

The Origin of Life: Theories on the Origin of Biological Order

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The second article of this series included a discussion of Fox's scheme, or thermal model, for overcoming the thermodynamic barrier to the formation of proteins (amino acid polymers), and a discussion of other polymerization schemes. It was pointed out that Fox's thermal model involves a series of conditions and events, most of which would have had such a vanishingly low order of probability on any plausible primitive earth, that the overall probability of protenoid microspheres arising through natural processes would have been nil. It was further pointed out that, in any case, the polymers produced by such a postulated process would have consisted of randomly arranged amino acids with no significant biological activity and thus Fox's model has no relevance to the origin of living systems.

The problem of overcoming the thermodynamic barrier in the polymerization of amino acids and nucleotides, as insolvable 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 possess 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 messages are 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 four 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 section of the last article in this series, in which Fox's scheme was being discussed, 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 sentence 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} tries could be made by all these monkeys in that five billion years ($10^9 \times 10^{16} \times 10^{17}$ divided by $10 = 10^{41}$). 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 *Impact* article is the naturalistic origin of life on the earth under assumed primordial conditions") without a spelling error, even once.

The number of tries 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 less than the impossibility threshold. 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} , 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} tries 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. 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."¹ 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."²

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 Steinman³). 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.^{4,5} 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 within a very complex, dynamically functioning multi-layered 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. They must have coexisted from the beginning, rendering evolutionary schemes impossible.

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 Fox⁶, by Young⁷, and by Kenyon and Steinman.⁸ 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. 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 protenoid 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 to science 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 in time and space in a harmonious system, all working together 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, deamination of cytosine, adenine, and guanine in DNA and RNA, 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 the final insuperable barrier to the origin of life by a naturalistic process.

We conclude that a materialistic, mechanistic, evolutionary origin of life is directly contradicted by known natural laws and processes. The origin of life could only have occurred through the acts of an omniscient Creator independent of and external to the natural universe. "In the beginning God created" is still the most up-to-date statement we can make concerning the origin of life.

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⁴ A. I. Oparin, *The Origin of Life on the Earth*, Academic Press, New York, 1957, p. 428.

⁵ A. I. Oparin, in *The Origins of Prebiological Systems and of their Molecular Matrices*, S. W. Fox, Ed., Academic Press, New York, 1965, p. 331.

⁶ S. W. Fox in Reference 5, p. 345.

⁷ R. S. Young in Reference 5, p. 348.

⁸ Reference 3, p. 250.

* An elaboration of this material in much greater detail may be found in Dr. Gish's monograph, "Speculations and Experiments Related to Theories on the Origin of Life." Creation-Life Publishers, 1972.

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