

Statistical Freedom of the Will*

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WHATEVER the philosophers and scientists say, the ordinary man stubbornly considers that there is a real external world. By this he presumably means that a part of the world has an existence which is independent of whether or not he or any other person has direct sensory experience of it.¹ But what does one mean by the phrase, a real, independent existence of the physical world, and how does such a notion arise? I believe that the answer is to be found in the fact that when an individual does experience a part of the world, it turns out that his description, as it becomes more and more accurate and intricate, approaches closer and closer to that of other observers; and that it is precisely this universality which is interpreted as reality.

When rocks are kicked it is not just a few selected persons whose toes feel the rock, it is everybody's toes. Therefore everybody believes in rocks: and the statement that everybody believes in rocks is equivalent to the statement, rocks exist. Samuel Johnson's retort² to Bishop Berkeley was, I think, quite justified.

For the ordinary man the universality is only approximate and vaguely sensed. For the scientist it becomes precise and consciously formu-

lated. But the universality is, for the scientist and non-scientist alike, the basis for the concept of reality, this being one of the many instances in which science refines but does not essentially alter the conclusions arrived at, however clumsily, by ordinary common sense.³

A belief in external reality is, of its nature, not provable. It is a statement of faith. Those scientists who ascribe to this faith presumably do so because they find it personally useful and satisfying. This belief admittedly introduces into the body of scientific thought—and indeed at its core—an alogical and even mystical element. This is not to be viewed as an imperfection. On the contrary, scientific thought loses no practicality because of, and derives beauty and significance from, this inner mystical element.

These remarks about the reality of the physical world vaguely involve operational concepts and procedures, but intentionally do not constitute a well formulated operational definition of reality. If they did, one would not need to refer to an alogical or mystical element. Some will indeed prefer to attempt to depress entirely the alogical and mystical elements from the whole of scientific thought. All I can say is that I think they are brave, over ambitious, and doomed to disappointment.

Between the objectively described events of this external world, scientists have observed and deduced relationships. One principal sort of relationship is that called the cause and effect relationship. This terminology has been loosely used, and a wide variety of connotations adhere to it. If an event *B* uniformly follows an event *A*, and if *B* never occurs except preceded by *A*, then some would say that *A* is the cause of the effect *B*. On such a definition Monday is the

* The writer is encouraged, by the interest of Dr. Millikan in such matters, to set down here, in his honor, a suggestion as to a relation between personal morals and the sort of statistical determination found in physics. Having, unfortunately, no command of the technical language of philosophy, the author has had to state the notions involved in terms which are surely amateurish and clumsy, but which will, it is hoped, be reasonably understandable.

¹ "The *problem of reality* is the question of the status of things while they are not being perceived," from "The reality problem in quantum mechanics," by Paul S. Epstein, *Am. J. Phys.* **13**, 127 (1945).

² "After we came out of the church, we stood talking for some time together of Bishop Berkeley's ingenious sophistry to prove the non-existence of matter, and that everything in the universe is merely ideal. I observed, that though we are satisfied his doctrine is not true, it is impossible to refute it. I shall never forget the alacrity with which Johnson answered, striking his foot with mighty force against a large stone, till he rebounded from it,—'I refute it *thus*.'" Boswell, James. *The Life of Samuel Johnson LL.D.* The Modern Library, New York, p. 285.

³ The reality here described must be understood to be only that special physical sort of reality with which science deals. There are undoubtedly other approaches to different sorts of reality. Thus, for example, one would wish to affirm the reality of beauty or of religious faith. These doubtless also have elements of universality, but nevertheless remain paradoxically personal.

cause of Tuesday. At the other extreme of the range of interpretation, one finds those who read a high degree of purpose and even of moral responsibility into the relation between a "cause" and an "effect."

The relationship of causality cannot be established by abstract reasoning, neither can it be proved nor disproved by experiment. It is a working hypothesis, as is any other scientific principle, to be applied when and where it proves useful. In spite of this, it seems to remain a matter of real moment whether or not one believes in the principle of causality. Some scientists think that much of ordered meaning will be lost unless the principle of causality be adopted for the whole field of science.⁴ On the other hand, some of these same persons believe that the dignity of personal inner life would be lost, did the principle of causality operate, inexorably and relentlessly, to control the sequence of a man's acts and thoughts.

Were it possible strictly to separate the two fields—the quantitative phenomena of the physical and biological sciences and the mental and ethical phenomena of inner life—then one would appear to be quite free to make separate choices for the two fields. The rub, however, seems to be that it is impossible to separate the two fields. If the mechanist viewpoint finally prevails over the vitalist, then the two fields become one. And pending the improbable moment when the mechanist-vitalist controversy will be settled, any line that can be drawn between the two fields is so broad and so vague that it can hardly serve as a boundary to shut in and out the principles by which men shall rule their lives.

How is this dilemma to be resolved? I do not think that it can be resolved in the same way for all men and for all time. The position which seems satisfactory to me in view of the present state of physical theories is that, the natural sciences having found it necessary to do with considerably less causality, man can find a tolerable compromise by doing with a little more causality. But the moment one proposes a compromise between causality and the absence of causality, one

must be very careful or he will find himself talking nonsense. One sort of compromise was proposed some years ago by Max Planck in his book *Where is Physics Going?* Planck appears to say that man both is and is not ruled by causality. In the fundamental and ultimate sense, he says, he *is* ruled: but at the moment of each individual decision, man lacks the perspective—and often what is required is the historical perspective which is automatically impossible at the moment of decision—to realize that he is ruled. In so far as I understand it, this view holds little comfort for me: it seems more noble for man to be bravely conscious of his position, whatever it may be.

The compromise that seems to me a more satisfactory one is just the compromise which physical science has adopted within its own domain, and it is based upon the distinction between individual events as opposed to statistical behavior. It is also based upon the idea that a man is the indivisible unit in the field of human behavior, just as an electron or a photon is an indivisible unit in electrodynamics. Faced with a situation which demands choice, man must either say "yes" or "no" and act accordingly. This single choice is here compared with the unit event—the single choice if you will—that plays the basic role in the behavior of physical units such as an electron or a photon. In both cases one is dealing with an individual event in which the actor or actors are indivisible units. An electron cannot be divided or reduced to component parts, but then neither can a man be divided and remain a man. The contrast between the two cases, however, is large. It consists in part of the fact that electrons do not maintain identity, whereas man does, at least for his life span, and permanently in some theologies. Probably, however, the contrast lies principally in the fact that the individual decisions of an electron or a photon are, in general, of little moment, while the individual decisions of a man may change the whole course of history.⁵

⁴ Compare, for example, Einstein's remark "I shall never believe that God plays dice with the world." Philipp Frank, *Einstein, His Life and Times* (Alfred A. Knopf, New York, 1947), p. 208.

⁵ A single neutron, to be sure, may initiate a chain nuclear reaction which has profound macroscopic effect. But this does not affect the accuracy of the statement above; for circumstances are so arranged that if a particular neutron "makes the choice" which leads it to miss a given uranium nucleus, it is nevertheless statistically assured that it or some other neutron will initiate the chain of events by hitting this or some other uranium nucleus. The

With the preceding preliminary remarks out of the way, it is now possible to state the suggestion which motivates this paper. In fact, the present thesis is, in all brevity, *that individual human decisions, like the individual events of physics, are not ruled by causality; while the statistical behavior of a man, like the statistics of a physical ensemble, is ruled by causality.*

Faced by the necessity for an individual decision, all my genetical constitution, my past training, and my experience combine to determine a spectrum of probabilities which make it improbable that I will choose thus, and probable that I will choose so. If I have been wisely reared and if I have profited by my past opportunities, then it is more likely that my choice will be the wise and ethical one—but it remains an open possibility for me to choose wisely or foolishly.

Thus one might say of a man that, confronted a thousand times by precisely the same problem of conduct, the probability is 0.92 that he make *this*, rather than *that* choice 950 ± 10 of the 1000 times. This is the sense in which his will is not free. But relative to a given single decision, he may make either *this* or *that* choice. This is the sense in which his will is free.⁶

decision here that may well have changed the course of history was the human decision to use the bomb.

It is interesting that some, notably Tolstoy, have taken a statistical view of human decisions. That is to say, if Truman had not said yes, some other man some other time and place would have said yes. Then from a long-term statistical point of view, the significance of individual human decisions would be comparable to that of individual elementary particles in physics. If this view be correct, it would be necessary to alter the sentence to which this whole footnote refers.

⁶ In his paper "Physics and metaphysics," *Sci. Mo.* 45, 49 (1937), Dr. Paul S. Epstein points out that modern physics makes untenable the concept of determinism, and hence of predestination. But he holds the view that the problem of the freedom of the will is, in the first instance at least, unaffected by the non-existence of determinism. He further holds that, in the realm of phenomena properly described by physical theories, the role played by pure chance excludes freedom of the will just as completely as did the strict determinism of the older theories. In his view, freedom of the will must therefore be denied by modern mechanists, although it can still clearly be claimed by modern vitalists.

To this I would reply, first, that I cannot myself accept an all inclusive mechanistic philosophy (see "Science and complexity," which is Chapter 1 of *The Scientists Speak*, edited by W. Weaver (Boni and Gaer, New York, 1947), and particularly pages 10 to 13, and pages 332 and 333.) Second, I would remark that just as I see no contradiction, in the world of physical events, in having causality operate in a statistical sense while individual physical events are subject to chance, so I also see no contradiction, in the realm of human decision, in having

The practical nature of the situation here differs in two important regards from what one finds in the physical sciences. Firstly, in the physical sciences one can, at least with very high accuracy, reproduce identical circumstances enough times so that the determined statistical trend is evident. Indeed, except for certain delicate experiments of the atomic physicist, the determined statistical trend is all that we observe, so that we got the impression of a wholly determined physical universe. Conversely, in the case of human behavior we can seldom or never reproduce the circumstances surrounding a choice, so that the unpredictability of the individual human event is much more obvious than the long-range regularity of the statistical behavior. It is quite possible that only a Super-Being, with knowledge of the behavior of all men for millions of years, can be wholly aware of the element of determination.

Secondly, the electrons, photons, etc., which are the individuals of purely physical happenings appear to maintain invariable characteristics, while the separate decisions of a man instantaneously and automatically become part of his (now changed) history and experience, so that the next following decision is subject to the influence of a more or less changed spectrum of probabilities. It is as though one were playing with a many-sided teetotum of plastic material, so that each throw changes the geometry of its shape and hence influences the probabilities on the next throw. In other words, the sequence of human decisions forms, in the language of statistical theory, a Markoff chain.

It may not be entirely grotesque to think of one's conscience, that Victorian abstraction which is so seldom mentioned today, as playing a role relative to human behavior similar to that played by Schrödinger's ψ function relative to the behavior of electrons. One's total moral history leaves him, at a given moment, in possession of a certain conscience—here strong, here weak—appeal to which determines the statistical probability that a given decision will be this or that. But the individual act remains free, and may be either this or that. If it is

causality operate in a statistical sense while the individual events are subject to freedom of the will.

"this," then our moral character is strengthened, and it is more likely to be "this" next time. But in any case, there are intelligible senses in which the decision is influenced, in which it is statistically determined, and in which it remains free.

The progress of science in the last half-century has surely taught us to respect the subjective and relative aspects of physical phenomena, and to be suspicious of any smug feeling that we have constructed permanent theories; yet one is tempted to see here an element of reasoning that might persist even if, for example, new

theoretical concepts and new experimental methods enable us later to describe the interactions of simple electrons, photons, etc., in terms of ordinary dynamic causality. For this description will of necessity consist of breaking the present unit events down into new component events. That is, the interaction of two electrons or photons may become a statistical event amenable to causality while the new unit events may continue to elude regular control, this leaving undisturbed the above suggested analogy with the individual decisions of men.