IS LIFE AN ACCIDENT?

by Malcolm E. Schrader

Objections to the theory of evolution stemming from apparent conflict with religious beliefs seem to be of two types. One is that of the biblical fundamentalists who advocate a literal interpretation of the account of primordial events given in Genesis. This approach of course results in contradictions with a number of facets of evolutionary theory. Perhaps the most serious of these is the question of the time that has elapsed between the appearance of the first living forms and the appearance of modern man, which ranges from the order of days in the fundamentalist approach to eons in the evolutionary scheme. The other objection to evolutionary theory, however, is not concerned with the account in Genesis but rather with the general religious-philosophical question of the existence of purpose in the evolutionary process (which can be interpreted as implying direction by a supreme intelligence) versus a randomly occurring, accidental sequence of events. This problem, which transcends questions of biblical interpretation or even of divine origin of the bible, is the subject of this paper.

The view that the production of advanced forms of life from inanimate matter by means of evolution is an accidental event stems from the hypothesis of "variation and selection," which is generally accepted as the basic mechanism of evolution. The fact that variation, the first of the two components of this mechanism, is essentially random has created a widespread impression that the entire process must be accidental. This of course is not the case since a selection component, operating on the variation in such a way as to produce a possibly inevitable evolution of matter to a higher life form, converts the total process to a nonrandom one. The hypothesis of randomness, however, has received additional support from mathematical calculations which purport to show that the number of possible variations along the evolutionary pathway leading to intelligent life is so large that the probability of the correct ones having occured during the lifetime of

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[*Zygon*, vol. 14, no. 4 (December 1979).]
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our planet is infinitesimally small.[1] This approach is of course in opposition to the Oparin-Haldane hypothesis, which forms the basis of today's studies of chemical evolution and the origin of life—by chemists and molecular biologists.[2] The Oparin-Haldane hypothesis states essentially that the origin and development of life forms occur inevitably as a result of a favorable sequence of physical and chemical conditions existing on the surface of a planet during its formation and evolution. This implies that life is likely to form on any planet in the universe which has a history similar to that of the earth. If this hypothesis is ultimately proven then the assumptions underlying the previously mentioned calculations will have to be radically revised. Nevertheless, even assuming that a high degree of randomness exists with respect to evolutionary possibilities resulting from the interaction of planetary history with physical laws, the question remains whether this justifies describing the existence of life as we know it as an "accident."

Probability

To answer this question it is necessary to define the word "accident" in a manner that is philosophically relevant to the question. For example, an accident in terms of occurrence of events under human control is simply an event which occurs outside the framework of the purpose of the human plan. On the other hand to describe natural events which have occurred before or independently of the existence of intelligent physical beings as accidental or otherwise requires a different definition of accident. An accident in terms of direct reference to "natural" physical occurrences only is defined here therefore as an event which occurs unpredictably in the presence of known physical laws and boundary conditions. It is important to note that this does not mean merely that the time or place of the event cannot be predicted but that its actual occurrence cannot be predicted from the known physical laws and prior conditions.

The problem of evaluating the validity of the application of the term "accidental" to the phenomenon of life is essentially one of determining whether life can be considered an artifact, or singularity, in the system of natural laws. This issue will be discussed within the framework of the current major cosmological theories.

To illustrate the basic aspect of probability relevant to the problem let us assign a blindfolded subject the task of withdrawing a black ball from a bag consisting of ninety-nine identical white balls and one otherwise identical black ball by withdrawing a ball and then replacing it and shaking the bag thoroughly. If we focus on any particular try,

that is, if we are interested in one particular try only, then if a black ball is withdrawn on that try it can be considered an accident. On the other hand, if in pursuit of our goal to withdraw the black ball from the bag we are unconcerned about which particular try is the successful one, the situation is radically changed. If the subject is permitted one thousand tries, one successful withdrawal is hardly an accident. Allowing an infinite number of tries, one successful withdrawal is a certainty.

History

There are two major current theories of the history of the universe. One is the big-bang theory, and the other the steady-state theory. The big bang has roughly two branches: The universe, presently in a period of expansion following the big bang, is destined to reach a state of maximum expansion. This is followed by a contraction which after reaching the point of maximum density may be followed by another big bang. If this process continues indefinitely there comes to be an infinitely oscillating universe. During the course of a single oscillation the number of planets in existence going through a prelife history similar to that of our earth is sufficiently large so that even at a calculated probability of 10^{-18} per planet the probability favors a few advanced life forms throughout the universe.[3] For an infinite number of oscillations the repeated occurrence of life is a certainty, regardless of how low the probability per planet. These same considerations hold for steady-state cosmology.

If the expanding-contracting universe can undergo no more than a few oscillations, the situation is similar to the second branch of the big-bang theory, the "one shot" exploding universe which continues to expand indefinitely. In that case the optimum set of natural laws or equations describing the universe from its inception until the present time is the simplest one that theoretically can reproduce all the events, from the macroscopic to the submicroscopic, of the universe from its beginning to the present. Sets which obtain additional simplicity at the expense of accuracy or completeness will be useful of course only for those purposes for which completeness or accuracy is not essential. A set of laws governing chemical reactions which obtains its accuracy by eliminating carbon compounds from consideration must be applied only to purely inorganic phenomena. A set of laws predicting with accuracy the properties of amorphous materials only is useless for dealing with crystalline phenomena. The former set can be demonstrated to be nonfundamental by the existence of carbon compounds, while the existence of crystalline material eliminates the latter

as a general formulation of natural law. No general statement of the laws of nature can exceed in accuracy or completeness a "motion picture" depicting all the events of the universe (from the macro down to the smallest observable entity) from time zero of the initial big bang to the end of observable time. Consequently any improvement over this hypothetical pictorial record must be in the direction of further simplicity of formulation. If a given simplification loses accuracy or completeness, it cannot claim equal validity with the motion-picture formulation. The importance of the loss in completeness for any given approximate formulation depends of course on the interest in the omitted entity. Suppose, for example, a given approximate formulation of the laws of nature omits the existence of the mineral beta-trydomite. If this formulation is used for the purpose of obtaining information on the relative stability of various crystal structures of silica, it will produce completely incorrect results. No approximation has validity if it alters the completely accurate motion picture in such a fashion as to eliminate or distort data vital to the application of the formulation.

Now any complete motion picture of the universe of the time period from the big bang to the present must include of course the existence of life on earth. An approximate formulation which does not predict life on earth may have some usefulness in dealing with the properties of a planet in a solar system in which life has never appeared. It does not have any intrinsic validity, however, other than its ability to generate portions of the motion picture. The extent that it fails to do this pinpoints the areas of its own inadequacy. Any proposed formulation of the laws of science that does not predict the existence of life on earth is fundamentally an incorrect formulation, which furthermore is totally lacking in usefulness for any application involving the life process or any phenomena in any way affected by it.

In summary, it is philosophically incorrect to describe the existence of life as an accident, that is, as something which did not have to occur within the framework of the laws of nature. For a universe of finite or limited time any proposed laws of nature that do not predict life are incorrect since they are in conflict with reality (the analogue of a scientific theory that is in conflict with experiment). For a universe of infinite time the argument might be made that life is accidental if the choice of any possible large segment of time other than the one including the present period does not include life. That argument then would be that the same laws are operating over all "lifeless" segments without ever producing life so that the present case is accidental. This is wrong, however, since the very same calculations of probability that allege life

to be highly improbable for the limited time of a few billion years on a given planet (thus forming the basis of the accidental-life hypothesis) do predict that it will occur repeatedly in the universe as a whole over a longer period of time.

NOTES

1. H. F. Blum, "Dimensions and Probability of Life," *Nature* 206 (1965): 131.

2. A. I. Oparin, *Prioskhozhdenie Zhisny* (Moscow: Izd. Moskovski Rabochii, 1924) (*The Origin of Life*, trans. Sergius Morgulis, 2d ed. [New York: Dover Publications, 1953]); idem, *Genesis and Evolutionary Development of Life*, trans. Eleanor Maas (New York: Academic Press, 1969); J. B. S. Haldane, "The Origin of Life," *Rationalist Annual* 148 (1928): 3; S. L. Miller, "Production of Some Organic Compounds under Possible Primitive Earth Conditions," *Journal of the American Chemical Society* 77 (1955): 2351. Some examples of subsequent work are found in S. L. Miller and H. C. Urey, "Organic Compound Syntheses on the Primitive Earth," *Science* 130 (1959): 245; K. Harada and S. W. Fox, "Thermal Synthesis of Natural Amino-Acids from a Postulated Primitive Terrestrial Atmospher," *Nature* 201 (1964): 335; S. W. Fox, "Thermal Polymerization of Amino-Acids and Production of Formed Microparticles on Lava," ibid., p. 336; C. Ponnamperuma, "Chemical Evolution and the Origin of Life," ibid., p. 337; M. Calvin, *Chemical Evolution: Molecular Evolution towards the Origin of Living Systems on the Earth and Elsewhere* (London: Oxford University Press, 1969); S. W. Fox and K. Dose, *Molecular Evolution and the Origin of Life* (San Francisco: W. H. Freeman & Co., 1972); S. L. Miller and L. E. Orgel, *The Origins of Life on the Earth* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1973).

3. Blum (n. 1 above).