ISSN 2045-5577

ORDER: GOD'S, MAN'S AND NATURE'S

Polkinghorne and Cartwright on Pluralism and Metaphysics

Eric Martin
London School of Economics
Centre for Philosophy of Natural and Social Science

Abstract: This paper reviews the natural philosophies of John Polkinghorne and Nancy Cartwright, with particular emphasis on the role played by pluralism in their respective writings. While often motivated by distinct projects, their philosophies display some interesting and perhaps unexpected similarities. It is suggested that Polkinghorne's views are not far away from some of Cartwright's proposals, and further that certain debates about God's providential action could be helpfully reoriented if the insistence on natural laws as a centerpiece of scientific explanation were relinquished.

At first sight it may seem odd to compare the work of John Polkinghorne and Nancy Cartwright, two scholars whose intellectual interests are often divergent, but the following paper will highlight a few points of philosophical consonance between their work. In particular, it will focus on the role that pluralism plays in their respective philosophies. While motivated by distinct projects, the scholars are both pluralists about scientific descriptions and methods, insisting that there is no one univocally true way of describing the world, say, by appeal to fundamental physics.

The work of Cartwright and Polkinghorne shares inspiration in the recognition that the classical epistemology describing a deterministic, mechanical world that has long dominated the scientific worldview is insufficient to account for the contemporary landscape of the sciences. While that insufficiency has been recognized in various ways and by various scholars, both Polkinghorne and Cartwright believe that the metaphysical significance of that breakdown in the classical worldview has not been fully appreciated.

Polkinghorne's metaphysical concerns most often arise from theological considerations, namely whether and how God's providential action is possible in the world described by the natural sciences. The physical world he elucidates is one that is not causally closed but 'open' to processes and causes that are opaque to the sciences. That openness provides space for God's influence as both a reliable sustainer of regularities, and as providential actor in history accessible to human experience.

Cartwright's metaphysical concerns more often come from an awareness of the inadequacy of an entrenched view she has labeled 'fundamentalism' about laws of nature: a doctrine supposing that successful explanations in science ultimately appeal to one or a few fundamental physical laws of nature. Laws have long been a mainstay of natural philosophy, but Cartwright's version of empiricism begins with a commitment to the centrality and reality of *causes*. The empiricist philosophy she builds from there upsets a number of traditional conceptual resources, but none more than the notion of fundamental laws. Unlike a previous generation of empiricists, though, Cartwright's philosophy of science does not shy away from metaphysics. The metaphysical view that arises from her work has emerged through several books, and is found most explicitly developed in *Dappled World* (1999).

At the outset, one wonders what these natural philosophical discussions have to do with God. Perhaps philosophers will find them intrinsically significant -- and even more plausible! -- without appeal to deities. But for Cartwright, science is the best means we have of learning about nature, and there is a curiosity about what sort of God would create the 'dappled' world over the perfect machine of the early moderns. Insofar as the metaphysics she imagines departs from standard images of nature, there is ample room to question the ramifications of this philosophy for other disciplines, including theology: What kind of God prefers a dappled world to a hegemonic one? Polkinghorne also finds the natural world relevant to responsible reflection on the character of its creator, and his natural theology departs from other versions of that enterprise offered today (Holder 2010). Polkinghorne's natural theology is not meant as an autonomous, rationalistic proof of God, but is meant rather to serve as insight about the way the world is. Such insight is supposed to be achieved even outside any particular framework provided by the special revelation of scriptures, so his natural theology can be independent from dogmatic theology. Polkinghorne writes that his understanding of nature is "fully consistent" with a Trinitarian God, but does not compel

such belief (2004, preface). Science does not determine theology, but constrains it, and a theistic interpretation of nature makes the world "more deeply intelligible" (2004, 61).

Before his work turned to explicit treatments of religion and science, Polkinghorne's first career as a mathematical physicist led to significant work in quantum theory. Polkinghorne is skeptical of the tradition of appealing to quantum mechanics as a magic bullet for solving philosophical problems, but one insight he does take from that branch of physics is a methodological pluralism about the sciences. The duality that is part of quantum phenomena means, for Polkinghorne, that there is no one unique best way of studying the world:

> "there is no universal epistemology, no single sovereign way in which we hope to gain knowledge. Although we can know the everyday world in its Newtonian clarity, we can only know the quantum world if we are prepared to accept it in its Heisenbergian uncertainty. Insisting on a naively objective account of electrons can only lead to failure. There is a kind of epistemological circle: how we know an entity must conform to the nature of that entity; the nature of the entity is revealed through what we know about it. There can be no escape from this delicate circularity" (2002, 87).

Elsewhere Polkinghorne has referred to the need to draw from multiple sciences as "epistemic specificity" (2004, 77). This methodological pluralism runs counter to the notion that there is one Scientific Method whose proper application is the most important (and possibly definitive) aspect of scientificity. And the recognition of diverse, legitimate methods of inquiry is certainly in accord with insights provided from years of scholarship in the field of science studies, which has emphasized the ways in which scientists – even in the very same field – have developed their own highly specialized practices and terminology for gaining knowledge about nature (e.g., Galison 1997). The claim of epistemic pluralism may seem innocuous enough on its own, but when coupled with Polkinghorne's claim that "epistemology models ontology," such pluralism has serious ramifications for metaphysics, and appears to commit Polkinghorne to a more contentious – and interesting – metaphysical pluralism.

This methodological pluralism and a concomitant sense of the richness of nature are themes Polkinghorne has developed not only from quantum mechanics, but through analyses of the chaotic behavior exemplified in classical systems. Even in the world of classical physics, which once encouraged a deterministic and monistic view of the world, Polkinghorne urges that there is no fixed state of a system uniquely determined by prior states. Dynamical systems such as collective molecules of gas exhibit in-principle limits to predictability that are impossible to overcome, since vanishingly small differences in

initial conditions will still lead to vastly different outcomes. Scientists are necessarily ignorant of much of what happens in such systems. Classical linear equations are therefore no more than "approximations" of a "more supple" reality than the billiard ball physics we are often taught (2005b, 35).

Polkinghorne's work has sometimes lent itself to the criticism that chaotic systems provide reasons to accept indeterminism as a metaphysical thesis. That argument is indeed flawed, to the extent that chaos theory is itself expressed in deterministic equations. But a close reading suggests that Polkinghorne does not see chaos as evidence for indeterminism, but instead holds the weaker thesis that it is compatible with indeterminism. His writing on this topic frequently makes reference to the interpretation of quantum mechanics, in which the experimental data underdetermine the theoretical interpretation. Likewise, the suggestion here is that the scientist must choose how to interpret the results of chaos, and one available option is within a indeterministic framework (Saunders 2002).

As with chaotic systems, so with much of physics: a substantial degree of simplification is necessary to apply the mathematical equations of physicists to the reality they are supposed to describe. For all we know, nature simply isn't as well behaved as our mathematical models of it. Polkinghorne's corpus provides a metaphysical interpretation of contemporary physics that tells of a "subtle, supple, and holistic" reality in which particular causes can neither be identified precisely nor parsed completely. Thus, he argues, knowledge of the natural world is circumscribed in ways that preserve the possibility of god's action. God's providence "will always lie hidden in those complexes whose precarious balance makes them unsusceptible to prediction" (2005b, 39).

A criticism that has attended Polkinghorne's work is that he has formulated a 'God of the gaps' account of providence. If God is responsible for just those patches of nature that science cannot account for, then God appears to be slowly squeezed out of explanation by the historical progress of science. This may leave little ground for theism, if an explanation of God's work depends on science's weakness rather than some more positive account.

There is some truth in such criticisms. Polkinghorne does suggest that those spaces of unpredictability allow the possibility of God's action. But he is not making a strict equation between ignorance and God's work, arguing instead that scientific uncertainty simply creates room for the possibility of divine action. Further, even

properly scientific accounts do not mean that 'nature' replaces 'God' as the explanans, for God is the ground of nature's regularities as well. Polkinghorne rejects the view of miracles which construes God's work as an interruption of nature's regularities. His distinction between natural and miraculous occurrences is not a sharp one: he argues that miracles should be understood not at odds with laws, but as refinements of divine rationality. Also, Polkinghorne's account is more principled, and less ad-hoc, than traditional god-of-the-gaps formulations. Insofar as his discussions appeal to aspects of science with built-in uncertainties, the gaps to which he refers carry more epistemic significance than, say, the contingent lack of knowledge based on sciences that may still be developing. It is not just happenstance that quantum and chaotic phenomena exhibit unpredictability: that unpredictability is a constitutive feature of the science.

While other physicists may agree with Polkinghorne on the challenges presented by very precise predictions, their metaphysics – however implicit – often supposes that the whole world is much like the simplest and most predictable part of the model systems they have constructed. For example, a standard view is that, even if Newtonian laws do not make literally true predictions of most objects in the world, those laws are nevertheless omnipresent as component forces acting on objects. What is true in the highly constrained environment of the laboratory is true in the rest of the world. These traditional views about metaphysics are arguably licensed under the supposition of a strong unity or consistency of nature: if something is true in a model system, why shouldn't it also be true out in the blooming, buzzing confusion of nature?

Polkinghorne's extrapolations from epistemology into metaphysics are in many ways more humble. He is willing to admit that the unknown bits of nature are just that: unknown. Crucially, he accepts a close link between epistemology and metaphysics, a stance he calls "realism" or "critical realism" (2000, 78; 2004, 79; 2005b, xi).[1] He takes this to mean that we should postulate of nature what we empirically know about it. Considerations along these lines lead him to favor something like Bohr's interpretation of

[1] His terminology here is confusing, because 'realist' sentiments seem just as likely to favor, say, determinism over indeterminism in the case of chaotic phenomena, or hidden-variables interpretations of quantum phenomena over the standard Copenhagen interpretation. The philosophical point he appears to be voicing might better be construed as a kind of empiricism – a commitment to the reality of the empirical results of science, and a sense that we ought to believe the world is as our sciences are. "[W]hy go to all the trouble involved in doing science if one does not believe that thereby we are learning what the physical world is actually like?" (2004, 79).

quantum indeterminacy, and the 'openness' or indeterminacy of chaotic systems containing unisolatable causes. Polkinghorne is acutely aware that scientific experiments do not always determine metaphysical commitments, and his training during the height of quantum mechanical debates has sensitized him to the need for metaphysical considerations in the interpretation of physical theory.

Polkinghorne further believes that resources of various branches of inquiry – sciences and otherwise – are needed to fully make sense of reality. "Every level of description is needed in our effort to do justice to the rich and varied processes of the world, in its nature both flexible and reliable – including the category of divine providence" (2005b, 36).

Pluralism about the methods of investigating the world opens a space for theology as an accounting for the spiritual dimensions of human experience. Neither theology nor other sciences are replaced or reduced by lower-level explanations: they are each necessary because they each describe a different part of reality. That point is relevant to Polkinghorne's treatment of the mind-body problem as well as the admissibility of religious inquiry (2000, 95-99).

Polkinghorne's articulation of an 'open' world not entirely determined by the rule of fundamental laws given by the 'lowest' level of physics may be a tough sell to fellow physicists, for whom the image of a tidy world ordered through natural law is commonplace (see, e.g., Weinberg 1993). This is where Cartwright's corpus proves not only complementary, but in fact provides a more sustained attack on a view that Polkinghorne also appears to resist. In Cartwright's 'dappled' world, the rule of law may be quite circumscribed indeed: "For all we know, most of what occurs in nature occurs by hap, subject to no law at all" (1999). At issue is just how much of nature is explained by lawful regularities. Polkinhorne provides detailed case studies from physics in order, one gets the sense, to demonstrate that there are at least some instances where laws do not rigidly fix the outcome of events. His point is to demonstrate that causal closure is not entailed by empirical evidence. Cartwright, on the other hand, enlists a whole philosophical program in order to turn the tables completely on the fundamentalist. It's not just that *not everything* is explained by fundamental laws, but really *not very much* is. The case studies she provides demonstrate how some theories – like the BCS model of superconductivity – come with built-in limits on the scope of their own applicability. Far from being true everywhere and for all time, the laws of superconductivity apply only to a specific range of phenomena.

Both Polkinghorne and Cartwright share the view that the kind of systems which instantiate natural laws are highly atypical, and do not represent the bulk of natural phenomena. Cartwright has developed an extended argument about the scenarios in which laws of nature are instantiated, calling those pattern-generating systems 'nomological machines,' and describing how, with a few exceptions, it typically takes remarkable engineering ingenuity to create such systems. They are not simply waiting around to be discovered, but are usually stitched together with an array of specialized knowledge sets. The nomological machines that give rise to exceptionally regular behavior *do* tell us something very interesting about nature, but it is not about omnipresent laws. It is instead about the causal *capacities* exhibited by those bits of nature – whether electrons or gasses in a laser chamber – in such specialized, isolated environments. While those capacities may be stable across similar environments, they may also vary in different contexts (1989).

We have seen how Polkinghorne's pluralism makes for one natural point of contact with other pluralistic philosophies. But for all that Polkinghorne adverts to a 'veiled' reality of quantum phenomena, or to an unpredictable and unknown reality that is the consequence of chaotic behavior, he nonetheless retains a traditional physicist's aesthetic regarding nature's beauty, simplicity, and intelligibility. "The fundamental structure of the universe is astonishingly rationally transparent to us… the universe is also rationally beautiful" (2004, 12). The rational component he thinks deals with the fact that mathematics is both the most abstract category of human thought and simultaneously the "key to unlock… physical secrets" (2004, 12). Such language reflects the traditional metaphysics and aesthetics of Polkinghorne's former teacher Paul Dirac, an architect of quantum theory who famously wrote that "It is more important to have beauty in one's equations than to have them fit experiment" (1963).

Yet this insistence on nature's beauty, order and intelligibility may stand in uneasy relation with the observations above that were meant to show nature's hiddenness, suppleness, and diversity. If we know about nature in a number of distinct ways, and nature exhibits "rich and varied processes", then it becomes difficult to understand the source of Polkinghorne's sense of wonder regarding nature's "marvelous order" and the process by which scientists can "penetrate the secrets of the subatomic realm" (2004, 63). One also wonders whether the subatomic realm is yet supposed to hold some special status among the diversity of scientific subjects, and if so, why.

Polkinghorne uses methodological pluralism, drawn from his study of physics, to open the way for theological investigation of the world. The reasoning seems to be that because there are multiple distinct ways of investigating physical phenomena (such as the wave and particle natures of light), then there is space for honest intellectual inquiry into the more abstract, spiritual dimension of human life as well. One possible concern is that Polkinghorne hasn't paid sufficient attention to the spaces in between fundamental physics and theology. But his pluralist stance would seem to apply equally well to other sciences, whether inorganic chemistry, neuroscience, or ecology. It is not only quantum phenomena that are studied in distinct ways: ethologists and geneticists study the world in distinct ways as well, each using specific methods, languages, and theories.

Giving due consideration to these other corners of science might mitigate Polkinghorne's philosophical prioritizing of physics. That could further alleviate the tension created between Polkinghorne's insights into an indeterministic and pluralistic metaphysics, and simultaneous praise for scientists' discoveries of physical laws, the relation of which to the rest of his metaphysical story is not explicitly articulated. Are laws probabilistic? Are they descriptive or prescriptive? Polkinghorne provides a clearly defended metaphysical interpretation of several physical theories, but laws do not appear to play a central role in that defense. By the lights of his own pluralism, his account may be may be best compatible with a philosophy that recognizes a diversity of sciences which identify and work with nature's diverse causes. If that is true, Polkinghorne's position might be closer to Cartwright's 'dappled' world than one might have supposed.

Cartwright has emphasized how the sciences give us the best basis for belief about nature; moreover, it is the science *as it is used* to predict and manipulate the empirical world that we have warrant for believing in. Such uses in fact rely on an enormous number of concrete, diverse, complicated, and particular laws – hardly just a few high-level fundamental laws of physics (Duhem 1906). It is a mistake to think the language of high theory can be a substitute for these diverse concrete laws, because, in trying to fit the concrete laws into its own framework, the high theory substitution distorts many of them, omits much of their information, ignores many of them, and overstretches its own abstract vocabulary. Trying to fit so many laws into the high theory of abstract ideas is a mistake, and must be resisted.

To appreciate the consequences of this view it is helpful to consider the ideas it might oppose. Take, for example, recent work from Lydia Jaeger (2010), which contains the following claims: that God's wisdom demands order and comprehensibility; that comprehensibility entails order; and that order entails the immutable rule of law. Cartwright disputes all three claims.

The scientific world view articulated by Jaeger and a host of others is that science shows, hidden within the all-too-apparent mess, a truer and more fundamental reality that is beautiful, clean, and entirely orderly. This tidy image of nature is governed *thoroughly* by laws: essentially those of high theory physics. Physics, then, ends up as the ultimate arbiter of reality, its laws pervading and ordering the natural world.

Cartwright has hardly been the only one to question such a world view. In fact, an abundance of scholarship in the field of science studies might be thought to constitute a revolution in terms of the (above) received view of natural order. This scholarship has been devoted to answering such questions as: how far does the reach of natural laws extend? And does physics reign supreme, or is it one part of a more motley assembly of sciences?

Cartwright and others have drawn on case studies to construct their arguments about scientific practice, and contemporary science requires more than just the principles of high theory. For example, building a SQUID or designing a laser requires many more principles than those of quantum mechanics. These different principles arise from various corners of expertise: physicists in various sub-disciplines do not speak the same language, let alone that of engineers, who do not share a single language either. The quarreling camps in high-temperature superconductivity may not share a common meaning for the same terms. Nor, Peter Galison argues, do theoretical and experimental physicists with respect to the very same claim.

So science, it seems, is conducted within this Babel of languages, drawing on expertise from different corners of research. Why then suppose the Book of Nature is written in a single language when science is not? The problem is not unity at the 'high' end – the grand unity in one mathematical theory that many physicists long for. Rather, the problem is unity at the 'low' end – where physics engages with the empirical world. There, unity is a superstition.

If nature does not fit the old image of law-governed order, whither then order and comprehensibility? Cartwright imagines God as an engineer, not as a mechanic, as the mechanical philosophy would have it, where those terms are intended in their 19th

century sense. Charles Babbage divided objects of machinery into *engines*, employed to produce power, and *mechanisms*, objects indeed merely to transmit force and execute work (Wise, 2007). While engines imply productive power, mechanism, in this more specific sense, referred to a device for executing a typically repetitive mechanism. Engineers use principles about how things behave in special circumstances to construct devices that give rise to regular behavior, where those principles are not necessarily universal laws. Cartwright supposes that God is more like an engineer than mechanic, and order, where it exists in nature, results from clever engineering.

This metaphysical picture is in many ways more modest than the received scientific world view. It suggests only that the world is as our sciences are, and that order, where it exists, arises from good engineering, whether God's or our own. Such order need not be universal or necessary, and yet the world – at least some parts of it – remains comprehensible.

The standard response to this statement is to draw a line between ontology and epistemology, and to insist that *really*, the world is totally ordered under the rule of universal law, and it's only our limited knowledge that is failing. But that is hardly the simplest or most natural conclusion to draw from the evidence. Moreover, it is an unattractive metaphysical conclusion, on several fronts. Nothing ever happens in a mechanical world under the universal rule of law; genuine novelty and creativity is nowhere found. A single time-slice contains all the information about the past and the future. Is God then a mechanic in this sense? As HG Wells' (1895) Time Traveler teaches, "there is no intelligence where there is no change and no need to change." Why would the Deity create such a boring universe?

An engineered universe, on the other hand, provides a new aesthetic, a new view of nature, new questions about God, and new questions about the human role in nature. It suggests an aesthetic based on diversity and variety rather than uniformity. It suggests that nature is piecemeal and more like a hodge-podge than a solid color. It contains new theological questions: what kind of God prefers a hodge-podge to hegemony? Further, there are new queries about us. Is it our job to build order? What kind of order? What counts as order, beauty, or perfection?

We have above suggested that Polkinghorne might be more consistent if he relinquished his traditional appeals to physical laws as a centerpiece of scientific insight: they do not seem to play much of a positive role in his interpretation of physical theories, and they only come into the discussion at other points, when emphasizing the rationality

of nature, divine intent, or the anthropic principle. Laws further do not clearly fit with the pluralistic metaphysical interpretation of nature he has provided.

Were Polkinghorne to follow such a path, a further consequence might be to re-frame debates about God's providential action in the world. Those theological discussions have long taken place in the context of assuming divine governance of the world through laws. The question then seems to be how and why those very laws are eclipsed by the same entity that made them. A robust philosophy of science that eschews the omnipresence of such laws would provide a new way of thinking about God's action in the world. It would provide not only a new aesthetic of nature, but also a new context to consider God's creative activity. The details of such an account remain to be worked out. But it could helpfully re-orient an old debate which has often foundered between a need to recognize ubiquitous, universal natural laws, while simultaneously accounting for special divine action (Saunders, 2002).

References

Cartwright, Nancy. 1983. *How the Laws of Physics Lie*. Oxford: Clarendon Press.

--. 1989. *Nature's Capacities and Their Measurement*. Oxford: Clarendon Press.

--. 1999. *Dappled World.* Cambridge: Cambridge University Press.

Dirac, Paul. 1963. "The Evolution of the Physicist's Picture of Nature" *Scientific American* 208: 5, 43-53.

Duhem, Pierre. [1906.] 1991. *The Aim and Structure of Physical Theory.* Princeton, NJ: Princeton University Press.

Galison, Peter. 1997. *Image and logic: A material culture of microphysics.* Chicago: University of Chicago Press.

Holder, Rodney. 2010. "Natural Theology: A Comparison of the Approaches of John Polkinghorne, Alister McGrath, and Richard Swinburne"

Jaeger, Lydia. 2010. *Einstein, Polanyi, and the Laws of Nature.* West Conshohocken, PA: Templeton Press.

Polkinghorne, John C. 1994. *The Faith of a Physicist: reflections of a bottom-up thinker: the Gifford lectures for 1993-4.* Princeton, NJ: Princeton University Press.

--. 2000. *Faith, Science, and Understanding*. London: SPCK.

--. 2002. *Quantum Theory: A Very Short Introduction.* Oxford: Oxford University Press.

-- . 2004. *Science and the Trinity*. London: Yale University Press.

--. 2005a. *Exploring Reality*. London: Yale University Press.

--. 2005b. *Science and Providence: God's interaction with the world*. London: Templeton Foundation Press.

Saunders, Nicholas. 2002. *Divine Action and Modern Science*. Cambridge: Cambridge University Press.

Weinberg, Stephen. 1993. *Dreams of a Final Theory: The Search for the Fundamental Laws of Nature*. New York: Vintage Books.

Wells, H.G. 1895. *The Time Machine, an Invention*. London: William Heinemann.

Wise, M.N. 2007. "The Gender of Automata in Victorian Britain" in Jessica Riskin (ed.) *Genesis Redux.* Chicago: University of Chicago Press.