

Creation Research Society Quarterly

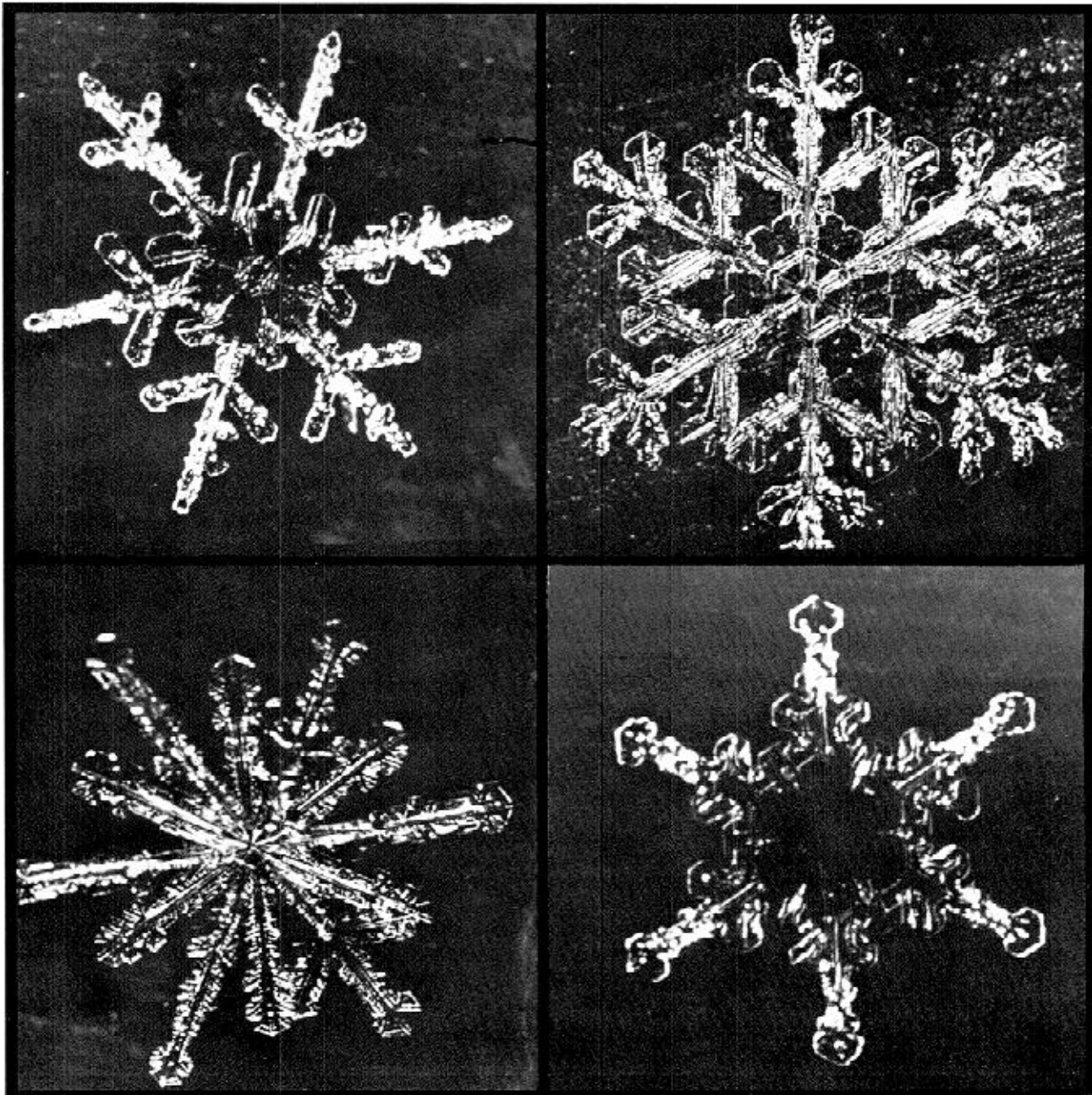
Haec credimus:

For in six days the Lord made heaven and earth, the sea, and
all that in them is and rested on the seventh. — Exodus 20:11

VOLUME 15

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NUMBER 4



CREATION RESEARCH SOCIETY QUARTERLY

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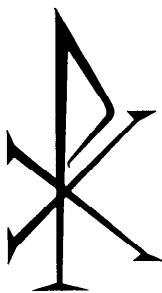
MARCH, 1979

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NOTICE OF OPEN MEETING

Notice Regarding Research Reports

An open meeting of the C.R.S. Board will be held at 6:00 p.m., Friday, April 20, 1979 at the Concordia College, Ann Arbor, Michigan. At this session general announcements and progress reports will be given.

C.R.S. does not hold conventions and this meeting is not to be understood as a "Creation Seminar" in the usual sense of that term. However, various individuals and groups carrying out research under the auspices of C.R.S. will give progress reports on such activity. C.R.S. members wishing to present short reports of their own creation research projects should write to Dr. Emmett Williams, Jr., 403 Library Drive, Greenville, South Carolina (20609) submitting a one-page abstract of the data and conclusions to be shared. Abstracts of papers accepted will be circulated at this meeting. Dr. Williams will coordinate this session and will include as

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many papers as the allotted time will permit. Those wishing to attend are cordially invited.

On Saturday morning, April 21, 1979, the Board of C.R.S. goes into closed sessions.

COVER ILLUSTRATION

On the front cover are shown four photographs of snowflakes. The beauty, symmetry, and variety of snowflakes never cease to be sources of wonder to all who think about such things; and Mr. Willis E. Keithley, elsewhere in this issue of the *Quarterly*, has enlarged a little upon these considerations. Mr. Keithley also supplied the photographs for the front cover.

TO MAKE A SNOWFLAKE†

WILLIS E. KEITHLEY*

In the infinity of space, whirls an infinity of stars, galaxies and universes of a magnitude that dwarfs our wildest dreams. What an infinite interaction of chemical and physical energies God initiated in those celestial nuclear reactions!

Then one day, God tired of the titanic, and sought a design that would bring His cosmos to a perfect climax. So He made a snowflake.

By bringing together all those great forces that had formed the worlds themselves, He forged this delicate mini-meteor. With the flaming power of the sun, He drew from the ocean a few drops of water and dissected them into a pure breath of vapor. Then with a mighty gust of wind He blew them high above the world into the clear non-resistant environment of the upper atmosphere. There in that pristine heaven, where no earthly influence could hinder their outward growth, He began to reassemble those misty molecules, atom by atom; as Isaiah would describe it, "line upon line, line upon line, here a little, and there a little."

But line by line seemed a bit monotonous. Then came a magnificent thought—why make them all the same? Why not program the design computer for a chain reaction and let each line punch the card for the next, and adjust the output for infinity?

Yet there should be some overall trademark which would identify their Creator. It was clearly evident that God should be presented in His triune nature; so a perfect triangle was programmed. Then God in His eternal foreknowledge saw the day when He would

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†An account, similar to this, is given on pages 3-5 of Mr. Keithley's book, *Portraits on Nature's Palette*, available from the author at the address given above. The book was reviewed on page 76 of the *Quarterly* for June 1977.

assume the human trinity of man's body, soul and spirit. Why not combine the two triads into a perfect six-pointed star?

What a triumphal triunity to reflect Christ as the morning Star of hope!

Does that sound a bit idealistic? Secular philosophy says all natural phenomena result from the casual cast of some capricious crap game. And here is a chance to exploit that conjecture of chance. It is reported that no two snowflakes are exactly alike; of course no one has ever verified that by examining all of them. Certainly the ones shown on the front cover are all different. But their manifold variety points to infinity. Would not that diversity seem to suggest the randomness upon which all the facets of nature could be built?

Yet these spontaneous anomalies of snow exhibit no tendency to develop into anything but a snowflake. With such infinite variation, surely they should at least have developed a wheel, as Henry David Thoreau described them so expressively, "There they lie, like the wreck of chariot wheels after a battle in the skies . . . these glorious spangles, the sweepings of heaven's floor." If unlimited randomness be the script for the cosmos, here should be enough deviation to prove both polemic and platitude.

But we must not neglect the evidence of design and purpose. Could it be mere chance that the heart of each snowflake is the very essence of geometry? Those sets of sixes and their precise sixty degrees reveal not only the holy Star of David, but witness the centrality of plan and pattern. Even Thoreau was compelled to look beyond the caprice of nature when he wrote in his journal, "Nature is full of genius, full of divinity. Nothing is cheap and coarse, neither dewdrop nor snowflake. A divinity must have stirred within them before the crystals did thus shoot and set."

MARINE LIFE AND THE FLOOD

E. NORBERT SMITH*

Received 24 May 1978

Stenohaline plants and animals could not have survived a global homogeneous flood. Since salt water is more dense than fresh water, a situation in which dense salt water is overlaid by less dense fresh water is stable. Stenohaline organisms might have survived the flood by inhabiting extensive pockets of salt water lying underneath the predominantly fresh-water deluge. Brine pockets have been described in recent literature. A simple experimental model showed the plausibility of a heterogeneous flood.

How Salinity Affects Marine Creatures

Terrestrial animals, including man, survived the catastrophic deluge described in Genesis by God's provi-

sion of the Ark. The Biblical account is silent regarding survival of fresh water and marine organisms. It is true that many kinds of organisms can survive marked changes in salinity. Howe¹ provided evidence that at least some plant seeds can survive long period of soaking in varying concentrations of salt water. Salmon, striped bass and several other fish hatch in fresh water,

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mature in the sea, then return again to spawn in fresh water. Young eels hatch in the sea, mature in fresh water and return to the sea to spawn. Many crustaceans and other invertebrates survive marked daily and seasonal changes in salinity. Whitcomb and Morris noted the problem and cited examples of tolerance to changes in salinity of a few fish.² They suggested that if salinity changes were slow enough at least a few individuals would be able to adapt. Certainly many fish (and some invertebrates) can adapt to wide changes in salinity if the changes are slow.

There are however, many kinds of plants and animals that cannot tolerate marked salinity changes no matter how slow. Such animals are called stenohaline and must live within a narrow range of salinities. There are also many fresh water organisms that cannot tolerate an influx of sea water. How did they survive the flood?

The Bible tells us there were two sources of water for the flood. The windows of Heaven were opened (or rain) and the fountains of the deep were broken up. The latter statement probably refers to juvenile water trapped beneath the earth's crust since creation. One would hardly expect rain to contain significant amounts of salt. Juvenile water could contain varying amounts of inorganic salts, but would probably be qualitatively and quantitatively dissimilar to the sea. However, the problem remains; a homogeneous fresh-water deluge would kill stenohaline marine forms and a homogeneous salt-water deluge would destroy many fresh-water organisms. One is then left with but two alternatives: Organisms that cannot tolerate marked changes of salinity have radiated since the flood; or the flood waters were not homogeneous with respect to salinity. Since many complex physiological changes are necessary to change a euhaline organism into a stenohaline organism, this author does not believe the multitude of osmoregulatory mechanisms described today have developed in the short span of time since the flood. Let us, therefore, examine the other possibility, namely, that of heterogeneous flood waters.

Existing Nonhomogeneous Situations

The density of seawater increases linearly with the salt content. Salt water is more dense than fresh water. A stable configuration exists if salt water is overlaid by fresh water. Natural occurrences of this type are not uncommon. An interesting example was related to the author by Dr. Vernon Proctor, Texas Tech. University. About 10 km Southwest of Cuatrocienegas, Coahuila, Mexico, a spring-fed creek is formed near the base of the Sierra de Los Alamitos mountains. The creek contains considerable salts in solution. Occasional flooding leaves small pools typically 1-3 m across and about 1/2 m deep. During periods of drought, evaporation increases salinity in the isolated pools near the flowing creek. On one occasion, flooding of the creek resulted in fresh water spilling over the salt water in the pools. The duration of this situation was undetermined but Dr. Proctor and his students made two interesting observations. First, a marked thermocline was obvious, the lower salt water being too hot to hold one's hand in and the surface water being relatively cool. Secondly, they

observed an unidentified species of fish living in the surface fresh water. When frightened, the fish would swim momentarily into the lower hot salt water and immediately return to the cooler fresh water on top. If forced to remain in the lower water the fish would quickly die, due, probably, to the high water temperature. The author visited the area a few years later. Unfortunately, prolonged local flooding had purged the depressions of the bottom brine.

A similar situation has been described in the Venezuelan Antilles on the Island of Gram Rogue about 150 km north of Caracas, Venezuela.³ A small brackish lagoon, roughly circular, with a diameter of about 0.5 km, was found to consist of hot brine overlaid with about 25 cm of seawater. The two densities were relatively constant above and below the 25 cm thermocline despite observed shallow-water circulation due to dominant easterly winds. Density-stratified lakes having a sharp thermocline were first described in Somaliland⁴ and later in Washington⁵ and Antarctica.⁶ It is interesting that solar ponds of Israel, used to produce electricity, consist of about 50 cm of brine topped with fresh water.⁷ It is widely known that rivers flowing into the sea ride atop a wedge of salt water. The depth of the wedge (from the surface) changes with the ebb and flow of the tides. Each of these situations is stable because, even when hot, the lower salt water is more dense than the surface water. Under natural and artificial conditions density stratifications will survive surface mixing by wind.

Possible Nonhomogeneity During the Flood

Could not this simple phenomenon account for the survival of marine organisms during the flood? Certainly pre-flood seas would have been overlaid by rain and continental run-off. Large basins of seawater of extent measured in km would have been immensely stable if overlaid by tens or hundreds of meters of fresh water. Turbidity, and the depth of the surface water, would have minimized radiant heating of the lower seawater. A stable situation would result, facilitating survival of stenohaline organisms for the duration of the flood. It is conceivable that in many places enough light would filter through to enable photosynthetic plants to produce oxygen. Certainly diverse food chains would abound from the continual "rain" of detritus from the surface water.

The survival of marine organisms during the flood can then be accounted for in terms of a heterogeneous flood. Survival of surface fresh-water life is straightforward. Continental uplift and mountain formation toward the end of the flood would result in many isolated fresh-water lakes, rivers and streams. These would be populated with fresh-water organisms remaining and colonizing new areas until the present time.

How did the pockets of marine life survive and populate the seas? During the first forty days of the flood, juvenile water no doubt brought with it varying quantities of brine. Some were probably toxic and some may have been considerably more salty than today's seas. These pockets of brine would have survived the flood water intact due to their very high density.

Toward the end of the flood, continental uplift would have again released juvenile water and additional salts. The natural salts would begin mixing with the seawater. As the continents were uplifted our present global patterns of winds and ocean currents would gradually be established and consequently much of the sea would become homogeneously mixed. The density gradient would be reduced and the "pockets" of marine organisms would be released. One might predict that if the flood was indeed heterogeneous complete mixing of the brine would not have happened for many years. In fact, if certain brine basins were very dense, sheltered from oceanic currents, and deep enough to be protected from surface mixing, one might expect to find some today. Hypersaline water has been found in deep boreholes in the Gulf of Mexico;⁸ and bottom waters from three Red Sea Basins⁹ are hypersaline.

It is interesting to note that a hypersaline basin was recently reported in Science.¹⁰ The basin, named Orca, is in the Northern Gulf of Mexico (about 27°N, 91°W) and extended from a depth of about 2200 meters to the bottom at about 2400 meters. Its area is approximately 400 km². (Table 1 compares selected water chemistry differences of Orca with sea water and Red Sea Basin.) Salinity of Orca approaches that of the Red Sea Basins; and it is over eight times more salty than the sea.

While the Orca Basin may have been formed by some non-flood mechanism, it does indicate a strong stability of natural density gradients and clearly shows that even

today the ocean is not homogeneous. Certainly marine life could have survived the flood by simply being overlaid by fresh water. Obviously, more work needs to be done. Geologically, qualitative estimates of available salts and final densities need to be made and compared with sea water. Biological studies need to be made to establish the limits stenohaline organisms can tolerate.

Table 1. Comparison of chemistry of sea water with water from two naturally occurring hypersaline basins. See Reference 10.

	Salinity g/L.	Cl ⁻ g/Kg	Na ⁺ g/Kg	Density g/ml
Sea water	36.3	19.4	10.8	1.025
Red Sea Basin	317.1	155.3	92.9	1.199
Orca Brine	308.5	149.5	91.5	1.85

Experimental Arrangement

A simple experiment was performed to test the survival and extent of mixing in an aquarium containing sea water overlaid with fresh water. A small all-glass aquarium measuring approximately 16 cm × 16 cm and 30 cm high was filled to a depth of about 24 cm. The lower half was filled with natural sea water (collected from a bay having a salinity somewhat less than water in the ocean). A hermit crab, and natural sea sand

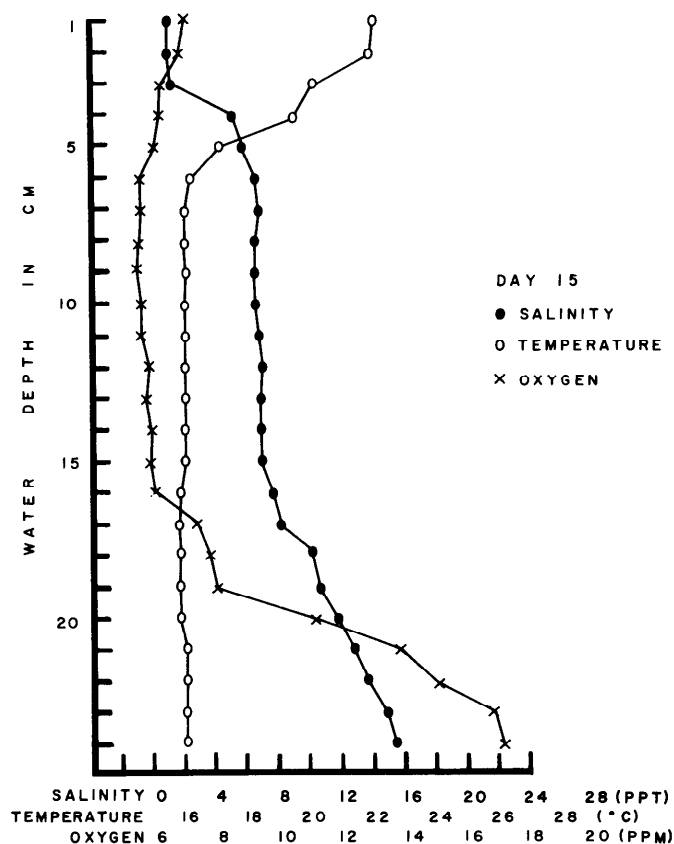
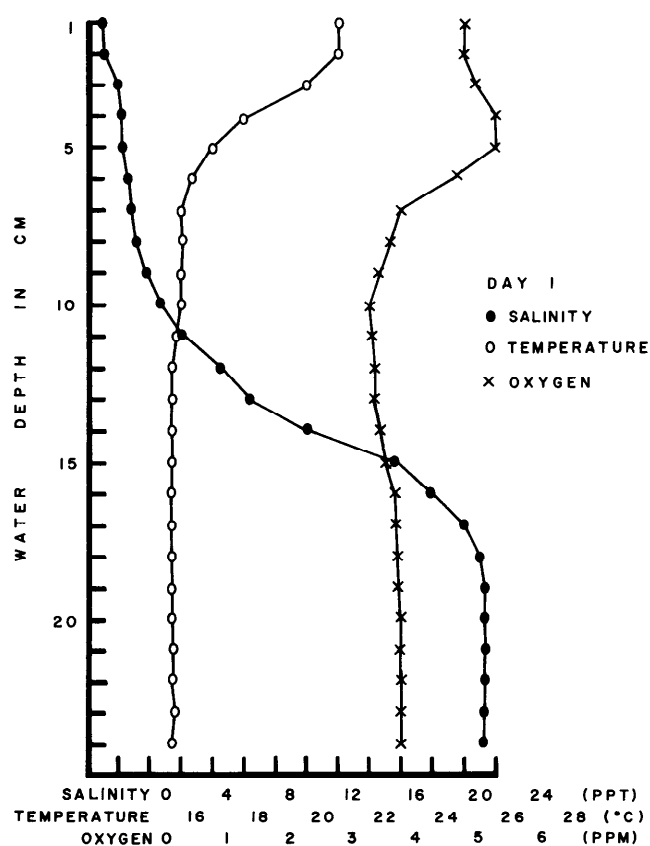


Figure 1. Relation between water depth and the measured values of salinity, temperature, and dissolved oxygen. A 4.5 cm goldfish was present and apparently contributed significantly to the mixing of the water.

containing algae, were introduced into the salt water. A sheet of paper was placed on the salt water and fresh water added slowly (to minimize mixing). A 4.5 cm goldfish, fresh water snails, duckweed and *Elodea* were introduced in the surface water. The aquarium was placed near a north window (December and January). The water temperature, oxygen, and salinity were measured from time to time at 1 cm intervals of depth for 15 days. Temperature was read and conductance (read out as salinity in ppt) was measured on a YSI Model 33 S-C-T Meter. Oxygen was measured on a YSI Model 57 oxygen meter. Measurements were taken in the afternoon between 4:00 and 6:00 p.m. Since it appeared that the goldfish contributed significantly to the mixing of the boundary layer a second experiment was conducted without the goldfish.

Experimental Results

The goldfish swam (with great difficulty, due to high buoyancy) through the salt water to the bottom when first released. It soon left the bottom and remained in the fresh-water portion of the tank. Most of the time was spent in the upper 5-10 cm. After a few days it would often swim rapidly down into the upper few cm of salt water but was not seen near the bottom after the first day. It fed at the surface on fish food. Food dropping on to the bottom was eaten by the hermit crab. The fresh-water plants survived and showed growth.

Figure 1 shows the relation between water depth and the measured water parameters with the goldfish. The salinity gradient was steep on day 1, but by day 15 the gradient was almost gone. Oxygen concentration increased toward the end of the experiment especially in the salt water, due to photosynthetic activity of algae. No thermocline was found at the fresh-salt water boundary because solar radiation was unavailable.

Figure 2 shows the same relation without the goldfish. Surface and bottom water remain considerably less mixed. Oxygen concentration is again high due to photosynthetic activity of Marine Algae. A small amount of foam was present on the surface due to oxygen bubbles coming from the lower water.

Figure 3 shows isohaline depths during the course of the two experiments. Clearly the goldfish contributed to mixing in the first experiment. In the second experiment a stable condition exists and the experiment could probably have been continued for several weeks with little change.

Discussion of Results

It is apparent that marine organisms can indeed survive if overlaid with fresh water. Photosynthetic activity can supply adequate oxygen if light is available. In the very small experimental model described here the movements of one goldfish resulted in mixing of the fresh and salt water. During the flood the large extent of

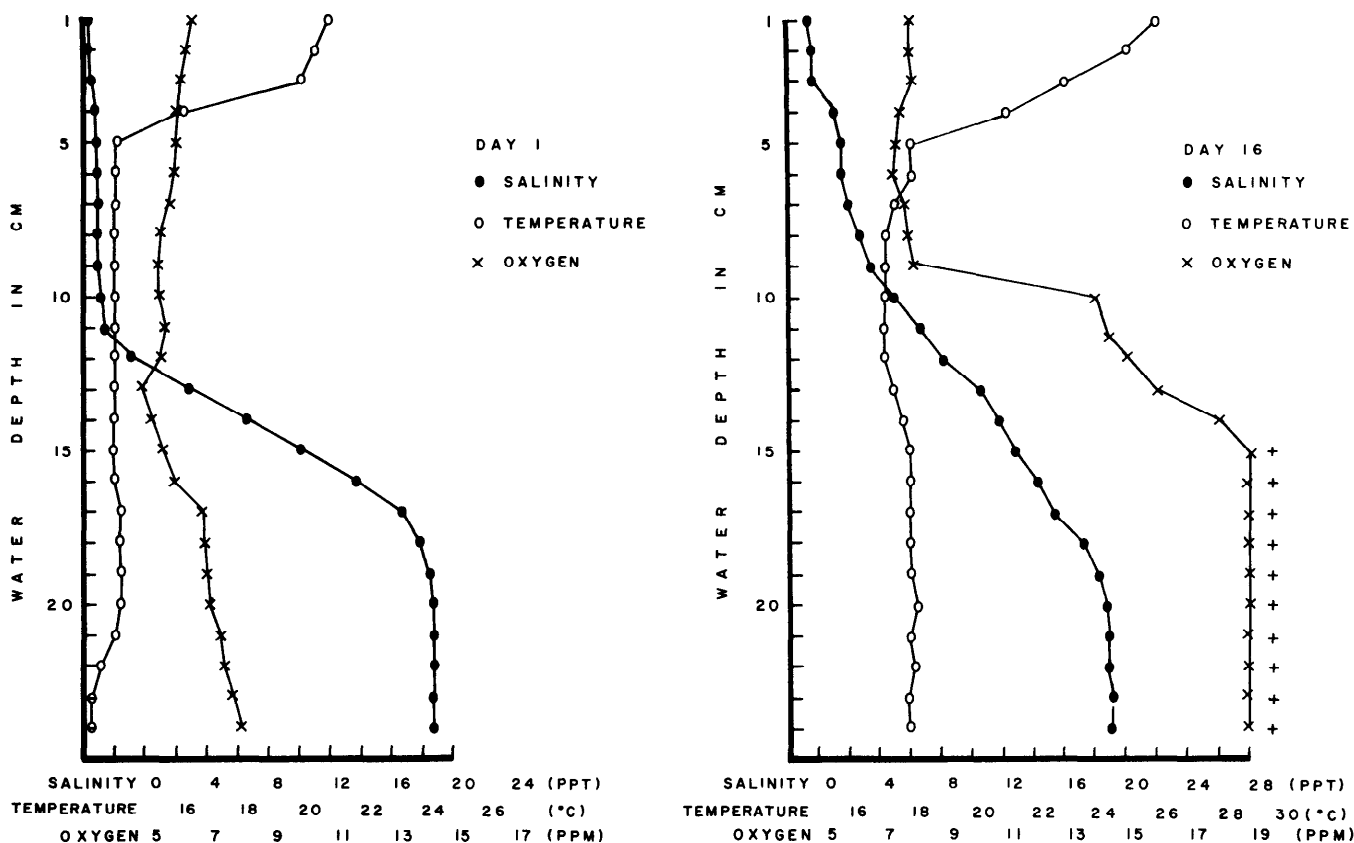


Figure 2. Relation between water depth and the measured values of salinity, temperature, and dissolved oxygen in a second trial. The goldfish was not present. The oxygen meter only measured to 20 ppm, so plus signs (+) indicate full scale reading of oxygen, i.e., 20 ppm or more.

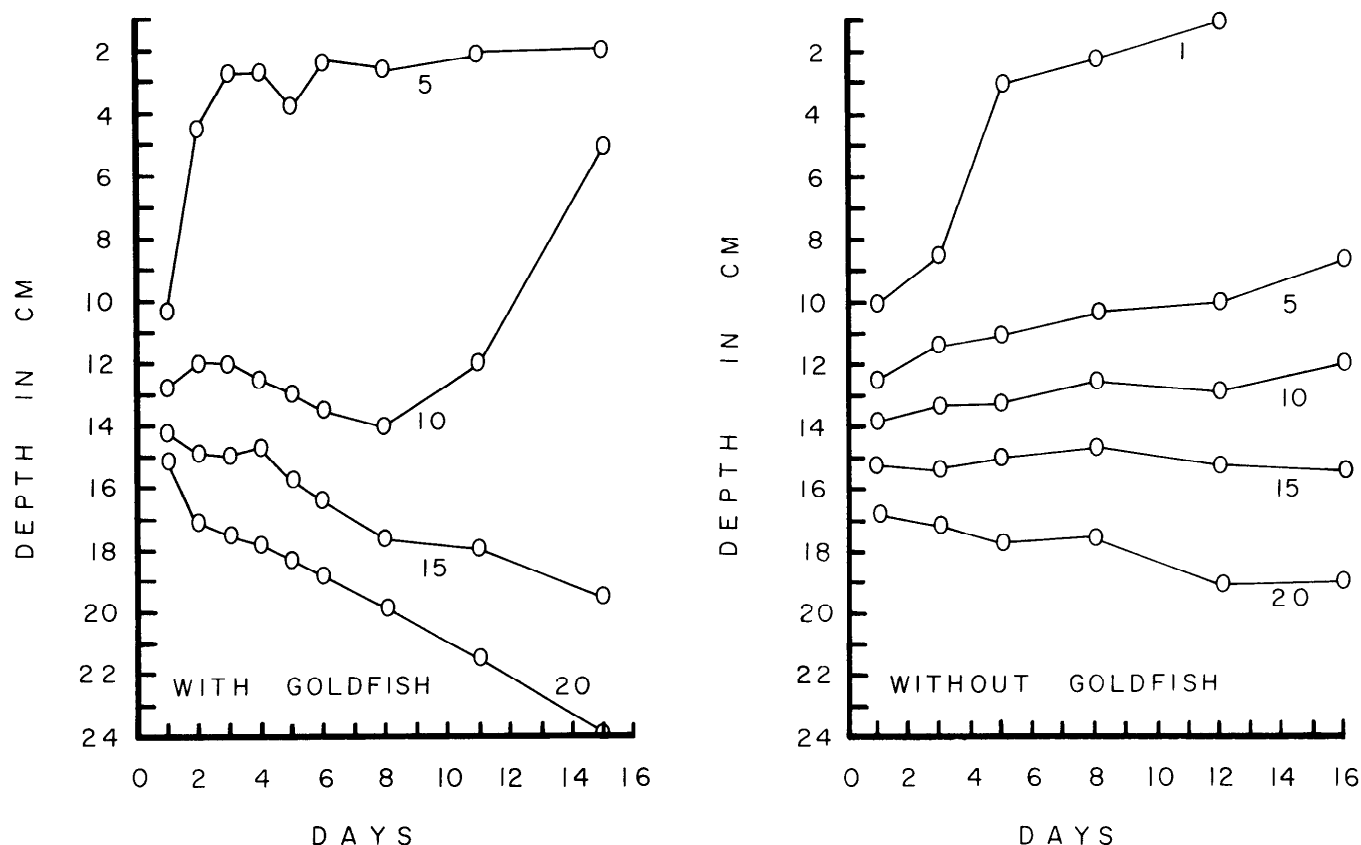


Figure 3. Isohaline depths shown as a function of time with and without the goldfish. The curved marked "10", e.g., shows the depth at which, at the respective times, the concentration of salt was 10 parts per thousand.

interface region would no doubt allow stability for a period far exceeding the year of the flood.

Conclusion

It is suggested that fresh-water and marine stenohaline organisms could have survived a heterogeneous deluge simply because dense salt water can be overlaid with lighter fresh water. This phenomenon occurs naturally and can be produced artificially. A simple experimental model illustrated that marine and fresh-water organisms can indeed live in the same aquarium without undue mixing of the two media. Clearly research is needed to ascertain the geological implications of this model. Additional biological studies to determine survival of marine organisms under low light and low oxygen concentrations are needed.

References

¹Howe, G. 1968. Seed germination, sea water and plant survival in the Great Flood. *Creation Research Society Quarterly* 5 (3): 105-112.

²Whitcomb, J. C., and H. M. Morris. 1961. *The Genesis Flood*. Baker Book House. Grand Rapids, Michigan, p. 387.

³Hudec, P. O., and P. Sonnefeld. 1974. Hot brines on Los Roques, Venezuela. *Science* 185 (4149): 440-442.

⁴Fulda, E. 1928. *Z. Deut. Geol. Ges.* 79: 70.

⁵Anderson, G. C. 1958. Some limnological features of a shallow saline meromictic lake. *Limnology and Oceanography* 3 (3): 259-270.

⁶Shirtcliffe, T. G. L., and R. F. Benseman. 1964. A sun-heated Antarctic lake. *Journal of Geophysical Research* 69 (16): 3355-3359.

⁷Browland, F. K., and G. Koop. 1972. Thermocline structure in a fresh water reservoir. *Bulletin of the American Physical Society* 17 (11): 1108.

⁸Manheim, F., and J. Bischoff. 1969. Geochemistry of pore waters from Shell Oil Company drill holes on the continental slope of the northern Gulf of Mexico. *Chemical Geology* 4, 63-82.

⁹Brewer, P., C. Densmore, R. Munns, and R. Stanley. 1969. Hot brines and recent heavy metal deposits in the Red Sea. E. Degens and D. Ross. Eds. Springer-Verlag, New York. Pp. 138-147.

¹⁰Shokes, R. F., P. K. Trabant, and B. J. Presley. 1977. Anoxic, hypersaline basin in the northern Gulf of Mexico. *Science* 196 (4297): 1443-1446.

QUOTABLE QUOTE

"Hence all the nonsense . . . that the *élan vital* is capable of surmounting all obstacles . . . as if we could believe that any social or biological development on this planet will . . . reverse the second law of thermodynamics."

C. S. Lewis, in a sermon,
The Weight of Glory, given at Oxford.

GLOBAL PRECIPITATION UNDER A CANOPY†

DONALD L. CYR*

In our continuing effort to "pick fights" with the establishment, we have tended to concentrate on astronomers and archaeologists, neglecting almost completely the geologists. This is not to say that geologists are not vulnerable, but rather that they tend to admit their limitations more openly. Such candor has a charm that is all too rare!

In a recent issue of *Science*¹ a group of geologists reported the estimates of the sedimentation rate in the oceans during the past 60 or 70 million years (the Cenozoic Age). Their reasoning was that any changes in the rate of sediments falling on the floor of the ocean would reflect continental weathering rates. In turn, weathering would depend on the amount of precipitation, which is turn is obviously effected by atmospheric circulation. So far so good!

Of course the geologists have obviously never heard of the Vailian Canopy theory,^{2,4} or they would "know" that the atmospheric "circulation" was under planetary control for most all of geologic time. Since the Canopy is now absent, the storms (not the same as precipitation)

cause severe damage and erosion to increase the sedimentation rate. Yet, as the geologists suspect, the record is there, available to be read by anyone who asks the right questions.

When the "Canopy Factor" was in control of the earth's climate, it acted to control the amount of precipitation in a gentle fashion, so that in some epochs precipitation was greater (on an average basis) although the amount of erosion was actually less. At other times, the precipitation was somewhat less, so that climate was milder in Britain (say) at a time when it was also a bit cooler (compared to now) in the Mediterranean region. The ice particles in the Canopy actually filtered the heat rays of the sun like cosmic sunglasses.

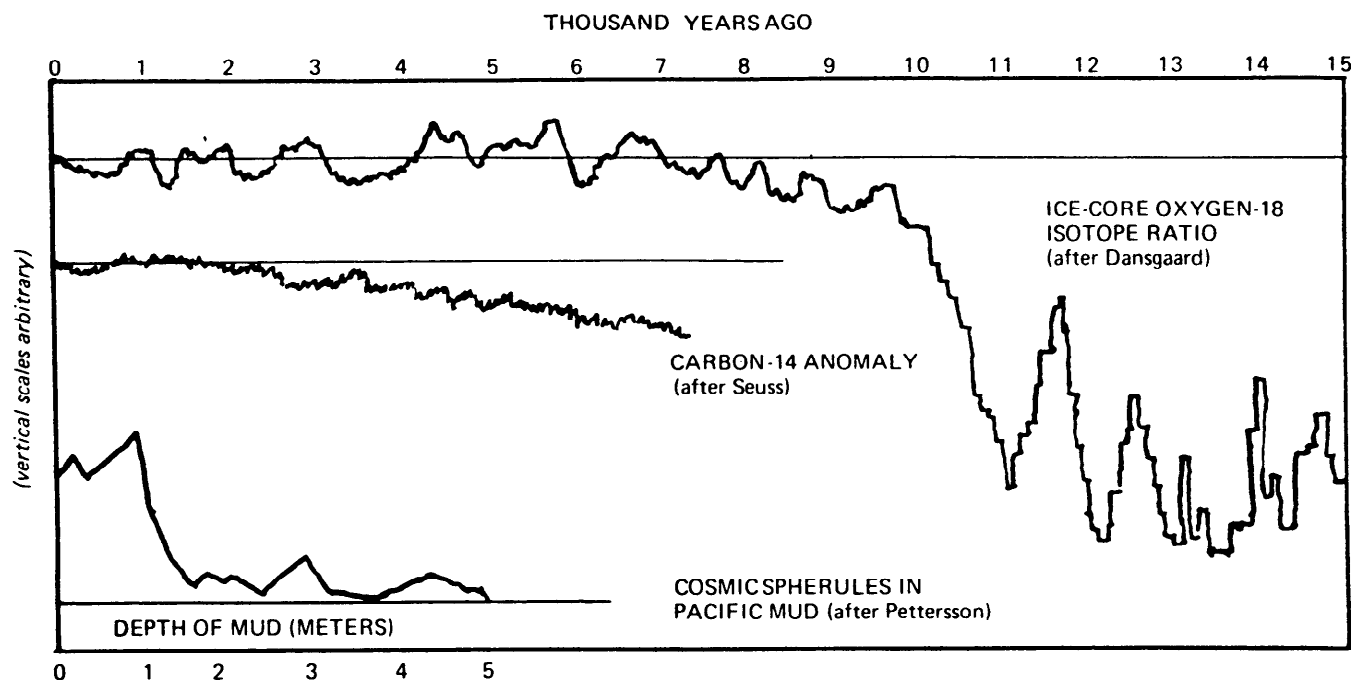
Davies, Hay, Southam, and Worsley, the geologists who are investigating the rates of sedimentation, draw some most interesting conclusions. They conclude that "These data suggest that there may have been significantly different modes of weathering of continents during the Paleocene-early Eocene and late Eocene-early Miocene." The implication is that the continental climates prevailed over wide areas that were *unlike those prevailing today and may reflect a different state of atmospheric circulation*.

The surprising thing is that the legends and sacred writings have known about this early state for a long time. The legends refer to a "golden age" and the sacred

(Continued on page 211)

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†This item is reprinted, by permission, with a few slight changes, from the *Stonehenge Viewpoint*, volume 9, number 4, July and August 1978. The *Stonehenge Viewpoint* is concerned with the study of antiquity, and especially of the megalithic cultures. Its mailing address is P.O. Box 30887, Santa Barbara, California 93105.



The Canopy Factor can also explain certain other variables that have been detected in physical records for the last 100,000 years, and may well provide an explanation for certain effects that are now only suspected. The pattern of the oxygen-isotope ratio in Greenland and Antarctic ice sheets is one "mystery" that can readily be resolved by the Canopy Factor. Also the distribution of cosmic spherules in oceanic muds has occurred in a manner that shows control by the Canopy, which acted to monitor the inflow of meteoric debris during the same period.

For the work by Dansgaard, Pettersson, and Suess, see references 5, 6, and 7 respectively.

Many Creationists would disagree with the time extending back more than 10,000 years. It is not proposed here to defend such ages; but the figures quoted might be taken as relative dates.

A CONSISTENT CHRISTIAN-SCIENTIFIC VIEW OF THE ORIGIN OF LIFE

DUANE T. GISH*

Received 21 April 1978

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-

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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 reviews¹⁶⁻²⁰ 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 ac-

counted 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 if it 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 evi-

dence 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 Brinkman³⁵ 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 Walton³³ 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 phosphoric 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 scientist! 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 sugars⁵⁵ and of nucleotides⁵⁶ 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 insoluble 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 pre-

cise 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 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 (4³) 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 pro-

duced 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 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.

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 incre-

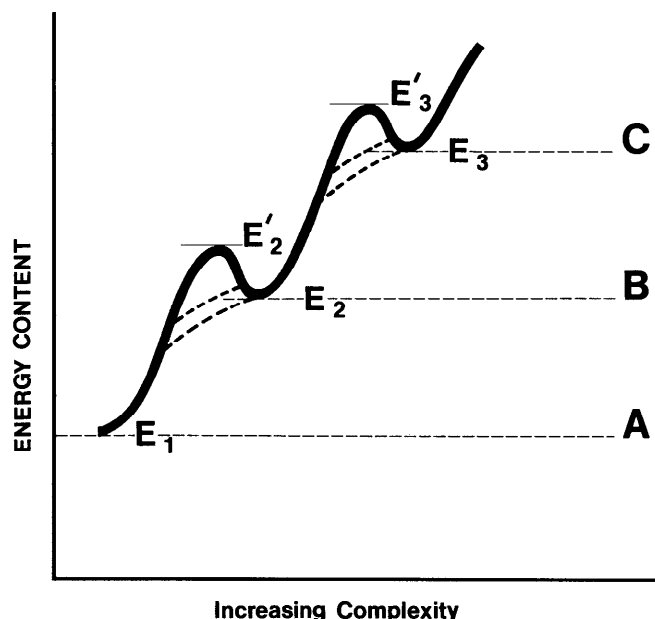


Figure 1. Energy content as a function of increasing complexity of organic chemical molecules.

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.

ments 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.

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 Young⁶⁸ 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, $dS = d_e S + d_s S$, 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; $d_e S$ is the entropy change of the earth system due solely to internal processes, which must be positive, according to the Second Law; and $d_s S$ is the entropy, assumed to be negative and in excess of $d_e S$, 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 $dS = d_e S + dE_e$, 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 organisms 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

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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-Cambri-

an 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".

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.

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And Tempus caused macromolecules to form in the primal oceans; and the macromolecules began to reproduce themselves and develop a cellular structure.

And the sea brought forth protozoans and algae, and spore yielding organisms after their kind; and energy from the sun which ruled the day, was effectively used by some of the organisms; and Tempus was satisfied with the outcome. And the time that elapsed was the third age.

And Tempus caused other special forms of life to appear, the sponge, the jellyfish, the shellfish and later the starfish followed by the sunfish.

Swimming fish then appeared so that the sea had life but the land was barren. So Tempus caused seaweeds to evolve into mosses and ferns and spore yielding plants in their manner; great forest swamps also sprung up.

And Tempus caused great sharks to evolve and many creatures that move within the sea.

Then reptiles appeared on the earth, and some were great and dreadful, and Tempus was satisfied with the outcome.

And the time that elapsed was the fourth age.

And Tempus caused more life to evolve abundantly upon the earth, creatures that crawl upon the earth and fowls that fly above the earth in the open sky.

And Tempus caused pines to appear and cone-bearing trees and winged fowl that might shelter in the trees; and Tempus was satisfied with the outcome.

And among all the forms of moving life that appeared, the stronger strains destroyed the weaker strains so that only the fittest survived to multiply in the earth.

And the time that elapsed was the fifth age.

And Tempus caused many other living creatures to evolve on the earth, creeping things and cattle and beasts of the field; but the stronger strains destroyed the weaker strains so that only the fittest survived.

Those that survived were best able to adapt to their changing surroundings, and Tempus was satisfied with the outcome.

And Tempus caused the struggle to continue until a man evolved, with differences from the other forms of life. He had greater intelligence and thus acquired dominion over the fish of the sea and over the fowls of the air and over all the earth, and over every creeping thing that creepeth upon the earth.

So Tempus evolved man in a special image, in both male and female forms they evolved.

And Tempus caused them to be fruitful and multiply and increase in the earth and to take charge of it, having dominion over the fowl of the air and over every living thing that moveth upon the earth.

And Tempus caused them to take of every herb bearing seed upon the face of the earth and of every tree bearing fruit and of anything else they chose for their food.

And the animals also ate of the plants, but some ate other animals smaller and weaker than themselves and some ate one another.

And Tempus was satisfied with everything that had evolved, and the time that elapsed was the sixth age.

Thus the major evolution of the earth was finished, and all the life within it.

Comments

Any valid comparisons between the theories of evolution and creation must be made on the basis of similarly structured presentations. The above account indicates that the theory of evolution appears to be no less mythical than that of creation, when presented in similar style to the biblical account of creation. When

evolution theory is commonly presented with the questionable assumptions in the background, it appears to have a sound scientific structure, and the role of faith in time, to bridge the unproven gaps, is not readily obvious.

Many of the weaknesses in the evolution theory have been well documented by Morris in his book, *The Troubled Waters of Evolution*,² by Gish in *Evolution, The Fossils Say No!*,³ and in the works of other creation scientists. It has also been pointed out by these authors how these weaknesses are resolved by a creation-based theory. The major objection to the creation concept is that it requires a belief in a supernatural power at the beginning, to bring the earth and life into existence, whereas in evolution, the current laws are supposed to operate "*ad infinitum*". A careful examination of the theory of evolution, however, indicates that effects like mutations, which are limited in scope, are extrapolated beyond their observed scope, to make the theory tenable. Such extrapolation gets into the realm of the supernatural; but faith in time is required to naturalize the supernatural. So the supernatural does exist in the theory of evolution as well, although in a more subtle form. There is really no sound basis for labelling creation as a religion while evolution is a science.

At the same time, it must be acknowledged that evolution appears to many to have a better scientific structure than creation. This is easily explained by the total expenditure both in terms of financial support and in intellectual expertise, invested in this field. Since the theory of creation has as firm a basis for further scientific investigation, there can be no justifiable reason for the denial of similar financial support for creation-oriented research. It is our conviction that such research will establish the scientific superiority of the creation theory.

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(Continued from page 214)

²⁴Wolpoff and Brace, *op. cit.*

²⁵*Ibid.*

²⁶Pilbeam and Gould, *op. cit.*, p. 893.

²⁷Simons, *op. cit.*, p. 675.

²⁸1976. Rethinking human evolution. *Nature* 264 (5586): 507-508.

²⁹*Ibid.*

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POLYAMINO ACID—THE MISSING LINK

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It is established that simple chemicals, under influences such as electrical discharges, can combine to form such organically important structures as amino acids. Evolutionists have often proposed some such reaction as the beginning of life. However, the amino acids are neither life nor are they sufficient for life. It would be necessary to have them polymerized into polyamino acids. Several schemes for such polymerization have been proposed; but it is shown that there are strong reasons to doubt that any of them ever happened.

One suggestion, in particular, has been that hydrogen cyanide, formed under primitive conditions, polymerized to form complicated molecules which were at least on the way to forming part of living things. However, a closer investigation shows that there is no evidence that the result of the polymerization—if such it be—is the production of molecules of the kinds necessary for life.

Introduction

Since the earliest recorded times, questions concerning the meaning and origin of life have been pre-eminent in the religious and scientific thought of man.¹ For many thousands of years science and mysticism have been intermixed by man in order to rationalize his existence.

An example of such a rationalization was the theory of spontaneous generation. In 1864, however, Pasteur seemingly destroyed the concept of spontaneous generation. While Pasteur's experimentation was aimed at the explication of the evolution of complex biological entities, such as bacteria, original scientific thought concerning the origin of life was not forthcoming for nearly 60 years.

Oparin² and Haldane³ independently theorized that life might have originated in pools of organic matter existing in the primitive ocean. Thus, the concept of spontaneous generation was reborn, albeit on a time scale involving billions of years.

It is claimed by many evolutionists that the atmosphere of the primitive earth did not contain oxygen gas (O₂). In 1929, Russell⁴ found that hydrogen is the most abundant element in the universe. Oparin⁵ and Urey⁶ argued that since the cosmic abundance of hydrogen is so great, the atmosphere of the primitive earth must have been highly reducing.

Synthesis of Amino Acids

The first experimental test of the Oparin-Haldane hypothesis was conducted by Miller in 1953.⁷ He subjected a mixture of methane, ammonia, water and hydrogen to electrical discharge. His isolation of glycine, α -alanine, β -alanine, aspartic acid and α -aminobutyric acid from the reaction solution provided the first experimental support for the Oparin-Haldane hypothesis. Abelson⁸ studied the effect of electrical discharge on 20 different gases including hydrogen, ammonia, methane and carbon dioxide. He found that glycine, β -alanine and sarcosine were produced, among other products. Groth and von Weyssenhoff⁹ exposed mixtures of methane, ethane, ammonia and water to ultraviolet radiation and identified glycine, alanine, and aminobutyric acid as reaction

products. Ionizing radiation,¹⁰ x-rays¹¹ and heat^{12,13} have all been used to produce amino acids under presumed primitive earth conditions.

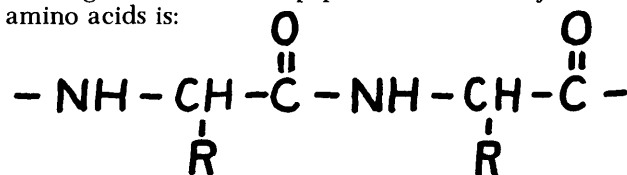
Synthesis of Polyamino Acids

Polyamino acids are readily prepared under stimulated supposed prebiotic conditions by heating suitable proportions of dry amino acids.^{14,15} Such polymers, termed proteinoids, according to the evolutionists, show many properties envisionable as being important in evolutionary processes (for example, catalytic activity, morphogenesis), and they are regarded as models for prebiotic protein.¹⁴

Temperatures conducive to the removal of nascent water (120° to 200°C) typically have been used in the synthesis of proteinoids, although the polymerizations are known to occur at 60°C in the presence of dehydrating agents.¹⁴ It has been suggested,¹⁶ however, that polyamino acids formed at 120° to 200°C could not have played a major role in evolutionary processes, because such temperatures probably would have occurred only locally on the surface of the prebiotic earth (juxtaposed with much higher, detrimental, temperatures) and would have, on long contact, destroyed any resulting polyamino acids.

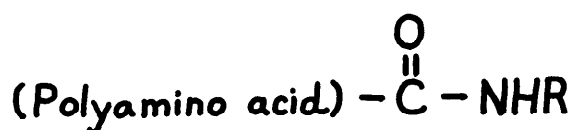
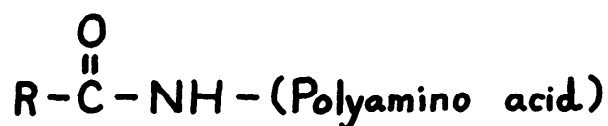
Another type of research has shown that peptides and polypeptides can be directly synthesized from α -amino acids under certain conditions. In aqueous ammonia solutions at about 160°C, Oro and Guidry^{17,18} found that up to 18 glycine molecules could be linked together. Glycine precursors such as aminoacetonitrile could be converted to small peptides in aqueous reactions¹² or by heating with clay.¹⁹ Condensing agents that have been postulated to be present in primordial times have also been used. By allowing free α -amino acids to stand in aqueous solutions (acidic) containing cyanamide, Ponnamperna and Peterson²⁰ and Steinman, Lemmon, and Calvin²¹ obtained tripeptides, while in the absence of water, Schramm and coworkers obtained polypeptides by using phosphorus pentoxide in ether.

The general form of a peptide bond which joins two amino acids is:

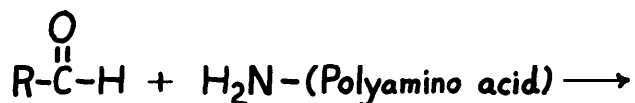
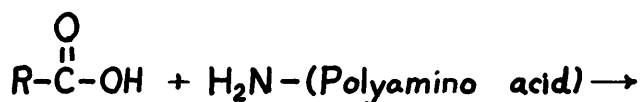


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where the carbonyl moiety is from one amino acid, and the amine moiety from the other. The same thermodynamic conditions producing the polymerization could just as easily have brought about the production of an acyl amide bond of any organic acid with the amine of an amino acid, or an amide bond of an amino acid with any organic amine, as follows:



If any of these forms are produced, there will no longer be a possibility of lengthening the polypeptide polymer from the terminal amino group, or from the terminal carbonyl group.²³ Condensation of an aldehyde and carboxylic acid with an amine group, according to the reactions:



will also prevent further polymerization from the side of the terminal amino group.

It has been shown earlier that polyamino acid polymerization could be done only in a pure system consisting of a reaction mixture of amino acids and the dehydrating agent. A mixture of other acids and amines with amino acids, which should be in a primitive world, has been proven mathematically to fail in polymerization.²³ Besides, the specialized conditions suggested by the model experiments do not have universal appeal²⁴ since anhydrous locales, high-temperature surface milieu, and acidic oceans or pools are not characteristic of the common view of a young, developing planet. The thermodynamic barrier to spontaneous α -amino acid polymerization is not easily overcome,²⁵ and indeed seems impassable by any reasonable condensation mechanism.

A completely different sequence of events leading to polypeptide formation has been postulated. This is by condensation of hydrogen cyanide.

Condensation of Hydrogen Cyanide

Hydrogen cyanide is produced in significant amounts when gaseous mixtures containing compounds of carbon, hydrogen and nitrogen are subjected to electrical discharges.²⁵⁻³⁰ Cyanide is also formed if other energy sources, such as heat, are used.^{31, 32} It would appear very likely that hydrogen cyanide would have been formed in the atmosphere supposed to have existed on the primitive earth. This has led many authors to suggest that hydrogen cyanide may have played an important role in terrestrial prebiological chemistry.^{28, 30, 32-34}

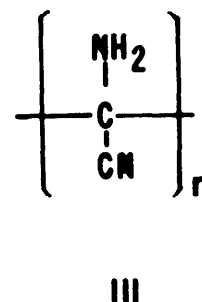
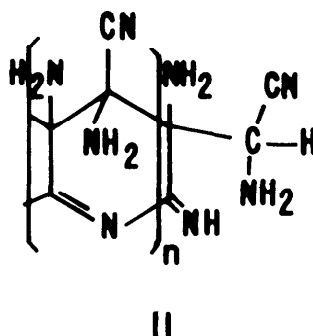
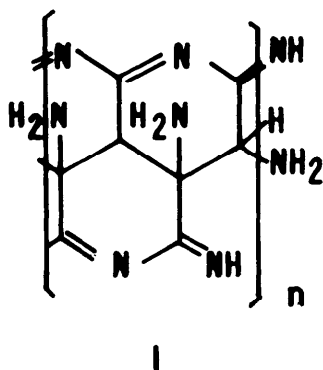
Hydrogen cyanide is known to self-condense to form "polymers". In 1806, Proust^{39, 40} observed a black solid that precipitated in aged, aqueous solutions of hydrogen cyanide. Boullay⁴¹ called this black solid "azulmic acid", a name still used by some German and French researchers. Gautier⁴² believed that this black solid was a "polymer" of hydrogen cyanide.

This "polymer" has also been prepared by irradiating solutions of hydrogen cyanide with radiation derived from radon^{43, 44} and by electrolysis of aqueous solutions of potassium cyanide.⁴⁵ The simplest method of producing the "polymer" is by alkali-induced polymerization of hydrogen cyanide.⁴⁶⁻⁴⁸ The most commonly used base is ammonium hydroxide. The polymerization has been conducted in non-aqueous solutions as well.⁴⁹

Bedel, in studying the hydrolysis of the "polymer" with alkali found that aminoacetic acid (glycine) and oxalic acid are produced. Volker⁴⁹ found the black material derived from hydrogen cyanide to be relatively stable. Decomposition of this material occurred at about 200° liberating hydrogen cyanide, ammonia, carbon dioxide, and left a black residue containing approximately 30% nitrogen. The "polymer" was found to be insoluble in most organic solvents but was partially soluble in mineral acids. The infrared spectra of "polymers" prepared in aqueous solution exhibited a shoulder for the cyano group at 4.5 μ but a very well defined peak for the cyano group was observed when the "polymer" was prepared in chloroform solution.

Volker converted the nitrile functionality to an acid by hydrolysis and this was converted to an ester. An imine function, which was readily hydrolyzed, was also reported to be present. Based on limited evidence, Volker proposed the cyclic structure I for the hydrogen cyanide "polymer" obtained from aqueous solutions; and a partially cyclised structure II for the "polymer" obtained from non-aqueous solutions. The cyclic structures I and II were proposed rather than the open-chain structure III on steric arguments. The value of n was given as 5-7.

Matthews and Moser^{37, 38} have shown that when "polymers" produced in these reactions are hydrolyzed in acid, no fewer than 14 amino acids result. The amounts of glycine and ammonia were substantially larger than those of other amino acids. However, large variations were observed in the absolute amounts of each amino acid produced in different samples. It was claimed that hydrolysis of the polymer with water yielded polypeptides which were then cleaved to amino acids with 6N hydrochloric acid. In subsequent papers^{51, 52} the role of iminoacetonitrile, which was stated to possess



carbenoid character, in the formation of the polymer was stressed.

Most research related to the polymerization of hydrogen cyanide has been conducted on relatively concentrated solutions of cyanide (about 1 M). It is not expected that such high concentrations of cyanide would have been present in the primitive oceans. Sanchez et al.⁵⁶ claimed that dilute solutions of HCN might be concentrated by freezing. It was demonstrated that a frozen solution of 0.01M HCN is converted to diaminomaleonitrile more rapidly than one that was not frozen. It was suggested that repetitive freezing and thawing of lakes and oceans containing hydrogen cyanide might have provided a mechanism for the conversion of dilute solutions of cyanide to hydrogen cyanide polymers.

The fact that alkaline solutions of hydrogen cyanide turn brown, and that material precipitates from solution, has been accepted as proof that a "polymer" of hydrogen cyanide is formed.^{35, 41} This concept has been almost universally accepted even by the most respected researchers in this area.⁵⁶

It should be noted that no polymer has ever been isolated or characterized from these reactions. Molecular weight determinations have indicated a maximal molecular weight range of 500-1000 for undefined products from this system.⁴⁹

Generally, alkaline condensations of hydrogen cyanide are conducted at pH 9.2⁵⁶ (the pK_a of hydrogen cyanide is 9.2).⁶⁵ If the proposal that polymerization is propagated by condensation of hydrogen cyanide with cyanide anion is accepted,⁵⁶ then this reaction is conducted under conditions where the concentrations of monomer and initiator are equal. Under such conditions polymer formation is hardly expected.⁶⁵

How Polyamino Acid was Produced?

Amino acids are liberated when the products of hydrogen cyanide oligomerization are hydrolyzed in acid.^{35, 36, 53, 55} This has led many researchers, particularly Matthews, to assert that hydrogen cyanide "polymers" contain peptide linkages. The fact that peptides and proteins are hydrolyzed to amino acids, in acid, does not constitute proof that peptide linkages are existent in this system. Again, it must be emphasized that no compound containing a peptide linkage has

been isolated and characterized from the products of this reaction. Despite this fact, Matthews has attempted to rationalize the formation of peptides from hydrogen cyanide "polymerization".^{36, 37, 38, 51, 52}

Labadie has also studied the cyanide system and was unable to find any indication that peptides were present using pronase, trypsin, or papain digests of reaction solutions. Amino acids were produced upon acid hydrolysis of the hydrogen cyanide polymers.⁵³⁻⁵⁵ Unfortunately, data concerning methodology and controls used in experimentation was lacking or terse. Labadie accepted Volker's proposal for the structure of the material produced by reaction of hydrogen cyanide polymer as a catalytic medium (for example to decarboxylate oxaloacetic acid) and has compared his results to those obtained using enzymes.

Two characteristics of enzyme action are the catalytic effect and specificity of the enzyme. Since we can see (based on electrophoresis and paper chromatography) that the oligomer system is actually composed of a great number of compounds, it is impossible to ascribe any catalytic effect to a specific compound (only small catalytic effects were noted). To discuss specificity with regard to such a system is obviously not possible.⁴ It might be that compounds such as ammonium hydroxide, oxalic acid or urea were, in some way responsible for some of the results obtained (in Rensselaer Polytechnic Institute Laboratory, it was identified as products of the oligomerization process)⁶⁵ yet one would hardly compare these simple organic molecules with an enzyme.

Although it has proved difficult precisely to characterize the final products of the oligomerization of hydrogen cyanide, a number of compounds have been suggested as possible intermediates in the "polymerization" process.⁵⁶ It is generally agreed that the oligomerization reaction proceeds via the initial formation of a dimer of hydrogen cyanide. Matthews first suggested that the dimeric species (IV) shown in Scheme I has the properties of a carbene (VII). He postulated that this carbene dimerized to VI and polymerized to VIII.^{35, 37, 38} It was further suggested that mild hydrolysis of VIII yielded polypeptides, while it was known that vigorous hydrolysis produces amino acids. The reactions leading to the formation of the alkyl substituent (R) of VIII were not discussed in detail and remain nebulous. Scheme I presents the details of Matthews' proposed polymerization sequence.

Discussion and Summary

In recent years great interest has centered on chemical evolution⁵⁷⁻⁶⁰ and the possible role of hydrogen cyanide in such a process.

While it must be admitted that the nitrile functionality possesses great versatility and capacity for a wide variety of reactions,⁶¹ it should be noted that attempts to ascribe a too specific role to hydrogen cyanide (or any chemical species) in chemical evolution is futile. Argument concerning the course of prebiological synthesis has, in many instances, constituted little more than "a sound and a fury" neglecting the fact that our knowledge of the conditions existent on the primitive earth is, in a large part, speculative. Therefore, results obtained in simulation studies can be only as accurate as the model they seek to represent. Attempts to prove or disprove the role of hydrogen cyanide, or any compound, in the early history of the earth must be viewed with caution and, perhaps, skepticism, in view of the uncertainty involved in constructing a model system and the virtually infinite number of chemical processes that conceivably might have occurred.

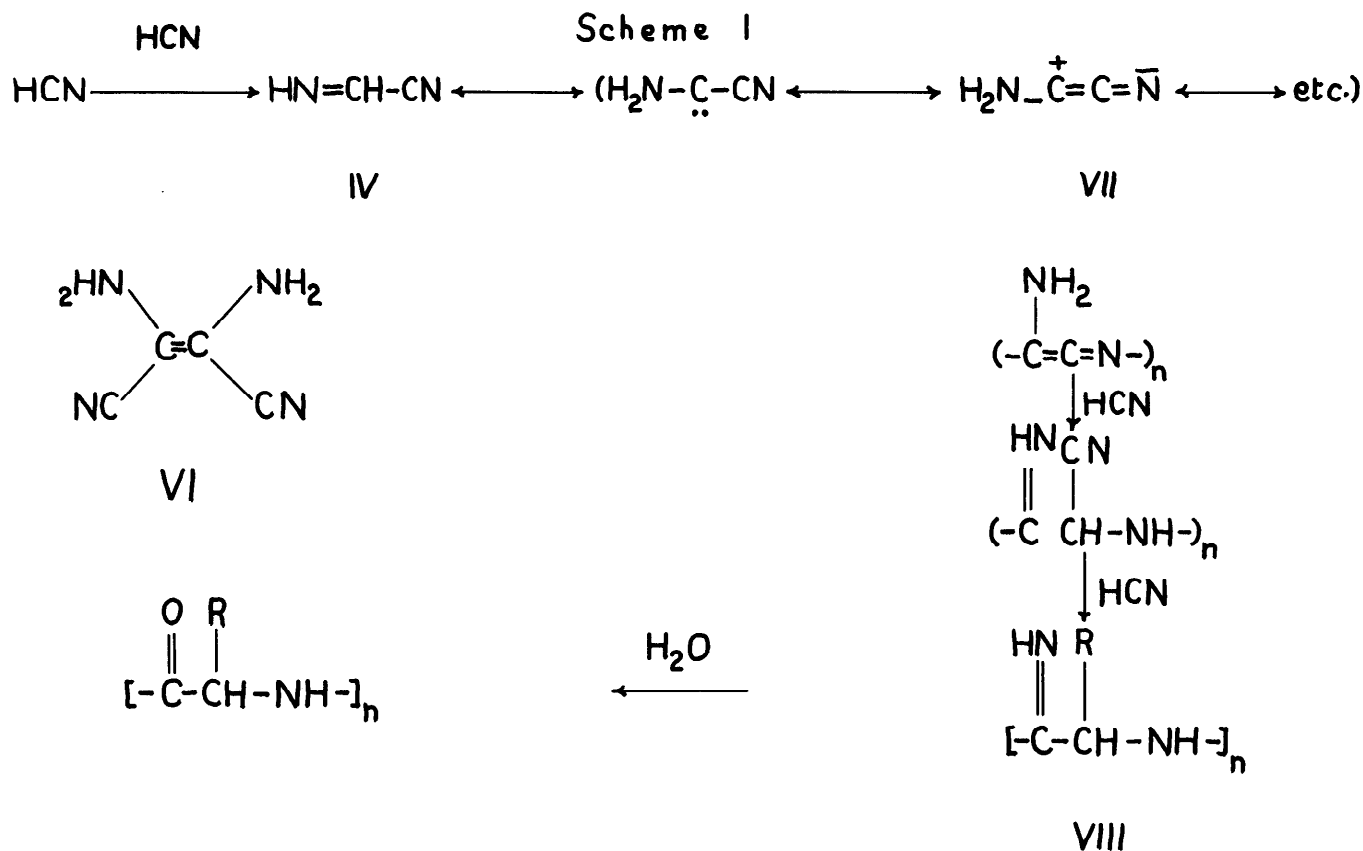
All studies related to the evolution of life should meet the criterion of being scientifically valid. The fact that the accumulated knowledge of prebiological conditions is at best fragmentary cannot be considered as an excuse for presenting speculation as fact or desire as dogma. Instead, those standards which apply to chemistry (as one area of scientific endeavor) must be rigidly adhered to when simulation studies are conducted. It is unfortunate that much has been written concerning prebio-

logical synthesis which has no experimental foundation.

It may be that the failure of experiment to maintain pace with theory was born of the great desire of primitive earth chemists to seek a connection between biomonomers, of the type synthesized by Miller,⁷ and complex bipolymers, such as proteins and polynucleotides, which molecular biologists have implicated as having import in the nature and function of life.⁶² Indeed, the fact that molecular biology (born in large part as a result of the work of Crick and Watson)⁶³ became a viable field at almost the same time that Miller's work served to stimulate interest in chemical evolution, almost inevitably led researchers in the latter discipline to formulate prebiological sequences leading to the formation of proteins (since amino acids seemed to be more accessible than purines or pyrimidines in simulation experiments). For example, many researchers have concluded that "polymeric" forms of hydrogen cyanide may have served as a link between biomonomers and peptides and eventually proteins on the primitive earth.^{35, 38} Experimental data presented in this paper have shown that this theory is not correct.

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OUTLINE OF THOMISTIC PRINCIPLES ON CREATION THAT PROVE THE IMPOSSIBILITY OF THEISTIC EVOLUTION

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The Church has taught in ancient, medieval, and modern times that God and God alone has created. Some examples of that teaching are the following.

If anyone does not say that the Father made all things through the Son and His Holy Spirit, that is, the visible and the invisible; he is a heretic.¹

If anyone does not confess that the world and all things which are contained in it, both spiritual and material, as regards their whole substance, have been produced by God from nothing . . . let him be anathema.²

It was St. Thomas Aquinas (1225-1274) who most fully elaborated the theological and metaphysical principles that support the above doctrinal pronouncements of the Church. It is no exaggeration to assert that every explanation of Creation by God that is not in agreement with these Thomistic principles, is in error. The fact can be seen clearly when certain basic ideas are grasped.

First of all, it is well to understand what St. Thomas means by the analogy of being. Being, or existence, is what God is, absolutely, but what all creatures only *have* from Him. St. Thomas says that to exist is God's very essence or nature. We creatures possess an *essence*, which is expressed logically in a definition. Thus, man is a rational animal. But our *existence* is what makes us to be *actual*, what makes us to *be* and to be *this specific* individual person or thing. God is all Act, all actuality, all being; but we and all creatures *have* our existence *from* God and it is an essence or nature that is thus *given* existence. All creatures are thus a *mixture or composite* of essence and existence whereas God is all Being and admits of no such imperfect mixture. The mixture of essence or potency and act is by its nature limiting and limited, imperfect. But there can be no such imperfection in God.

The fact that we have our existence from God constitutes the relation of creation. This relation of creation is only in us, the creature, and is not in God the Creator because He is absolutely self-sufficient, self-existing, and depends on nothing. Thus God as Creator is utterly transcendent. The relation of creation or *our* absolute dependence upon God for existence is confused by many philosophers today (most notably Paul Tillich) with Creation itself, with the Creation of the universe that took place "In the Beginning". Thus it is necessary to have a very clear appreciation of what it means for God to *create*.

Only God can create because to create is to bring into *total being*, that is, to bring into being the whole substance, the entire creature,—from nothing, *ex nihilo*. *Ex nihilo* simply means from *no pre-existing being*. The best possible expression of God's Creative Action is to be found in the First Chapter of Genesis. Here the Creation

of the universe is reduced to certain specific Acts on God's part that correspond to the kinds of creatures brought into being, in the first six days of the world. It is to be noted, too, that *time* itself is a creature, having come into existence—or begun—with the first material or corporeal being. This is indeed, as Aristotle defined it, *the measure of motion* and cannot exist apart from some corporeal being in space and in motion. It is thus impossible, in a true cosmology, to conceive of a separation of time from beings in motion or from the space in which they live and move. Einstein's system is fantasy and was made to order for the literature of science *fiction* which builds its other worlds upon this false cosmology.

God's Act of Creation, or as in Genesis I, His multiple Acts of Creation according to the creatures brought into existence on different successive days of the first week of the world, is an *Act* and not a *process*. It is most important to distinguish carefully between God's Act of Creation or His Creative Activity and any kind of process, because all processes, as Dr. Henry Morris has pointed out, are decayings and un-doings, according to the Second Law of Thermodynamics. Even the process of cell division by which the animal or human zygote grows into an embryo and is finally born as an individual, even this process of becoming or coming to a certain state is ruled by the Second Law written into the DNA code, and biologically all corporeal beings begin to die as soon as they are conceived.

The difference between the human zygote and the animal zygote is worth noting in this context of Creation. The life principle of plants and animals inheres in the material of the DNA code and is passed on by generation, not requiring a special act of creation by God. But the human soul is a spiritual immortal substance and as such can only be created directly and immediately for each human person by God Himself. This creation of the human soul which immediately informs the zygote and causes it to be a human being, is well illustrative of God's *Act* of Creation over and against the *process* of growth, development, aging and dying that leads to biological extinction. The generative and degenerative processes of growth and dying constitute what St. Thomas terms *the order of generation as opposed to the order of creation*. The entire order of creation or the universe, the whole natural order which was brought into existence "In the Beginning" came to be *not* by any kind of process but by God's atemporal *Fiat*.

God did not create from all eternity, however, nor is He creating now, except for human souls. Even though His Act of Creation is identical with Himself because He is absolutely simple and contains no potencies (this is the Platonic error from which stem all other errors about Creation) still His Act of Creation, this Act of God's Will, resulted in creatures. The *effect* of God's

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Creating Will must not be confused or identified in any way with God's nature. God infinitely transcends all of His creatures and the relation of creation is not in God but in the creatures only. This distinction, which is a most real one, is necessary to grasp in order to avoid pantheism.

The immanence which modern philosophers and theologians so ardently desire is to be found in the relation of creation, in the fact of our *absolute* dependence upon God for our existence every moment of time. Our being is from Him alone and thus St. Paul said: "In Him we live and move and *have our being*." This is in the purely natural order. In the order of Grace, the Divine Intimacy is even more marvelous, and beyond our power to understand. The Grace of God can only be answered with love.

Essence or nature is the area of secondary or instrumental causality. In the order of generation, creatures give rise to creatures of their own nature and essence, like produces like, in obedience to God's command in Genesis I that every creature reproduce "according to its kind." St. Thomas says that each creature causes or effects "what is proper to itself." But that any creature should actually create something out of nothing, that is, from no pre-existing materials, or that any creature should produce something greater, of a higher order of being than itself, which would amount to creating, such hypotheses are absurd and against all the observed laws of nature, logic, and Grace. Even Grace only perfects human nature, it does not elevate it to something higher than human nature. Man will never become an angel nor even a "super-man". Should he aspire to be such, he will fulfill the promises of Satan (Genesis 3) rather than the Promises of Our Divine Lord Jesus Christ. The "new man" is man con-formed to Christ, through His Grace.

And yet, this is what the theistic evolutionists are telling us to believe and to do! St. Thomas says that matter cannot exist without form, and the form of every creature, of every being, *limits* and defines its created nature or essence, essence being the principle of potency and limitation as well as of individuation. But if each creature is limited, as it is, by its created essence or nature, according to Genesis I, then no creature can produce something of which it is incapable, something the potency for which it simply does not possess within itself. It is thus metaphysically, which is to say, philosophically impossible for a sea-creature to give rise to a land-creature, no matter how much time it be allowed, or for an animal to issue in a human being.

The question of time is somewhat irrelevant here, for if the potency were within the creature to evolve into something higher, then it could be done in six or six hundred as well as in six hundred million, or in billions of years. Nor is the question of life from non-life of any greater import than that of the bird from the dinosaur or that of the man from the ape, or that of the amphibian from the lung-fish. The question that must be asked first of all is this: on the side of *reason*, is the nature of the being capable of producing something that is not in its nature; and from the side of Biblical *Faith*, is evolution of any kind, theistic or otherwise, in accordance with Scripture and the teachings of the Church?

In both cases, of course, the answer is a definite NO. Evolution makes of creation a *process*, it reduces the *order of creation* by God to the *order of generation* by secondary causes, thus placing the *creative power* itself *within nature*. And this is pantheism. This heresy—of pantheism—militates against or is destructive of the truth.

The words of St. Thomas about instrumental causes are this:

The proper effect of God creating is what is presupposed to all other effects, and that is absolute being (existence).

In other words, the entire natural order is presupposed to all other talk of "creating" and/or producing.

Hence, nothing else can act dispositively and instrumentally to this effect, since creation is not from anything presupposed, which can be disposed by the action of the instrumental or secondary agent.

So therefore, it is impossible for any creature to create, either by its own power, or instrumentally, that is, ministerially.

No created being can cause anything unless something is presupposed; which is against the very idea of creation.³

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Global Precipitation Under a Canopy (Continued from page 184)

writers refer to an Edenic period of mild climate. It isn't very effective to quote scripture to geologists these days, but the "geologic book" of sedimentary layers says the same thing (or so Vail suggested): "... the Lord God had not caused it to rain upon the earth ... But there went up a mist from the earth, and watered the whole face of the ground." Genesis 2:4-5.

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UNTHINKING *HOMO HABILIS*

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"... no evolutionary scheme should be hinged on evidence with this degree of uncertainty."¹

The taxon Homo habilis has recently re-entered the evolutionary scenario of human origin. It has, unfortunately, been also entered into the scenario of some creationists. The evidence is poor, fragmentary, uncertain and fraught with controversy. Evolutionists assign the material to Homo because they think it evolved into Homo, not because of what the creature looked like. Creationists should not accept such a taxonomic assignment without first analyzing the evidence and the taxonomic philosophies of evolution. In reality, the small-brained, primitive creature looks like an australopithecine.

Habilis History

In 1964 L. S. B. Leakey announced that recently discovered hominid fossils from Olduvai Gorge in East Africa were being assigned to a new species: *Homo habilis*. The declaration implied that the material did not match known hominid species and did not fall into the known range of variation of previously discovered species. The australopithecines, formerly thought to be human ancestors, were dismissed as evolutionary dead ends. The Leakey criteria for the new species were: increased brain size, "advanced" dental features, some "advanced" features found in the fragmentary postcranial remains, and inferred cultural activity involving the use of stone tools.

Backers of *Australopithecus* for the fossil ancestor of man gave little ground. The Leakey opinion gained only a small following, and by 1972 the majority opinion that *Australopithecus africanus* was the "missing link" prevailed. In that year Time-Life Books published their volume with the title *The Missing Link*.² *Australopithecus africanus* was enthroned. But the volume was soon out of date. Skull KNM-ER 1470 had been found that same year. The Leakey name was once more the center of controversy, and the stage was set for the revival of *Homo habilis*, though it would be a few years in coming. The bigger brained 1470 was soon looked upon as being the human ancestor. *Australopithecus africanus* lost his throne.

Struck with what he considered the uniqueness of KNM-ER 1470 Richard Leakey, in those first few years following the discovery, did not advocate a taxonomic connection between the skull and his father's *Homo habilis*. Newsweek summed up the situation in 1974 as follows:

This find (1470) also consigned the small-brained but later *Homo habilis* . . . to another evolutionary backwater. Leakey reasoned that skull No. 1470 must represent the lineal ancestor of *Homo erectus*, and hence present-day man. The next deduction was that the tool using *Homo habilis* from Olduvai Gorge must now be placed in the ranks of a type of *Australopithecus* which became extinct after many years of coexistence with man's true ancestor.³

But the claims and taxonomy have changed again. KNM-ER 1470 is now called *Homo habilis* and is

grouped with many of the fossils which earlier received that designation. Leakey says, "... I do believe that *Homo habilis*, as represented by the type specimen from Olduvai, OH 7, is the same as the more complete and slightly earlier material, such as KNM-ER 1470. On this basis, *Homo habilis* has priority."⁴ Additional finds by Mary Leakey at Laetoli, Tanzania, and Donald Carl Johanson at Hadar, Ethiopia, have been included in the list. The uniqueness of 1470 has been subsumed. *Habilis* has been rehabilitated.

A Valid Taxon?

Evolutionists, however, are far from presenting a united front on the matter of whether *Homo habilis* is a valid taxon, and if it is, just what fossils ought to be placed within it. Wolpoff and Brace said it well: "The problems involved in the *Homo habilis* concept are nowhere better outlined than in the difficulties in deciding what specimens to include in it."⁵ Richard Leakey admits "there is an inherent problem in hominid taxonomy caused by the present lack of any precise diagnosis for fossil forms."⁶ Elwyn Simons highlighted another problem when he spoke of "the common tendency to feature each new hominid fossil as taxonomically distinct and by so doing overemphasize the uniqueness of the discovery."⁷

Absolutely critical to an understanding of the thinking of Richard Leakey, Donald Carl Johanson and others when they place certain fossils in *Homo habilis* (or "primitive" *Homo*, etc.) is a knowledge of the theoretical taxonomic concepts of anagenesis and cladogenesis.

Anagenesis is grade classification. Animals are placed together in the same category because they look alike. In this evolutionary theory it is believed that there is change in time without diversification. Cladogenesis places animals in the group that they are believed to have evolved into. This theory says new forms are derived from splitting and branching of the ancestral form. Classification by clade "stresses the importance of a group at the beginning of a new lineage by incorporating the group in the taxon of the new lineage."⁸ For the evolutionist there are drawbacks to both theories if they are followed to their logical conclusions. Grade classification ultimately means that one generation will be in one taxon, the next in another. Clade classification means that part of a single population will be in one taxon, while another part of the same population will be in the next taxon.

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The Leakeys, Johanson and others are using clade classification when they assign their "advanced" hominids to *Homo*. Their classification is according to what they *believe* the form evolved into. It is not according to what the specimen looked like. They are saying, in effect, that since brain sizes for some *habilis* specimens appear to be a little larger than the "standard" australopithecine size there is, therefore, evidence of an evolving line. Though *habilis* does not yet look really human, it is on its way to becoming man and therefore deserves to be called *Homo*.

Cranial Considerations

One of the major reasons for placing *Homo habilis* in *Homo* is brain expansion beyond the presumed australopithecine level.⁹ It remains a bit of a mystery, however, how one can know what constitutes brain expansion beyond the australopithecine level. Who is to say what the australopithecine level really is? The situation is quite complicated by the nearly continuous series of endocranial volumes: 506, 510, 530, 590, 650, 687, 775 cm³.¹⁰ Body size, though difficult to measure in such a meager sample, seems to be larger for those specimens assigned to *Homo habilis*. But even this, McHenry says, "does not solve the problem of dividing the brain size continuum into taxonomic groups . . ."¹¹ Cranial capacities for *Homo habilis* as listed by McHenry follow:¹²

OH 7	687 cc (cc = cubic centimeters)
OH 13	650 cc
OH 16	excluded because too fragmentary
OH 24	590 cc
ER 1470	775 cc

He divides the cranial series thus: 506 cc to 530 cc are *Australopithecus*; 650 cc to 775 cc are *Homo*. Richard Leakey suggests a cranial capacity of 750 cc for defining early species of *Homo*.¹³

The volume listed for KNM-ER 1470 seems well accepted, but there are severe problems with the other capacities listed here. Pilbeam and Gould list the cranial capacities for *both* OH 7 and OH 16 at 700 cc or more!¹⁴ The conservative estimates of Holloway¹⁵ and McHenry are to be preferred, or even reduced, especially in light of the condition of the fossils. Wolpoff and Brace remarked that:

The parietals (of OH 7) were found crushed flat, and both the curvature of the bones and their fit on the sagittal suture were reconstructed. The cranial capacity is, and has been, anybody's guess, but the close correspondence of the parietal arc dimensions with those of other specimens of known capacity suggest a value significantly in excess of 500 cm³ is unlikely. The hand is very small . . . Specimen OH 16, unfortunately fragmented by a herd of cattle, has been reconstructed three times, and in all cases there is no continuous bone surface in any direction. The present reconstruction is known to be inaccurate . . . Neither the actual shape nor the size of this cranium can as yet be determined, and at present, there is no possibility of determining the cranial capacity.¹⁶

Holloway reports the capacity of OH 13 as 650 cc.¹⁷

Though it has been called the paratype of the taxon *Homo habilis*, and placed by McHenry in his *habilis* list, Gould and Pilbeam did not use it in their study. Richard Leakey even suggests that it "might be classified as gracile *Australopithecus*."¹⁸

Olduvai hominid 24 (OH 24) is attributed by some to *Homo habilis* as the most complete cranium,¹⁹ yet there are several problems with its morphology and status. Holloway says that its estimated cranial capacity of 590 cc is "possibly overestimated."²⁰ McHenry calls it an australopithecine.²¹ Leakey says that it, like OH 13, might be gracile *Australopithecus*.²²

I have discussed the morphology of KNM-ER 1470 more fully elsewhere.²³ To that I will add here some pertinent observations by Wolpoff and Brace:²⁴ 1) The face of 1470 is extremely large, second only to that of *Australopithecus boisei* ("Zinjanthropus" or OH 5). 2) The skull displays the anterior masseteric attachment known for all australopithecines. 3) The posterior dentition is very large and is therefore reminiscent of *Australopithecus*. They further suggest that "perhaps ER 1470 and 1590 are simply large australopithecine specimens."²⁵ Other than the cranial capacity of 775 cc (which very well may be indicative of the upper range of australopithecine encephalization) there is little about skull 1470 that is not australopithecine. With Alan Walker I would agree that we ought to classify specimens according to what they look like, not according to what they supposedly evolved into.

Jaws and Other Bones

There are morphological considerations other than cranial capacity that deserve at least a brief mention. *Homo habilis* is considered by some to be intermediate in tooth proportions between *Australopithecus africanus* and *Homo erectus*.²⁶ We have seen that Skull 1470 does not necessarily fit this conception, however. Elwyn Simons raises a serious question about the type specimen mandible, OH 7:

Nor do we know whether the type mandible of so-called 'Homo habilis' is really advanced or not. The relatively large canines and narrow premolars of this type jaw associate the find with *Ramapithecus* and *Dryopithecus*.²⁷

In addition the fossil jaws discovered by Mary Leakey at Laetolil, Tanzania, a few years ago present a problem. Mary Leakey has placed the Laetolil jaws in early *Homo* along with the other fossils discussed in this paper. However, the Laetolil jaws are reported as being morphologically similar to the hominid remains from Sterkfontein in South Africa. The Sterkfontein hominids are gracile australopithecines. A writer in *Nature* remarks that "the acknowledgement of such morphological affinities does not strengthen the final attribution of the Laetolil hominids to the genus *Homo*."²⁸ The writer goes on to say that attribution to genus *Homo* should not rest solely on the presence of certain dental features. All hominids share a basic, underlying morphological pattern which is particularly evident in the jaws and teeth . . . The taxonomic position of the Laetolil hominids (and ER 1470) must . . . be considered uncertain.²⁹

A caution by Richard Leakey on this theme deserves repeating: "It is extremely difficult to identify mandibular fragments with any exactness . . ." ³⁰

Postcranial bones for *Homo habilis* are not numerous. Where they do exist they are controversial.

A study by Day and Wood (1968) of the talus (astragalus) of *Homo habilis* by a multivariate statistical technique indicates that it was very different both from the modern human and from the gorilla and chimpanzee pattern. Its nearest counterpart is the talus of *Australopithecus* from Kromdraai in South Africa. This and other evidence (unrelated to bipedalism as such) point to the possibility of *Homo habilis* being an advanced australopithecine rather than an early *Homo*. ³¹

Two fossil femora (KNM-ER 1472 and KNM-ER 1481c), discovered in the Koobi Fora formation of East Rudolf (now Turkana), are often placed in the same taxon as Skull 1470. The proximal end of the bones is said to have a modern human appearance. Yet multiple discriminant analysis reveals some differences. McHenry reports

The two fossils from East Rudolf approach more closely the modern human form, although they share certain unique features with the other early hominids, such as the long femoral neck, and several other more subtle characteristics. ³²

The Species Question

Our discussion thus far has been on the generic question, "Was *habilis* *Homo*?" I want to now briefly turn to the question of species: "Was *habilis* *habilis*?" The specific name means "handy man" and was given to the fossil by the late L. S. B. Leakey out of his conviction that the creature was the tool maker of Olduvai Gorge, Bed I. Such a hypothesis has not stood up well. Its fatal weakness was demonstrated immediately. In 1959 the tool maker of Olduvai was thought to be *Zinjanthropus*, the superrobust australopithecine. When Leakey changed his mind one year later with the finding of *Homo habilis* he was in effect admitting that the archaeological evidence is equivocal. It could be read several ways. And that is still the case. There is no positive proof that *Homo habilis* made and used stone tools. Marvin Harris points out that "paleontological and archaeological data do not prove definitely that the earliest hominids used tools." ³³ Richard Leakey virtually admits the same thing: ". . . Who made the tools? Again, if we are honest, we have to admit that we shall never really know." ³⁴

Summary and Conclusion

The picture we get of *Homo habilis* is this. The cranial capacity of the type specimen (OH 7) is 687 cc; it is 700 cc; it is not much more than 500 cc. The paratype specimen (OH 13) is *Homo*; it is *Australopithecus*. OH 24 is *Homo*; it is *Australopithecus*; it has a cranial capacity of 590 cc; its cranial capacity is overestimated. KNM-ER 1470 is *Homo*; it looks like an australopithecine; it is *Australopithecus*. OH 16 has a cranial capacity of 700 cc; the cranial capacity cannot be determined; the cranium has been reconstructed three

times; the present reconstruction is inaccurate. The teeth of *Homo habilis* are intermediate between *Australopithecus* and *Homo erectus*; the teeth are advanced; they are not advanced; they are like *Ramapithecus* and *Dryopithecus*. The mode of locomotion of *habilis* was like that of man; it was like that of *Australopithecus*; it was neither—it was unique. *Homo habilis* was a tool maker; he was not a tool maker; we can never know.

I am not missing the mark by much in saying that the foregoing is a very confused picture. I believe that creationists are being seriously misled if they use the designation "Homo" for the so-called "habilis" fossils in order to advocate an early sudden appearance of man. Though the young-earth creationist model would predict the appearance of man in the fossil record as early as other primate fossils, I do not believe the *habilis* fossils fulfill that prediction. If one does accept *habilis* as *Homo* he must contend with, in addition to all the problems listed above, the Leakey admission that (a) major differences do exist between *habilis* and *Homo erectus* (retrogressed, but true man), and (b) that "intermediate forms are unknown" between the two. ³⁵ Creationists should not be taken in by a scheme that assigns a fossil to *Homo* status on the basis of what it is thought to have evolved into, rather than on the basis of what it looks like. Small-brained *Homo habilis* is far too primitive a creature to be called a man. "Homo *habilis*" is the creature of philosophy. The taxon should be "sunk" as Wolpoff and Brace suggest. ³⁶

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- ¹⁸Leakey, *op. cit.*, p. 176.
- ¹⁹Wolpoff and Brace, *op. cit.*
- ²⁰Holloway, *op. cit.*
- ²¹McHenry, *op. cit.*, p. 430.
- ²²Leakey, *op. cit.*
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(Continued on page 204)

PANORAMA OF SCIENCE

Another Vestigial Structure Found Useful

As knowledge replaced ignorance the list of organs in the human body, thought by the evolutionist to be vestigial, has dwindled from nearly 200, a hundred years ago, to but a few (if any) today. Since we know more about man than we know about other animals it is not surprising that many structures found in various animals are still considered vestigial by evolutionists. If history is predictive one can assume *a priori* that functions will be found for each so-called vestigial structure.

An interesting case-in-point is the pelvic spurs (or vestigial "hind limbs") of boid snakes. Since most snakes lack legs and since snakes supposedly evolved from lizards evolutionists have considered the tiny pelvic spurs of boas to be useless relics of their evolutionary past. Casual observation fails to show a function. Boas crawl, swim, and kill and ingest prey without using the spurs. However, the pelvic spurs appear to have at least two functions. Before the turn of the century the spurs were found to be used in courtship in *Constrictor*¹ and recently have been found to function during combat between males.² The recent paper reviews the literature and indicates the importance of the spurs in courtship for six genera of Boid snakes. In courtship the pelvic spurs apparently function in "scratching, stroking and vibrating against the female". This tactile communication during courtship apparently induces passiveness and body alignment of the female. The paper describes the use of the pelvic spurs in combat between two male madagascan boas, *Sanzinia madagascariensis*.

If a structure is functional it cannot be vestigial. The term "vestigial organ" means a useless "vestige" of a former functional organ. The concept of vestigial organs is important to the evolutionist. If animals change with time certain structures should indeed lose their usefulness, yet few, if any, truly useless structures have been described. This is precisely what a creationist would expect. Animals were created for particular niches. Thrift is adaptive. In looking at all of creation or parts of a creature one is reminded that "God saw all that He had made, and behold, it was very good" (Gen. 1:31a).

—Contributed by E. Norbert Smith

The Radiocarbon Timescale—Some Loose Ends

Hopes that the tree-ring calibration of C-14 dates can be extended to cover the last 10,000 years are expressed in the literature, but in the last 10 years, the tree-ring sequence has been extended only slowly from 7104 to nearly 8200 years. Research projects which are complementary to the tree-ring studies continue to be reported and a recent paper by Stuiver³ highlights two areas of investigation.

The first is concerned with recent atmospheric C-14 variations: over the last few hundred years. Tree-rings for this period are in plentiful supply and interest in C-14 variations from one year to the next has been actively maintained in a number of laboratories. Wood from a particular year has been analyzed and the at-

mospheric C-14 activity for that year determined. Results which are claimed to be of a very high accuracy have been published and discussed. The difficulty has been that no two sets of results tell the same story. Stuiver discusses one set which shows an 11-year cycle and large variations from year to year, and reports another set which has no periodic variations and only minor changes in activity in successive years.

These discordant results may be indicative of some unusual and unexpected localized C-14 variations in different parts of the earth, and it is also possible that they reveal systematic errors in the experimental procedures used by the laboratories. Stuiver writes: "The standard experience with analytical work is that experimental problems introduce larger variability. More interlaboratory calibration checks of high precision are needed to solve some of the problems mentioned". Until a coherent picture of radiocarbon variations emerges, all statements about the reliability of the dating method should be carefully qualified.

Stuiver goes on to consider radiocarbon activity levels between 9,000 and 32,000 BP, and he compares C-14 dates with age estimates from Th-230/U-234 ratios, thermoluminescence studies and geomagnetic profile studies. He concludes that "the information thus obtained supports the concept of a reliable C-14 timescale back to 32,000 BP, within a maximum error of about 2,000 yr." Such a conclusion will undoubtedly be welcomed by those who hold to a uniformitarian view of the past, but it is the opinion of the writer that Stuiver's conclusion is premature and unwarranted.

The Th-230/U-234 dating method has hardly been rigorously investigated. Why are the dates thought reliable? "We conclude that this type of agreement can only be obtained if both methods give ages close to the actual age of deposition." Thus, concordance is considered to imply reliability. However, there is no justifiable reason for the word "only" in the above quotation. Since the Th-230/U-234 method has been only superficially studied, the conclusion of Stuiver is more of a subjective hope than an objective statement.

The thermoluminescent dates must be similarly qualified. The method is still very much in the development stage. Researchers are only willing to accept the dates if they agree with expectations. The controversy over the "Glozel Affair" has shown this to be the case.⁴ The fact that only a few TL dates have been published, despite the considerable number of research groups working on the method, is evidence that only a few of the dates are thought to be reliable.

The geomagnetic profile studies do not provide absolute dates. Changes in the non-dipole field of the earth have been postulated to account for certain magnetization patterns observed in lake sediments. A constant periodicity is assumed, and this enables dates to be calculated. Again, confidence is engendered by concordance: "Our assumption of constant periodicity is a weak point in the C-14 against magnetic age calibration, but it seems to be a very reasonable and straightforward concept. The excellent agreement between the

magnetic and Th-230 date near 24,000 BP supports the soundness of the assumption of constant periodicity of magnetic variations."

Stuiver also mentions his own varve studies, which show comparatively high atmospheric C-14 levels in the early Holocene—but neglects to mention the varve studies of Tauber⁵ which gave conflicting results. The great temptation to which Stuiver appears to have succumbed is that of selecting data which agrees with his own preconceived ideas, and passing by other data which fails to support them.

The concluding paragraph is significant: "It has been standard practice in geochronology to compare other dating methods with C-14 dating mainly to prove the reliability of the other methods. Here, the best examples of the other methods are used to check on the reliability of C-14 dating." This methodology is weak. The standard practice must be rigorously to justify the dating methods using many different samples. Unless the dating methods can be shown to be useful, the results are worthless. The three ways of dating discussed by Stuiver cannot be said to be in more than a development stage and, as yet, they are in no position to check the reliability of any other dating method. The consequence is the classic circular argument: the C-14 method is used to check the reliability of minor dating methods, and the "best" results of these minor methods are those that show good agreement with the C-14 method.

—Contributed by David J. Tyler

Vanishing Species

The July, '78 issue of *New Scientist* expresses grave concern about the pending fate of many plant and animal species. It quotes Erik Eckholm, author of a *Worldwatch* report entitled *Disappearing Species: the Social Challenge* as stating: "Not hundreds, but hundreds of thousands of unique, irreplaceable life forms may vanish by the century's end" due to human population pressure, resource exploitation, and pollution with toxic wastes. There are experts who contend that the extinction rate in tropical forests alone is one *species* (our italics) a day. One wildlife specialist predicts that over one million species will have vanished by the year 2000 due to human activity."⁶ (Note: We wonder whether the term "life forms" might not be more accurate than the term "species", in view of the fact that all too many plant and animal varieties have been classified as species because of slight morphological differences. In recent years taxonomists have started efforts to correct these mistakes of the past by lumping many forms of organisms that should never have been given species status.)

The article proceeds to list some of the reasons for concern when species are eliminated: 1. Only a small fraction of the earth's plants have as yet been screened for medically useful ingredients, 2. Of the thousands of plants which are edible, some may eventually prove useful in meeting human food needs, and 3. Genetic variation must be protected, since "such variation can be the key to future development".

The creationist will surely agree that the first two reasons listed are major causes for concern. The third

reason, however, will elicit differing reactions between evolutionist and creationist. Since the former considers each life form (or species) the stuff from which new species arise, he has just cause for concern. The creationist, on the other hand, considers the multitude of different life forms as end products which have since the time of creation arisen out of the various "kinds" of plants and animals placed on earth by the Creator. We know that no new "kinds" of life can arise from any present day forms of life.

The creationist's attitudes toward the use of God's creatures is also mixed. He remembers that God has placed all creatures on this earth for the benefit of man. They are to be "subdued". He remembers too, however, a corollary injunction, namely, that we should love our neighbor as ourselves. If the use of these living resources, therefore, is in any way harmful to other fellow humans, such exploitation becomes a sin. What better reason to become good ecologists!

—Contributed by Hilbert R. Siegler

A Well-Designed Energy-Handling System

Some simple calculations of the expenditure of energy in the human body reveal interesting, although not surprising, results. In the "Interface Series" in the *Journal of Chemical Education* for August 1978, calculations about energy and exercise show that a typical long-distance runner produces a maximum output corresponding to about 20 kcal/min. Excess heat produced during this exercise must be removed, chiefly by perspiring. The maximum rate of perspiring of most adults is about 2 l/hr. If the perspiration is all evaporated, the article notes, this means the removal of energy at about 20 kcal/min.⁷

As if that were not enough, it is noted also that excess carbon dioxide, from the metabolism of carbohydrates, must be removed at the rate of about 14 moles/min. Can it be done? The calculations show that it is easily accomplished—at a heart rate of 70 beats/min.

In a steam power plant, the capacity of the condenser, which rejects waste heat, and the chimney, which ejects the waste products of combustion, are correlated with the capacity and size of the whole plant. Did the correlation come about by chance? Ask the engineer who designed the plant! Did a similar correlation in the human body come about by chance?

Incidentally, a lesson may be drawn from the very existence of the process of perspiration. Mammals perspire, reptiles do not. If mammals evolved from reptiles, how did the ability to perspire come about? Why should it have evolved, a little at a time? The first beginning of such an ability would be of no use to the creature possessing it, and hence would not be favored by natural selection.

—Contributed by Mr. David Paul Licata

Junctions Between Living Cells

After a preliminary paragraph giving a sort of evolution-oriented introduction by using such phrases as "having become specialized" and "relinquished some of their independence to function together" the authors of an article on this subject proceed exactly as crea-

tionists in describing the remarkable complexity of cell contacts in higher organisms.⁸

Thus they say "If one were given the task of contructing an organism out of individual cells, one could foresee the need for three functional categories of intercellular junctions: (1) impermeable junctions that would enable an organism or an organ to maintain an internal environment that is chemically distinct from its surroundings, (2) adhering junctions that would promote adhesion between the cells of a tissue reinforcing its physical integrity, and (3) communicating junctions that would enable cells to exchange nutrients and signal molecules and thereby coordinate their activities." In the last 20 years biologists have not only confirmed the existence of these types of junctions but have developed a wealth of information about their molecular *architecture*. (Is not an architect then needed?)

Every living cell is enclosed by a plastic membrane which regulates the flow of nutrients and ions between the cell's interior and exterior milieu or surroundings. Intercellular junctions are small regions of plasma membrane specialized for one of the above three functions. Electron microscopes are needed to study these small cells and junctions. The techniques of freeze fracturing and thin sectioning are used to prepare the cells for study. Freeze fracturing has added a new dimension to membrane study since the proteins in the membranes assume specific configurations that can be made visible in freeze fracture platinum-carbon replicas. To make these the tissue is fractured by passing a microtome knife through it, and a platinum-carbon replica is made of the exposed surfaces. The replica can then be examined after the underlying tissue has been dissolved away.

Tight junctions vary in different tissues as regards the number of sealing strands forming a network. Thus only a few strands are found in cells which must expand to accumulate a secretory product such as the mucus cells of the stomach. Intercellular junctions are particularly important in epithelial cells covering the surface of the body and lining its cavities. Thus the cells that line the lumen of the small intestine selectively take up nutrients and transport them across the cell by means of gap junctions to be described later, thus getting them into the bloodstream. If leakage back into the lumen occurred much metabolic energy would be wasted. So intercellular junctions called tight junctions prevent passage of molecules across an epithelium.

In this region the plasma membranes of two adjacent cells appear to fuse. In fact the evidence indicates that tight junction ridges consist of two rows of tightly packed proteins with one row contributed by each of the adjacent plasma membranes. These rows make head to head contact in the form of a modified zipper, holding the two membranes so close together that intercellular space is obliterated! And so leakage is prevented. The effectiveness of tight junctions depends on the number of sealing strands in them. Thus in the central tubule of the kidney only one or two strands occur and little resistance is offered to the passage of ions. In the urinary bladder six or more strands per junction give a high electrical resistance and allow the formation of steep concentration gradients across the epithelium.

After stating the general principle that the network of tight junctions determines the extent to which tissues can respond to stress, much as a fabric depends on the closeness of the weave, the authors make a rather astonishing statement. They write that "The design of the tight junction is clearly a beautiful example of biological engineering at the cellular level." Now my comment is how can one have a design without a designer?

Now tissues and indeed the whole organism must remain together in spite of many strains and stresses. The uniting of the cells into tissue units is done by adhesion, and the adhering junctions are called desmosomes. There are two kinds, belt and spot. The belt ones form bands that link adjacent cells in the region just below the tight junction. They consist of fine filaments about 70 angstroms in diameter. (An angstrom is one hundred millionth of a centimeter, two and a half centimeters making an inch.) So these desmosomes are really small! They contain actin as in the muscle cells so they can contract. The spot desmosomes are button-like points of contact between the plasma membranes at various levels. Within it the adjacent cell membranes are strictly parallel and separated by a gap of 300 angstroms. Filamentous material fills the gap, which is bisected by a dense line called the central stratum. Bundles of filaments called tonofilaments originating deep within the cytoplasm loop through discs of the spot desmosomes. A continuous structural network for the entire epithelium is thus created. Also half or hemidesmosomes exist forming anchoring sites for bundles of filaments and thus join individual cells to the underlying matrix of connective tissue. Clearly the tissues of the body are remarkably well built to endure stress and strain!

Finally structures that govern the direct transfer of chemical messages between the cells exist and are called gap junctions. They are intercellular pipes or channels that bridge both the adjacent membranes and intercellular space, thereby allowing the exchange of molecules between cells. By using fluorescent tracer molecules it has been shown that those with a weight of up to 1000 daltons can easily pass through these channels from one cell to another. These pipes or channels are about 20 angstroms in diameter. This means that ions, most sugars, amino acids, vitamins, and "messenger" molecules such as the steroid hormones and cyclic AMP can easily go through them. In electrically excitable tissues gap junctions transmit electrical signals virtually instantaneously. Thus they synchronize the contractions of the heart muscle and peristaltic movements of the intestine. Their permeability is regulated by the concentration of calcium ions in the cells, normally quite low. Injection of calcium into a cell uncouples it from its neighbors and it is left quite alone until its mitochondria gradually sequester the excess calcium and the channels become normal again.

Gap junctions contain one major protein called connexin, which has a molecular weight of 18,000 daltons and consists of two chains of amino acid units. It is still not known how intercellular junctions are assembled at the molecular level.

Some cancer cells have a low level of coupling which suggests that one cause of uncontrolled cell growth may be the inability to send or receive messages across gap junctions. The ones with apparently normal junctions may possess some defect in their ability to respond normally to transferred signal molecules.

Clearly as the psalmist David says: "I am fearfully and wonderfully made;" (Psalm 139:14). The clear evidence of such intricate design in cell tissues and cells points to a designer, namely our Lord and Saviour Jesus Christ, for as St. John says, "All things were made by him and without him was not anything made that was made." (John 1:3)

—Contributed by Walter E. Lammerts

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BOOK REVIEWS

Focus on Creation, edited by David C. Watts and David J. Tyler, 1978. Rainbow Press, 18 Livingstone Road, Normanton, Derby, England. 51 pages, £1.50 (about \$3.00).

Reviewed by H. L. Armstrong.*

In this little work are some papers presented at the Conference on Creation and Origins held at the Hayes Conference Centre, Swanwick, Derbyshire, England, in 1978, somewhat abridged. The sections include: "The Genesis Flood Narrative", "Jesus Christ and Creation", "Evil and Evolution", "Ancient Civilisations", "Creation, Communication, and Linguistics", "Man's Attitude to the Natural World", and "The Presentation of 'Ape-Men' Evidence".

The treatments of the topics, it may be said, are scholarly and moderate, usually with many references for further study. For this reason, and also because of its brevity, the book could be a good one to give to someone who, while not yet convinced, is willing to read what may be said for Creationism.

I found the section: "Evil and Evolution", by Nigel M. de S. Cameron especially interesting. For one thing,

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it contains an argument, which is more or less new to me, against the doctrine of theistic evolution as an attempt at a compromise between the Scriptural and the uniformitarian viewpoints. For Scripture teaches definitely that man, had he not fallen, would have been immortal. If this is to be reconciled with the view, proposed in theistic evolution, that God's creation of man consisted of introducing some new abilities into some hominid, there are difficulties. For it will not be maintained that the hominid was previously immortal. So, for consistency, it would have to be maintained that, at the same time, God made whatever changes were necessary to bring about immortality, and, moreover, where necessary altered the environment to suit. But it would seem that anyone who will concede all of this might as well give up uniformitarianism entirely, and become a Creationist.

This seems to be the first production of the Rainbow Press. The aim is to go on, to produce Creationist technical monographs for students, and educational or popular books for children, relating to origins and to natural history. *Focus on Creation* is an auspicious beginning of such work. Creationists will wish much success for this endeavor.

LETTERS TO THE EDITOR

Complex Behavior of Carbon 14

David Tyler is to be commended and thanked for providing what is probably the best treatment yet published on harmonization of C-14 age data with the chronologic constraints in the book of Genesis.¹

The data he has presented indicate that the non-equilibrium of C-14 concentration in the upper biosphere prior to 1000-2000 B.C. which is an unavoidable requirement of these chronologic constraints cannot be

modeled with a simple approach based on only a 5730 year half-life and a constant C-14 generation rate. Under these simplifications approximately 25,000 years are required to attain a practical approach to equilibrium (95% of the equilibrium limit would be attained in 24,801 years). The data for C-14 generation and radioactive conversion given by Mr. Tyler suggest that the C-14 concentration has reached only about 70% of the equilibrium limit. The simple model requires 9953

years between a concentration of essentially zero at the time of the Flood and a concentration at 70% of the equilibrium level.

Figure 2 in Mr. Tyler's paper indicates a relative C-14 concentration increase of approximately 1% per 1000 years over the past 2000 years. At 70% of equilibrium the rate of increase for a 5730 year half-life nuclide would be 5.2% per 1000 years. The rate of increase would not drop to 1% per 1000 years until the concentration reached 92% of the equilibrium level, a situation that would not be attained until 21,265 years after the concentration began increasing above the zero level.

It is apparent that the task of developing a model for satisfactorily relating C-14 age data with the chronologic constraints of Scripture is complex. The concentrations of C-14 in the biosphere during the period of non-equilibrium following the Flood have evidently been controlled more by biosphere mixing factors than by nuclear transformation.

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Cordially yours,

R. H. Brown

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Received 31 August 1978

Comments on Dr. Brown's Letter

Dr. Brown has pointed out that a simple model of radiocarbon variations in the past is inadequate to account for the observed trends. The problem is that the rate of increase of C-14 in the atmosphere has not been exponential. A closer examination of the earth's carbon exchange reservoirs is necessary to explain why a simple model is unrealistic.

Fig. 1 represents the different reservoirs as boxes, and shows the quantities of C-14 in each reservoir as a percentage of the total.¹ The main route for radiocarbon is from the atmosphere to the surface ocean to the deep ocean, and it is in the deep ocean where most of it is found. The atmosphere/biosphere/humus cycle is comparatively small and is of little importance in calculations of the transport of radiocarbon between the reservoirs.

Table 1 records the mean activities of the three main carbon exchange reservoirs.² The figures for the whole system are those cited in reference 3. The atmospheric concentration is approximately 17% greater than the mean figure and, as a passing comment, the magnitude of this difference is a further geophysical indication of non-equilibrium.

If the atmosphere were to be isolated from the oceans, it would take only a little more than 100 years for the activity of this reservoir to increase from zero to its present value, with a generation rate of 2.3×10^4 atoms/m²s. Similarly, if the atmosphere and surface ocean were isolated from the deep ocean, these two reservoirs would increase from zero to present levels in

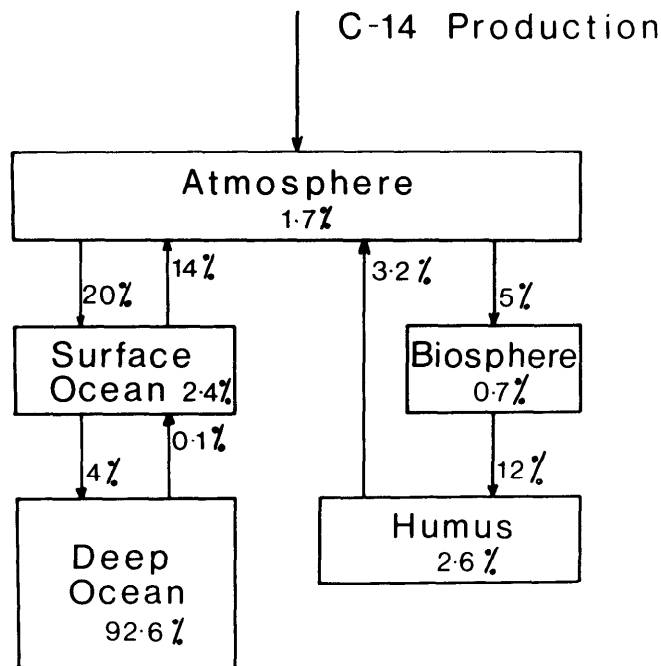


Figure 1. The carbon exchange reservoir.

an interval of less than 350 years. Obviously, these calculations are hypothetical, but they do indicate that the transfer coefficients for the movement of radiocarbon between the reservoirs are extremely important. Estimates of contemporary transfer rates are indicated in Fig. 1. A rigorous non-equilibrium model must assess the C-14 activity variations with time in each reservoir. However, precision is impossible because assumptions must still be made about C-14 generation rates, the sizes of the reservoirs and the C-14 transfer rates in the past.

I am sure that useful work can be done in this area: to show that the C-14 reservoirs are not in a state of equilibrium at present, and also to investigate the implications of non-equilibrium on atmospheric C-14 activities. However, it is most important that we relate theories to facts, and avoid interpreting radiocarbon variations from theoretical considerations only. This is why C-14 calibration is so important, since its authority depends on the reliability of the ages assigned to the samples.

Table 1. Distribution of natural C-14.

Reservoir	Total Carbon (grams)	Concentration (atoms/gram)	Number of C-14 atoms	Rate of Disintegration (D/min/gram)
Atmospheric Carbon Dioxide	0.68×10^{18}	6.03×10^{10}	41×10^{27}	13.87
Surface Ocean	1.0	" 5.8	58	" 13.34
Deep Ocean	38.0	" 5.1	1940	" 11.73
All Reservoirs	42.0	" 5.14	2160	" 11.83

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David J. Tyler
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 Received 5 October, 1978

Extreme Longevity Nowadays Questioned

There are several areas of the world that have residents who claim to be extremely old, well over 100 years. Such alleged ancients are found in various areas of the Hunza in Kashmir, Vilcabamba, Ecuador, and the most publicized are areas in Georgian S.S.R. and the Altay region of Siberia. Observations of these people reveal them to be in good spirits and fine health. These people feel needed and are very much a part of their societies. There is little osteoporosis and few broken bones. Eyesight and hearing are usually good. Few suffer from cardiovascular or respiratory disorders or cancer. For the ages they claim their health is remarkable.

In Europe, North America and Japan the average life span is seventy to eighty years. The maximum is 105 to 110 years. The number of centenarians is 2 to 3 per 100,000. Only one in one million lives to be 105, and only one in 40 million lives to be 110. However, in the Caucasus there are claims of 42 centegenarians per 100,000, and 2 people 120 to 170 years of age per 100,000!

There are reasons to believe that in these areas there are some very old people, but has anyone really reached the extreme ages claimed? There are several factors about all of these regions that cause one to doubt:¹⁻³

- 1) There are very few written birth certificates that can be used to document age claims.
- 2) Birth records are kept for churchmen and public officials. None of these records shows ages much beyond 100.
- 3) Researchers returning to previously visited areas have found that some ancients exaggerate their increase in age.
- 4) The physical functions and metabolism of centenarians in these regions do not match those of well documented centenarians in other areas, but appear younger.

In the words of exiled Soviet researcher Zhores Medvedev:

In most cases the phenomenon of exceptional longevity restricted by specific geographical areas does not exist, and a lot of direct and indirect information strongly suggests that we have in this neither a medical nor biological problem, but a complex social problem which developed for many social, cultural, habitual, traditional, local, and political reasons and which was backed by science under conditions which normally lead to the transformation of science into pseudoscience, conditions which

do not permit real objective and neutral or critical study, and which intentionally produce only conforming information.⁴

With respect to Capt. Whitehouse's article⁵ of June, 1978, I would think it a bit odd that an article first written in 1977 and then reprinted in 1978 should reference material no more recent than 1966. As to the editor's note: recent information would seem not to show that there exists longevity comparable with that recorded in the Bible from Abraham on.

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Sincerely,
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Evidence Against Great Contemporary Longevity

In a recent issue of *CRS Quarterly*, Whitehouse¹ reported on the apparent phenomenon of longevity in Soviet Georgia. This topic received the attention of an article² in *Nutrition Today* in which recent studies are described which seem to show that the old people in this and other areas are not any older than old people in America and elsewhere.

According to several reports by Leaf (professor of medicine at Harvard) in 1973,^{3,4,5} there appeared to be good evidence that there were remote regions where people "had actually found the secret of longevity."⁶ Those regions investigated by Leaf were "Hunza, deep in the Karakoram Range of the western Himalayas in Pakistan; Abkhazia in the Caucasus Mountains of Georgia, U.S.S.R.; and Vilcabamba, high in the Ecuadorian Andes."⁷

Leaf's work in 1971 served as the basis for the reports in 1973. Leaf returned to Vilcabamba in 1974. Leaf's suspicion that the reported ages were not accurate resulted when one man who reported his age in 1971 as 122, said that he was 134 in 1974. Further investigation led Leaf to conclude that in this particular settlement, age exaggeration is the rule rather than the exception. It has now become known that people who were previously thought to be as old as 150 are really less than 100.

Leaf's new findings have been supported by researchers Mazess (assistant professor of radiology at the Univ. of Wisconsin) and Forman (assistant professor of anthropology at the Univ. of Massachusetts) who closely examined records of baptisms, marriages and deaths in Vilcabamba. Exact age is difficult to determine from the records since many villagers take identical names of their fathers and mothers. It was also learned that

village elders gain esteem by exaggerating their age. It was found that age exaggeration begins at about age 70 and that the average person claiming to be over 100 turned out to be about 86.

With regard to the high percentage of elderly people in the Ecuadorian village, the situation is compared with that in St. Petersburg, Florida. The old people tend to move to Vilcabamba from other villages, and young people tend to move out.

No similar follow-up studies have been done in Hunza or in Soviet Georgia. The Hunzakuts have no written language and few have mastered the spoken language, making investigation difficult. It was reported that these researchers feel that in these other regions the outcome of further investigation would be similar to that in the Ecuadorian Andes.

Readers of the *Quarterly* should be aware of these new findings and should view with caution reports of unusual longevity in today's world.

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 Received 9 November 1978

The Identity of Imhotep

In a recent article in this journal James Strickling suggested identifying the famous Egyptian Vizier Imhotep with the patriarch Joseph.¹ In the light of what information is known about this great Egyptian official, who served under the Pharaoh Djoser of the Old Kingdom, such an identification seems very unlikely. While it is true that there are certain superficial similarities between the two men, the differences are far more striking; it is therefore worth examining what is known of the career and accomplishments of Imhotep in comparison with the Biblical information about Joseph.

It is true that both men held the title Vizier, or Prime Minister, of Egypt (for Joseph, cf. Gen. 45:8). Joseph, however, is given two other technical Egyptian titles in the same verse—"Father to the Pharaoh" (most certainly the Egyptian title God's Father)² and "Lord of all his House", which can best be equated to the Egyptian dignity Chief Steward of the King.³ Imhotep never held these two important posts.⁴ The fact that both men were Viziers indicates little since literally dozens of Egyptian officials held that post.⁵

Imhotep's connection with magicians and the occult is by no means certain. What is clear is that he was a doctor and, in fact, a noted medical expert. Manetho, writing his history of Egypt in Greek in the third century B.C. makes three comments about Imhotep: that he invented monumental stone architectural techniques, that he was a famous physician, and that he was a noted writer.⁶ There seems to be no involvement on the part of Imhotep with dream interpretation.

A late tradition recounted on a Ptolemaic stele from the second century B.C.⁷ places a famine of seven years' duration in the reign of Djoser and tells of the measures taken to alleviate it. Since the stele was inscribed 2500 years later than the days of Djoser and Imhotep and has been shown to have been a composition of the Ptolemaic age and not a reworking of an earlier inscription,⁸ there is no good reason to conclude that any such event as the seven year famine occurred at the time of Imhotep; but we may have in this tradition the remembrance on the part of the later Egyptians of the biblical famine in the days of Joseph. The solution to the problems caused by the famine was simply credited to the wisest figure popularly remembered from the distant past, Imhotep.

Imhotep was, as Strickling has pointed out,⁹ an administrative and architectural genius. The only specific detail that can be cited in this regard, however, is the designing of the first pyramid and the concurrent invention of monumental stone architecture. It is hard to believe that Joseph the man of God would have had anything to do with the construction of pyramids, the very symbol of Egyptian paganism. Also, we know nothing of any administrative reforms or even general accomplishments of Imhotep which might match the Biblical deeds of Joseph; nor do we have any mention of Imhotep in primary sources which would connect him in any way with the building of granaries. The latter were in any case built of mud brick and not stone in ancient Egypt.

Strickling's view that Imhotep was a foreigner cannot be supported from the available source material.¹⁰ Both of his parents' names are known and both are good Egyptian names. Imhotep's father, an official by the name of Khnum-nefer, even held the important title Overseer of Works of Upper and Lower Egypt. I know of no examples of such a post being held by a foreigner.

Nor does the lack of a tomb for Imhotep prove any connection with Joseph. Of all the officials of every description and from every period of Egyptian history the majority of the tombs are lost; it is more common for the tomb of a Vizier to be missing than not, so we cannot conclude that the absence of the final resting place of Imhotep means that that notable was not buried in Egypt.

The greatest obstacle in the way of identifying Joseph with Imhotep is in fact the chronological one: according to the traditional dates (which this writer feels are acceptable both biblically and historically) Imhotep lived before 2500 B.C., and according to scriptural calculations Joseph served as Vizier sometime after 1870 B.C. Strickling suggests a solution to this discrepancy by accepting D. Courville's theory that Joseph was Men-

tuhotep, the well known Vizier under Sesostri I of Dynasty XII, and then assuming on the basis of certain similar titles held by both men that Mentuhotep and Imhotep were the same person mistakenly assigned two lifespans.¹¹ Even if Courville's thesis were accepted and Mentuhotep was actually Joseph, an equation of that official with Imhotep seems very unlikely for the following reasons. While Imhotep is connected beyond question to Djoser of the Old Kingdom, Mentuhotep is equally solidly associated with his king, Sesostri I. This fact was clearly stated by Mentuhotep himself on his long known biographical funerary stele.¹² Also, the parents of both Mentuhotep and Imhotep are known, and the two men had different mothers and fathers—for example, Imhotep's mother was Kherdu-ankh, while Mentuhotep's was named Asenka.¹³ Thus, it is best to regard Mentuhotep (even if that individual was Joseph, which seems doubtful if not utterly impossible) and Imhotep as different men.

While the present author cannot accept the view of Strickling that Imhotep was Joseph, it does seem possible that he has brought to light one interesting point. The late tradition that there was a famine of seven years' duration in Imhotep's days may well really reflect the famine at the time of Joseph. The Egyptians of the Ptolemaic era remembered the event, but not the correct period and the correct Vizier. Thus, Joseph's accomplishments were credited to the famous Imhotep.

References

- ¹Strickling, James E., 1977. Im-who?-tep. *Creation Research Society Quarterly* 14 (3): 147-148.
²Yahuda, Abraham S., 1933. The language of the Pentateuch in its relation to Egyptian. London. II, pp. 23 et seq; also Ward, William A., 1957. Egyptian titles in Genesis 39-50. *Bibliotheca Sacra* 114: 51-52 (January).
³This high title seems to fit Joseph best, contrary to Ward's view, *op. cit.*, pp. 52-53.
⁴For a list of the major titles of Imhotep, see Weil, Arthur, 1908. *Die Veziere des Pharonenreiches*. Strassbourg. P. 3.
⁵See the list in Helck, Wolfgang, 1958. *Zur Verwaltung des mittleren und neuen Reichs*. Leiden. Pp. 433-465.
⁶Waddell, W. G., 1940. *Manetho*. Cambridge. Fragment 11, pp. 41-42.
⁷The stele is discussed by Redford, D. B., 1970. A study of the Biblical story of Joseph. Leiden. Pp. 206-207. Although Redford rejects the historicity of the story of Joseph, he admits that the Egyptians had a tradition of a seven years' famine.
⁸See Barguet, P., 1953. *La stele de la famine a Sehel*. Cairo.
⁹Strickling, *loc. cit.*
¹⁰See Weil, *op. cit.*, p. 3, for a genealogy of Imhotep.
¹¹Strickling, *loc. cit.*, p. 148.
¹²Breasted, James H., 1906. Ancient records of Egypt. Chicago. I, p. 255.
¹³For Imhotep, see Weil, *op. cit.*, p. 3; for Mentuhotep, Weil, *op. cit.*, p. 39.

Charles F. Aling, Ph.D.
 Professor of History and
 Archaeology
 Tennessee Temple Schools
 Chattanooga, Tennessee
 Received 11 October 1978

Reply to Dr. Aling's Comments on "Im-Who?-tep"

In spite of only a superficial examination of Joseph and Imhotep being made in "Im-Who?-tep", I repeat

my statement from the last paragraph: "The existence of two such similarly described noteworthy individuals of antiquity in such similar circumstances in the same cultural setting strains the bounds of coincidence. It appears that one man has been credited with two lifetimes . . ." The points of correlation do not constitute a proof, but Dr. Aling has not negated their very strong suggestion.

In examining the titles of the two personalities and their association with the occult, Dr. Aling has cited voids and uncertainties—not contradictions.

The late date of the Siheil inscription was recognized. The fact that it was not a reworking of an earlier inscription does not justify rejecting the *account* as possibly "ancient". Aling admits that the inscription may record the famine occurring in the days of Joseph, but he says the very same inscription amounts to a fabrication in its reference to Imhotep; that it *could* refer to the time of Joseph but *not* to the time of Imhotep. If the basis of this contention is Imhotep's presumed greater antiquity, this is circular reasoning. In any case, it is not objective.

Aling finds it hard to believe that Joseph would associate himself with pyramids, "symbols of Egyptian paganism." Joseph accepted the administration of the kingdom—What is the difference? The pyramids were built by pagans, but the kingdom itself consisted of pagans. Ignorance of Imhotep's general accomplishments is another void. Also, "granaries of mud brick" is consistent with the suggestion that Joseph (subsequently) initiated architecture in stone.

Multiple names were common in Egypt. Joseph was given an Egyptian name. There is also the possibility of "assumed" relationships. Joseph is called father of Pharaoh in the Bible, and Imhotep is called son of Ptah in mythology.

Absence of a known tomb for Imhotep does not prove any connection with Joseph, but it is certainly a necessary condition for such a connection; a condition not yet violated.

My reference stating ". . . two such similarly described noteworthy individuals . . ." was to Joseph and Imhotep—not Imhotep and Mentuhotep, although the latter might be easily inferred.

No matter which of the two is correct, Velikovsky and Courville have both shown that "accepted" Egyptian chronology has been "weighed in the balances and found wanting." This is also true of the identification of many Egyptian personalities. Given the number of apparent correlations in the lives of Joseph and Imhotep, their single identity remains a strong possibility until a contradiction arises—such as the discovery of the tomb of Imhotep.

James E. Strickling
 3309 DeKalb Lane
 Norcross, Georgia 30093
 Received 7 November 1978

Talents Available

May I use the *Quarterly* to make a request?

I am a photographer, and am also engaged in the production of video and other audio-visual aids for school.

I have also taught biology, mathematics, and physics in high school, and have an extensive acquaintance with natural history.

I see a need for more presentations of natural history which recognize that natural phenomena are examples of God's providential care for His creation. As a corollary to this, such programs should teach that man has been entrusted with the environment, and that he is its steward.

There are no doubt many others who have similar

concerns; and I should be glad to correspond with them. Also, I should be interested in suggestions about how I may apply my talents to this very important work.

Sincerely,
Ralph P. McKelvy
302 Tally Drive
Pittsburgh, Pennsylvania 15237
Received 10 August 1978

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OPENNESS AS A PRINCIPLE OF SCIENCE

We hear that the Committee on Openness as a Principle of Science now has over 700 signatures in support of the Statement Affirming Openness as a Principle of Science, which is quoted below.

The Committee is not a committee of the Creation Research Society, nor has it any connection with the Society; it is an independent group.

Those who wish to put on record their support of the Principle, by subscribing to the Statement, or who wish more information, may write to the Chairman of the Committee on Openness as a Principle of Science, Dr. Thomas G. Barnes, 2115 N. Kansas St., El Paso, Texas 79902.

Statement Affirming Openness as a Principle of Science

In recent years the origin of matter/energy, the cosmos, the solar system, and life on the earth have been presented in the classroom from the evolutionary point of view only. The traditional creationist point of view has been suppressed. We are concerned with the social, ethical, and scientific consequences of the current exclusive presentation of a humanistic evolutionary point of view regarding origins. The students have a right to know there is an alternative creationist point of view. They have a right to know the scientific evidences which support that alternative. They have a right to make the choice between evolutionary and creationist points of view so far as their understanding of origins is concerned.

Controlled experimentation may be applied only to a limited degree to problems dealing with the past or the future. For that reason, any conclusions regarding either the past or the future lack the scientific reliability of conclusions regarding present phenomena. Accordingly, it is especially important that there be openness in discussing matters related to origins.

We therefore affirm a policy of openness as a principle of science with respect to presentation of matters of origins in the classroom. The evidences supporting an evolutionary point of view and the evidences supporting a creationist point of view should be given proper presentation in any classroom where the topics under discussion relate to the origin of matter/energy, the origin of the cosmos, the origin of the solar system, or the origin of life.

We are not asking that religious dogmas be presented in the classroom, but we are asking that scientific evidences supporting both of these alternative points of view be presented. We call upon all local school boards, manufacturers of textbooks and teaching materials, concerned citizens, and teachers and educational agencies to resist pressures toward scientific dogmatism and presentation of only one point of view on origins.

QUOTABLE QUOTE

"... We would likewise do well to examine, whether our taxing the waste of seeds and embryos, and accidental destruction of plants and animals before they come to full maturity, as an imprudence in the Author of nature, be not the effect of prejudice contracted by our familiarity with impotent and saving mortals. In man indeed a thrifty management of those things which he cannot procure without much pains and industry may be esteemed wisdom. But we must not imagine that the inexplicably fine machine of an animal or vegetable costs the great Creator any more pains or trouble in its production than a pebble does; nothing being more evident than that an Omnipotent Spirit can indifferently produce everything by a mere fiat or act of his will. Hence is it plain that the splendid profusion of natural things should not be interpreted as weakness or prodigality in the Agent who produces them, but rather to be looked on as an argument of the riches of His power."

Berkeley's *Principles of Human Knowledge*

CREATION RESEARCH SOCIETY

History The Creation Research Society was first organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a real need for an association devoted to research and publication in the field of scientific creationism, with a current membership of about 500 voting members (with graduate degrees in science) and over 1600 non-voting members. The *Creation Research Society Quarterly* has been gradually enlarged and improved and now is recognized as probably the outstanding publication in the field.

Activities The Society is solely a research and publication society. It does not hold meetings or engage in other promotional activities, and has no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund is maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible.

Membership Voting membership is limited to scientists having at least an earned graduate degree in a natural or applied science. Dues are \$10.00 (Foreign, \$11.00 U.S.) per year and may be sent to Wilbert H. Rusch, Sr., Membership Secretary, 2717 Cranbrook Road, Ann Arbor, Michigan 48104. Sustaining membership for those who do not meet the criteria for voting membership, and yet who subscribe to the statement of belief, is available at \$10.00 (Foreign, \$11.00 U.S.) per year and includes subscription to the Annual Issue and Quarterlies. All others interested in receiving copies of all these publications may do so at the rate of the subscription price for all issues for one year: \$13.00 (Foreign, \$14.00 U.S.).

Statement of Belief Members of the Creation Research Society, which include research scientists representing various fields of successful scientific accomplishment, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution), both of the universe and the earth with its complexity of living forms.

We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. In 1970 the Society published a textbook, *Biology: A Search for Order in Complexity*, through Zondervan Publishing House, Grand Rapids, Michigan 49506. Subsequently a Revised Edition (1974), a Teachers' Guide and both Teachers' and Students' Laboratory Manuals have been published by Zondervan Publishing House. All members of the Society subscribe to the following statement of belief:

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.

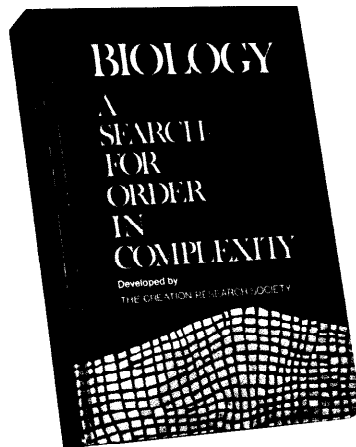
2. All basic types of living things, including man, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.

3. The great Flood described in Genesis, commonly referred to as the Noachian Flood, was an historic event worldwide in its extent and effect.

4. We are an organization of Christian men of science who accept Jesus Christ as our Lord and Saviour. The account of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Saviour for all mankind. Therefore, salvation can come only through accepting Jesus Christ as our Saviour.

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BIOLOGY: A SEARCH FOR ORDER IN COMPLEXITY (Revised Edition, 1974)

A textbook for high school presenting creation AND evolution.
595 pp., 436 illustrations, \$9.95.

TEACHER'S GUIDE TO ACCOMPANY BIOLOGY: A SEARCH FOR ORDER IN COMPLEXITY

Paperback, \$1.95.

INVESTIGATIONS INTO BIOLOGY: STUDENT'S LABORATORY MANUAL

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ANTHOLOGIES

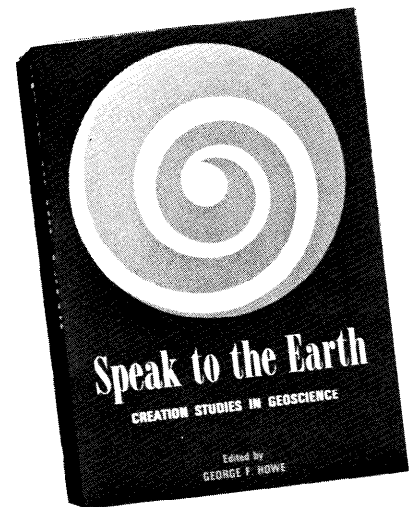
SPEAK TO THE EARTH (*Creation Studies in Geoscience*)

A classified anthology of articles from *Creation Research Society Quarterly* for second five-year period, 1969-1974.

Presbyterian and Reformed Publishing Company, Nutley, New Jersey. \$12.50.

WHY NOT CREATION?

A classified anthology of articles from *Creation Research Society* for the first five-year period, 1964-1969. \$7.50.



Available from Baker Book House, Grand Rapids, Michigan and Presbyterian and Reformed Publishing Company, Nutley, New Jersey.

SPECIAL REPRINTS

A Decade of Creationist Research by Dr. Duane T. Gish, from the *Creation Research Society Quarterly* for June, 1975. 16 pages, 75 cents postpaid (50 cents for orders of 100). Some of the considerable amount of Creationist research done in the decade 1964-1974 is described, under the headings: Geology, General Geological Reports, Genetics, Natural Selection, General Biology, Taxonomy, and Thermodynamics.

Darwin's Last Hours, by Dr. Wilbert H. Rusch, Sr., from the *Quarterly* for September, 1975. Rusch's investigations find no evidence for the story, sometimes published, that Darwin, toward the close of his life, repudiated evolution and became enthusiastic for Christianity. 25 cents postpaid.

Both reprints are available from the College Bookstore of Concordia College, 4090 Geddes Road, Ann Arbor, Michigan 48105.

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