THE DRAUGHTSMAN RECONSIDERED: POPPER AND THE ONTOLOGY OF NATURAL SCIENCE

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Karl Popper recommends that we "reject all views of a closed universe"[1] —whether such views assume the guise of Newtonian mechanics or a nonlinear field theory. It is claimed by Popper that even *prima facie* deterministic theories are sufficiently indeterministic to refute the assertions of monists. His reason is that under the presupposition of any deterministic state of affairs there is an impossibility in ascertaining and recording the initial and boundary conditions of a closed system—in other words, in any theoretical description of the world there will be gaps, notably, as concerns the growth of scientific knowledge. Since the world can never be complete, Popper concludes that it must be indeterministic, and, as a matter of course, that we should reject all theories not compatible with this ontology.

This position, however, mistakenly identifies the notion of causal closure with that of completeness, thereby conflating ontological and epistemological considerations. It is simply incorrect to argue that a lack of completeness in theoretical descriptions signifies an indeterminacy in the world. On the contrary, deterministic systems may be incomplete, but causally closed.

Popper is bothered by determinism. And for good reason: his three world theory, or objectivist epistemology, demands that the world of nature (world 1) both contain an element of chance and that it be causally open to worlds 2 (the subjective world) and 3 (the world of objective knowledge). Both are denied by a deterministic or closed world theory.

In virtue of his own extensive work in quantum mechanics, one might expect Popper to solicit the positive successes of this discipline to endorse his indeterminism.[2] However, he is well aware that while quantum mechanics is a statistical theory, and not a *prima facie* deterministic one, David Bohn, for one, has shown that it is compatible with determinism.[3] Rather, the strategy he employs to ground his epistemological views is to argue that determinism has no basis in science, since its strongest support—classical Newtonian mechanics—is undermined by certain considerations.

If we take scientific determinism to be the claim that the future is not only fixed (*pace* metaphysical determinism) but also may be foreknown without limit by scientific calculation or prediction, as Popper advocates,[4] his objective, then, is to show that there are gaps in our knowledge of the world. As Bartley asserts, Popper thus "aims to scotch the hope (as in Einstein) that some future more general theory might return physics to a classical situation which would endorse determinism".[5]

In his "Indeterminism in Quantum Physics and in Classical Physics", Popper asks us to consider a "predictor"—a classical calculating and predicting machine constructed so as to produce records capable of being interpreted as predictions of the positions, velocities, and masses of physical particles—a variation of the much discussed "Laplacean Demon". Popper's claim is that this predictor may be able to admirably fulfill its task but with one crucial exception—namely, it cannot fully predict its own future states. The reason is that although it can be isolated from outside interference, it cannot be isolated from interference from within—in short, from itself or its "closer environment".

In obtaining initial information, the predictor interacts with its environment, and this introduces into the system a disturbance whose magnitude is unpredictable.[6] What this suggests, of course, is that even under the presupposition of classical mechanics there exists an impossibility in ascertaining and recording the initial and boundary conditions of a

closed system. The upshot of this is that the predictor cannot fully predict or be predicted by any similar mechanism with which it interacts. Moreover, in a society of such predictors, no member of such a society can fully predict the future states of that society or of any of its members.

In his "Replies to My Critics", Popper offers a variation of the foregoing. He asks that we consider a draughtsman who draws a large plan of a room in which he is sitting, including in his plan a plan of the plan he is making. The draughtsman, of course, can never complete his drawing, that is, up to the last touches he has made. The reason, as with the predictor, is that the room (or the draughtsman's closer environment), although capable of being isolated from outside interference, cannot be isolated from interference from within, or from the draughtsman himself. In describing the room, the draughtsman interacts with it, thereby continuously disturbing the information he receives in a way he cannot ascertain.

If this example is employed as analogous to the attempt of physicists to describe the world, then the thrust of Popper's argument is that physics will remain *incomplete*. It may very well be complete so far as universal laws are concerned, but it can never be complete in every particular because the physicist—like the draughtsman—is both the composer of his description and part of it. What this means is that in every theoretical description of the world there will be gaps, notably, as concerns the growth of scientific knowledge. Consequently, a true theory of a closed world is not possible, although a good approximation may be *prima facie* deterministic.

This argument is a stunning critique of the determinism of a Leibniz or Laplace. However, it is *not* a sound critique of the determinism of relativity theory or any relativistic field theory, for that matter. To explain, the distinguishing mark of deterministic systems is that they are closed: entities specified by the system can interact only with one another. An additional feature implied by such systems, and formally adduced by the special theory of relativity, is that *there is in principle no unique perspective from which to derive a complete description of the world*. Any observer, in virtue of his existence as part of the world, whether he be a physicist or a draughtsman, must put forth incomplete descriptions. In Leibnizian jargon, we might say that every individual perceives the universe (confusedly) from his own point of view. This stands in direct opposition to Newtonian mechanics, for example, whereby any entity can be given 'simple location' without reference to other entities. More importantly, it clearly asserts the impossibility of Popper's illustration: a draughtsman cannot reside simultaneously both within and outside of his description any more than a Newtonian particle can be given simple location. In the language of relativity theory, this is simply to compound frames of reference.

From the point of view of this theory, completeness is an unattainable ideal: while science attempts to create more comprehensive views, the limit of completeness is never realized, but only approached asymptotically as a line approaches a curve. The ramifications for Popper's argument are serious—he has confused the notion of causal closure with that of completeness of description, thereby conflating ontological and epistemological considerations. It is this which prompts him to maintain that the lack of completeness in theoretical description signifies that physics is sufficiently indeterministic to provide the rationale for his three world theory. Once this confusion is noted, *it is evident that deterministic systems can be incomplete, but remain causally closed.*

Popper is correct in at least one respect, however, when he asserts that "such considerations do not prove that the objective physical world is incomplete, or undetermined: they only show the essential incompleteness of our efforts". But he is mistaken in adding that "they also show that it is barely possible (if possible at all) for science to reach a stage in which it can provide genuine support for the view that the physical world is deterministic".[8] Once we have resolved ourselves to the incompleteness of our descriptions, we can allow our theories to suggest whether the world is closed or otherwise. The issue will not be weighed, as Popper wants it, by the epistemic question of what our theories can and cannot accomplish, but simply by what they positively assert about the world.

One final note: these considerations are quite compatible with Popper's view of science. We can embrace determinism, and nevertheless acknowledge our experience of science as an endless process of self-correction.

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NOTES

1 Popper, K., "Indeterminism is not Enough", *Encounter*, Vol. 40 (1973), p. 26.
2 Cf. K. Popper, "Indeterminism in Quantum Physics and in Classical Physics", *The British Journal for the Philosophy of Science*, Vol. 1 (1950), part 1, p. 127—"Quantum mechanics . . . implies that, however full and precise the initial information obtained, and however well isolated the system in question, there are certain events which cannot be predicted, although it is possible to predict the frequency of their occurrence under like conditions."
3 See P. A. Schilpp (ed.), *The Philosophy of Karl Popper*, Vol. 1 (La Salle 1974), p. 75.
4 Popper (1950), pp. 120—25.
5 Bartley III, W. W., "The Philosophy of Karl Popper, Part II: Consciousness and Physics", *Philosophia*, Vol. 7 (1977), p. 690.
6 Popper (1950), p. 127.
7 Schilpp (1974), Vol. II, pp. 1056—1058.
8 Schilpp (1974), Vol. 1, p. 104.

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