The alternative way for producing a new species could be by virgin birth. This is proven to occur under the most rigid laboratory conditions, among carefully controlled strains of mammals used for research.

The chances would be enormously increased, but still, would be too hard to swallow. And yet with direction, plan and control, its occurrence is more likely, and may well be established through intensive research someday. Just to be able to produce a new, gentically perfect pair from the same flesh, might open our eyes to the great depth of shared throughts and feelings and the intimacy with the Creator of such a couple.

On the other hand, there are thousands of people, including the present writer, who experience and live by the guidance of the Creator, and have been privileged to see and live through critical turning points in their lives far ahead of the time of decision. Though blessed with enough adversity to keep them struggling, they carry on with that guidance that has not failed them. Since science has verified statement after statement in the Bible, then for us to accept as our personal Guide, our Creator, is a small act of faith indeed.

THE EVOLUTION OF COMPLEX ORGANIC COMPOUNDS FROM SIMPLER CHEMICAL COMPOUNDS: IS IT THERMODYNAMICALLY AND KINETICALLY POSSIBLE?

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Present sources of energy for conversion of inorganic molecules to various organic molecules are given. Electrical discharges, used by Miller and Urey, are shown to be relatively minor ones, compared to the sun's energy which is so effective in destroying organic compounds.

Even though set up as a closed system, so as to force the reaction to the product side by selectively removing and accumulating the products, only slight amounts of various organic compounds, such as glycine, resulted. Quoting Hull as estimating the half-life of glycine as only about 30 days, 97% of it would be decomposed before reaching the earth.

Considering the possible 3% which falls into the ocean, Hull concludes that ultraviolet radiation would decompose it in the upper 100 meters in a half-life of about 20 years. The physical chemist guided by proved principles of chemical thermo-dynamics and kinetics cannot offer any encouragement to the biochemist who needs an ocean full of organic compounds to form even lifeless coacervates.

Miller's experiment is an excellent one, scientifically-speaking, and when properly interpreted leads to the conclusion that life could certainly never originate spontaneously.

Introduction

One of the necessary steps in the supposed process of evolution is the formation of complex organic compounds from the reaction of simpler chemical compounds such as NH_3, CH_4, and H_20. The hypothesis of spontaneous generation of life would fall apart if such chemical reactions were impossible for there would be no organic compounds available for life.

Even if the reactions would occur, the production of extremely large amounts of organic compounds is also necessary, Thus, if any reaction is possible, it must produce high yields of organic compounds or spontaneous generation would be very unlikely.

In the July 31, 1959 issue of *Science, S.* L. Miller and H. C. Urey published an article entitled, "Organic Compound Synthesis on the Primitive Earth" outlining the evolutionary position on this subject. In answer to this paper, D. E. Hull wrote an article entitled, "Thermodynamics and Kinetics of Spontaneous Generation," that appeared in the May 28, 1960 issue of *Nature.* The position put forth in Hull's paper is that the production of complex organic compounds from simple chemical species is impossible under the conditions given by Miller and Urey.

This paper is simply a review of both articles, and frequent reference is made to the above papers.

Use of Electrical Discharges

Oparin[1], taking the evolutionary viewpoint, thought that the spontaneous generation of the first living organism could have taken place, if large quantities of organic compounds had been present in the oceans of the primitive earth,

Miller and Urey[2] state that the greatest progress in the formation of organic compounds under supposed primitive conditions has been made by utilizing electrical discharges as a source of energy. This energy would come from lightning and corona discharges from pointed objects. It is interesting to consider the table given by Miller and Urey[2] showing the present-day sources of available energy for a postulated evolutionary process.

Table 1. Present Sources of Energy Available for Evolutionary Processes Averaged Over the Earth[2]

Source	*Energy* ($cal\text{-}cm^{-2}\text{-}yr^{-1}$)
Total radiation from sun	260,000
Ultraviolet light–portion of sun radiation (wavelengths less than 2500A)	658.5
Electrical Discharges	4.0
Cosmic Rays	0001.5
Radioactivity (to 10 km. depth)	0.8
Volcanoes	0.13

It should be noted that the most readily available and abundant sources of energy are not considered as promising as this minor source (electrical discharges), simply because experiments utilizing ultraviolet light have successfully produced only very small yields of organic compounds.[3-5] The largest available laboratory, our planet, utilizes radiation from the sun. However, on the postulated primitive earth, no photosynthetic organism had yet evolved.[2] Also most of the sun's energy is in the range of wavelengths that would be more effective in destroying organic compounds that in aiding their development.

Experiments Conducted Under Reducing Conditions

Since oxidizing conditions are now present on the earth, many attempts were made by scientists to synthesize organic compounds under oxidizing conditions.[6] Most of the experiments were unsuccessful, and if any organic compounds were produced, the yield was very small.[2]

Since these experiments offered no promise, the primitive earth must have had a reducing atmosphere to allow for the formation of organic compounds. This was suggested by Oparin.[1] Miller's experiments[7] were run under reducing conditions.

Miller's experimental apparatus[2] was a closed system of glass, except for tungsten electrodes used to discharge the electrical arc. Water was boiled in a 500 ml flask, and the water vapor and gases were mixed in a five liter flask where the electrodes were located. The products of the discharge were condensed and then brought through a U-tube back into the 500 ml flask.

It should be noted that the well-known principle of increasing the yield of a reaction by selectively removing the product from the reacting mixture has been utilized in this experiment.[8] In other words, the reaction has been forced to the product side of the supposed chemical equation. An analysis of the products is given in Table 2.

Table 2. Analysis of Yields from Sparking A Mixture of CH_4, NH_3, H_2O, and H_2, (710 mg of Carbon was added as CH_4)[2,9]

Compound	*Yield (moles)*
Glycine	.00063
Glycolic Acid	.00056
Sarcosine	.00005
Alanine	.00034
Lactic Acid	.00031
N-Methylalanine	.00001
α-Amino-n-butyric Acid	.00005
α-Aminoisobutyric Acid	.000001
α-Hydroxybutyric Acid	.00005
β-Alanine	.00015
Succinic Acid	.00004
Aspartic Acid	.000004
Glutamic Acid	.000006
Iminodiacetic Acid	.000055
Iminoacetic-propionic Acid	.000015
Formic Acid	.00233
Acetic Acid	.00015
Propronic Acid	.00013
Urea	.00002
N-Methyl Urea	.000015

Thermodynamics of Spontaneous Generation

Hull[8] in his paper quantitatively considered the formation of the very simple amino acid, glycine. This basic constituent of proteins is believed to be coded by the DNA triplet of nucleotides: adenine, cytosine, cytosine. Other amino acids are more complicated in that one of the hydrogen atoms attached to the central carbon atom in glycine is replaced by some other combination of atoms, such as CH_3 in alanine. Thus, other amino acids are more complex.

It should be obvious that if it is difficult to form simpler compounds, it would be almost impossible to form more complex compounds. Hull used the concentrations of raw materials as given by Miller and Urey[2] in his calculations. He worked within the supposed favorable reducing atmosphere.

Miller and Urey[2] were very concerned in showing that raw materials would be available for the formation of organic compounds, and assumed that their experiment would show that these raw materials would react to form the organic products. They applied thermodynamics to find the equilibrium concentrations of the raw

materials, but did **not** apply thermodynamics to the synthesis of the organic compounds.[2] Hull did the latter,

Consider the reaction:

$2CH_4 + NH_3 + 2H_2O \rightleftharpoons NH_2CH_2COOH + 5H_2$

which leads to the formation of glycine with the reactants used by Miller.[9] The equilibrium constant (K) for this reaction is 2×10^{-40}. Based on principles of physical chemistry, the larger K is, the more products will form (reaction tends to the right); the smaller K is, the fewer products will form (reaction tends to the left). For the reaction,

$$K = \frac{a_{NH_2CH_2COOH} \cdot a^5_{H_2}}{a^2_{CH_4} \cdot a_{NH_3} \cdot a^2_{H_2O}}$$

where "a" is the activity of the substances involved in the reaction. Rules[10] for expressing these activities for dilute solutions are:

$a_A = N_A$ (mole fraction) if A is the solvent (for pure solvents, solid or liquid, $a_A = 1$);

$a_A = C_A$ (concentration) if A is a solute (concs. to be expressed in moles per 1000 grams of solvent; or, what is nearly the same thing for dilute aqueous solutions, in moles per liter of solution;

$a_A = P_A$ (partial pressure) if A is a gas (pressures, or partial pressures, to be expressed in atmospheres).

Miller and Urey[2] calculated for a primitive atmosphere that

$$a_{CH_4} = P_{CH_4} = 4 \times 10^3 \text{ atm.}$$

$$a_{NH_3} = P_{NH_3} = \frac{P_{NH_3}}{P^{1/2}_{N_2}} = 0.04$$

$$a_{H_2O} = P_{H_2O} = 10^{-6} \text{ atm.}$$

$$a_{H_2} = P_{H_2} = 1.5 \times 10^{-3} \text{ atm.}$$

Using these values and the value for K, the aqueous concentration of glycine was found to be 10^{-27} moles per liter.[8] Similar calculations for more complex amino-acids yield smaller concentrations.[8] Therefore, at equilibrium conditions, there is little chance of having available enough organic compounds suitable for any evolutionary process. Hull[8] states, "It is possible that, in an energy-rich medium, steady-rate concentrations can be maintained far from equilibrium. In such cases the expected concentrations depend on the available mechanisms for synthesis and decomposition." Assume that concentrations much greater than 10^{-27} moles per liter of glycine could be formed. Once formed, would anything in the supposed primitive atmosphere cause decomposition of the organic products? To answer such questions the kinetics of spontaneous generation processes must be considered.

Kinetics of Spontaneous Generation

From Table 1, it is seen that ultraviolet light is an important source of energy for any natural process occurring on earth or in the earth's atmosphere. It must also be considered from the standpoint of decomposition of organic compounds. The atmosphere proposed by Miller and Urey[2] is transparent to ultraviolet radiation down to 2250A.[8] Hull[8] states,

> A glycine molecule formed in such an atmosphere is immediately vulnerable to radiation up to 3000A, adsorbing in a part of the solar spectrum far more intense than that which produced it. Decarboxylation of activated glycine would presumably occur with a quantum efficiency of the order of unity. Thus, any glycine formed would be rapidly decomposed.

Hull estimates that the half-life of any glycine molecule is about 30 days; and, this is a much shorter time than the half-time it would take the glycine molecule to descend to the surface of the earth from the stratosphere, where it would be formed. This transport half-time is estimated at three years from fall-out data.[8] Therefore, 97 per cent of the glycine would be decomposed before it reached the earth.

Recall that the supposed source of energy for generation of these organic compounds is electrical discharges in the atmosphere which is a minor energy source. Such a source, operating at maximum efficiency, could not generate much product. The greater source of energy, ultraviolet radiation, would have a destructive influence on any organic material formed.

This destructive energy source is hundreds to thousands of times more abundant than the electrical energy source.[8] Table I shows only ultraviolet light available below wavelengths of 2500A. However, all ultraviolet radiation wavelengths which are destructive to organic compounds must be considered.

Suppose that three per cent of the initially formed glycine did fall into the ocean without decomposing. Would it begin to concentrate there in such quantities so as to favor other spontaneous generation processes? Ultraviolet radiation penetrates the ocean to considerable depth. Ten per cent of the light radiation with a wavelength of 2600A can penetrate sea water to a depth of six inches, and can penetrate fresh water (which is more like the proposed primitive oceans) to a depth of three feet.[11] Hull[8] states,

> In the mixed layer above the pycnocline, about 100 meters deep, glycine would have a half-life to ultraviolet destruction of about 20 years. Even assuming it to be mixed to the bottom of the ocean, with an average depth of four km., the half-life is only 1000 years. These

short lives for decompositions in the atmosphere or ocean clearly preclude the possibility of accumulating useful concentrations of organic compounds over eons of time.

Eventually the rate of formation of glycine would equal the rate of decomposition, and no further glycine would form, Thus, the build-up of high concentrations of glycine would be impossible.

Groth and von Weysenhoff[4] exposed mixtures of CH_4, NH_3, and H_2O vapor to ultraviolet radiation (1165-1470A). After an exposure of 10^{21} quanta, glycine could barely be identified in the product. If 0.1μ grams of glycine can be detected, then the yield can be calculated.[8]

It is found that the partial pressure of any glycine that would be formed would be only 10^{-14} atm. If three per cent reached the ocean, and considering its life there, the maximum concentration in the sea would be 10^{-12} molar.[8] Hull[8] states:

> This concentration is far from equilibrium. The actual concentrations realized would probably lie between 10^{-27} and 10^{-12} molar; but even the highest admissible value seems hopelessly low as starting material for the spontaneous generation of life.

Summary

Hull's conclusions are quoted:

> The conclusion from these arguments presents the most serious obstacle, if indeed it is not fatal, to the theory of spontaneous generation. First, thermodynamic calculations predict vanishingly small concentrations of even the simplest organic compounds. Secondly, the reactions that are invoked to synthesize such compounds are seen to be much more effective in decomposing them.
>
> Further, it must be remembered that both lines of argument become quantitatively of an overwhelmingly greater magnitude when organic compounds other than-the very simplest are considered. From thermodynamics, the equilibrium concentration of glucose is 10^{-134} at unit activities of the component reactants. The values for the simplest proteins must be unimaginably small. Also, in agreement with the thermodynamic prediction, the kinetic steady-state concentration falls rapidly with increasing complexity of organic compounds, because (1) the quantum yield for their formation decreases; (2) at the same time their stability against thermal decomposition decreases; and (3) their opacity to ultraviolet radiation and decomposition by this means increases. 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.

Miller's experiment is an excellent one, scientifically speaking. However, mixing water vapor with gases and sparking them in a closed glass system, then selectively removing the products certainly does not approximate any supposed primitive earth atmosphere.

The experiment simply proves that if these gases and water vapor are mixed in a closed glass system, sparked, and the reaction product removed to force the reaction to the right, then small amounts of simple organic compounds can be formed. The extrapolation of this up to a primitive atmosphere is not valid.

If the reacting mixture had been exposed to large doses of ultraviolet radiation, and the products left in the reacting chamber, the experiment would have more closely approximated supposed primitive conditions, but it still would be foolish to extrapolate it to a system the size of the earth's atmosphere.

If the postulated primitive atmosphere was reducing and electrical discharge energy was utilized to form certain simple amino acids, these compounds must randomly drift around in a hostile atmosphere of destructive ultraviolet radiation until eventually some of the product possibly could escape to the ocean to reach a limiting concentration there. Miller's experiment does **not** approximate this.

Many evolutionists, when faced with the second law of thermodynamics, state that the universe or living organisms are open systems; and, thermodynamics can only be applied to closed systems, which only exist in theory or can be approximated in a laboratory. The writer hopes to deal with these objections in a later paper, but for now it should be realized that Miller's experimental apparatus is a **closed** system.

The processes observed in this closed system are simply *assumed* to be possible in this part of our "open" universe (the earth) many years ago. Why reject unfavorable thermodynamic results in closed systems, and accept favorable results in other closed systems as being applicable to a natural situation? Even the favorable results are not so favorable when examined closely.

The line of reasoning of evolutionists can be seen from the various experiments conducted on organic compound synthesis:

For instance, since the earth's atmosphere is oxidizing, then experiments were run trying to synthesize organic compounds under oxidizing conditions. These were not successful, but experiments run under reducing conditions were successful. Then the "primitive" earth must have had a reducing atmosphere.

An energy source is needed and, if experiments utilizing the most abundant sources of energy are unsuccessful or unfavorable, then tests must be run employing the minor sources of available energy. If these are successful in the laboratory, then these must have been the processes occurring in spontaneous generation.

Well-trained men, given enough time and funds, could, through continual laboratory experimentation come up with a seemingly "experimentally proved" process of evolution. Laboratory conditions may never even closely approximate any natural situation that ever existed, but men of an evolutionary bent will **interpret** the results to suit themselves.

If men will not admit to a creation by God, then they will continue to look for experimental results that will suit their assumptions. Such men will accept only those results that aid their cause, or, will continue to look for experimental results that seemingly fit their theories. Men are in rebellion against God, and this rebellion is reflected in all of their activities, including scientific work.

The paper by Miller and Urey is very honestly written. They state their assumptions and direction of effort readily. The opening statement of the paper is as follows:[2] "Since the demonstration by Pasteur that life does not arise spontaneously at the present time, the problem of the origin of life has now been one of determining how the first forms of life arose, from which all of the present species have evolved."

This statement admits that uniformitarianism does not hold a satisfactory answer to the origin of life. Therefore, to explain the origin of life a scientist must look beyond present known scientific processes. For instance, although the atmosphere of the earth is oxidizing, experiments have shown that spontaneous generation could only have taken place under reducing conditions, another violation of uniformitarianism.

Scientist who believe in creation by a direct act of God, and believe in a universal flood are ridiculed because of their dependence on miraculous events and on catastrophism. Both direct creation and catastrophism are violations of uniformitarianism.

However, to explain evolution at key points, scientists must deviate from present known conditions and from present scientific processes. This is necessary in both the origin of life and the origin of the universe. This is catastrophism in reverse. Some fortunate or blessed event happened at the necessary time to help the process of evolution in its upward climb.

When a reducing atmosphere on the earth was necessary, it must have been there. When any spontaneously-generated organic material fell to the earth or into the ocean, a non-equilibrium condition must have existed to have allowed concentration of large quantities of these chemical compounds, so that the process of evolution could have continued to another stage.

The evolutionist needs these blessed events to explain his theories. The uniformitarian approach offers no help, and, in fact, present scientific processes allow only for reactions and mechanisms that are destructive to evolution.

Many people think that scientists go into an experiment unbiased as to the results that will be obtained. Miller and Urey[2] state: "Our discussion is based on the assumption that conditions on the primitive earth were favorable for the production of the organic compounds which make up life as we know it." This is a purely evolutionary approach, and all results will be interpreted according to this assumption. How can anyone come up with experimental results other than those that favor evolution with such an experimental bias?

It is also thought possible that many of the reactions necessary for spontaneous generation were catalyzed by the adsorption of organic compounds on clay and mineral surfaces.[2] It would indeed by unusual if adsorption processes on these materials did not catalyze at least some of the many reactions necessary for chemical evolution.

It has been found that the polymerization of aminoacetonitrite to glycine peptides is accomplished in the presence of acid clays.[12] But this does not say that this actually happened, or could it ever be proved that it did happen. Research of this nature will turn up facts not related to evolution. Yet, these facts could be utilized by some biased scientists to explain theoretical evolutionary processes, but actually they prove nothing.

This trend of thinking and scientific investigation will continue in the same direction as long as men are determined to rule out God in their lives. Only when a man accepts the Lord Jesus Christ as his personal Savior, and yields his life to Him. will he begin to realize the uselessness of scientific investigation into the origin of life and simply believe the Genesis account of Creation.

We can learn much of the creation through scientific research and many beneficial advances can be made, but science can not legitimately be used as a tool to refute the Biblical position that God created the physical universe and all that is in it.

References

[1]A. I. Oparin, *The Origin of Life,* Macmillan, New York, 1938, Academic Press, New York, 3rd cd., 1957.
[2]S. L. Miller and H. C. Urey, *Science,* 130, 245, 1959.
[3]S. L. Miller, Ann. *N. Y. Acad Sci,* 69, 260, 1957.
[4]W. Groth and H. von Weyssenfoff, *Naturwissenschaften,* 44, 510, 1957.
[5]A. N. Terenin, *Reports of the Moscow Symposium on the Origin of Life,* p. 97, August, 1957.
[6]E. I. Rabinowitch, *Photosynthesis,* 1, Interscience, New York, 1945.
[7]S. L. Miller, *Science,* 117, 528, 1953.
[8]D. E. Hull, *Nature,* 186, 693, 1960.
[9]S. L. Miller, *J. Am. Chem. Soc.,* 77, 2341, 1955.
[10]H. A. Bent, *The Second Law: An Introduction to Classical and Statistical Thermodynamics,* Oxford Univ. Press, New York, 1965.
[11]L. R. Koller, *Ultraviolet Radiation,* John Wiley, New York, 1952.
[12]P. H. Abelson, *Science,* 124, 935, 1956.

MUTATIONS REVEAL THE GLORY OF GOD'S HANDIWORK

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Mutations have been studied through three levels of investigation: (1) their original discovery and proof of inheritance according to Mendelian principles; (2) the artificial production of them by radiation and mutagenic chemicals and parallel with this work, the study of their actual behavior in natural populations; and (3) the molecular genetic approach.

In spite of great enthusiasm and many claims, no investigator has shown as yet that ***any*** *mutation is so advantageous as to spread through an entire species population of plants or animals. Molecular geneticists, such as Seymour Benzer, conclude, "in the DNA of living organisms, typographical errors are never funny and are often fatal."*

The technique used by Benzer in analyzing T_4 bacteriophage virus mutations is described, and it is shown that all mutations in this phage are either deletions of varying length, nucleotide base changes, or addition or loss of a base. When either an addition or loss of a base occurs the remainder of the code becomes a nonsense code and the combination is non-functional.

Molecular genetics shows the DNA code to be a marvelously complex one. Surely in studying it we are coming close to understanding how God is daily at work maintaining and preserving all creatures.

For many years mutations, or suddenly appearing changes in either the appearance or behavior of individual organisms, have been considered the material basis of evolution. However, as more is learned about the exact nature of mutations, the less likely do they seem as building blocks for the origin of even varieties, let alone species of plants. Indeed, cyto-genetic research, and especially molecular genetics, has revealed an ever-increasing complexity of the physical basis of inheritance called the "gene."

First Level of Investigation

The study of mutations has involved probably three levels of investigation. First, after their discovery by such pioneers as Hugo DeVries, there was the painstaking work of T. Hunt Morgan and his associates, Calvin Bridges and A. H. Sturtevant. These men patiently accumulated information on the naturally occurring changes, or mutations, in eye color, wing form, eye structure, bristle arrangement and numerous other features of the fruit fly, *Drosophila melanogaster.*

Careful intercrosses and back-crosses showed that these mutations could be grouped into four linkage groups corresponding to the four chromosomes of the species. Within each chromosome the mutant genes were located serially, like beads on a string. The order of their sequence was determined by crossing-over studies; those far apart showing much recombination, while those close together, very little. As a result "chromosome mapping" could be done with fair precision, though odd "clumping" of genes in certain areas remained puzzling. Similar detailed chromosome maps were made in corn, tomatoes, flour beetles, and various grains, such as wheat.

Meanwhile the *process* of mutation was greatly speeded up by X-ray irradiation of the fruit fly. Muller first made this discovery in 1928. Here was a way by which biologists could, in a few years, obtain more mutations than Morgan and his associates found in a lifetime of patient observation. Thus quantitative studies as to the percentage of harmful vs. neutral, or possibly advantageous mutations, could easily be made.

Here was the first disappointment for evolution-minded biologists, for most mutations found