A CONSISTENT CHRISTIAN-SCIENTIFIC VIEW OF THE ORIGIN OF LIFE

DUANE T. GISH*

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It is shown that any attempt to account for the origin of life in a naturalistic way runs into insuperable difficulties. The only way in which it is possible to give alleged accounts of the origin by naturalistic means, in textbooks for instance, is to take good care not to notice those difficulties. The only view of origins which is free of such difficulties is that which ascribes the origins to the action of the Creator.

Introduction

All scientists agree that any process that involved or involves the intervention in any way of a supernatural being is not subject to the scientific method of observation, hypothesis, and test. We must agree as scientists, then, that if the origin of life involved an act of God or required His influence or intervention *in any way*, the origin of life is obviously beyond the limits of scientific investigation. If God was the Creator of life, the origin of life was miraculous in the most meaningful sense of the word.

There are therefore two views of the origin of life that are logically and philosophically consistent. Either life was created and its origin was miraculous and beyond the reach of the scientific method, or its origin was altogether naturalistic and mechanistic and therefore subject to rationalistic scenarios. It is contradictory and irrational, then to profess belief in God as the Creator of life and at the same time profess belief that life arose by a mechanistic, evolutionary process that is subject to investigation by the scientific method. It is, in fact, to want a Creation in which nothing was created.

Ernst Haeckel, one of the most strident of all propagandists for Darwin during the nineteenth century, recognized the basic irreconcilable contradictions in such a position, which he termed monistic pantheism and pseudo-Christianity. Thus with respect to the Darwinian revolution, Haeckel said "Liberal Protestantism, on the other hand, took refuge in a kind of monistic pantheism, and sought a means of reconciling two contradictory principles. It endeavored to combine the unavoidable recognition of the established laws of nature, and the philosophic conclusions that followed from them, with a purified form of religion, in which scarcely anything remained of the distinctive teaching of faith. There were many attempts at compromise to be found between the two extremes; but the conviction rapidly spread that dogmatic Christianity had lost every foundation, and that its valuable ethical contents should be saved for the new monistic religion of the twentieth century. As, however, the existing external forms of the dominant Christian religion remained unaltered, and as, in spite of a progressive political development, they are more intimately than ever connected with the practical needs of the State, there has arisen that widespread religious profession in educated spheres which we can call 'pseudo-Christianity'—at the bottom it is a 'religious lie' of the worst character."[1] Here we see Haeckel's conviction that it is impossible to wed true Christianity to Darwinian evolution and his utter contempt for those who profess to do so.

The American astronomer and atheist Harlow Shapley, although his cosmogonical theories were little more than speculative suggestions with little empirical content, at least was philosophically consistent when he said "Some people say 'In the beginning God', but I say 'in the beginning hydrogen'". He then went on to claim that beginning with hydrogen and known natural laws he could derive the universe.[2] Of course he could do no such thing; but with time and chance as his only agencies, at least his proposals were consistent with his philosophy.

If, on the other hand, it is a historical fact that in the beginning God created and therefore God is indeed the Creator of life as all Christians must believe, then the origin of life did involve His intervention. The process by which life originated was thus a supernatural process and cannot be accounted for by natural processes and natural laws now operating on planet Earth. Those of us who believe that God was the Creator of life are thus confident that an analysis of proved principles of chemical thermodynamics and kinetics, well-established physical laws, probability considerations, and related scientific principles, along with our present knowledge of the incredibly complex, dynamic, intricately coordinated, self-maintaining, self-replicating entity we call the living cell, will demonstrate beyond a reasonable doubt that it could not have arisen spontaneously over *any* length of time by naturalistic, mechanistic processes due to properties inherent in matter. My own studies of this problem have convinced me that indeed our present state of knowledge forces us to the conclusion that the origin of life by naturalistic processes can be dismissed with as much confidence as are schemes for the construction of perpetual motion machines.

The immensity of the problem is rarely appreciated by laymen, and is generally ignored by evolutionary scientists, themselves. The simplest form of life imaginable would require hundreds of different kinds of molecules, perhaps thousands, most of them large and very complex. With respect to this point, Van Rensselaer Potter states, "It is possible to hazard a guess that the number is not less than 1,000, but whether it is 3,000 or 10,000 or greater is anyone's guess."[3] This statement not only acknowledges the immensity of the problem, but also is a tacit admission of how little is really known or knowable about the problem.

In addition to these many molecules, which would include the large and complex protein, DNA and RNA molecules, each with up to several hundred subunits arranged in a precise sequence, the origin of life would re-

*Duane T. Gish, Ph.D., is Associate Director of the Institute for Creation Research, 2716 Madison Avenue, San Diego, California 92116.

quire many complex and dynamically functional structures, such as membranes, ribosomes, mitochondria (or energy-producing complexes of some kind), etc. Furthermore, life requires marvelous coordination in time and space, with many regulatory mechanisms. To believe that all of this came about by mere chemical and physical processes, does indeed constitute an immense exercise of faith.

In spite of the highly speculative nature of all origin-of-life theories, and the utter hopelessness of ever testing, let alone establishing, any comprehensive origin-of-life theory, a not insignificant proportion of our nation's scientific resources is being devoted to exploring these speculations. Much of the rationale for the design and objectives of our space program is related to this purpose.

Laboratory exercises and the speculations that have inspired them have resulted in a large number of publications and national and international symposia. The latter have generated a number of symposia proceedings. [4-8] Beginning with the pioneer but classic work of Oparin,[9] a number of books have been written on the origin of life, a few of which are listed.[10-15] Also available are a number of reviews[16-20] and critical and theoretical discussion.[21-23] Creation scientists, in addition to many articles published in the *Creation Research Society Quarterly* and elsewhere, have published a number of critical works.[24-26]

Although a mechanist may suggest a rationalistic scenario for the origin of life, one must realize that such scenarios cannot be accorded the status of scientific theories. There is much that we can say about how life could *not* have arisen on this planet, but we could never establish, scientifically, how life actually did arise. No theory on the origin of life can be subjected to the scientific method of observation and test. Thus Mora has said ". . . how life originated, I am afraid that, since Pasteur, this question is not within the scientific domain."[27] Bernal supported this contention of Mora when, in discussing a paper by Mora, he stated ". . . Dr. Mora has shown that the principles of experimental science do not apply to discussions on the origin of life, and indeed cannot apply in any problem of origin."[28]

Green and Goldberger also have pointed out that theories on the origin of life are not scientific theories at all. Thus they say ". . . macromolecule-to-cell transition is a jump of fantastic dimensions which lies beyond the range of testable hypothesis. In this area, all is conjecture. The available facts do not provide a basis for postulating that cells arose on this planet."[29]

It should be obvious that any concept that lies beyond the range of testable hypothesis cannot be accorded the status of a scientific theory. In fact, evolutionary theories on the origin of life are no more scientific than the concept of creation, even though they embrace a naturalistic, mechanistic viewpoint. The Santa Claus theory of Christmas is certainly more naturalistic and mechanistic than is the Christian view, but it is obviously not a scientific theory. As Green and Goldberger have stated, ideas by evolutionists on the origin of life are nothing more than conjectures. A Christian who therefore suggests that the origin of life can be accounted for by naturalistic mechanistic processes which can be incorporated into a "scientific" theory on the origin of life is embracing a proposal that is both theologically and scientifically incorrect.

On the contrary, objections to a mechanistic evolutionary origin of life are not based on conjectures but are based on proven scientific principles. I propose to show that, among others, there exist the following insuperable barriers to an evolutionary origin of life.:

1. The rate of destruction of even relatively simple organic chemical compounds by any available energy source would so greatly exceed their rate of formulation that no significant quantity of such compounds could have accumulated under any plausible primitive earth conditions.
2. The presence of a trap or traps, if any, to solve problem (1) would in itself be fatal to an evolutionary origin of life.
3. Compounds indispensable to an evolutionary origin of life would have been irreversibly removed under all plausible hypothetical primitive earth conditions.
4. The spontaneous formation of large polymers such as proteins, DNA, RNA, and carbohydrates, would have been prevented by thermodynamic barriers.
5. It is impossible for chemical and physical processes to give rise to other than randomly arranged sequences in protein, DNA, and RNA molecules, regardless of how much time one assumes was available on the earth. Thus the mechanistic, evolutionary origin of biologically active molecules which require a precise and specific arrangement of their sub-units, would have been impossible.
6. Life without enzymes is impossible, but enzymes without life is also impossible.
7. Even it if were assumed that the ocean was densely populated with all kinds of biologically active molecules, the spontaneous organization of such molecules into the amazingly complex, highly coordinated, stable systems required for life would have been impossible by natural processes.
8. All systems are inherently unstable, and thus no system can be perpetuated without reproduction. Only living things can reproduce, however.
9. Although results (1) and (4)-(8) may be derived without reference to the Second Law of Thermodynamics, these results would be predicted on the basis of the Second Law and the observations on which it is based. The operation of natural processes on which the Second Law of Thermodynamics is based is alone sufficient, therefore, to preclude the spontaneous evolutionary origin of the immense biological order required for the origin of life.

Primitive Earth Models

Hypotheses concerning conditions on earth during the time it is presumed life originated are of necessity exceedingly speculative. Extrapolations from the known into the unknown are always fraught with uncertainties, but when these extrapolations extend into the very distant past, uncertainties are magnified greatly. As a matter of fact, evolutionary uniformitarian geologists in some cases have reached diametrically opposed positions concerning past conditions on the earth.

With reference to the presumed primitive earth atmosphere, evolution-of-life chemists must abandon the usually tightly held uniformitarian principle that the present is the key to the past. Adherence to this principle would be fatal to all origin-of-life theories. Our present atmosphere, which consists of 78% nitrogen, 21% oxygen, and 1% of other gases, such as argon, water vapor, and carbon dioxide, is of course highly oxidizing. Some early origin-of-life theorists assumed that the primitive atmosphere was the same as the present atmosphere.

When it was pointed out, however, that it would be thermodynamically impossible for the types of organic chemical molecules found in living things to accumulate in the presence of an oxidizing atmosphere, the assumption was immediately made that the earth had had a reducing atmosphere during the early part of its history. In fact, it was a Russian biochemist, A. I. Oparin, one of the pioneers among origin-of-life theorists, who first proposed that the early earth's atmosphere was drastically different from the present day atmosphere. When he became aware that life could not have evolved in an oxidizing atmosphere, Oparin suggested a primitive earth atmosphere consisting primarily of methane (CH_4), ammonia (NH_3), nitrogen (N_2), hydrogen (H_2), and water vapor. Thus, the assumption of a primitive reducing atmosphere was based on the requirements of evolution theory, not on an objective analysis of geological and geochemical evidence.

In an oxidizing atmosphere, gases such as methane and ammonia, and other organic compounds would be rapidly oxidized to carbon dioxide (CO_2), nitrogen, water, and other oxidized compounds, rendering the formation of amino acids, sugars, purines, pyrimidines and other organic compounds impossible. Evolutionists are thus forced to assume that the atmosphere on the hypothetical primitive early earth differed greatly from the present day atmosphere.

Because the terrestrial abundances of the rare gases, neon, argon, krypton, and xenon are many orders of magnitude lower than cosmic abundances of these gases, it is generally assumed by evolutionary geologists that the residual atmosphere, if any, remaining after the earth formed, was lost to space. It is assumed that the primordial atmosphere was subsequently formed by outgassing,[30] and, as previously mentioned, was reducing.

Following Oparin, most origin-of-life chemists have assumed that the primordial atmosphere contained considerable quantities of methane and ammonia, in addition to other gases, and this type of gaseous mixture has been used in most origin-of-life experiments. Urey and Miller,[31] among others, have presented arguments supporting such an atmosphere, but their arguments contain so many assumptions they could have condensed their paper into one sentence: "We assume the primordial earth atmosphere consisted chiefly of methane, ammonia, nitrogen, hydrogen, and water vapor."

As a matter of fact, Abelson argues that there is not only no evidence that the earth ever had a methane-ammonia atmosphere, but that there is compelling evidence against it.[32] He suggests a reducing atmosphere in which carbon monoxide is the chief form of carbon, the remaining gases consisting chiefly of hydrogen, nitrogen, and water vapor. His model is also based on a series of assumptions. Abelson must assume, for example, that vast quantities of carbon monoxide and hydrogen were released into the early atmosphere by outgassing.

The evidence from present-day volcanoes, however, offers evidence against the idea that the earth could have acquired a reducing atmosphere by outgassing. Gases emanating from volcanoes and fumaroles today consist chiefly of water vapor (usually 90-99%) and carbon dioxide.[33] Methane and ammonia are rarely found, and then, only in trace quantities. Carbon monoxide, hydrogen, and hydrogen sulfide occur in only a fraction of volcanoes tested and then only in very small quantities.[33] In other words, gases given off by volcanoes and fumaroles today are in a highly oxidized state.

C. F. Davidson, a uniformitarian geologist, argues against a reducing atmosphere at any time during the earth's history, maintaining that there is no evidence that the earth ever had an atmosphere differing from that of today.[34] Brinkman[35] has pointed out what he believes are errors in the earlier calculations of Berkner and Marshall[30d,36] which limited net oxygen production by photolysis of atmospheric water to a small percentage of the present atmospheric content until relatively late in earth history. Brinkman maintains instead that this mechanism would have produced as much as 25% of the present atmospheric oxygen content very early in earth history, long before life is supposed to have evolved.

Brinkman's mechanism is supported by photographs, taken from the moon of the earth's geocorona, which show substantial amounts of hydrogen leaving the earth's atmosphere.[37] When water vapor is broken down into hydrogen and oxygen by photolysis, the hydrogen escapes into space, but oxygen is too heavy to escape the earth's gravitational field. The result is a net production of oxygen.

The preponderance of ferrous oxide (FeO), the partially reduced form of iron, over ferric oxide (Fe_2O_3) in certain Precambrian formations has been cited as evidence for a reducing atmosphere. However, as Walton has pointed out,[38] vast quantities of magnetite (Fe_3O_4) and hematite (Fe_2O_3) are present in Precambrian formations, and the formation of these minerals would require an immense quantity of oxygen. Furthermore, metamorphic processes often lead to partial reduction of iron; and minerals in a reduced or partially reduced state may have been transported hydrothermally from reducing conditions deep in the earth's crust. The oxidation state of such minerals, then, does not necessarily indicate the nature of the earth's atmosphere at the time of their deposition. Walton maintains that since all oxidation states of iron, from hematite to magnetite to siderite ($FeCO_3$) to pyrite (FeS_2), have been found in sediments of all presumed ages, the oxidation state of sediments depends primarily on local conditions that do not necessarily reflect the nature of the atmosphere at the time of deposition.

Walton contends that the evidence indicates that oxygen has always been an important constituent of the earth's atmosphere.

This discussion of the history of the earth's atmosphere has been necessarily brief. The review by Walton[33] is especially excellent and thorough and should be consulted for further information and as a source for other literature on the subject. If the studies of Davidson, Brinkman, and Walton are correct, the earth's atmosphere would have contained a relatively high percentage of oxygen very early in its history, absolutely precluding an evolutionary origin of life. There is thus good evidence that the conditions postulated as necessary for an evolutionary origin of life have never existed on the earth. Creationists assume, of course, that life, and an atmosphere similar to the present atmosphere, were created simultaneously.

It is postulated by evolutionary geologists that the oceans were generated by outgassing very early in the earth's history. Some models of the sun's evolution would have produced lower temperatures on the earth in the past. There is evidence, on the contrary, however, that, if anything, temperatures in the past have been warmer than today.[39] As will be seen later, temperatures for the ocean of near freezing or lower must be postulated for the survival over geologic time of the organic chemical compounds required for life.

The pH of the primitive ocean is assumed to have been about 8, very near the present pH. Energy would have been abundant, most of it provided by the sun, minor amounts being produced by electrical discharges, and even less from radioactive decay and thermal processes.

Production of Amino Acids, Sugars, Purines, Pyrimidines, and Other Relatively Simple Organic Compounds

The metabolism of even the simplest form of life imaginable would have required a wide variety of metabolites for its energy sources and other needs. Furthermore, vast quantities of amino acids, the building blocks or subunits or proteins; purines, and pyrimidines, constituents of DNA and RNA; and sugars, constituents of complex carbohydrates and of DNA and RNA, would have been required. Even if the dubious assumption is made that a primitive ocean system would have contained only 10% as much water as the present ocean, that would still amount to about 35 million cubic miles of water. Efficient methods of producing these compounds would have had to exist, then; since many billions of tons of each would have been required to give a significant concentration in such a vast body of water.

In 1953 Stanley Miller announced the first successful synthesis of amino acids and of a few other simple organic chemical compounds under assumed primitive earth conditions.[40] Miller circulated a mixture of methane, ammonia, hydrogen, and water vapor through an apparatus containing an electrical discharge chamber. Products of the reaction were collected in a cold trap. After circulating the gases for about a week, Miller analyzed the aqueous solution in the trap. He found that it contained glycine and alanine, the two simplest amino acids, plus small amounts of two other amino acids, glutamic acid and aspartic acid. In addition to these amino acids, which are constituents of proteins, several other nonprotein amino acids, as well as a number of amines and acids, were found.

Since Miller's experiment, other origin-of-life chemists have produced a variety of amino acids, sugars, purines, pyrimidines, and other compounds under a variety of conditions and using various gases.[7-14] Evolutionists have generally accepted these results uncritically, hailing them as providing sure evidence that naturalistic processes would have provided the prebiotic "soup" necessary for the origin of life. Kenyon and Steinman state, for example, "The experiments discussed in this chapter indicate that a rich variety of biologically important molecules could have been synthesized on the primitive Earth by simple means."[41]

The first thing that must be emphasized about these results is that while the production of these compounds is a vital necessity in any origin-of-life scheme, success at this stage is many orders of magnitude easier to achieve than success at the next stage, which would include arranging these subunits in the precise order required for biologically active proteins, DNA and RNA. Furthermore, bringing these large biologically active molecules together into a coordinated functional system required for a living cell is again many orders of magnitude more difficult and less likely. In other words, even if these results are accepted uncritically, they are trivial in view of the immensity of the overall problem.

Secondly, the success that was achieved in these experiments, limited as this actually may have been, was due to special conditions imposed by the research scientists, conditions that would not have existed on the primitive earth. In all origin-of-life experiments in which significant quantities of amino acids and other products have been produced, a trap or some means was used to isolate the product from the energy source used for the synthesis. In Miller's experiment,[40] for example, products produced in the sparking chamber were swept into a trap which isolated the non-volatile products. The gases continued to sweep through the sparking chamber, any minute quantity of non-volatile products formed being immediately trapped out and isolated so that they were no longer exposed to the energy source. Without this feature, no detectable quantity of product would ever have been produced.

Any energy source, in the above case the heat and radiant energy produced by the electrical discharge, is far more efficient in the destruction of the products than in their production, the quantum yield of destruction being many times the quantum yield in the synthetic step.[42,43] Furthermore, the amount of radiation available from the sun at the wave lengths at which these gases absorb (below 1500 angstroms), and thus available for synthesis, is less than one-thousandth of the light (up to 3500 angstroms) absorbed by the products, and thus available for destruction. The overall result is that destruction is 10,000 to 100,000 times more effective than production.

The time required for any products produced in the atmosphere to reach the ocean would have been several years.[43] During that time these products would be subject to the destructive effects of ultraviolet light, electrical discharges, and cosmic rays. There were no organic chemists on the primitive earth to trap out products of course. Practically none of the products therefore would reach the surface of the earth in significant quantity.

Even the ocean would provide no haven of safety, for rates of destruction there would far exceed the rates at which these compounds could have become involved in further synthesis.[42-44] With reference to rates of destruction in the ocean, Miller and Orgel state "The rates of depurination of DNA, of hydrolysis of peptide and polynucleotide polymers, and of decomposition of sugars, are so large that it seems impossible that such compounds could have accumulated in aqueous solution and have been used in the first organism, unless the temperature was low."[45] Later on, these same investigators state that because of the instability of organic compounds, there is a compelling argument that life could not have arisen in the ocean unless the temperature was below 25 °C. They state that a temperature of 0 °C would have helped greatly and that −21 ° would have been even better (at this temperature the ocean would have been frozen solid!).

Thus, even if these compounds could have survived transit from the atmosphere to the ocean, which is contraindicated by all available evidence, these prominent origin-of-life chemists assert that these compounds could not have survived there unless the temperature of the ocean was about 0 °C or lower. As has been indicated earlier, however, the evidence indicates that, if anything, temperatures have been warmer in the past. Furthermore, if the temperature were low enough to prevent the more facile destructive reactions, how could further reactions leading toward the origin of life have occurred? When origin-of-life theorists finally face up to the real facts, they are forced to make assumptions that are increasingly untenable.

The accumulation of significant quantities of even these simple organic chemical compounds seems definitely to be precluded, then, by the fact that their rates of destruction in the atmosphere and in the ocean would have far exceeded the rates at which they could have accumulated by synthesis. Hulett, in his excellent paper, after carefully and thoroughly considering all facets of the problem says, "It is in fact hard to reconcile the thermodynamic and kinetic characteristics of these compounds with the postulated pathways for chemical evolution and the primitive environment."[46] He still believes, nevertheless, that life must have evolved at least once, because life does, in fact, exist. His evolutionary philosophy thus requires him to accept what his science would lead him to reject.

Hull, in his research, calculates that vanishingly small quantities of these relatively simple chemical compounds could have accumulated in the primitive ocean. His calculations showed, for example, that the simplest amino acid, glycine, would have had a concentration as low as 10^{-24} molar, which is negligible, and that glucose, a six-carbon sugar, more complex than glycine and thus harder to form but more easily destroyed, would have had a concentration of 10^{-134} molar, which means that the chances of finding a single molecule in the entire ocean would have been essentially nil. Hull concluded that "The physical chemist, guided by the proved principles of chemical thermodynamics and kinetics, cannot offer any encouragement to the biochemist, who needs an ocean full of organic compounds to form even lifeless coacervates."[43]

Faced with the inescapable fact that the very energy sources required for the formation of organic compounds destroys these same compounds at rates many orders of magnitude greater than the rates of formation, origin-of-life chemists have suggested traps or some other means on the primitive earth for isolating the products from the energy sources. Isolation of products such as amino acids, purines, pyrimidines, sugars and other compounds from energy sources would be fatal to any supposed origin-of-life scheme, however.

Every step upward in the origin of life would be energetically unfavorable, requiring the input of energy. The formation of peptide bonds, for example, in the synthesis of proteins, requires about 3.0 kcal/mole/bond. The formation of nucleotides, the sub-units of RNA and DNA, requires energy for the formation of the phosphoric acid-sugar bond, and the sugar-purine and sugar pyrimidine bonds. The formation of the internucleotide bonds during the polymerization of the nucleotides to form RNA and DNA also requires energy. The formation of membranes and other cellular structures which contain covalent bonds would also require energy.

The process is somewhat analogous to driving a car uphill. See Figure 1, and the associated comments, later in this article. The car does not run uphill spontaneously, it must be driven uphill. Driving a car uphill requires the expenditure of energy (also required, of course, is an engine and someone to direct the course of the automobile). If the car runs out of gas, all progress ceases, and the car spontaneously runs back down to the bottom of the hill.

Ordinary thermal processes are not sufficiently energetic to supply the energy required to form organic compounds or to form the peptide and internucleotide bonds in proteins, RNA and DNA. Intense energy sources, such as radiant energy, would have been required.[47] Removal of products, once formed, from these energy sources would eliminate the energy required for the next step in the origin of life, but would leave these products to be steadily degraded by ordinary thermal and chemical processes. Origin-of-life theorists are thus caught between the horns of a dilemma. As rapidly as minute quantities of product are formed, these products must be trapped out and removed from the energy source to prevent their destruction, as was done in Miller's experiment. Once this is done, however, all progress ceases. No further synthesis is possible. If the products are not trapped out, on the other hand, degradation exceeds the rate of formation so greatly that no detectable quantity of product accumulates. There is thus no way out of the dilemma.

This well-established experimental fact, easily predicted on the basis of chemical thermodynamics and kinetics, is fatal to all origin-of-life schemes. Origin-of-life experiments utilizing equipment that results in isolation of products are nothing more than exercises in organic chemistry, without relevance to any plausible primitive earth conditions necessary for the generation of the billions of tons of each of many organic compounds required for the origin of life.

Even if very efficient methods for the formation of organic compounds were available on the primitive earth, the number of compounds into which each element would be distributed would in itself insure that no significant quantity of any one product could accumulate.

Consider nitrogen-containing compounds, for example. If all of the nitrogen in the present atmosphere were combined in a single compound (ammonia for example), and dissolved in the present ocean, the concentration would be only about 0.2 molar, the concentration usually used for reactants in origin-of-life experiments. It would be quite generous, however, to estimate that about 0.1% of this nitrogen would be in the form of organic compounds under the most favorable conditions imaginable, and assuming efficient methods of synthesis. Most would remain as gaseous nitrogen in the atmosphere, just as it is today. This immediately reduces the total concentration of nitrogen-containing compounds to about 0.0002 molar, hardly sufficient to enter into further reactions in the primordial ocean.

The concentration of any one particular nitrogen-containing compound, however, must necessarily have been far less than this. The available nitrogen must be split between hundreds, most likely, thousands of different nitrogen-containing compounds. For example, including, as we must, both the L- and D- forms of the amino acids now commonly found in proteins, the number of different amino acids would number 40, some of which have more than one nitrogen atom. If it is assumed, however, that amino acids were formed spontaneously by chemical processes on the earth, a number far exceeding those now found in proteins would have formed. In addition to the alpha amino acids found in proteins, beta, gamma, and delta amino acids could have formed. A variety of cyclic, sulfur-containing, hydroxylated, and branched-chain amino acids other than those found in present-day proteins are also possible. The number of possible amino acids, counting stereoisomers, would alone number in the hundreds.

One would also have to assume as well that a wide variety of purines, pyrimidines, ordinary amines, and other nitrogen-containing compounds would have formed. The number of possible nitrogen-containing compounds would easily range into the thousands. Assuming that the number of nitrogen-containing compounds that would have formed in significant quantity on the primordial earth would have numbered only about 1000, the concentration of any one single nitrogen-containing compound, even ignoring all arguments against the possibility of efficient methods of synthesis, would thus still amount to only about 2×10^{-7} molar. This concentration is several orders of magnitude less than any conceivable concentration necessary for the spontaneous origin of life. This factor alone renders the evolutionary, spontaneous origin of life inconceivable.

When all of the above factors are taken into account, even the most efficient concentrating mechanisms conceivable would not be effective enough to overcome the vast chasm between the minute concentrations potentially producible and the concentrations required for the origin of life. Furthermore, while discussing possible mechanisms for concentrating organic compounds on the primitive earth, origin-of-life chemists forget the fact that such mechanisms could at best produce only local and temporary concentrations. For example, if organic compounds were concentrated by evaporation of a lake, or by spray along the ocean shore, rain would soon descend to dilute and flush out the contents of the lake and to wash the products along the seashore back into the ocean. Such proposed mechanisms are thus futile suggestions.

There are yet other difficulties that would be fatal to origin-of-life theories. As Abelson has pointed out,[30a] at pH 8-9, within the pH range postulated for the hypothetical primitive ocean, amino acids react with sugars (or with any carbohydrate or other compound containing an aldehyde or keto group) resulting in the mutual destruction of each of these compounds. Since it is postulated that the supply of amino acids would exceed the supply of sugars, this reaction would totally eliminate all sugars. Since sugars are required for the formation of ATP, the compound utilized nearly universally in living things for the storage and exchange of energy, and sugars are required for the formation of RNA, DNA and carbohydrates, the origin of life in the absence of sugars would have been impossible.

Abelson further pointed out that all the phosphoric acid in the primitive ocean would have been precipitated out in the form of its insoluble calcium salt.[30a] The abundance of calcium far exceeds the quantity of phosphorus on the earth, assuring that precipitation of phosphate would have been complete. Since phosophoric acid is a constituent of ATP and of RNA, DNA, and other vital phosphorus-containing compounds, the origin of biological systems in the absence of phosphoric acid would have been impossible.

Significance of the Viking Probe on Mars

Evolutionists, in spite of these insuperable difficulties, refuse to abandon origin of life theories. In just the last few months, however, the Viking landings on Mars and subsequent experiments on that planetary surface have supplied the best conceivable test of origin-of-life theories. All laboratory experiments conducted here on earth have imposed on them man-made conditions and controls. The surface of Mars, on the other hand, provides a completely natural setting, free from the manipulations of a human experimenter with his biases. Here is a natural planetary surface, endowed with an atmosphere containing the elements of carbon, nitrogen, hydrogen, and oxygen in free or combined form. Radiant energy from the sun is abundantly available. According to origin-of-life theories, we must expect to find, at the very least, organic chemical compounds in Martian soil.

In fact, origin-of-life theorists and "exobiologists", of whom Carl Sagan and Cyril Ponnamperuna have been among the most vocal, were very hopeful of finding some form of life on Mars, and were certainly confident of finding organic chemical compounds on that planet. These expectations met with total disappointment, however. Not only was there no life on Mars, the Martian soil was found to be totally devoid of any detectable organic material.[48]

The results on Mars have provided a definitive test of origin-of-life theories. No speculations are involved, no theories to be argued for and against, no man-made conditions or human biases were imposed. Mars provided a totally natural test of origin of life theories. The result was total failure of the theories.

The Formation of Biologically Active Macromolecules, Such as Protein, DNA, and RNA

The origin of significant quantities of the large, complex macromolecules—proteins, DNA, RNA, and complex carbohydrates is a problem that dwarfs all earlier problems, as impossible as their solution may seem. Huge quantities, billions of tons, of each of these molecules that eventually became involved in living systems, would have had to have been produced. These molecules generally have from more than one hundred to several hundred subunits arranged in precise sequence in the case of proteins, and up to several thousand precisely ordered subunits in the case of DNA and RNA. These large molecules are long chains, with the subunits constituting the links in the chain. The subunits, or links, in proteins consist of amino acids. Of the hundreds of amino acids that are chemically possible, only 20 are found in proteins. The subunits of DNA, which make up the genetic material or genes, and of RNA, material used by the cell to translate the genetic messages contained in the genes into the specific structure of proteins and other structures found in living things, consist of four different kinds of nucleotides, units which include a sugar, phosphoric acid, and one of four purines or pyrimidines.

Thermodynamic Barrier to Polymerization

The first problem involved in the origin of these large complex molecules is the fact that there is a thermodynamic barrier to their spontaneous synthesis by chemical and physical processes. As previously mentioned, the formation of the chemical bonds between amino acids to form proteins; or between sugars, phosphoric acid, and the purines and pyrimidines to form nucleotides; and between the nucleotides to form DNA and RNA, requires an input of energy. Rupture of these bonds, on the other hand, releases energy. What happens naturally and spontaneously, therefore, is not the formation of these compounds, but their destruction.

Only what could have happened naturally and spontaneously would have happened on the primordial earth. Proteins and DNA and RNA do not form naturally and spontaneously, but if they do exist, they spontaneously disintegrate. How then could they ever have formed on the hypothetical primitive earth by natural processes? What mechanism or machinery could have existed on the primordial earth to force the synthesis of these molecules, to force chemical processes to run uphill against all the natural forces that would tend to make them run downhill? On the face of it, this problem defies explanation. Although a variety of attempts have been made to solve the problem, no plausible explanation has yet appeared.

Fox's Thermal Model

The suggestion that has gained more attention than all others is the idea of Sidney Fox. Fox has published papers on various aspects of his thermal theory in numerous scientific journals and in many books, a few of which are listed in the bibliography of this paper.[4,14,49-51] An outline of Fox's theory can be found in practically every modern high school and college text on biology, evolution, and related subjects. Recently a review volume was published in honor of his 60th birthday.[52] And yet if anything in science is certain, it can be said that however life arose on this planet, it did not arise according to the scheme suggested by Fox. One could not be judged to be too unkind or critical if he were to label Fox's suggestion as pseudoscience.

Fox uses intense heat as the driving mechanism in his model. In the laboratory demonstration of Fox's origin of life scheme, a particular mixture of pure, dry amino acids are heated at about 175 °C (water boils at 100 °C) for a limited time (usually about six hours). Intense heating is then ceased, and the product is stirred with hot water, and insoluble material is removed by filtration. When the aqueous solution cools, a product precipitates in the form of microscopic globules, which Fox calls proteinoid microspheres. Analysis of this material shows that it consists of polymers, or chains, of amino acids, although of shorter lengths than are usually found in proteins. Some of these globules resemble coccoid bacteria, and others bulge and superficially appear to be budding similar to certain microorganisms. Fox claims that his proteinoid microspheres constitute protocells (that is, they are almost, but not quite, true cells), and were a vital link between the primordial chemical environment and true living cells. He claims that the amino acids in these polymers are not randomly arranged as would be expected, but that a few highly homogeneous (having identical chemical structure) protein-like molecules are obtained with their amino acids arranged in a precisely ordered sequence. He further claims that these compounds possess detectable catalytic or enzyme-like properties. Finally, Fox claims that these microspheres multiply by division somewhat in the manner of true cells.

When asked where on the primordial earth a locale could be found where amino acids might have been heated at about 175 °C, Fox suggests that such a locale would have been found on the edges of volcanoes. When it was pointed out that heating at that high a temperature (not much reaction occurs at temperatures much below 175 °C) would cause complete destruction of the products if heating continues much beyond six hours, Fox suggests that rain might occur just at the right time to wash away the products.

Fox's scheme would require such a unique series of events and conditions, the probability of which would be so vanishingly small that it could be equated to zero. These are the following:

1. Heating at a high temperature for a limited amount of time.

Fox's suggestion that the combination of the edges of volcanoes with rain at just the right time would suffice to produce billions of tons of these polymers has been severely criticized even by numerous evolutionists.[53] Miller and Orgel point out that when lava solidifies, the surface of the lava is hardly warmer than air temperature. In discussing this feature of Fox's model they say, "Another way of examining this problem is by asking whether there are places on the earth today with appropriate temperatures where we could drop, say, 10 grams of a mixture of amino acids, and obtain a significant yield of polypeptides . . . We cannot think of a single such place."[54] Even if there were such places, they would be so limited in extent, and the timing of the rain would be so restrictive (not much less nor much more than six hours from the time heating begins), that the rate of production would be very much less than the rate of destruction by hydrolysis and other degradative reactions once the products were washed into the ocean or other bodies of water.

2. Fox's reaction mixture consists solely (as far as organic material is concerned) of pure amino acids.

Where on earth could a mixture of pure amino acids be found? Only in the laboratory of a twentieth-century scientists! According to the chemical evolutionary scheme to which Fox and every other origin of life theorist subscribes, however, a great variety of organic chemical compounds, numbering in the thousands and most likely many tens of thousands, would have been produced on the primordial earth. The probability of a mixture of pure amino acids accumulating anywhere, assuming that they were being produced, would be absolute zero. Any amino acids produced would be admixed with sugars, aldehydes, ketones, carboxylic acids, amines, purines, pyrimidines, and other organic chemicals. Heating amino acids at almost any temperature with a mixture of such chemicals would be certain to result in complete destruction of the amino acids. Beyond question, no polypeptides or proteinoids would be produced. This factor alone completely eliminates Fox's scheme from any rational discussion.

3. A totally improbable ratio of amino acids is required.

If random proportions of amino acids are heated, no product is obtained. A very high proportion of one of the acidic amino acids, aspartic and glutamic acids, or of the basic amino acid, lysine, is required. Generally, about one part of one of the acidic amino acids, or one part of lysine, a basic amino acid, is heated with two parts of all the remaining amino acids combined. Under no naturally occurring conditions would any such ratio of amino acids ever exist. In all origin-of-life laboratory experiments, the amino acids produced in highest ratios are glycine and alanine, the simplest in structure and therefore the most stable of all the amino acids. Aspartic and glutamic acids are generally produced, but in small proportions. Detectable quantities of lysine are rarely, if ever, produced. Again, Fox's scheme is completely out of touch with reality.

4. Serine and threonine are mainly destroyed.

Two of the most commonly occurring amino acids in proteins consist of serine and threonine. Yet they undergo severe destruction during the heating process required in Fox's scheme. The resultant product thus contains only minor amounts of serine and threonine in contrast to naturally occurring proteins.

5. The claim that the products consist of a few relatively homogeneous polypeptides ("proteinoids") with amino acids arranged in a highly ordered sequence is patently absurd.

If a monkey were allowed to type away on a typewriter, the sequence in the string of letters produced on the paper would be completely random. The result would be nonsense. So it is with polymers produced from amino acids, nucleotides, or sugars according to ordinary chemical and physical processes. Chemistry and physics, just like monkeys, are dumb things, and have no ability to arrange subunits in any particular order. Probability considerations based on relative reactivities of functional groups and activation energies *require* the production of random structures or sequences in any polymerizations involving mixtures of amino acids, nucleotides, or sugars. It has been demonstrated that, in fact, polymerization of sugars[55] and of nucleotides[56] leads to random sequences.

Fox's claim that his product consists of relatively large quantities of a few polypeptides (polymers of amino acids are called polypeptides when the chains are shorter than proteins), each with the amino acids arranged in a highly specific sequence, rather than an enormous number of polypeptides with random structures, is based upon entirely inadequate separation techniques and analyses. There is no valid evidence whatever to show whether or not the amino acids in Fox's products are ordered. In fact, some of his fellow origin of life theorists accuse Fox of deception in this respect. Thus, Miller and Orgel, concerning Fox's claim that his product consists of nonrandom polypeptides, say "Thus the degree of nonrandomness in thermal polypeptides so far demonstrated is minute compared with the non-randomness in proteins. It is deceptive, then, to suggest that thermal polypeptides are similar to proteins in their nonrandomness."[57]

Beyond the above considerations, there is additional compelling evidence that Fox's product must consist of random structures. The high temperature required for the reaction nearly completely racemizes the amino acids. All but one of the amino acids found in proteins (glycine is the exception) may exist in at least two forms, forms in which the arrangement in space of the atoms differ. These forms are designated as the D- and L-forms (sometimes called "right-" and "left-handed"). They bear the same relationship to each other that a right hand bears to a left hand; each is a mirror-image of the other but not superimposable. Chemically and physically they exhibit identical properties except that solutions of the two forms rotate plane-polarized light in opposite directions. Biologically the difference is enormous, however. All naturally occurring proteins contain exclusively the L- or "left-handed" form. The replacement of a single amino acid in a protein with its D-form completely destroys all biological activity.

Racemization is the process which converts D-amino acids to a mixture of the D- and L-forms, or L-amino acids to a mixture of the D- and L-forms. When an amino acid is completely racemized it consists of equal quantities of the D- and L-forms. All amino acids tend to racemize under natural conditions, the rate of racemization depending on the particular amino acid and environmental conditions. The brutal treatment of heating amino acids several hours at 175 °C, as mentioned above, extensively racemizes the amino acids, changing the amino acids from L-forms to a mixture of L- and D-forms.

Since the D- and L- forms of amino acids have identical chemical properties, the probability of the D-form being incorporated at any point in the chain is equal to the probability of the incorporation of the L-form. There would be no way then, chemically, of specifying which form would be incorporated at any particular point. The sequence of the first two amino acids in the chain might thus be L-L, D-D, D-L, or L-D. Each would have equal probability. The sequence of the first three amino acids, whatever the particular amino acids, might be L-L-L, L-L-D, L-D-L, L-D-D, D-D-D, D-D-L, D-L-D, or D-L-L. Thus, it can be seen that even if the sequence of the first three amino acids were the same (such as, for example, arginine-valine-threonine), eight different structures can be obtained, differences which would exert enormous influence biologically. In fact, based on known biochemistry, only the L-L-L form could have had any potential significance.

It is thus impossible for Fox's product to consist of specific structures. A particular sequence of ten amino acids but consisting of mixtures of the D- and L- forms would yield a thousand different structures (2^{10}) and a particular sequence of 100 amino acids existing in D-and L- forms would yield 10 billion times 10 billion times 10 billion different structures (2^{100}, or approximately 10^{30}). It is apparent that Fox's claim for a high degree of homogeneity, or non-randomness, in his product is indeed absurd.

6. Catalytic, or enzymic, properties claimed for the product are barely detectable and unrelated to present enzymes.

The catalytic properties of enzymes found in present-day organisms are due to the precise sequence of the L-amino acids in these proteins. Fox's product consists of random sequences of these amino acids (in their D-and L-forms). Any enhancement of the catalytic activity of the free amino acids themselves by this polymerization would be no more than that conveyed by the incorporation of these amino acids into random polymers or nonspecific chemical structures. Furthermore, these polymers consist of mixtures of D- and L-amino acids. As mentioned earlier, the substitution of only one L-amino acid by its D-form in an enzyme (which may consist of several hundred amino acids) completely demolishes, for all practical purposes, its biological, that is, its catalytic, ability (residual activity, if any, is reduced below a detectable quantity). Further discussion of this point may be found in my monograph on the origin of life.[25] It is probable that if Fox had swept up the dust on the floor of the university administration building and thrown it into his test mixture, it would have had as much activity as his proteinoid.

7. The proteinoid microspheres are unstable and are easily destroyed.

Fox claims a rather high degree of stability for his proteinoid microspheres, yet he, himself, reveals that microspheres contained in aqueous suspension between microscope slides can be easily redissolved by merely warming the slides.[58] Stable, indeed! Furthermore, dilution of an aqueous suspension by adding water also dissolves the microspheres.

8. Division of the microspheres is due to simple physicochemical phenomena and has no relation to cell division by living organisms.

Cell division in even the simplest organisms requires an incredibly complex process and machinery, involving duplication of each unit of the cell with extremely high fidelity. On the other hand, the division reported for Fox's microspheres is a simple physicochemical phenomenon, like the separation of a soap bubble into two bubbles. It has no greater significance. As material precipitates from solution in the form of globules, and as the quantity that has collected in any particular globule exceeds a certain amount, physicochemical forces may cause the globule to split into two globules. No reproduction, no replication of any kind, however, takes place. The material in the first globule would be randomly distributed between the two product globules.

This discussion of the Fox scheme for the origin of life, even though incomplete, has been relatively extensive. This is believed desirable, however, because of the tremendous promotion (and naive acceptance) of Fox's theories in high school and college texts and in scientific circles as well. Fox's success confirms the bias and unscientific attitudes that dominate the educational and scientific establishments in relation to the question of origins. Anything that incorporates evolutionary philosophy is acceptable, no matter how unscientific.

Other Models

Other suggestions have been offered (good but concise reviews of these may be found in the paper by Horowitz and Hubbard[59a] and the book by Miller and Orgel[59b]). Those that involve reactions in aqueous solution (and thus in the oceans, lakes, and all other aqueous environments) can be effectively eliminated because the high energy reagents required to provide the energy to form the chemical bonds between the amino acids, nucleotides, etc., would be rapidly destroyed by water. These reagents are effective in laboratory syntheses because the reagents are prepared in non-aqueous solvents under anhydrous conditions, and the reactions in which these reagents are used are generally carried out under similar conditions. There is no possibility that these reagents could form on the primitive earth, however.

Other suggestions, utilizing elevated temperatures in a dry environment, in addition to the suggestion of Fox, have been offered.[60] Orgel and his collaborators have published a series of papers, for example, on the thermal synthesis in a dry environment of nucleotides and of polymers of nucleotides. Orgel, himself, however admits that these experiments have no relevance to the origin of life. After discussing the possibilities of such reactions occurring under primitive earth conditions, Miller and Orgel state, "However, we doubt that very extensive polymerization of nucleotides could have occurred in this way, or that *'biological' polymerization could have taken place except in an aqueous environment.*"[61]

Miller and Orgel have thus stated their conviction that polymerizations that gave rise to proteins, DNA, RNA, and other biological molecules ("'biological' polymerizations") must have occurred in an aqueous environment. But as stated above, this would have been impossible because the high energy compounds needed to drive these polymerization reactions could not have formed or existed in an aqueous environment.

In the concluding paragraph to their chapter on polymerizations, Miller and Orgel state, "This chapter has probably been confusing to the reader. We believe this is because of the very limited progress that has been made in the study of prebiotic condensation reactions."[62] This lack of success has resulted from the extreme difficulties in attempting to imagine how such processes could have occurred under natural conditions. Some might suppose, on the other hand, that limited progress has been made mainly because comparatively little research has yet been done on the origin of life. In that limited amount of research, however, enough work has been done to test all principles involved. Further work will not alter the principles of thermodynamics, chemical kinetics, or other basic principles involved. These stand as barriers to a naturalistic origin of biologically active molecules.

Theories on the Origin of Biological Order

The problem of overcoming the thermodynamic barrier in the polymerization of amino acids and nucleotides, as insoluable as this appears to be, is dwarfed by a vastly greater problem—the origin of the highly ordered, highly specific sequences in proteins, DNA, and RNA which endow these molecules with their marvelous biological activities. Proteins generally have from about a hundred up to several hundred amino acids arranged in a precise order or sequence. Twenty different kinds of amino acids are found in proteins, so it may be said that the protein "language" has twenty letters. Just as the letters of the alphabet must be arranged in a precise sequence to write this sentence, or any sentence, so the amino acids must be arranged in a precise sequence for a protein to posssess biological activity.

Human growth hormone has 188 amino acids arranged in a unique and precise sequence. Ribonuclease, an enzyme that catalyzes the hydrolysis of ribonucleic acids (RNA), has 124 amino acids arranged in its own unique sequence. Bovine glutamate dehydrogenase, another enzyme, has six identical chains of 506 amino acids each. The alpha chain of human hemoglobin, the red blood protein, has 141 amino acids, and the beta chain has 146 amino acids. Hemoglobin is a complex which includes four protein molecules, two each of the alpha and beta proteins, plus iron, plus a complex chemical called heme.

The particular amino acid sequence of each of these protein molecules is responsible for their unique biological activity. Furthermore, a change of a single amino acid generally destroys or severely diminishes this activity. For example, some individuals inherit a defective gene which causes the amino acid valine to be substituted for glutamic acid at position 6 in the beta chain of their hemoglobin. The other 286 amino acids (the remaining 145 in the beta chain and the 141 in the alpha chain) remain unchanged—only one out of 287 amino acids is affected. The defect, however, causes sickle cell anemia, a disease that is invariably fatal.

The genetic information is encoded in the genes, which are composed of DNA, via the specific sequence of the nucleotides. There are four different nucleotides, but each "letter" of the genetic "language" consists of a set of three of the nucleotides. Sixty-four such sets (4^3) can be derived from these four nucleotides, and thus the genetic "language" has an alphabet of 64 "letters." Genes generally have from a hundred or so of these sets up to several thousand of the sets. This would require the precise ordering of three times that many nucleotides, since there are three in each set. The various kinds of RNA would have equal complexity.

As mentioned earlier in the discussion of Fox's scheme, when amino acids and nucleotides are combined, or polymerized, by chemical methods, the amino acids in polypeptides (proteins) and the nucleotides in polynucleotides (DNA and RNA) so derived are arranged in disordered, or random sequences, just as a string of letters typed by a monkey would be randomly arranged. For biologically active molecules to have arisen on the earth by naturalistic processes, there would have had to be some machinery or mechanism in existence to cause ordering of the subunits in a precise or nearly precise fashion.

The ordering mechanism would have had to be highly efficient, since the precise structures required for biological activity impose the severest restraints on the structures of these molecules, just as writing this sequence correctly allows one way and one way only, for the letters composing it to be arranged. No such ordering mechanism has yet been suggested, nor could any exist under natural conditions. Once ordered sequences, such as enzymes, DNA and RNA, as well as complex energy-coupling and energy-generating systems existed, one might imagine how these ordered sequences could have been duplicated, but that would never explain the origin of these ordered sequences in the first place.

Some have imagined that random processes, given the four or five billion years postulated by evolutionists for the age of the earth, could have generated certain ordered sequences by pure chance. The time required for a single protein molecule to arise by pure chance, however, would exceed billions of times five billion years, the assumed age of the earth.

For example, only seventeen different amino acids (one of each) can be arranged in over 355 trillion (17 factorial) different ways. Put another way, 17 people could line up over 355 trillion different ways (if you don't believe it, get 16 friends together and try it!) Furthermore, if one were to arrange a sequence of 17 amino acids, and could choose from 20 (the number of different amino acids found in proteins) instead of 17, and were allowed to repeat amino acids (as would have been the case in the origin of proteins), about ten sextillion sequences could be obtained (20^{17}, or 10^{22})!

Immense as these numbers are, it could be argued that their origin even by completely random processes would have a finite probability in five billion years. But 17 is far too short for biological activity. Proteins, DNA, and RNA usually contain hundreds of subunits. A sequence of 100 might be more realistic. One hundred amino acids of 20 different kinds could be arranged in 20^{100} or 10^{130} different ways. What would be the probability of one unique sequence of 100 amino acids, composed of 20 different amino acids, arising by chance in five billion years?

Let it be illustrated in the following fashion. The number of different ways the letters in a sentence containing 100 letters of 20 different kinds could be arranged would be equal to the number of different protein molecules just mentioned (10^{130}). A monkey typing 100 letters every second for five billion years would not have the remotest chance of typing a particular sentence of 100 letters, even once, without spelling errors.

In fact, if one billion (10^9) planets the size of the earth were covered eyeball-to-eyeball and elbow-to-elbow with monkeys, and each monkey was seated at a typewriter (requiring about 10 square feet for each monkey, of the approximately 10^{16} square feet available on each of the 10^9 planets), and each monkey typed a string of 100 letters every second for five billion years (about 10^{17} seconds) the chances are overwhelming that not one of these monkeys would have typed the sentence correctly! Only 10^{41} trials could be made by all these monkeys in that five billion years ($10^9 \times 10^{16} \times 10^{17} \div 10 = 10^{41}$). There would not be the slightest chance that a single one of the 10^{24} monkeys (a trillion trillion monkeys) would have typed a preselected sentence of 100 letters (such as "The subject of this origins article is the naturalistic origin of life on the earth under assumed primordial condition") without a spelling error, even once.

The number of trials possible (10^{41}) is such a minute fraction of the total number of possibilities (10^{130}), that the probability that one of the monkeys would have typed the correct sentence is for all practical purposes nil. The degree of difference between these two numbers is enormous, and may be illustrated by the fact that 10^{41} times a trillion (10^{12}) is still only 10^{53}, and 10^{53} times a trillion is only 10^{65}, and 10^{65} times a trillion is only 10^{77}, etc. In fact, 10^{41} would have to be multiplied by a trillion more than seven times to equal 10^{130}. Even after 10^{41} trials had been made there would still be much, much more than 10^{129} arrangements that hadn't yet been tried (10^{41} is such an insignificantly small number compared to 10^{130} that $10^{130} - 10^{41}$ is about equal to 10^{130} minus zero!).

Considering an enzyme, then, of 100 amino acids, there would be no possibility whatever that a single molecule could ever have arisen by pure chance on the earth in five billion years. But if by some miracle it did happen once, only a single molecule would have been produced, yet billions of tons of each of many different protein, DNA, and RNA molecules would have to be produced. The probability of this happening, of course, is absolutely nil. It must be concluded, therefore, that a naturalistic origin of the many biologically active molecules required for the most primitive organism imaginable would have been impossible.

Origin of Stable, Complex, Biologically Active Systems

The problem of explaining the manner in which the above macromolecules became associated into systems that would have had even the most rudimentary ability to function as metabolically active systems capable of assuring their own maintenance, reproduction, and diversification is tremendously more complex and difficult than any attempts to explain the origin of the macromolecules themselves. As noted earlier, Green and Goldberger have stated, ". . . the macromolecule-to-cell transition is a jump of fantastic dimensions, which lies beyond the range of testable hypothesis. In this area all is conjecture. The available facts do not provide a basis for postulating that cells arose on this planet."[29] Kerkut, in his little book exposing the fallacies and weaknesses in the evidence usually used to support evolution (although he, himself, is not a creationist) said, "It is therefore a matter of faith on the part of the biologist that biogenesis did occur and he can choose whatever method of biogenesis happens to suit him personally; the evidence for what did happen is not available."[63]

Nevertheless, there are those who persist in attempts to provide a rational explanation for bridging the vast chasm separating a loose mixture of molecules and a living system. The extent of this chasm is enormous when we view the two extremes—an ocean containing a random mixture of macromolecules (proteins, nucleic acids, carbohydrates) and other molecules essential for life, in contrast to an isolated, highly complex, intricately integrated, enormously efficient, self-maintaining and self-replicating system represented by the simplest living thing.

Assuming that there was, at one time, an ocean full of these marvelous macromolecules that somehow had become endowed with at least some measure of "biological" activity, one must explain, first of all, how these macromolecules disassociated themselves from this dilute milieu and became integrated into some crude, but functional and stable system.

We can say immediately that under no naturally occurring conditions could complex systems spontaneously arise from a random mixture of macromolecules. There is absolutely no tendency for disordered systems to spontaneously self-organize themselves into more ordered states. On the contrary, all systems naturally tend to become less and less orderly. The more probable state of matter is always a random state. Evolution of life theories thus contradict natural laws. Nevertheless, evolutionists persist in speculating that life arose spontaneously.

Oparin's Coacervate Theory

Because of limitation of space, only one theory, that of A. I. Oparin, the Russian biochemist and pioneer in origin of life theories, will be discussed. Most of the basic objections to his theory are applicable to Fox's microspheres and all similar suggestions. Oparin has proposed that coacervates may have been the intermediates between loose molecules and living systems (a review of Oparin's proposals may be found in Kenyon and Steinman).[64] Coacervates are colloidal particles which form when macromolecules associate with one another and precipitate out of solution in the form of tiny droplets. Complex coacervates are those that form between two different types of macromolecules. For instance, such a coacervate will form between a histone, which is a basic protein, and a nucleic acid, which is acidic. Another example is the coacervate that will form from a complex of gelatin (basic, and thus positively charged) and negatively charged gum arabic.

Oparin, and others, have claimed that complex coacervates possess properties that may have enabled them to form protocells. It was shown that certain coacervates absorbed enzymes from the surrounding medium and that these enzymes were able to function inside the coacervate.[65,66] It should be understood, however, that the association of macromolecules to form coacervates, and the absorption of molecules from the surrounding medium, is due to simple chemical and physical phenomena, and is thus not selective, self-organizing or stable. Basic histones and nucleic acids form coacervates simply because one is basic, thus positively charged, and one is acidic, and thus negatively charged. There is a simple electrostatic attraction between the two. Basic histones, of course, would attract *any* acidic, or negatively charged, particles, and nucleic acids would attract *any* basic, or positively charged, particles. This attraction would not be selective, and if a chaotic mixture prevailed in the medium, the coacervates would be a chaotic mixture.

Enzyme activity is only useful when it is coordinated with other enzyme activities. We have already given reasons why it would have been impossible for any one particular macromolecule, such as a protein enzyme, to have been formed in any significant amount. But suppose that it did just happen that a few enzyme molecules were absorbed into a coacervate. The action of this enzyme would have been meaningless and useless unless some other enzyme was also present which produced the substrate for the first enzyme, and unless there was another enzyme that could utilize its product. In other words, it would be useless for a coacervate to convert glucose-1-phosphate into glucose-6-phosphate unless it also possessed a source of glucose-1-phosphate and unless it could further utilize the glucose-6-phosphate once it was produced. A factory that has no source of raw materials, or which has no market for its product must shut down in a short time. Living systems are extremely complex, having hundreds of series of metabolic pathways perfectly coordinated and controlled. Substrates are passed along these pathways as each enzyme performs its highly specialized chemical task, and coordination in space and time is such that each enzyme is provided with a controlled amount of substrate, and the successive enzyme is there to receive the substrate and in turn to perform its task. Each chemical task performed is useful and purposeful because it is coordinated in a marvelous way with all the other activities of the cell.

Without this coordination, enzyme activity would not only be useless, it would be destructive. Let us assume, for example, that a proteolytic enzyme (this is an enzyme which catalyzes the hydrolysis, or breakdown, of proteins) somehow did arise in the "primordial soup" and this enzyme was absorbed into a coacervate or one of Fox's proteinoid microspheres. The results would be totally disastrous, for the enzyme would "chew up" all the protein in sight, and that would be the end of the coacervate or microsphere! Similarly, a deaminase would indiscriminately deaminate all amines, a decarboxylase would decarboxylate all carboxylic acids, a DNAse would break down all DNA, and an RNAse would break down all RNA. Uncontrolled, uncoordinated enzymatic activity would be totally destructive.

Such control and coordination in a coacervate, microsphere, or other hypothetical system, would have been nonexistent. The complex metabolic pathways and control systems found in living things owe their existence to the highly complex structures found only within living things, such as chloroplasts, mitochondria, Golgi bodies, microsomes, and other structures found within the cell. Some of these are enclosed within membranes, and the cell, itself, is of course, enclosed with a very complex, dynamically functioning multilayered membrane. Control and coordination, absolutely essential to any living thing or to any metabolically active system, could only exist through the agency of complex structures similar to those mentioned above, but they, in turn, can only be produced by complex, metabolically active systems. One could not arise or exist in the absence of the other.

We can thus see that without enzymes life is impossible, but without the control of enzymatic activity that exists only in a living cell, enzymes are useless and destructive. Enzymes are nothing more than catalysts. They have no ability whatsoever of making chemical reactions go in a direction they would not otherwise go. Enzymes, as catalysts, merely speed up the rate of chemical reactions that would nevertheless occur in the absence of enzymes, but at a much slower rate. See Figure 1, and the comments in its caption.

As Morowitz has pointed out,[47] intense energy sources, such as ultraviolet light or high energy chemical compounds such as ATP, are needed to promote synthesis, such as the formation of amino acids, or the formation of DNA or RNA from nucleotides. Thermal processes, however, are sufficient to degrade these and other biological compounds, since degradation, in contrast to synthesis, is an exothermic reaction involving the release of energy.

One might wonder why, if the breakdown of chemical compounds such as amino acids, sugars, proteins, DNA, etc., is an exothermic reaction in which energy is released, these compounds have any stability at all. Why don't they break down as fast as they form? An examination of the energy relationships involved during synthesis and degradation reveals the answer, and further emphasizes why the origin of enzymes before the origin of life would have been impossible. Consider again Figure 1.

Let us assume that the energy content of compound A is E_1, that of compound B is E_2, and that of compound C is E_3. Compound B is more complex than A, and can be degraded to A, and C is more complex than B, and can be degraded to B.

To convert compound A to B requires an input of energy equal to $E_2 - E_1$, plus an amount of energy, called the activation energy, equal to $E_2' - E_2$ (see Fig. 1). The conversion of B to C requires an amount of energy equal to the difference of the energy content $E_3 - E_2$, plus the activation energy, $E_3' - E_3$. The large increments of energy required to form compounds B and C are due mainly to the higher energy contents of B compared to A and of C compared to B.

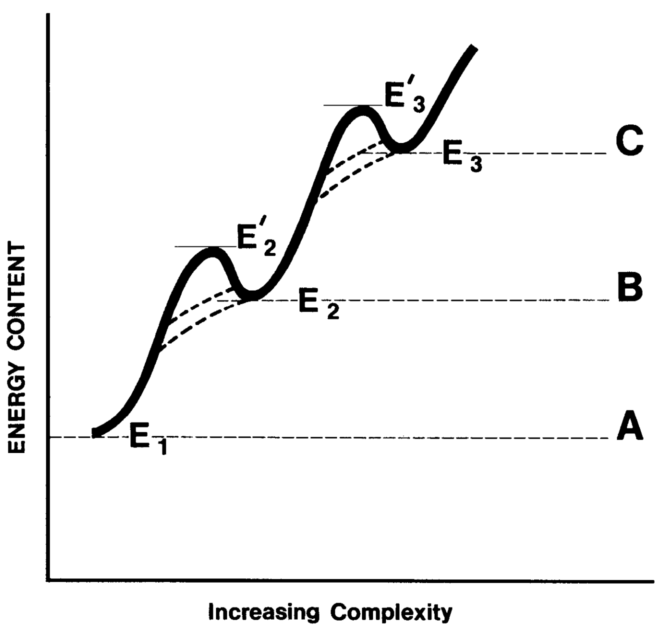

Figure 1. Energy content as a function of increasing complexity of organic chemical molecules.

If this graph were thought of as a path, it is plain that tunnels, as hinted by the broken lines, through the peaks E'_2 and E'_3, would make it much easier to go down hill, but would not help much in going up.

The chemical action of a catalyst is something like the provision of such tunnels. And likewise, as mentioned in the text, it would help the process toward less complexity greatly, but would not make it much easier to go in the direction of greater complexity.

To degrade C to B requires an amount of energy equal only to the activation energy, $E_3' - E_3$, and the degradation of B to A requires an amount of energy equal only to the activation energy, $E_2' - E_2$. While these energy requirements are obviously much less than those required for the formation of these compounds, they are nevertheless significant. As a result, compounds B and C exhibit some stability, although they are less stable than their precursors.

How do enzymes (or any other catalysts) speed up chemical reactions? Catalysts act by eliminating or greatly reducing the activation energy that is ordinarily required in a chemical reaction. It can easily be seen, then, that in the presence of the specific enzymes that catalyze the conversion of compound C to compound B and of compound B to compound A, the degradation of C to B and of B to A will proceed rapidly and spontaneously since the vastly reduced activation energies, if any remains at all, are readily supplied thermally, even at room temperature or lower, and energy is liberated as chemical bonds are broken. As shown in Figure 1, it is like tunneling through a peak, in a downhill direction.

The synthesis of B from A and of C from B, even in the presence of enzymes, is another matter, however. The appropriate enzymes greatly reduce the amount of activation energy required, but they cannot reduce the differences in energy contents, $E_2 - E_1$, and $E_3 - E_2$, in going from compounds A to B and B to C, respectively. These energy differences are generally fairly large and thus require, as stated earlier, a high energy source. On the other hand, in the presence of the appropriate enzymes, degradation proceeds rapidly and spontaneously. Likewise, in Figure 1, the tunnels would not help much in going uphill.

Let us consider the synthesis and degradation, or hydrolysis, of proteins as an example. As seen earlier, the formation of a protein requires the linking together of amino acids. The chemical bond between amino acids, called a peptide bond, requires about 3.0 kcal/mole for its formation (in addition to the required activation energy if no enzyme is used). This energy requirement remains the same, no matter what route is taken in the synthesis. If the synthesis of a protein of 100 amino acids is carried out in the laboratory, in spite of the fact that energy can be supplied through the use of specially prepared high energy peptide reagents (which could never form spontaneously without the intervention of organic chemists), and in spite of the fact that all the ingenuity and carefully devised plans of the chemist are utilized, including the use of enzymes, if available, the synthesis is very laborious and time consuming, and the overall yield is incredibly small.

But now that the protein has been synthesized through such a vast expenditure of energy and time, just dissolve the product in water at the appropriate pH, add a tiny amount of proteolytic enzymes (enzymes which catalyze the hydrolysis or rupture of peptide bonds), and spontaneously, in a matter of minutes, the protein is broken down to the free amino acids from which it was so laboriously formed. The hydrolysis of each peptide bond liberates energy, and since, in the presence of enzymes, no activation energy must be supplied, the hydrolysis or rupture of the peptide bonds in the protein proceeds rapidly and spontaneously.

Thus it would be in every step on the way to the origin of life. Every step in the direction of the origin of life, requiring the formation of billions of tons of each of thousands of different kinds of protein, DNA, RNA, and carbohydrate molecules as well as a wide variety of other molecules, the organization of these molecules into systems, the synthesis of complex structures such as membranes and mitochondria, and the organization of the whole into the unique and incredibly complex structure of the first living cell, would require an input of energy. The existence of enzymes that could catalyze each step would only slightly reduce the amount of energy required. Thus the road to the formation of a living cell is a continuous road upward, a road going in the direction diametrically opposed to the direction matter goes spontaneously.

Every step in the road downward, however, rather than requiring energy, releases energy, and thus occurs naturally and spontaneously. The presence of enzymes would accelerate tremendously these degradative chemical reactions. The existence of enzymes in the "primordial soup" would thus have been fatally destructive, but the existence of life without enzymes is impossible.

Instability

Another very serious objection to the idea of Oparin's coacervates is their inherent instability. They form only under special conditions, and readily dissolve with dilution, shift in pH, warming, pressure, etc. This instability has been cited by Fox,[67] by Young[68] and by Kenyon and Steinman.[69] Instability is a most fundamental objection to any type of system that can be proposed to bridge the gap between molecules and living cells. All of these proposed models, whether they be Oparin's coacervates, Fox's microspheres, or any other model, suffer this basic and fatal weakness. One of the reasons living cells are stable and can persist is that they have membranes that protect the system within the membrane and hold it together. The membrane of a living cell is very complex in structure and marvelous in its function. The constituents that make up the membranes enclosing the cell and the membranes found within the cell are bound together by stable, covalent chemical bonds. A coacervate or a protein microsphere may have a pseudomembrane, or a concentration or orientation of material at the point of contact with the surrounding medium that gives it the appearance of having a membrane. There are no chemical bonds linking the macromolecules in this pseudomembrane, however, and it is easily broken up, and the contents of the coacervate or microsphere are then released into the medium.

Since these coacervates have this inherent instability, no coacervate could have existed for a length of time that would have had any significance whatsoever to the origin of life. Even if we could imagine a primitive "soup" concentrated sufficiently in macromolecules to allow coacervates to form, their existence would have been brief. Any organization that may have formed in these coacervates by any imaginable process would then have been irretrievably lost as the contents of the coacervate spilled out into the medium.

Theories that attempt to account for the origin of stable metabolic systems from loose macromolecules thus suffer from a number of fatal weaknesses. First is the requirement that the necessary macromolecules be produced in sufficiently vast amounts to saturate the primeval seas to the point where complex coacervates or proteinoid microspheres would precipitate out of solution. Secondly, such globular products are inherently unstable and would easily be dissolved or disintegrated, spilling their contents out into the medium. Geological ages, however, would have been required for a loose system to evolve into a stable, living cell, assuming such a process were possible at all. As we have seen above, however, there is no tendency at all for complex systems to form spontaneously from simple systems. There is a general natural tendency, on the other hand, for organized systems to spontaneously disintegrate to a disordered state. Thirdly, even if it were imagined that a coacervate of some kind could accrete or inherently possess some catalytic ability, this catalytic ability would have been purposeless, and thus useless, and actually destructive.

The Origin of the First Completely Independent Stable Self-Reproducing Unit—the First Living Cell

The simplest form of life known contains hundreds of different kinds of enzymes, thousands of different kinds of RNA and DNA molecules, and thousands of other kinds of complex molecules. As mentioned above, it is enclosed within a very complex membrane and contains a large number of structures, many of which are enclosed within their own membrane. The thousands of chemical reactions which occur in this cell are strictly coordinated with one another towards the self-maintenance and eventual reproduction of this living cell. Every detail of its structure and function reveals purposefulness; its incredible complexity and marvelous capabilities reveal a master plan.

It seems futile enough to attempt to imagine how this amazingly complex system could have come into existence in the first place in view of the vast amount of contradictory evidence. Its continued existence from the very start however, would have required mechanisms especially designed for self-maintenance and self-reproduction. There are numerous injurious processes which would prove fatal for the cell if repair mechanisms did not exist. These injurious processes include dimerization of the thymine units in DNA, deamidation of glutamine and asparagine in proteins, and the production of toxic peroxides, just to cite a few.

The cell is endowed with complex defense mechanisms, in each case involving an enzyme or a series of enzymes. Since these defense mechanisms are absolutely necessary for the survival of the cell, they would have had to exist from the very beginning. Life could not have waited until such mechanisms evolved, for life would be impossible in their absence.

The ultimate fate of a cell or any living thing is death and destruction. No dynamically functioning unit therefore can survive as a species without self-reproduction. The ability to reproduce, however, would have had to exist from the very beginning in any system, no matter how simple or complex, that could have given rise eventually to a living thing. Yet the ability to reproduce requires such a complex mechanism that the machinery required for this process would have been the *last* thing that could possibly have evolved. This dilemma has no solution and thus poses another insuperable barrier to the origin of life by a naturalistic process.

The Second Law of Thermodynamics and the Origin of Life

Of all the statements that have been made with respect to theories on the origin of life, the statement that the Second Law of Thermodynamics poses no problem for an evolutionary origin of life is the most absurd. However one may define the Second Law or seek to limit its applications so as to exclude an evolutionary process from its domain, the observations on which the Second Law is based do absolutely exclude the possibility of an unaided, spontaneous, naturally occurring, evolutionary origin of life.

If the Universe began in a completely disordered state as postulated by the Big Bang theory of the origin of the universe, and stars and planets, including our own solar system, spontaneously came into being, followed by the spontaneous, evolutionary origin of life, finally culminating in the evolutionary origin of millions of highly complex species, including man, then matter must have an inherent ability to self-organize itself, and to transform itself into higher and higher levels of organization. Thus, Julian Huxley has stated "Evolution in the extended sense can be defined as a directional and essentially irreversible process occurring in time, which in its course gives rise to an increase of variety and an increasingly high level of organization in its products. Our present knowledge indeed forces us to the view that the whole of reality is evolution . . . a single process of self-transformation."[70]

Scientists should have recognized this inherent property of matter and should have constructed a natural law or set of natural laws describing this property of matter. No such property of matter has ever been recognized by scientists, however, and thus no such law exists. Just the opposite tendency of matter has been recognized by scientists, and this tendency is so universal and unfailing that it has resulted in the construction of a natural law to describe it—the Second Law of Thermodynamics.

The relationship between the Second Law and the origin and maintenance of order, and more particularly biological order, can be seen by noting statements made by those knowledgeable in the field of thermodynamics.

R. B. Lindsay states "There is a general natural tendency of all observed systems to go from order to disorder, reflecting dissipation of energy available for future transformation—the law of increasing entropy."[72]

Isaac Asimov writes, "Another way of stating the Second Law then is, 'The universe is constantly getting more disorderly!' Viewed that way, we can see the Second Law all about us. We have to work hard to straighten a room, but left to itself it becomes a mess again very quickly and very easily. Even if we never enter it, it becomes dusty and musty. How difficult to maintain houses, and machinery, and our own bodies in perfect working order: How easy to let them deteriorate. In fact, all we have to do is nothing, and everything deteriorates, collapses, breaks down, wears out, all by itself —and that is what the Second Law is all about."[73]

If the above statements are true, then we can assert that there is a tendency for *all* systems, open or closed, to become less and less orderly. Certainly all real processes (those that occur naturally and spontaneously) proceed with an increase of disorder. The investigators cited, furthermore, associate this increase of disorder or randomness with entropy and the Second Law.

In all of the mass of our common experience, then, all observable natural systems tend to deteriorate, to become less ordered, to move to a state of maximum entropy. That is what is going on out there in the real world, everywhere we can observe.

On the other hand, the origin of the universe, the origin of life, and the origin of millions of highly complex species of plants and animals is postulated to have been brought about by a mechanistic naturalistic process of self-transformation of matter beginning with a primordial disordered state. According to this scheme there has been a spontaneous increase in order and a decrease in entropy in every part of the observable universe, since stars exist everywhere in the universe and certainly represent ordered systems. More particularly here on earth, complex, highly ordered biological systems, it is assumed, have arisen spontaneously from a primordial disordered inanimate physicochemical system.

This, however, is not science, since it is not based on common experience. Actual observations tell us that living things do not arise spontaneously from inanimate systems, but that they spontaneously age, die, and revert to inanimate material. Ordered, biologically active macromolecules such as proteins and DNA do not form spontaneously from their sub-units, but spontaneously break down into their sub-units. Amino acids do not spontaneously arise from simpler substances or change spontaneously from racemic mixtures to one optical isomer or the other, but if asymmetric, they tend to racemize and then eventually to decompose to simpler chemicals.

The tendency to disorder is all pervasive, unceasing, and implacable antagonist to the origin of biological order, so universal it is referred to as the law of increasing entropy. In the fact of this, it is indeed impossible to explain, on a naturalistic, evolutionary basis the incredible increase in order and complexity involved in the origin of the universe and of life.

Every attempt to explain the origin of biological order here on the earth always begins with the assertion that this has been possible because it has occurred in an open system involving an energy gradient. Thus, in the earth-sun system we are told, there has been a decrease of entropy on the earth due to evolution which has been more than compensated for by the increase in entropy in the sun. This has been accomplished by a flow of energy from the sun to the earth system. It is thus maintained that the entropy changes that have occurred in evolution, as expressed in the relationship, $dS = d_iS + d_eS$, have been brought about by a simple energy gradient in the earth-sun system (dS is the overall entropy change of the earth system, assumed to have been negative; d_iS is the entropy change of the earth system due solely to internal processes, which must be positive, according to the Second Law; and d_eS is the entropy, assumed to be negative and in excess of d_iS, introduced into the earth system from the sun).

It seems immediately apparent that there is a flaw in such an assertion. If all that were required to bring about a negative entropy change here on the earth (or any system) is an input of energy, then the above expression would read $dS = d_iS + dE_e$ where dE_e would represent the necessary input of energy into the earth system. The decrease in entropy, or the increase in order and complexity, and certainly the tremendous increase in order, information, and complexity required for the origin of life, however, requires more than just the mere input of energy. *An open system and an input of energy are necessary but not sufficient conditions for increase in order and complexity within a system and thus for the origin of life on the earth.* Two other conditions must exist.

First, an energy conversion system must exist for converting the otherwise raw, uncontrolled, destructive energy from the external source into the controlled, constructive form of energy that can be utilized by the system. More than just the input of energy from the sun is required for green plants to convert carbon dioxide and water into carbohydrates, and to construct other complex molecules and structures from simple precursors. An absolute requirement is the complex photosynthetic apparatus possessed by the green plant and used to convert light energy into a form of chemical energy utilizable by the plant. Also required, of course, are the many metabolic processes, or "motors," utilized by the plant for its activities.

Similarly, automobile plants can produce automobiles, which certainly represent an increase in complexity in an open system, but this can only be accomplished because of the many complex machines, or energy conversion systems, found within the automobile factory.

More than an open system, an input of energy, and energy conversion systems must exist, however, for an increase in order and complexity to occur within a system. A control system must exist which operates, controls, and maintains the energy conversion systems. In the green plant this control ultimately resides in the incredibly complex genetic system. This is the system, as far as we know now, which turns things on, turns things off, and in general regulates and maintains the energy conversion machinery (and eventually initiates and controls its replacement, as needed). In the automobile factory the control system is a combination of the assembly line, and the human operators. Replace the human operators with monkeys, and no automobiles will be built.

Even such an unabashed evolutionist as George Gaylord Simpson (perhaps during a momentary lapse from his evolutionary philosophy) recognized this fact when he said (along with his co-author) ". . . the simple expenditure of energy is not sufficient to develop and maintain order. A bull in a china shop performs work, but he neither creates nor maintains organization. The work needed is *particular* work; it must follow specifications; it requires information on how to proceed."[74]

In every open system, then, where there is an increase in order and complexity, certainly beyond what could be called irrelevant and trivial, four conditions must exist: 1) the system is open to the environment, 2) a sufficient input of energy is available, 3) the system possesses an energy conversion system, 4) there exists within the system a control mechanism that operates and maintains the energy conversion machinery. Then, and only then, is it possible for order and complexity to be generated within any system.

Within the hypothetical primitive earth-sun system, only two of these conditions could have been satisfied. The earth would have been open to the sun, and more than enough energy would have been available. But where was the energy conversion system for converting the radiant energy from the sun, otherwise deadly and destructive, into useful chemical forms of energy? Where was the control system? Where were the specifications on how to proceed?

Scientists are expressing fear in the slightest decrease in the ozone layer now protecting the earth from the deadly ultraviolet light from the sun. Remove that ozone layer and all life on the earth, from the lowest microorganism to man, would cease. But evolutionists are forced to postulate that life evolved in the absence of oxygen, and thus in the absence of ozone, and so in the presence of the deadly destructive ultraviolet light of the sun, which is intolerable to living things. The open system argument against the contradiction between the Second Law and evolution is completely without foundation.

The hypothetical primordial universe (the cosmic egg of the Big Bang advocates) would have satisfied *none* of the above four requirements. It was an isolated system, not an open system, since no energy would be available from an outside source, there existed no energy conversion systems, and no control systems. It is incredible that all rational scientists agree, fully in accord with the Second Law, that an isolated system cannot transform itself from a disordered state to an ordered state, and yet most of these scientists profess to believe that the universe, although an isolated system, by a process of self-transformation converted itself from a primordial disordered state into a highly ordered state. Furthermore, the solar system is, for all practical purposes, isolated from the remainder of the Universe. How, then, did it get organized? Evolutionists profess belief in a rationalistic, materialistic system, but their evolutionary philosophy forces them to abandon good science in a most irrational fashion.

Perhaps something should be said about crystallization, since it is often asserted by evolutionists that crystallization represents a spontaneous increase in order and complexity, and therefore there is nothing within natural laws that would prevent the spontaneous increase in order and complexity required for the origin of life, invalidating the Second Law argument against evolution. Even some creationists have used this argument.[75] The claim that crystallization disproves the Second Law argument against evolution is trivial in the extreme. There are some evolutionists, in fact, who have admitted that this is the case.

Prigogine and his coworkers, for example, have said "The point is that in a nonisolated system there exists a possibility for formation of ordered, low-entropy structures at sufficiently low temperatures. This ordering principle is responsible for the appearance of ordered structures such as crystals as well as for the phenomena of phase transitions.

"Unfortunately this principle cannot explain the formation of biological structures. The probability that at ordinary temperatures a macroscopic number of molecules is assembled to give rise to the highly ordered structures and to the coordinated functions characterizing living or;ganisms is vanishingly small. The idea of spontaneous generation of life in its present form is therefore highly improbable even on the scale of the billions of years during which prebiotic evolution occurred."[76]

Prigogine and his colleagues believe, nevertheless, that there must be some way around the apparent contradiction between the Second Law and evolution since, as evolutionists, they subscribe to the proposition that both the Second Law and evolution are true. They are heroically seeking to resolve the problem, although they are nowhere near a solution at the present time. Their statement quoted above includes two important observations. First, as already noted, crystallization provides no principle that can explain the origin of biological order. It should be noted that in addition to the argument advanced by Prigogine and coworkers, a crystal is not complex at all but represents regularity, not complexity. The structure of a crystal is preordained, the atoms or molecules assuming a rigidly predetermined order. The origin of biological order would require just the opposite principle.

Furthermore, a crystal is at equilibrium. No energy exchange takes place within a crystal. It is about as dead as inanimate matter can be. It is thus readily seen that in using crystallization as an argument for the compatibility of the Second Law and evolution, evolutionists are moving in a direction diametrically opposed to their own theories.

Special note should also be taken of the statement by Prigogine, *et al*, that "The probability that at ordinary temperatures a macroscopic number of molecules is assembled to give rise to the highly ordered structures and to the coordinated functions characterizing living systems is vanishingly small." It is thus conceded that an ocean full of amino acids, purines, pyrimidines, etc., could not have been given rise to life, for certainly the ocean was at ordinary temperature (or less).

On the other hand, as noted earlier, Miller and Orgel conceded that the molecules necessary for the origin of life could not have survived in the ocean even at ordinary temperature. Thus we recall that they stated "The rates of depurination of DNA, of hydrolysis of peptide and polynucleotide polymers, and of decomposition of sugars, are so large that it seems impossible that such compounds could have accumulated in aqueous solution and have been used in the first organism, unless the temperature was low." They went on to concede that there is a compelling argument that life could not have arisen in the ocean unless the temperature was below 25 °C.

Now let us combine the statements of Prigogine and his colleagues and of Miller and Orgel. Speaking from the viewpoint of thermodynamacists, the Prigogine group says that it is impossible for highly ordered structures and the coordinated functions characterizing living organisms to have arisen at ordinary temperatures. Speaking as organic chemists, on the other hand, Miller and Orgel concede that such vitally important molecules as proteins DNA, and RNA could not survive, even at ordinary temperatures, and so are forced to postulate that the temperature of the primitive ocean was below ordinary temperature. If these substances cannot survive at ordinary temperatures, but even ordinary temperatures do not provide sufficient energy for their formation and further evolution, it is obvious that an evolutionary, naturalistic origin of life is precluded.

It must be concluded that the total mass of common experience on which the Second Law of Thermodynamics is based, the universal tendency of matter to assume a more random, disordered state, is in itself sufficient scientifically to invalidate all theories on the evolution of life.

Conclusion

Other important problems in an evolutionary origin of life scheme, such as the origin of asymmetry in biological structures, and the fact that the synthesis of DNA and RNA is dependent on protein enzymes and yet the synthesis of protein enzymes is dependent on DNA and RNA molecules, have not been discussed. But then, how many nails are required to secure a coffin lid?

Let us finally, in the light of all the information discussed in this article, consider the probability of the existence of a living thing in comparison to the inanimate world from which, according to evolutionists, it was derived by natural processes. By adding up the energy content of all the chemical bonds in a "simple" bacterium and comparing this to the energy content at equilibrium of the constituent atoms from which it was formed, Morowitz calculated the probability of this cell to be $10^{-10^{11}}$ that is, one chance out of a number formed by writing the number one followed by 100 billion zeroes![77] That number is so large that it would require 100 thousand volumes of 500 pages each just to print! Yet, the improbability of the existence of a single-celled organism, in comparison to inanimate matter, is of that order of magnitude. Are there natural processes at work that could enable this monstrous improbability to be overcome? Of course not. In fact, increase the probability a quadrillion times (one followed by 15 zeroes) and the probability would still be only one out of one followed by 99 billion, 999 million, 999 thousand, 985 zeroes! No wonder no organic chemical molecules were found on Mars, let alone living organisms!

It must be concluded that all the facts of physics, chemistry, thermodynamics, kinetics, and probability considerations reveal the absolute impossibility that life arose spontaneously on this planet by mechanistic, naturalistic evolutionary processes from inanimate matter. The law of biogenesis, that life arises only from preexisting life, was just as valid throughout the entire history of this planet as it is today. "In the beginning God created" is still the only valid statement that can be made concerning the origin of life in the Universe.

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THE STORY OF EVOLUTION IN BIBLICAL STYLE

E. Theodore Agard* and Charles D. Howes**

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The story of evolution, as it is commonly presented, is put into a literary style similar to that of the Biblical account of creation. The days of creation are replaced by "ages" of evolution. The role of "time" as the medium in which faith is exercised to bridge the supernatural gaps in the evolutionary theory, is emphasized by the use of "Tempus", the Latin word for time, as if it were the name of a god. When the two accounts are thus compared in similar literary forms, evolution appears to be no more scientific than creation. It is therefore suggested that there is abundant evidence for a creation-based "scientific" theory of the origin of this earth and of the life upon it. The indications are that such an approach could have a better scientific structure than evolution. The details could readily be worked out if the same level of financial support could be obtained for the creation approach.

Introduction

A theory of the origin of this earth based on the story of creation as recorded in the first chapter of Genesis in the Christian Bible, is commonly rejected by supporters of evolution theories, on the grounds that this Biblical account should be regarded as a myth since it lacks a proper scientific structure. It is often overlooked that the Bible is not primarily a scientific textbook and was not written primarily for that purpose. Consequently, only the basic outlines of the story are presented, necessary for the establishment of a link between the origin of man and his spiritual destiny, which is the main theme of the Bible.

So much scientific thought and financial support has been given to the development of the evolution theory that it is not surprising to find it presented with an apparently better scientific structure. This article is designed to point out that evolution theory appears to be no less mythical than creation theory, when it is presented in the same format. The implication is that creation may also be found to have an acceptable scientific structure, if given the appropriate treatment.

Wherever gaps exist in the theory of evolution for which there is no sound scientific support, "time" is usually invoked as the medium in which faith is exercised, to resolve the difficulties. It can therefore be concluded that "time" serves a similar role in the theory of evolution, to that attributed to God by creationists. Hence the use of the term "Tempus", the Latin word for "time", in the narrative that follows where the story of evolution is presented in similar style to the Biblical account of creation.

The "days" of creation are replaced by "ages" of evolution. The first two ages correspond to the pre-geologic period. Events associated with the pre-Cambrian era make up the third age, the Paleozoic follows in the fourth age, the Mesozoic is identified with the fifth age and finally the Cenozoic with the sixth age. The evolutionary sequences of events differ in some respects from those in the Genesis account and parallels them in others, but the presentation of the theory of evolution in this literary form puts it in perspective in relation to creation, and emphasizes the role of faith in "Tempus".

*E. Theodore Agard, Ph.D., is a Radiation Physicist at the Kettering Medical Center, Dayton, Ohio 45429.

**Charles D. Howes, Ph.D., is Technical Director of Loma Linda Foods, 13246 Wooster Road, P.O. Box 388, Mount Vernon, Ohio 43050.

Narrative

In the beginning Tempus evolved space and a mass.

And the mass was exceedingly large and very dense and darkness filled the entire space. And the spirit of Tempus moved about the mass.

And Tempus caused the mass to explode, and there was a great big bang.

And Tempus was satisfied with the fragments resulting from the explosion as they receded at exceedingly high speeds. And Tempus separated the fragments from each other, placing each in its own path and grouping them.

And Tempus selected a special disk-shaped group of fragments, and called the largest and brightest portion near the center the sun. He then selected a special part for occupation and named it the earth. And the time that elapsed was the first age.

And Tempus caused an atmosphere to form about the earth, to separate the earth from outer space.

And Tempus caused water to escape from the congealing surface of the earth as it cooled, and much water rained upon it but some remained in the atmosphere.

Thus Tempus divided the waters.

And Tempus called the moist atmosphere Sky. And the time that elapsed was the second age.

And Tempus caused the earth's crust to sag in places, and the waters gathered together there.

So dry land appeared, great mountains formed and in some places the dry land parted and drifted as it was separated by the waters.

And Tempus called the dry land Earth, the gathering together of waters he called the Seas; and Tempus was satisfied with the outcome.