THE SPONTANEOUS GENERATION OF LIFE

PAUL A. ZIMMERMAN
Concordia Lutheran Junior College
Ann Arbor, Michigan

Man has an insatiable curiosity concerning his origin. This urge to know more about his beginning has provided a powerful stimulus for scientific investigation concerning the origin of "life." from non-living material. In late years advances in biochemistry, microbiology, and allied sciences have provided powerful new tools for such inquiry.

In an age dominated by materialistic philosophy one finds infrequent reference to the possibility of life having been initially created by God. It is usually asserted that "chance," operating over a long period of time, provides all the creative force that is needed. Gaffron states, "It is the general climate of thought which has created an unshakable belief among biochemists that evolution of life from the inanimate is a matter of course." [1]

It is, of course, true that evolutionary theory, to be successful, needs to account for the origin of life. Darwin himself prior to 1871 in one of his letters spoke of the spontaneous generation of life. He speculated concerning the chance formation of a protein compound in "some warm little pond with all sorts of ammonia and phosphoric acid salts, light, heat, and electricity." [2]

The search for the answer to the origin of life proceeds along several lines. One is the attempt to synthesize living material today. A second approach is to use modern scientific knowledge to reconstruct how life might have evolved from inorganic chemicals. Another is to attempt to find evidence of life forms in extra-terrestrial sources.

Newspapers and popular magazines often carry misleading headlines. It it not uncommon to read "Life Created in Test Tube" and then go on to discover that the accomplishment has been considerably less significant. So much depends on the definition of life.

What is living material? Actually it is difficult, if not impossible, to offer a definition satisfactory to all. Certainly life involves far more than the mere ability to reduplicate one molecule from the pattern of another. Inorganic crystals have this ability in a suitable medium. Life as an organized process calls for much more. Mora recently listed four characteristics of living material which provide a more comprehensive approach to a definition. (1) A living organism must be autonomous, similar to others of its kind, but not an exact duplicate. (2) It must be self-maintaining, i.e., able to repair itself and to duplicate itself. (3) A living organism must be able to adjust to changing environmental conditions to survive. (4) Finally it must have what Mora calls an "urge" or drive toward "self-fulfillment." [3] Certainly it is not too much to say that any theory seeking to account for the origin of life must start with the obviously inorganic and go at least at far as a functioning cell. Viruses, often regarded as a primordial type of life, do not meet the requirements of this definition. Essentially they consist of a shell of protein enclosing a core of nucleic acid. They multiply themselves only by invading cells of another organism and using its chemistry to produce virus particles. Thus they depend entirely on other life and may be regarded as parasitic.

The theory must first reasonably account for the origin of the macro-chemicals which play such vital roles in the machinery of the cell. Most vital are the highly complex giant molecules called proteins. They are found in every form of life and involved in every basic function of living organisms. Closely allied in the complex are the various deoxyribonucleic acids (DNA) and ribonucleic acids (RNA). These remarkable molecules represent the genetic material of living organisms and are the materials which direct protein synthesis. They almost infallibly pass down to succeeding generations the pattern of each and every living organism. Life without these complex molecules is unimaginable.

Virtually all scientists agree that spontaneous generation is impossible today under existing conditions. The environmental conditions obtaining in our world render organic molecules of the required complexity much too unstable. Oxygen in the air and existing organisms would quickly kill any such new product of spontaneous generation before it had taken its first toddling step. It is universally agreed that such complex molecules as make up living material need the indispensable protection of living systems. They cannot live outside this protective environment.

Thus man is led to attempt a simulation of conditions which he theorizes might have obtained in the early days on the earth. It must be recognized at the outset that this type of scientific activity amounts to speculation. It may rest upon biochemical laws and be judged with reference to them. But it cannot be said to reproduce actual conditions. The Dutch geologist, Rutten, states, "The time elapsed is so enormous that it is difficult to prove anything at all, because the record is not only incomplete in the extreme, but is also often changed beyond recognition by younger events." [4]

Mora agrees. He writes, "This question is not within the scientific domain, at least if we consider probability as an essential part of a scientific statement."[5] Fuller and Tippo give as their judgment. "The evidence of those who would explain life's origin on the basis of the accidental combination of suitable chemical elements is no more tangible than that of those people who place their faith in Divine Creation as the explanation of the development of life. Obviously the latter have as much justification for their belief as do the former." [6]

The difficulty of accounting for the evolution of life by spontaneous generation (sometimes called "biopoesis") is of the highest order. It amounts to cloaking "chance" with all the attributes of deity. In this writer's opinion it requires a greater act of faith to embrace spontaneous generation than it does to believe in a divine creative act.

The difficult of explaining the evolution of life from the non-living lies in the amazing complexity of the chemistry of the living cell. Even in 1964 biochemists and microbiologists do not profess to understand the intricacies of cell chemistry. Nor do they yet claim confidence in the ability to duplicate its wizardry. To then postulate that the cell, with its rich panoply of chemicals, developed from a few simple inorganic compounds, is to face odds which stagger a statistician and would scare off any gambler. Moreover such an assumption runs contrary to the consistent experience of the chemist who knows the careful controls he must impose when he synthesizes far less complex molecules in his laboratory.

Despite the strong evolutionary dogma against teleology, design is evident in living organisms. Twenty amino acids are commonly found in proteins. The total number, including those discovered by chromatographic techniques, is considerably larger. Only four organic bases occur in the nucleic acids. Yet these few components are linked and coded in such a marvelous way as to spell out the chemistry of life in all its glorious variety. The amino acids in proteins are built chain-like into an architecture o-f molecules with weights ranging from 12.700 to 760,000. DNA and RNA molecules range as high as two million molecular weight units. These molecules are so structured as to provide coded information for the cell that enables the cell to develop, to maintain itself, to preserve its identity, and to produce off-spring with the characteristics of the living organism. The development of the various systems of the organism as well as the metabolic processes by which they function are governed by this coding. All structure and all activity of living organisms is made possible by the complicated symphonic action and reaction of miraculous molecules in a vast number of cell systems. All are coded and directed by the master chemicals!

Synge has calculated that for one typical protein with a molecular weight of 34,000, containing 288 units selected from 12 amino acids it is possible to obtain 10^{300} isomers or distinctly different protein structures.[7] If only one molecule of each of these possible proteins existed, the weight of the earth from organic material alone would be 10^{280} grams. Contrast this with the actual weight of 10^{27} grams. How then were the correct codes selected for living material in view of the vast possible number of "nonsense" codes that the continuous rolling of the dice of biochemical chance would produce ?

But far more is necessary than merely to be assured of the production of the right molecules. They must be organized in the right systems. Furthermore, they must be protected against degradation so that they might multiply. Living systems are extremely sensitive. Almost all soluble proteins denature upon heating. They are extremely unstable in this regard. Most of the enzymes that catalyze reactions in the cell are damaged irreversibly if exposed to temperatures as high as 40-50 degrees centigrade. Only a few are able to survive above 60 degrees.

Furthermore, peptides decompose readily by hydrolysis to revert to amino acids. The thermodynamic equilibrium for this reaction strongly favors the decomposition. Thus the reaction causes peptides, the precoursers of proteins, to degrade to amino acids, rather than to build more complex protein molecules. The amino acids must be activated by the complex ATP (Adenosine triphosphate) before it can pass the energy barrier and be linked in a peptide chain.

Reactions in the living cell call for an exquisite symphony of cooperation. For instance, the oxidative decarboxylation of amino acids requires the cooperation of no fewer than five complex cofactors, each of which is essential. What are the odds that such exquisite and vital balance, such well coordinated chemical syntheses, such intricate coding of living material arose by chance? It is begging the question to say that originally life proceeded by simpler and unknown pathways.

Despite the staggering odds against spontaneous generation many scientists prefer this hypothesis to the creation hypothesis. They have performed experiments with ammonia, hydrogen, water, and other simple chemicals in an effort to simulate a "primordial" atmosphere. Electricity, ultraviolet light, high speed electrons, etc., have been used to induce these simple compounds to combine into more complex molecules. The results have been interesting.

As long as half a century ago Emil Fischer linked amino acids in smaller peptide chains. In more recent years Calvin used radiation from the Berkeley cyclotron to bombard carbon dioxide and hydrogen. He obtained formic acid and formaldehyde. Three years later (1953) Urey and Miller used a mixture of methane, water, hydrogen, and ammonia. This mixture was subjected to discharges of high-voltage electricity. Several amino acids were found in the mixture after bombardment. In 1960 Wilson succeeded in producing larger polymers forming sheet-like solids.

Another more recent approach is that of Fox who heated mixtures of amino acids in molten glutamic acid. He felt this simulated conditions which might have existed alongside some primordial volcano. This process produced polypeptides resembling proteins in many respects. Molecular weights ranged from 3000 - 9000.[8] More recently adenine, one of the organic bases occurring in the structure of DNA was produced by the bombardment of a "primitive earth environment" with beams from a 4.5 million electron volt linear accelerator.[9]

From these and similar experiments it has been concluded that bombardment by cosmic rays, ultraviolet, radioactive materials, and lightning can produce fairly complex molecules. It is then postulated that beginning with these molecules, more and more complicated interrelationships developed until finally "life" had arrived. Indeed a strong spirit of optimism usually accompanies reports of research in this area. Is this optimism justified?

One may begin a critical appraisal by noting that these experiments have been characterized by some scientists as exercises in chemistry and nothing more. Consider the formation of amino acids in Miller's experiment. The results might well have been predicted from the thermodynamic properties of these compounds. They are quite stable, possessing an inner salt structure (zwitterionic) . Those who seek to explain the origin of life must start with an explanation of why these compounds have these characteristics? Why do atoms form bonds as they do? For that matter, how do we account for the origin of matter? One may push back the ultimate question; but it cannot be eliminated.

Bombardment of chemical compounds by high energy particles *also* very understandably tears atoms apart, opens active linkages, and gives rise to more complex chemicals. But far more than that is required. Useful chemicals, formed along with a host of useless compounds in the reaction mass would have to be able to function and fight off degradation back to more simple chemicals. They would have to organize themselves into a highly structured system capable of producing the catalysis necessary to pass difficult energy barriers and to ultimately accomplish their own reduplication.

In evaluation of this point Mora judges, "These polymerizations are only exercises in synthetic organic chemistry. They use similar monomers, but they do not really resemble a self-perpetuating, coordinated process, and they do not lead to the synthesis of a living unit with the characteristic urge. They do not even produce functional polymers with a specific structure. "[10] In effect it is as though a number of meaningful words have been produced by chance rolling of children's alphabet blocks. But what is required is that of the meaningful wisdom and complexity of the Encyclopedia Americana. What are the odds against this having been produced by the rolling of wooden alphabet Mocks?

A survey of the literature easily reveals a long list of special environmental conditions which must be provided for life to have been formed of its own accord by spontaneous generation. Unless these special conditions are assumed the theories fall flat. The problems faced by the hypothesis of spontaneous generation are truly challenging.

Most scientists agree that the original environment must have been free of oxygen. Oxygen in the atmosphere would effectively oxidize any early organic molecules and prevent the development of life. It would also by the formation of ozone effectively shield the earth's surface from the high energy ultraviolet radiation required by the theories. On the other hand, ultraviolet light has a lethal effect on living organisms. If it were not filtered out by the atmosphere, no life could exist on earth today. It thus seems a most unlikely source upon which to depend for starting life. The problem is for the theory to account for a manner in which plants would form oxygen quickly enough to prevent ultraviolet rays from sterilizing any living matter that had developed. Since our present supply of green plants would require 5,000 years to double our present oxygen supply, it is most doubtful that the necessary oxygen could have been provided quickly enough by primordial life forms.[11]

Even the transition from an oxygen-free atmosphere to an oxygen containing environment would be most traumatic for anaerobic organisms. Ehrensvard is of the opinion that the increasing oxygen concentration would have represented a "catastrophe, a brutal intervention in their metabolism."[12] He believes there must have been "wholesale eradication" of organic life with only a few survivors. We regard the survival of any organisms under the stipulated conditions as most unlikely and question the "escape clause" that some must have quickly and resourcefully developed specialized enzyme systems.

Moreover the possibility of the synthesis of macro-molecules having been carried out by ultraviolet rays has been challenged. Calvin has pointed out that ultraviolet is most abundant in the wave length range from 2000 to 2500 Angstroms. However, these wave lengths are not absorbed by methane, hydrogen, or water. Hence he feels this source of energy may not have played the major role assigned to it by some theories. He turns instead to radiation from potassium-40.[13]

This, however, seems an unlikely prospect in view of the comparatively weak radiation provided by this isotope, unless we postulate a rate of radioactivity far higher than that which we observe today.

A realistic view of any chemical process will consider the concentrations of reactants. Most theorists seem to assume a convenient meeting of chemicals in just the right concentrations. This, however, is a most unlikely assumption. Ehrensvard calculates that the concentration of non-carbonate carbon in the forms of organic compounds in the seas could not have amounted to more than 0.00001 percent.[14] It is not plausible to assume that increasingly complicated reactions would take place in such a thin primeval soup. This objection is usually met by assuming concentration processes in inland lagoons. The weakness of this reply is implicit in the additional assumption required, namely that the prerequisite concentrations were held more or less constant over vast periods of time.

An additional restriction is imposed by the solubility of phosphorus compounds. Phosphorus is essential for life processes. Today available phosphorus is quite limited because it is present in the oxidized form. Calcium ions tend to precipitate calcium phosphate and thus reduce the amount in solution. It is thus unlikely that sufficient phosphorus would have been available in the primordial seas to make it possible to form the requisite compounds. Gulick seeks to overcome this objection by suggesting that originally phosphorus was present in the more soluble hypophosphite form. However, this form tends to oxidize extremely easily to the insoluble phosphate. This means that no oxygen can be tolerated in the early atmosphere. Here again very special conditions and delicate balance and transition are called for to such a degree as to strain the limits of credulity.[15]

Spontaneous generation must also account for the origin of the enzymes which speed up the life processes, many of which otherwise proceed with great slowness. Indeed, any satisfactory theory must account for the development of the cell which governs life processes and makes them possible today. It is not enough for Oparin to postulate the concentration of chemicals in little droplets (coacervates). The cell is vastly more than a little sac. The old idea of the protoplasm as a colloidal system has been replaced by the knowledge that the cell is a chemical factory with many different compartments. Under the electron microscope the cell is seen to consist of a three dimensional network of tubules and globules with a diameter of 100-150 millimicrons. Inside this network proceed all chemical processes. They operate under the control of the cell for the service of the living unit. Not only have investigators thus far failed to account for the chance development of such a highly specialized organization; they freely admit we still have much to learn of what goes on in this area of biochemistry.

It is often overlooked that the concept of a delicately balanced, ordered functioning organism developing from simple inorganic molecules runs counter to the second law of thermodynamics. Disorder comes naturally in nature. Or, to be more exact, an increase in entropy is to be expected. Only in the living cell do we find today entropy decreasing. This is true of the growing state. However, at death the chemicals immediately revert to an increase in entropy, that is to decay and degradation. No one has shown how material originally dead could have reversed this universal principle of nature.

Calvin has observed that the same forces which tore apart the primitive inorganic molecules would start tearing apart the more complex ones formed from the simple.[16] He and others call upon "natural selection" to promote the cause of the more complex compounds by giving them somehow more survival value. However, selection at the molecular level is a far different thing than selection among living plants and animals. Experience with the latter cannot be appealed to in support of the former. Selection at the molecular level is selection only in the passive, physiochemical sense. Under such conditions our knowledge of chemistry indicates we should expect indiscriminate mixing of the chemicals with dispersion and degradation. To say it is not so is to beg the question. Certainly the least that can be expected in support of the theory would be well-worked-out models, taking into full account the questions of mixing and degradation.

Invariably probability is invoked as proof that selection would be successful at the molecular level. It is argued that given enough time and opportunity it is certain that very complex arrangements of the right compounds would come into the proper relationship. Some of these "right" compounds and systems would somehow escape destruction and be given an opportunity to take the next step up the organizational ladder. They would function in such a way that finally a pattern, a pathway would be established and preserved. "Given enough time the improbable becomes the inevitable." This is the creed.

This line of reasoning must be recognized as wishful thinking. The very fact that very long times are invariably involved for these developments in itself is an admission of the improbability of such development. Mora says of this line of thought: "Using such logic we can prove anything . . . When in statistical processes the probability is so low that for practical purposes indefinite time must elapse for the occurrence of an event statistical explanation is not helpful."[17]

What we know of chemical processes indicates that such items as the stability of certain configurations of molecules, e.g., the helix, are limited processes. They resemble crystallization, stopping at the next level without any tendency in the non-living state to go on and on to higher organizational levels. To invoke probability and infinite time to overcome this observed difficulty is to operate on the level of faith.

Living forms have certain peculiarities which any theory of spontaneous generation must take into account. One of these is the optical activity of amino acids. Peptide chains are formed universally of natural amino acids of the levo-configuration. This is most unexpected, since ordinary chemical processes produce racemic mixtures of D and L isomers. Living cells, however, have special mechanisms to hinder racemization and insure the production of the levo-isomers. Gause, Russian expert on optical activity, indicates this as proof that all life on this planet arose from a single source.[18] It should be noted, however, that dextro-series amino acids occur in nature to a very small extent, e.g. in the proteins of certain bacteria.

It is simple to account for optical activity if life was created. However, if it evolved, then the question arises, how did this peculiarity of living material arise ? It is most strange since it does not exist in the inorganic world. Several explanations have been offered. One is that the first synthesis took place on an optically active quartz crystal. However, in nature there are as many dextro surfaces of quartz grains as levo surfaces. It is also pointed out by some that sunlight, having passed through the atmosphere, has a slight right circular polarization which might have selectively destroyed dextro forms of early organic compounds. But this presumes a selective destruction not justified by the amount of rotation. It is more likely that all such early unprotected organisms would have been destroyed. Thus optical activity remains as one more indication of created life, as opposed to spontaneous generation.

Finally it is important to note two trends. One is a seeming lessening of interest in the theory that life came from another planet. Some feel that life forms have been found in meteorites, but this has not yet been demonstrated beyond question. It has been pointed out that explaining that life drifted in from another planet only transfers the locale of the problem. Moreover, there is little chance that the spore of any living organism would survive years of drifting through space and enduring fierce radiation. Then, too, the hope of life on Venus has been exploded since it was learned that its surface temperature is about that of molten lead. Mars remains a possible, though unlikely, candidate as a source of life. Certainly it is far less hospitable than the planet earth. The next star system is many light years away. Thus accounting for life seems to be a local problem.

The other trend is a growing recognition that there is something to the idea that life has a design and what inescapably seems to be a purpose. Waddington recently pointed out that it is inadequate to think of basic processes as being "non-finalistic." He stated, "The non-finalistic mechanisms interact with each other in such a way that they form a mechanism which has some quasi-finalistic properties, akin to those of a target-following gunsight."[19]

Mora suggests that science remove its mental block on teleology and consider the "purpose" shown by living things.[20]

It may well be concluded that modern biochemical research has served to unravel much of the mystery of the chemistry of life. But in the unraveling of the vast complex of cell chemistry it has exposed still more the statistical improbability of spontaneous generation. It is an improbability so large as to be equated with "impossible." The facts point to the hand of God the Creator. who brought matter into being, who fashioned the solar system, who placed life on this planet by the word of His mouth. "For every house is builded by some one, but He that built all things is God." (Hebrews 3:4)

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