe, however chaotic might have been previous periods, the fact is that *now* we observe certain very stable processes, and the rock and water cycles are examples of them. Their cyclicity means the same processes and sub-processes happen again and again: the *very same* kinds of things take place, whatever the particulars on each occasion of recurrence. Aristotle thought that the eternal stability of the universe was not something thrown up by chance, and so required an explanation, moreover one in terms of final causes – in particular those of the living things which the inorganic world served. But even without the eternity of the universe, and even leaving aside any question of the final causes of living things to whose satisfaction the inorganic world contributes, I contend that the mere stability and recurrence of certain processes such as the rock and water cycles license teleological talk in terms of functions and roles going beyond mere causation.

'Mere causation' has to be interpreted carefully, however. I mean causation stripped of any reference either to final causation or to instrumental causation. Now instrumental causation might be thought to be just a type of efficient causation, and since I claim there to be instrumental causation in the inorganic world I am asserting the existence of a certain kind of efficient causation. But instrumental causation may be efficient – as when a rock is propped up by another rock – or it may be final, as when I use a toothbrush to clean my teeth. The kind of inorganic instrumental causation I

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also – as my theory of inorganic teleology implies – because his insistence on the necessity of a value condition rules out inorganic teleology from the start.

<sup>25</sup> Cooper, 'Aristotle on Natural Teleology', pp. 202–3.

am advocating, being functional, might appropriately be termed 'final', as properly interpreted in accord with my earlier remarks. Or, if one restricts 'final' so as to exclude the inorganic case, then the instrumental causation will be a kind of efficient causation. Either way – and this is the main point – it is not like the mere causing of a backwash by a stick; it is a kind of causation in respect of which we are entitled to say that a function is being performed. We are not entitled to use functional talk unless what we are dealing with is relatively stable, in Cooper's words a 'permanent structural fact' about the way the world works. The presence of cyclicity only brings this point into relief. Functional talk is inappropriate when dealing with transient phenomena, coincidences, random events (if there are any) or highly variable processes. Of course talk of relative stability, high variability and so on is vague, and the more we investigate inorganic processes with a teleological eye the more we should be able to sharpen our concepts. But this would require detailed investigation that I cannot engage in here.

One feature that can be noted, however – and this is the third point about function talk – is what might be called the *role-specific* nature of the entities and processes involved in the cycles I have been discussing. If water is to be precipitated, then condensation or something very like it has to take place. Evaporation of surface water is going to produce clouds or something very like them. If igneous rock is to produce sedimentary rock, then exposure, sedimentation and pressure, or something very like them, have to occur. Heat and pressure applied to sedimentary rock is going to produce metamorphic rock or something very like it. And so on. If there is any essentialism lurking here, it will apply only to the cycles themselves, which is a pretty mild form of essentialism likely to prove palatable to even the most sceptical of metaphysical or scientific minds. It does not involve any claims about the essence of kinds of rock, the essence of water or even the essence of processes such as condensation or sedimentation. All it involves is the thought that for something that is recognizably the rock cycle or the water cycle on Earth to occur, certain kinds of thing have to play certain kinds of role, and certain kinds of processes have to take place. Perhaps even a Humean could accept that.

When it comes to the stick caught between a backwash and a hard place, though, things look different. Any old thing would serve as well as a stick to illustrate the idea that you can have causal relations without teleology. Any old liquid would do the job as well as water. And nothing is special about the rock against which the stick is pinned either. A different case would be that of a piece of paper being burned by fire. To reduce the paper to ashes, not any old event or source of ash production is possible: you need combustion. Doesn't combustion then play a special role – a function that is role-specific – in the burning of paper? But bits of paper are being burned all the time all over the world: there is nothing that could be called a single process, let alone a cycle, that is, a proper object of scientific investigation and that calls out for an explanation in terms of functions and roles. What about the investigation of combustion in general? Again, while one can investigate the causal role played by, say, friction or oxygen in the process of combustion, there is no such thing as the combustion system, let alone the combustion cycle. Combustion happens everywhere, all the time, but there is no integration of parts into a well-defined, stable, particular process that is the proper object of scientific investigation.

Where does this leave us as far as inorganic teleology is concerned? I have tried to eke out a notion of functional behaviour in the world of the non-living that sits in between phenomena that are not obviously teleological in character and those that clearly are. If the notion is plausible, then it leaves us with the following definition of inorganic teleology:

$x$  displays inorganic teleological behaviour with respect to  $y =_{\text{def}} x$  performs an inorganic function with respect to  $y$ .

The concept of inorganic function is then defined as follows:

$x$  performs an inorganic function with respect to  $y =_{\text{def}} x$  is inorganic and  $y$  is inorganic and  $x$  contributes causally to some entity, event or process in  $y$  and  $y$  is a stable, systematic process.

To say that  $y$  is not merely a system but a systematic process is to exclude systems with no causal relations between the parts. Hence one might come across a naturally occurring pattern, say an orderly arrangement of rocks, and these might even occur with great frequency, but that does not suffice to identify a function that any one rock performs in respect of the arrangement. Moreover, the concept of a systematic process is also meant to exclude naturally occurring patterns with causal relations between the parts, but where there is no ongoing series of transformations of entities and interactions between events such as one finds in genuine processes. Every individual material object, such as a single rock, is highly ordered internally at some level of organization, if only at the molecular or atomic level; and those highly ordered parts cause the object to remain as an integral whole throughout its existence. But there is no such thing as the individual rock-maintenance process. Geologists investigate what holds rocks together, but there is no individual rock-maintenance process that is the proper object of their study, unlike the rock cycle, which is also individual but a genuine process involving repeated kinds of interaction among specific kinds of entity. Finally, the reference to stability in the process rules out one-off events and coincidences that, although they might instantiate kinds of process, are not permanent or relatively long-lived, structural features of the inorganic landscape.

## Objections

This admittedly speculative examination of the idea of inorganic teleology is not going to convince many people who are committed to the existence of organic teleology alone, let alone those students of the natural world who are sceptical about the very existence of teleology anywhere within it. I now want to respond to some objections in the hope that by further clarifying my argument at least some concerns might be allayed.

*First objection:* inorganic teleological talk really is just causal talk, despite the distinction I have tried to draw. Reply: if it were just causal talk, we would not be able to separate the relevant from the irrelevant causal relations. Suppose that, in some place, sedimentation blocks the water supply to a region. Or suppose, somewhat more fancifully, that the presence of magma causes some species of bird to migrate. Neither of these phenomena are part of the rock cycle. They might be of interest to scientists

who study water supplies in a region or bird migration, but if you want to know about the rock cycle you do not need to know about the water supply or bird migration. Of course a phenomenon such as the blocking of the water supply in a region *might* be of relevance to a student of the rock cycle, insofar as it affected the production of rock at a particular time and place. If it were a regular occurrence all over the world then it might even be rightly thought of as part of the cycle itself. But that is a different point that the inorganic teleologist can accept. What he cannot accept is that any event causally related to the rock cycle or some process within it is either part of the rock cycle or a proper object of study for anyone investigating that cycle. Again, condensation in my vicinity might regularly cause arthritic pain in my big toe. But if you want to know about the water cycle, you do not need to know about the pain in my toe.

This shows that when a teleological process is under consideration, some causal relations are relevant and some are not. Now there are many causal relations involving both relevant and irrelevant events. When billiard ball A strikes billiard ball B, A also (let us suppose) causes a flattening of the baize, but the flattening is not relevant to what happens to B. (There might be a minimal physical relevance, but we can usually abstract that away for mechanical purposes.) But my point is not that the pain in my big toe caused by condensation does not cause any further water-related events. The point is that the pain in my toe is not relevant to the study of the water cycle in the sense that it performs no function within that cycle and is no functional product of that cycle. Can we say that the flattening of the baize performs no function in the causation of B's movement by A, and is not a functional product of it? Not in any sense that involves more than a mere restatement of the fact that the flattening does not causally contribute to B's movement. But we know that, just as we know that the pain in my big toe does not cause any water-related events. Again, that is not the point.

Is there some sort of system or process to which we can say that the flattening is not functionally relevant? It is hard to see what it might be. Considering the movement of billiard balls on a table, from a purely causal point of view the flattening of the baize is as relevant an event as is the smacking of the balls into each other. *Unless*, of course, one relativizes relevance to such things as the game of billiards, or to the causal relations between the balls. But then relevance amounts to no more than *salience*, which is a feature of all causal relations. What is relevant in this sense is what one is interested in. But when it comes to the water cycle or the rock cycle, it is not merely a question of what one is interested in. True, the geologist is interested in the rock cycle, not the migration of birds: but that is because bird migration objectively, that is interest-independently, plays no functional role within the water cycle. Needless to say, if bird migration were found regularly both to cause and to be caused by rock-formation events (an improbable scenario, but we could conceive of more likely ones), then the geologist might be correct to investigate bird migration when he studied the rock cycle – because bird migration would have been found to play a functional role.

*Second objection:* talk of functions really does import an intrinsic *telos* into things that do not have it. The reply is that as long as I do not identify function with intrinsic purpose, no such importation can be found. At no point in describing the rock and water cycles have I spoken of anything's having an intrinsic purpose. Rocks do not flourish; there is nothing that is good for evaporation; sedimentation does not need anything that fulfils it because fulfilment does not apply to such a thing. Now to many,

not importing such notions means by that very fact that function talk is inappropriate at worst, bizarre-sounding at best. I contend that the account I have given of the rock and water cycles does not sound bizarre, and talk of functional behaviour in their respect is not obviously inappropriate. There is at least a case to be answered.

As an additional point, however, note that although the concept of flourishing does not apply to anything inorganic, we can and do speak of such things as *efficient* and *smooth* functioning. The water cycle can function more or less smoothly and efficiently, where 'efficient' need not mean – and would only mean on pain of irrelevance – something like 'good at producing potable water for human beings and other animals'. Presumably, the colder the average global temperature, the less efficient the water cycle is, since more water remains solid for more of the time than at lower temperatures. But whether or not this particular hypothesis is true, something like it will be. To the extent that phase-state changes for water are impeded by other natural phenomena, the water cycle functions less smoothly and efficiently. *Mutatis mutandis* for the rock cycle. I take the concept of smooth and efficient functioning, and its variability within a process, as being analogously for inorganic teleology what the concept of acting well (suitably interpreted) is for organic teleology; just as functioning itself, stripped of intrinsic purpose, is for inorganic teleology what functioning for an intrinsic purpose is in the organic case.

*Third objection:* teleological talk in respect of inorganic processes is no more than a 'stance', just as intentional talk is no more than a 'stance' in respect of beings with a suitable complexity of inputs and outputs.<sup>26</sup> In reply, observe first that for those who believe that intentionality is about more than taking a stance, this objection will carry no weight. But it might be thought that the idea of taking a teleological stance can be usefully applied to inorganic phenomena all the same. The idea would be that teleological talk is a useful fiction for describing certain natural phenomena. Leave aside the important question of whether useful fictions have any place in philosophy or science. The question remains as to why a putative fiction might be useful. Intentional talk applied to inanimate objects ('My computer is trying to reboot') has a useful social function, in that it significantly eases communication when it comes to describing complex processes that are largely unknown to most people who use such talk; and even if they knew, spelling out the details would take so long as to make communication almost impossible. But whether such talk actually explains any other phenomena is highly questionable. When it comes to inorganic teleological talk, its usefulness in explaining phenomena is apparent. It explains why it is that geologists are not interested in bird migration and why hydrologists are not interested in the pain in my big toe. And this in turn is evidence that teleological talk is not really a fiction after all. Maybe the reason such teleological talk is both useful and common is that it represents something *true*.

*Fourth objection:* inorganic teleological talk might not import the concept of intrinsic purpose, but it does import the concept of *extrinsic* purpose. Here the thought is that inorganic teleology is presented as a kind of stripped-down teleology shorn of some of the features of the organic case, but it is really full-fledged teleology masquerading as something else. For there is no function without purpose, and if the

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<sup>26</sup> See further Daniel Dennett, *The Intentional Stance* (Cambridge, Mass., 1987).

purpose is not intrinsic it must be imposed from outside, say by an omniscient and omnipotent being who endows the inorganic world with purposes directed either at the being itself or at animate beings on Earth, or both. The reply is that I have left it open whether functional talk applied to the inorganic realm entails, ontologically, any kind of extrinsically imposed purpose. Hence the rejection of inorganic purpose was restricted only to intrinsic purpose. Maybe inorganic function does metaphysically entail extrinsic purpose. That would require another argument altogether. My claim here, though, is that one does not have to *recognize* any such purpose in order to recognize the appropriateness of inorganic functional talk and hence of inorganic teleology. Many geologists and hydrologists who freely use such functional talk would be surprised to be told that they were really appealing to an extrinsic source of purpose and hence of function. They simply inspect the geological and hydrological phenomena, identify the cycles and look at the way in which the parts functionally interact. That is enough to give functional talk a foothold without the further suggestion that such talk is only coherent when it is seen to imply an extrinsic source.

*Fifth objection:* doesn't my earlier talk of instrumental causation in the inorganic world imply the existence of purpose after all? The reply, again, is that we have to use an attenuated version of the concept of instrumental causation. Evaporation serves for the formation of clouds, that is it serves that function. But that does not imply any purpose on the part of either the evaporation or the clouds. I said earlier that inorganic entities and processes could be instrumental for other inorganic entities and processes as well as for organic ones; but the kind of instrumental causation involved in each case is different. In the organic case, as when an animal takes in water or minerals for nutrition (albeit in the latter case usually via an organic food source), the inorganic food serves a purpose the animal has, even if it is not a conscious one. Here, immanent causation is involved, as it is in the organic-organic case.<sup>27</sup>

But when one inorganic thing or process serves another, no such purpose is involved and the causation is purely transient. Additionally, I said that organic entities do not instrumentally serve inorganic ones, at least not generally. This is because the organic and the inorganic are not usually parts of identifiable systems that are inorganic in character. Inorganic things are part of the food cycle, but that is an organic system serving living things. There are possible exceptions: some organic things respire, and respiration is part of the water cycle. So to that extent one could say that organic things and processes can instrumentally serve inorganic ones. Yet one should not expect this sort of phenomenon to be widespread, since living things maintain an independence of behaviour that raises them above the status of mere cogs in a large-scale machine of inorganic systems and processes.

*Sixth objection:* the existence of organic teleology has an evolutionary explanation, but there is no such explanation of inorganic teleology. In reply, note first that even if there is no evolutionary explanation of inorganic teleology, this does not mean there is no explanation whatsoever. It is at least coherent (modulo objections from other

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<sup>27</sup> Contrast this with unusual situations, as when one organic thing interacts with another through purely physical forces. Such cases – say, when one animal accidentally bumps into another – will almost always lack the character of instrumental causation, with the causation being only transient as well.

quarters) to hold that living things evolved while inorganic systems and processes were created by an omnipotent, omniscient being. I mention this only to put it to one side. More to the point is the question of whether, if organic teleology has an evolutionary explanation (which I assume for the purpose of argument), an analogue can be found for the inorganic case.

The prospects look dim, but Graham Cairns-Smith's well-known clay theory of the origin of life might hold out a brighter hope.<sup>28</sup> On his theory, clay crystals formed in the early oceans, and by a process of natural selection working on them, larger and more complex crystals evolved and replicated (through splitting), varying in kind (through irregularities in the crystal structures) and eventually reached a point of size and complexity sufficient for them to synthesize organic molecules, and eventually RNA and DNA, whose initial function was to enhance the structural integrity of the crystals. Eventually, the crystals were subject to a 'genetic takeover': having served as the 'scaffold' on which life formed, the carbon-based, living structures were better able to survive and replicate than the crystals on which they were assembled, which eventually dissolved.

In my view (and that of many scientists<sup>29</sup>) the clay theory does not work as an account of the origin of life,<sup>30</sup> and not just because of the lack of a 'standard of value' such as can give rise to teleology, as Bedau holds.<sup>31</sup> Crystal growth is nothing like the growth that living things undergo, and could not possibly give rise to the latter. Even so, might not the clay theory give the inorganic teleologist a foothold into an explanation of inorganic teleology in general? Most inorganic systems and processes do not exhibit the specific sort of behaviour crystals do, which is one of the reasons the latter are so interesting. But if we had an account of the 'evolution' of inorganic systems and processes – at least the ones that support functional behaviour – we might have the needed explanation. Process philosophers – if there are any left – would find the search for such an explanation much to their liking. If the universe is not eternal, as I have been assuming, it should not be that hard to give a general account of how things like water and rock cycles, and other stable systems and processes, could have evolved from unstable inorganic behaviour.

Perhaps there are stripped-down versions of adaptation, variation and heredity, as applied to crystals in the clay theory, that might be extended to other sorts of processes. If so, we would have a thin version of evolution by natural selection in respect of the inorganic world. I cannot examine any such explanation here; I only suggest that it is worth looking for. On the other hand, if there is no such viable general explanation, then we are faced with the possibility that inorganic teleology is a basic, underived feature of the universe, as I have argued elsewhere for organic teleology.<sup>32</sup> Of course

<sup>28</sup> A. G. Cairns-Smith, *Seven Clues to the Origin of Life* (Cambridge, 1990; orig. pub. 1985).

<sup>29</sup> See further Iris Fry, *The Emergence of Life on Earth: A Historical and Scientific Overview* (London, 2000), pp. 126–9.

<sup>30</sup> See my *Real Essentialism*, ch. 8.

<sup>31</sup> Bedau, 'Can Biological Teleology Be Naturalized?'. Bedau actually speaks of 'transcendent standards of value' (655), but the 'transcendent' can be left aside as a rhetorical flourish. Value is immanent in the organic world, not transcendent.

<sup>32</sup> *Real Essentialism*, ch. 8.

the water and rock cycles have not been around forever, but it may be that they developed from prior inorganic teleological systems, which themselves developed from earlier ones, perhaps going back to some primal, irreducible such system. If so, and we wanted to go further in search of an explanation, we would have to go outside the universe. Either way, the sixth objection is in my view hardly decisive.

## Conclusion

I have tried to make space for a plausible account of teleology in the world of non-living things. It will strike many as too bizarre and counter-intuitive to be true, but I think the alternative is far more bizarre: that there should be full-blooded teleology in the organic world, while the rest of the universe was a blooming, buzzing realm of wholly non-functional events. Why should we not expect a kind of gradation in nature, from a thin, attenuated kind of functionality in the inorganic world to a full, rich kind of purposive behaviour such as we find in the living world? Just such a view is what we find in the Aristotelian tradition. One does not have to think – as Aristotle did not – that falling objects ‘seek’ the centre of the Earth, or ‘try’ to get there, in order to be a believer in a kind of teleology in non-living nature. Such thoughts are a fantasy of the post-Aristotelian age, as exemplified par excellence in the writings of Hobbes and the other revolutionaries against metaphysical tradition.

Yet to admit inorganic teleology is not to diminish one whit the special character of teleology in the living world, especially as it finds its optimal expression in human life and action. The contrast between the two is stark, yet the existence of both militates against a Cartesian-style dichotomizing of the universe. If there is even *inorganic* teleology, how much more is there teleology in those weird and wonderful entities we call living things? And how much more than that, in the human case, do the system of morality, the works of beauty and the orderly arrangement of the affairs of mankind take their place at the height of worldly life? Yet we are only one rung in a ladder of perfection, and we have no reason to suppose that our rung is at the summit. Still, by recognizing both the sameness and difference that connect us to the rest of creation, we can have our teleological cake and eat it too.

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