

1983

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PHILOSOPHY OF SCIENCE

UNIVERSAL DETERMINISM AND RELATIVE DETERMINATION

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Recent works have shown that it is possible to devise a clear thesis of universal determinism. Two such theses are formulated. Apparently the motivations for universal determinism have been: (1) to account for the explanatory power of scientific laws, (2) to support the principle of sufficient reason, and (3) to provide a methodological criterion for scientific progress. Universal determinism is, however, unsatisfactory in view of its apparent conflict with important physical theories such as quantum mechanics. The question then arises whether there is a weaker thesis, compatible with contemporary physical theories, that satisfies the motivation for universal determinism. A thesis of relative determination that satisfies these conditions is proposed.

† † †

INTRODUCTION

The nest of philosophical views grouped under the term determinism has a long history extending back to pre-Socratic science and philosophy. In particular, theories of physical determinism have commanded considerable attention throughout the history of philosophy. One sort of physical deterministic thesis, or other, has been a foundational part of most systems of explanation of physical phenomena. Physical determinism arose as complementary to the materialist systems devised by the ancient Megarian philosopher-scientists, and it was perpetuated later by the Epicureans in Athens. Among the most explicit proponents of a thesis of physical determinism were Leibniz and Laplace.

Many contemporary philosophers would agree with Austin (1970:231) that in the 1950s the expression "Determinism" did not name a clear philosophical view. Since the time of Austin's criticism, however, there has been some progress in the direction of clarifying precisely what is a deterministic system. There has been extensive clarification of the notions of causal explanation, event, and causal law. In recent years several precise statements of deterministic theses

have been developed. There is of course a variety of versions of determinism, but of primary concern here is one general kind of physical determinism, which may be called universal determinism, though remarks extend to some other kinds of deterministic theses as well.

Assuming that a clear statement of a thesis of determinism can be presented, the question of its fundamental interest must be asked. Von Wright's view is that philosophers are primarily interested in the logical possibility of determinism. Von Wright (1974:121) wrote:

. . . Interest in causes and deterministic developments [might] be replaced by an interest in probabilistic developments. This change of attitude could be entirely satisfying to the scientist. But would neither solve nor eliminate the philosopher's puzzlement about determinism as in its logical possibility. His interest concerns the self-consistency of a certain idea with ideas concerning action and human freedom.

Surely, philosophers are interested in this question, and it seems logically preliminary; but the ultimate issue regarding any form of determinism is whether or not there is a deterministic thesis that should be believed. It shall be argued that the apparent basis for belief of universal determinism is unsound.

It is unsatisfactory, however, simply to let the matter rest at a point at which universal determinism has no apparent sound basis. For, strong beliefs led to a tentative belief in universal determinism, and it might yet be hoped that a sound basis for some deterministic theses exists. Therefore, a modest alternative to universal determinism that does justice to sound considerations regarding causality, causal law, events, and scientific explanation shall be proposed. The alternative

framework for conceiving of causal systems is here called "relative determination."

First the meaning of relative determination is explained, and then three deterministic theses: classical universal determinism (CUD), modern universal determinism (MUD), and universal relative determination (URD) are distinguished. Next it will be important to try to understand and scrutinize the underlying motivation for a deterministic thesis such as CUD or MUD in order to determine the extent to which URD might serve the same purpose. There are important reasons for rejecting MUD as well as CUD which shall be reviewed. It shall be argued that such reasons for rejecting conventional universal deterministic theses do not apply to URD. Thus, URD can be viewed as a modest improvement over conventional theses such as MUD and CUD. Finally, the logical relation between MUD and URD is discussed.

RELATIVE DETERMINATION

By "relative determination" is meant a relation that holds between a scientific law (or more generally, an entire theory) and two sets of descriptive statements. Before citing the rigorous definition of this relation, what is intended by the expression is explained. Two non-simultaneous events are related to each other in accordance with some law, to the extent that a true, partial description of the earlier event together with the law are logically consistent with a description of the subsequent event. (Indeed, it is my view that there are no *complete* descriptions.) In the loosest sense of the term, the prior event description is said to determine the subsequent event description *relative* to the law.

Since this loose sense would seem of little use, the account should be ramified to say that the prior event description determines the subsequent one relative to the law in question, provided that the conjunction of the prior event description and the law entail some sub-description of the subsequent event description, as well as be consistent with it. To say that a set of descriptions Γ of some event E_1 *determines* the set of descriptions Σ of an event E_2 relative to a scientific law Λ is to say that: (1) Γ and Σ jointly entail that E_1 temporally preceded E_2 ; (2) the conjunction of Γ , Σ , and Λ is consistent; and (3) there are disjoint and logically independent subsets of Σ , say a_1 , and a_2 such that the conjunction of Γ , Λ , and a_1 entails some conjunction of elements of a_2 .

As an example, the events of shooting a billiard cue ball northward and its subsequent hitting of an object ball lying to the north can be pictured. The description of hitting the cue ball in a northerly direction together with certain laws of mechanics entails that the ball not travel in a southerly direction

before hitting some other object. Hitting the ball northward determines (relative to mechanics) that it will not strike a ball lying southward before hitting something else. If the description of the subsequent event includes a statement to the effect that the event takes place in a position that is not to the south of the position of the cue ball at the beginning of the prior event, and if all other aspects of the description of the subsequent event are consistent with the prior event description and the law, the prior event description determines the subsequent event description relative to the law. It is as if to say the law and the prior event description narrow down the subsequent possibilities which can be reflected in descriptions of subsequent events. The entailment of interest in this example is simply that of the sub-description, "the cue ball passes through a spot north of its initial position at time t ," by the conjunction of the law and a sufficient description of the prior event.

An obvious objection to this use of the term "determination" in connection with this relation is that the relatively determined events may in an intuitive sense be undetermined by the prior event. To this it must be replied simply that it is an arbitrary decision to use the term. There is, however, a further reason for using the term in this manner. It is the view here that determination varies in degrees, and that it may be the case that there is no highest degree of determination (no complete determination). Thus, it makes sense to speak of even the degenerate cases of "relative determination" as cases of fairly low degree of determination in the pre-formal sense. Thus, it seems that the thesis of Universal Relative Determination, to be explained shortly in terms of the above definition, can be correctly viewed as a deterministic thesis.

THREE DETERMINISTIC THESES: CUD, MUD, AND URD

In many respects, CUD is a paradigm of a universal deterministic thesis. Its roots lie in antiquity, but its recent history stems from Laplace (1952:16). In its roughest form, CUD says that every event is causally determined by prior events. This can be made more precise in the following manner:

Given any description of an event (provided it is accurate) there are causal laws of the universe (in principle) such that the event description follows logically from the laws together with accurate descriptions of prior events (descriptions that can in principle be given to any degree of detail).

There are difficulties with CUD primarily stemming from the question of whether it is an epistemological thesis or not (*i.e.*, whether or not it is to be understood as claiming that there

are knowable laws and descriptions corresponding to every knowable description).

It is unnecessary to ruminate on CUD, however, for even if the issues peculiar to it are cleared up there are further concerns common to it and its more modern cousin, MUD, that can be made clear. That there is a clear statement of universal determinism can be appreciated by a study of parts I and II of the writing of Berofsky (1971). The formulation of modern universal determinism (MUD) here is compatible with Berofsky's definition (see Berofsky, 1971:268–269). Berofsky developed important restrictions on descriptions and laws that should apply to this account as well. This account differs from his also in separating the notion of “deterministic system” and then stating the thesis in terms of that notion. By “deterministic system” it is meant that:

A collection of (possibly) interacting bodies forms a deterministic system under a set of causal laws if at any given moment any assertion that truly describes subsequent states of the system is deducible from the causal laws together with some true description of the state of the system at the given moment in question.

The thesis of MUD is then:

The Universe is a deterministic system of its particles under the set of the laws of nature.

Although the broadest deterministic thesis possible is exhibited, it is possible to present theses corresponding to portions of modern science (such as “sub-atomic particles constitute a deterministic system under the yet undiscovered laws of physics”). Such corollary theses are subject to the discussion that follows regarding MUD.

In order to state an alternative to MUD, the definition of relative determination must be recalled:

A prior event description determines a subsequent one relative to a law in question, provided that the conjunction of the prior event description and the law entail some sub-description of the subsequent event description, as well as be consistent with it.

The thesis of universal relative determination is:

Every true event description implies an event description that is determined in the appropriate sense by some other true event description relative to some law (not necessarily causal).

More precisely URD says:

For every true description of an event E_1 , there is a true description of another event E_2 and a scientific law Λ such that E_2 determines E_1 relative to Λ .

URD AND THE MOTIVATION FOR MUD

Any motivation for putting forth MUD is closely tied to the question of its rejection. Just what criteria are relevant for rejection of MUD depend upon what questions are supposedly answered by it. There seem to be three motivations for MUD: (1) the desire for an account of the explanatory power of the entire body of scientific laws, both known and yet unknown; (2) an interest in supporting the principle of sufficient reason; and (3) the need for a methodological criterion for relative progress of scientific theories.

It might seem clear that MUD is a metatheoretic statement regarding scientific explanations insofar as it makes reference to scientific laws. It appears to be a generalization about the explanatory power of all causal laws collectively (whether discovered or not). In that case MUD addresses the question: “What are the explanatory limits of scientific laws as a whole?” The motivation would then be to provide a holistic basis for the explanatory power of scientific laws. Thus, MUD says that any phenomenon describable in principle, is in principle explainable.

A similar, but rather unclear motivation for MUD would be to support the principle of sufficient reason. Despite Laplace's (1952) apparent argument to the converse, the principle of sufficient reason (if such a thing can be clearly stated) should be implied *by* CUD. Thus, MUD should imply the principle of sufficient reason.

A quite different motivation for MUD is to provide a methodological standard for scientific explanation. This is different from the first motivation in an important respect. The earlier concern was for the logical possibility of causal explanation; whereas now demands that should be placed on a scientific explanation are of concern. According to MUD then, mature science should be expected to provide theoretic models of deterministic systems under causal laws in explanation of describable phenomena. Theories that do not achieve this goal are relatively immature according to MUD.

To account for scientific explanation seems a respectable hope, though perhaps unrealistic. MUD attempts to address the question as to the limits of scientific laws by saying that in fact *causal* laws are unlimited. In light of modern physics, MUD has been challenged on this very issue, which shall be addressed when the rejection of MUD is considered. On the other hand, support of the principle of sufficient reason appears more difficult to appreciate as a reason for trying to

defend MUD, principally because of its own obscurity. The most worthy motivation for MUD is (3), need for a criterion of scientific progress.

There surely is an important role for a criterion (or criteria, for that matter) to judge scientific theories as to their relative progress in explanation. MUD suggests that progress is made by developing more extensive deterministic system models. Thus, a theory that provides a more complete deterministic system is to be preferred. This may be a misleading criterion as later consideration will tend to show. For, it would lead to the choice of a causal hypothesis over a statistical hypothesis even where the statistical one is more far reaching and unifies more theories.

It is not difficult to appreciate that URD tends to satisfy the need for a criterion of progress in science. Since URD provides that there are relative deterministic explanations (in the form of laws and descriptions of prior events) for any desirable phenomena, on the basis of URD an explanatory theory and observational research should be expected to yield such descriptions and laws. A quite natural way to judge relative progress, on the basis of URD, would be in terms of an increase in relative determination.

Concerning motivation (1) to account for scientific explanation, URD does not provide a precise answer, for it is very modest compared to MUD. It does, however, entail at least that it is always possible in principle to provide some relative-deterministic explanation for any given describable phenomena. Thus, URD tells something about limits of scientific explanation. It tells that there are not epistemologically discrete event descriptions in the sense that in principle every event description that is true can be related to some other event description in accordance with a law.

Even motivation (2), the interest in the principle of sufficient reason, might be seen as satisfied by URD, depending upon what the principle of sufficient reason is taken to be. But this point is not pressed, for little coherent substance to the alleged principle is to be found.

URD AND THE REJECTION OF MUD

Perhaps most contemporary philosophers do not accept MUD. But the reasons for its rejection are quite diverse, and there apparently is little consensus among those who have an educated opinion. The most prominent conditions for rejection of MUD are:

- (1) falsification of MUD (as some libertarians seem to argue, regarding CUD);

- (2) incoherence of MUD, as Austin (1970:231) argued;
- (3) incompatibility of MUD with other important beliefs (such as free will, or a particular understanding of Heisenberg's uncertainty principle);

and to this list one condition should be added:

- (4) implausibility of MUD.

Some contemporary philosophers seem to hold that condition (1) is satisfied, that MUD is falsified by quantum mechanics and molecular theory of gases. Berofsky (1971: 287-288) pointed out, however, that a theory of statistical laws is not necessarily indeterministic. Still there are arguments, to which Berofsky alluded, to the effect that quantum mechanics is essentially indeterministic. (More of this point is discussed below.) The view that freedom of the Will conflicts with MUD, and that freedom is undeniably experienced satisfies the condition of falsification. But none of these views seems as yet articulated clearly enough to falsify MUD conclusively.

The condition of incoherence seems unsatisfied by MUD or by Berofsky's (1971:285) definition of determinism. Even if MUD is unclear in certain respects, it can be clarified along the lines of Berofsky's account. Von Wright (1974:99-106) offered still another coherent statement of universal determinism. (I differ with Von Wright in stating deterministic theses in terms of event descriptions, rather than systems state changes. My account is more in keeping with Berofsky's.)

On the other hand MUD does seem to conflict with quantum mechanics in a serious way. [Von Wright (1974) alluded to this point in the earlier quote.] Roughly put, the problem is that as a logical consequence of quantum mechanics if a particle can be precisely located, then the particle's energy will be indeterminate. According to Hanson (1967), Heisenberg's uncertainty principle is the generalization of this limitation. Some have objected to the claim that the uncertainty principle be regarded as being incompatible with determinism, on the grounds that Heisenberg's principle is merely an epistemological limitation that is incompatible only with deterministic theses which are essentially epistemological. (Notice that whether quantum mechanics is true, as would be important with respect to the condition of falsification, is not now considered.) It must be realized that according to the uncertainty principle it is impossible *in principle* to determine both the energy and the location of a particle at a given time. What might be basis for supposing then that both properties are in fact precisely determined by prior states of the Universe?

These latest remarks, however, are insufficient to show that the third condition of incompatibility with other beliefs is satisfied by MUD with respect to quantum mechanics. On the other hand, they are appropriate in showing that MUD is implausible which is just condition (4). As a characterization of scientific explanation, MUD is implausible in light of actual scientific explanations.

Two of the motivations for MUD should be recalled: (1) the desire for an account of explanatory power of scientific laws and (3) the need for a methodological criterion for relative progress of scientific theories. On the basis of the uncertainty principle, it is implausible to make such a claim as MUD which makes an unwarranted generalization about the explanatory power of *causal laws*. It is doubtful that causal laws, even collectively, have the power MUD claims for them in the light of modern physics.

Concerning its service in satisfying the motive that there is need for a criterion of progress, MUD seems misleading as a criterion for scientific progress. It seems extremely implausible to regard quantum mechanics as immature compared to causal explanations of the same phenomena it addresses solely on grounds of MUD. As Hanson (1967:45) pointed out, quantum mechanics has more explanatory power than rival accounts insofar as it uniquely covers diverse phenomena. It seems more plausible to regard MUD as representative of a relatively immature concept of explanation in view of modern physics. Defense of MUD on grounds that modern physics may be retrogressive seems an even less plausible line.

As a result of these considerations there is reason to reject MUD. Surely, it seems not to fulfill its intended function in a reasonable way. On the other hand, URD would seem to survive each of the conditions for rejection entertained here. URD is certainly too weak to be falsified by an experience of freedom even if MUD can be falsified. In fact, URD seems very unlikely to conflict with important and relevant beliefs so that it survives the condition of incompatibility with other important theories, as well as the condition of falsification. It surely does not conflict with quantum mechanics. URD does not require that every feature of an event be entailed by some law and prior event descriptions, and it does not specify that the relevant laws be causal.

As for the plausibility of URD, earlier remarks regarding motivations might be recalled. URD would not lead to expectation of a causal explanation instead of a statistical one, when a causal one should not be expected in the context of contemporary physics. According to URD there are no discrete event descriptions. True event descriptions can always be related to others in accordance with some law. Thus, in the sense of relative determination, every describable phenomenon is explainable. This is more plausible than MUD insofar

as the history of science seems to disallow this without exception, whereas science does not nullify MUD unexceptionally.

CONCLUSION

Universal relative determination satisfies the most important motivations for espousing modern universal determinism, and in that sense URD can be viewed as an alternative to MUD. Furthermore, there are strong grounds for rejecting MUD and no similar grounds against URD. On the basis of these two points, it should be concluded that there is a philosophical justification for replacing MUD with URD.

There are, however, serious limitations to the importance of URD as implicitly admitted throughout this paper. URD is a very modest claim compared with MUD. They are compatible with each other. Indeed MUD implied URD. But, because of URD's greater generality than MUD, it is a weaker claim than MUD. Consequently, although it tends towards satisfying the motivations for an expression of the limits of scientific explanation and for a methodological criterion for scientific progress, URD does not satisfy these motivations *completely*, in the manner in which MUD might be thought to do, if it were acceptable. Much more should be said as to the limits of explanation and in regard for standards for determining relative scientific progress.

In its modest way URD performs a philosophical function: it articulates a logical relation that holds between phenomenal descriptions and laws of science, and asserts that we should expect such a relation to obtain. That URD does not, and cannot, perform the strong philosophical function that Laplace (1952) intended for CUD, and more recent determinists intended for MUD, ought not to be disappointing. For both MUD and CUD tend to stultify contemporary conceptions of scientific explanation and scientific progress rather than complementing those conceptions; whereas, URD does complement notions of explanation and progress. Reason advises that the implausible principle, MUD, be ignored in favor of the more modest, but plausible, URD with full intentions of continuing careful reflections on the conceptual framework of explanation of natural phenomena.

ACKNOWLEDGMENTS

This paper was presented at the Nebraska Academy of Science meeting in Lincoln, 9 April 1982, and at the Iowa Philosophical Association meeting in Iowa City in November 1982. An earlier version was presented at the Pacific Division meeting of the American Philosophical Association in Portland, 27 March 1982. Editing assistance was received from

participants in the Dakota Writing Project Workshop, Madison, South Dakota, 19–23 July 1982.

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