Dr. David W. Weiss heads The Lautenberg Center for General and Tumor Immunology at The Hebrew University—Hadassah Medical School, Jerusalem, Israel. His most recent contribution to these pages appeared in our Spring, 1981 issue.

RANDOMNESS AND DETERMINISM IN NATURE: LANGUAGE AND PERSPECTIVES

One of the motivations, albeit often subliminal, for the prevalent reserve in some religious circles toward scientific consideration of natural phenomena lies with a misunderstanding of randomness and determinism. There is the notion that both properties somehow clash with belief in a Divine Creator and Master of the universe, and that the pursuit of science is, accordingly, a hazardous, no-win proposition for the faithful. Where find God in nature if things transpire at random, where, if they are the blindly determined manifestations of natural laws? I have attempted in a recent essay to summarize, once again, the fallacy of conflict between a normatively Judaic and a scientific purview of nature.[1] In the present paragraphs, I should like to supplement that discussion by elaborating further on the meaning and implications, both scientifically and Judaically, of randomness and determinism in material transactions.

It is imperative to identify with care the ideational framework within which the designations randomness and determinism are applied to describe events in nature, and to circumscribe accurately the character and scope of phenomena denoted by the terms in each conceptual context. The vocabulary is a heavily loaded one. The words are invested with import that varies with the frame of reference impelling the observer; they are apt to generate blurred apprehension, even contradiction, when applied without awareness both of the true qualities of the effects contemplated, and of the unique perspective of the approach. The intellectual languages of Judaism and of science are distinct matrices—image repertoires—for formulating comprehension of the material world. Realization of man's potential for intelligence and evaluation of the universe is conditioned on resort to both languages; they are complementary, both requisite for an inclusive pronouncement of reality, for mental grasp to take form, discrimination, and communicability.

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The behavior of an individual natural unit—an integer—can be predicted in many instances with near absolute certainty. Laws of causality are seen to apply inclusively, to given effect in given circumstances, to each similar unit in a field of units. For example, a particular arrangement of chromosome constituents invariably controls production by a cell of the same, corresponding molecular product. The behavior of the integer is framed in a deterministic model; in statistical terms, it can be specified reliably in advance by a single value derived from the appropriate equation. Phenomena and transactions that follow patterns of such determinism are distinguished, individually and collectively, by the qualities of surety and constancy.

Deterministic consistency derives from the inherent attributes of each reactant, attributes that are identical, or sufficiently similar, for each analogous integer under scrutiny to make for equivalent function under the influence of particular conditions. Philosophically, the matter can be let stand at that, leaving untouched the questions of ontogenesis of the primary properties involved, and of their integration into larger, multifactorial domains of transaction. Such a stance by the observer is safe—and truncated; the analysis remains descriptive. If, however, the range of inquiry is extended, questions of ultimate causality and of larger order must be confronted, and the confrontation opens as well, unavoidably, the topic of purpose.

The Judaic response is categorical: The forces, attributes, and transactions discerned are manifestations and evidence of a master plan of creation and supervision of the cosmos. One way of phrasing this conclusion—and the conclusion is one to which many an observer has been driven inescapably by the evidence of nature itself—is to say that matter and its constituent components and energies are so fashioned and endowed as to make for all the eventualities and potentials that we perceive in the cosmos. God's agencies for unfolding of the creative design, and for intervention in the affairs of the world, are every created thing. There is no constraint on Divine creativity and managership in the determinism of natural events: Nature is God's daughter, God's hand[2]; the laws of nature are disclosure of the manner in which He has chosen to govern the universe. *Within* the matrix of determined natural law, the Creator conducts, actuating in given directions the integration of discrete transactional sets into progressively larger, coordinated constructs, that is, the realization of intrinsic potentials for larger order which do not come to fruition perforce automatically by virtue alone of the properties of the primary components; setting the conditions and coincidences in which reactions, individually deterministic, will proceed along a purposed course (shallow waters predictably recede under the impact of sustained wind from certain quarter—and the storm gathers the moment it must for

Israel to survive); modulating the circumstances of environment in place and time so that there can survive and develop that which is meant to survive and develop. There is no philosophic contradiction in Judaism between a determinism of natural processes and the omnipotence of Deity; from the appropriate perspective, there is complementarity. And, as every created thing can be the means of God's intent, so can it be a tool by which man exercises the responsibilities of free will, and of partnership in the perfection of creation, that are incumbent on him.

In contradistinction to the determinism that holds for some natural occurrences, it is in the nature of individual events within a related set often to take place at random (at certain levels of organization, in some regards, and in some circumstances). Thus, the quantum position and velocity of a single electron orbiting an atomic nucleus cannot be forecast, for a given point in time; neither can the precise locus and nature of a spontaneous mutational change in a given chromosomal region. Foreknowledge of the precise fate of an integer in a field of seemingly identical integers is uncertain; conclusive laws of causality cannot be formulated. Stated statistically, many natural occurrences, and especially those of biological nature that involve complex relationships between distinct units, do not fit deterministic models; they must be analyzed, instead, as probability (or, "stochastic") processes:

> Any description of . . . possible changes . . . with time must take account of the fact that things could turn out quite differently . . . a probability model is essential to describe the pattern of happenings that could occur with their relative chances of occurrence. We must therefore envisage the existence at any one point of a probability distribution . . . instead of the single value specified by a deterministic model.[3]

We can say with near certainty for such events that a particular transaction shall take place involving one of many seemingly equivalent units, and we can often closely approximate its frequency and timing, but we cannot pinpoint the particular integer to be so affected within the set. Such individual "randomness" applies frequently in nature, in different instances over a range of matter's organizational strata. In the dimension of human demeanor, with its unique elements of will, choice, and conscience, foresight of individual action is certainly not given, even where the pertinent variables appear to be known and "controlled."

And, in certain cases where deterministic laws do appear to fit phenomena in nature, they in fact pertain to the cumulative consequences of individually random transactions.

What are the possibilities of philosophic perception of such randomness? For one, the particular reaction can be designated as indeed wholly chance—"it just so happened"; analysis of causality in the aggregative

set within which the particular event transpired is restricted to the seemingly relevant forces immediately at play; and, questions of primary ontogenesis, integrative permutation, and purpose are, again, not touched.

The conceptualization can be less shallow, however. The single event that is, by any criterion, random within a family of related phenomena can be perceived nonetheless as requisite component of a *comprehensively* embracing blueprint: the behavior of a given integer may be wholly fortuitous, but that of the composite whole guided, subsuming all necessary eventualities for the revelation of Divine will and the expression of human volition.

There can be added the consideration that the individual unit's behavior that is putatively at chance in kind or time may, in effect, not evince randomness at all, but rather represent the consequence of some attribute, unknown to the observer, that distinguishes that integer from the homologous field and makes it subject to relevant rules of causality. It is always difficult to exclude such possibility categorically; its invoking shifts discussion of the event to the framework of determinism.

There is no necessity, however, from the philosophic position of Judaism to cast doubt on the *de facto* randomness, by scientific yardsticks, of single natural occurrences. Quite to the contrary. That which is in scientific terms a truly haphazard event can be read in theological ones as decreed, reflective of the determination of a force standing above nature. The man descending the ladder falls, and strikes and kills the passerby beneath.[4] Nothing in the constellation of tangible factors can explain the concatenation of happenings—that man on the ladder, slipping that instant, that person below in the fatal second. It is happenstance, by all the rules that govern natural reactions. But from another conceptual vantage point, it's not coincidence at all, but ordained retribution. Absence of it is a discernible natural cause for a specific occurrence in time, large or small, is an inference germane to one dimension of reality. The conclusion does not impinge on the truth of another: what took place did, when it did, because it was so directed to be by the Designer whose hand is nature. That arrogation devolves from another, coexistent dimension of reality.

Essence and meaning of material phenomena are, at least in part, as they are inferred by the beholder; they take form as cognition filters through the prism of his *a priori* conception of existence. The multifaceted grasp of reality can be given voice only by resort to distinct ideational languages, each suited to the facet it proclaims. In a paucity of words, however, the same nomenclature is often used in connoting decisively distinct apprehensions and valuations, and then special care must be taken to specify the purport and salience of each appellation. "Determinism" and "randomness" bear a wholly different import as they relate, on the

one hand, to scientifically demonstrable causality and predictability of material phenomena, and on the other to questions of superior authority and significance in the occurrence. There is no randomness in nature in the sense of chance disconnected from the will and potency of God to act; there is no determinism in the sense of an autonomous natural order, independent of, and in conflict with, Divine intent; in all events, whether they fit by the material standards of natural science deterministic or probability-stochastic models, the Jew can recognize the purposeful instrumentation of the Creator and Master.

NOTES

1. David W. Weiss, "Judaism and Evolutionary Hypotheses in Biology: Reflections on Judaism by a Jewish Scientist," *Tradition,* 19(1) (Spring 1981) pp. 3-27.
2. Meir Simchah Hacohen of Dvinsk *(Meshech Chochmah),* Commentary on Pentateuch, on Leviticus 26:3.
3. N.T.J. Bailey, *The Mathematical Approach to Biology and Medicine* (New York: Wiley & Sons, 1967), ch. 2.
4. *Makkot,* 10b.