

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

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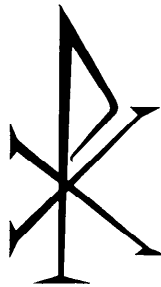


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COVER ILLUSTRATION

The picture on the front cover is a view of Upper Yosemite Falls, Yosemite Park, California, from across the Valley. The photograph was taken by Mr. Ralph H. Anderson in May 1938, and is used here by courtesy of the National Park Service, Yosemite National Park.

Yosemite is discussed in a reprinting of some work by Whitney, who was at one time State Geologist of California, elsewhere in this issue of the *Quarterly*. There evidence is adduced to show that the valley was not formed by erosion, due either to water or to ice. Rather, a block of the Earth's crust sank, in an event which could surely be called catastrophic. Thus the formation of the valley may have been quite sudden; and it is quite compatible with a young Earth.

QUOTABLE QUOTE

"... though I cannot with eyes of flesh behold the invisible God, yet I do in the strictest sense behold and perceive by all my senses such signs and tokens, such effects and operations, as suggest, indicate, and demonstrate an invisible God—as certainly, and with the same evidence, at least, as any other signs, perceived by sense, do suggest to me the existence of your soul, spirit, or thinking principle; which I am convinced of only by a few signs or effects, and the motion of one small organized body: whereas I do at all times and all places perceive sensible signs which evince the being of God. The point, therefore, ... seems manifestly to follow from the premises. ... For my part, ... I find myself under an absolute necessity of admitting it for true. ... I live and die in the belief of a God."

Berkeley's *Alciphron*.

CONCERNING VERNAL POOLS AND THE UNIQUE PLANTS FOUND IN THEM

WALTER E. LAMMERTS*

Received 28 October 1977

The October 1976 issue of *Fremontia*, journal of the California Native Plant Society, has a fascinating series of articles on vernal or spring pools. These are shallow temporary pools formed by the winter rain water collecting in flat-bottomed depressions. These all have an under-layer of claypan or hardpan at a variable depth below the surface, so that the water cannot seep away into the lower soil column. They are found both in the coastal parts of California and in the great valley areas of the Sacramento and San Joaquin rivers. Some are found in soils isotopically dated at over half a million years. But others, with an equally rich flora and fauna, are found in very recent soils. Usually they are round pools, though they may be of other shapes. Concentric displays of flowers succeed one another as the season advances. A photograph in the article by Robert F. Holland and F. Thomas Griggs entitled, "A Unique Habitat-California's Vernal Pools" shows a circular pool with the dainty white and rose meadow foam or *Limnanthes douglasii* var. *niveu* in full bloom. (Figure 1) This species has possibilities as an oil producing crop plant! Other pools have rings of the yellow goldfields, *Lasthenia fremontii*. The pool itself by this time is teeming with many forms of animal life such as the fairy shrimp, the oar-footed little shellfish called Copepods, and numerous aquatic insects. All of these must hatch from eggs, grow to maturity, mate, and lay eggs before the pool dries up again in about two months. Sometimes the rainfall of a season is so little that the pools remain dry, so both the plant seeds and the animal eggs have a built-in ability to survive several years between adequate rainfalls.

As time goes by and the shore line recedes, different sets of plants come into flower, succeeding one another in predictable order. Thus another kind of daisy, the yellow *Chaetopappa aurea* follows the goldfields which occupy slightly higher ground, now too dry for them to continue growth. Brass buttons of *Cotula coronopifolia* will begin to flower at the edge of the water or even in it. Incidentally this flower is not limited to vernal pools but grows in marshy places quite generally throughout California. Then when all the water is gone, the dried-up bed of the former pool will be carpeted with the azure blue of *Downingia pulchella* by the tens of thousands, all the flowers facing the sun! (Figure 2.) These plants are 1 to 4 inches high and seem to be all flower. As they begin to fade away, the blue color is replaced by the rich purple of the sweet aromatic mesa mint, *Popogyne ziziphroides*. Also the spreading coyote thistle, *Eryngium vaseyi*, becomes abundant, their flowers small and inconspicuous, but the sea-green plants contrasting like delicate carvings against the dark purple mint.

Summer comes and for months on through the long dry California fall the pools will be flats, covered with

dried-up leaves and stems, the tough shrubs on the mounds such as deerweed, scrub oak, laurel sumac, and chamise furnishing the only green color.

Some entire genera such as the *Downingia* species are found only in the vernal pools. There are 6 species of this remarkable plant, only one found at any given pool. They are of varying shades of blue and purple and differ strikingly from one another in the form of the flower. They are related to the garden lobelia, being members of the same family, *Lobeliaceae*.

Aside from the wide-spread generally occurring brass buttons which is naturalized from South Africa, most of the vernal pool species are endemic to or found only in California. The ardent evolutionist C. Ledyard Stebbins in his very informative article, "Ecological Islands and Vernal Pools", admits that they "probably evolved during the past ten thousand years."² In fact he says: "There followed a post-glacial period of drought and warmth when the Sierran glaciers disappeared completely and the mountains had less snow on them than at present. At this time, about 4000 years ago, lakes were being converted into isolated vernal pools, or were disappearing completely. Still later, during the Christian era, came a "little ice age" which brought on the small glaciers that still persist in a few places in the Sierra. The positions of the vernal pools undoubtedly changed during this period, and new opportunities were presented either for hybridization between varieties or closely related species, or for selective occupancy of new niches on the part of strongly isolated species that were competing with each other."² He furthermore states that in very recent years this changed again so that boats could be navigated from the Bay area all the way to Lockford, about 20 miles north-east of Stockton, a distance of about 78 miles. I called attention to the existence of very large lakes in California in my article on "Recency of the Pacific Southwest Desert".³ It would

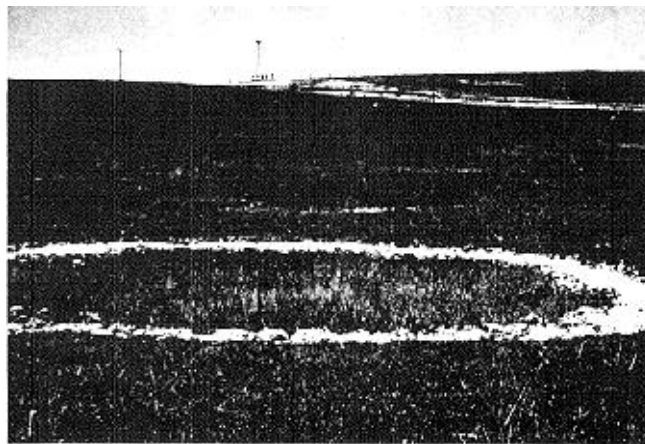


Figure 1. This is a photograph, taken by Alice Howard, of a vernal pool with a ring of meadowfoam (*Limnanthes douglasii* var. *nivea*.) This picture originally appeared in the journal *Fremontia*.

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seem then that the present location of the vernal pools is a very recent phenomenon. The method by which the endemics such as *Downingia* re-established themselves in these new vernal pools is not discussed in any of the articles, and may indeed be as yet unknown.

The unusual vernal pool species must have originated even according to orthodox geological theory within the last 10,000 years. As shown in our article "Plant Succession Studies in Relation to Micro-Evolution"⁴ natural selection is hardly the effective agent evolutionists would have us believe it to be. This is largely because plant populations do not remain in any one location long enough for any selection to occur. The frequent shifting of the location of the vernal pools in the last 10,000 years presents much the same problem. Certainly whole genera such as *Downingia* could hardly have originated by selection in the alleged 10,000 years since the last major glacial period.

From the creationist viewpoint these species can hardly be imagined as being part of God's original creation, for in the pre-Flood world the Bible records that there was no rain, but "there went up a mist from the earth, and watered the whole face of the ground" (Genesis 2:6). Accordingly there could not have been any vernal pools! It would seem then that they were created as part of God's providential care after the Flood as part of His plan to create a maximum beauty in the post-flood world.

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- ¹Holland, Robert F. and F. Thomas Griggs, 1976. A unique habitat — California's vernal pools. *Fremontia* 4(3):3-6.
- ²Stebbins, G. Ledyard, 1976. Ecological islands and vernal pools. *Fremontia* 4(3):12-18.
- ³Lammerts, W. E., 1971. Recency of the Pacific Southwest desert. *Creation Research Society Quarterly* 8(1):50-54.
- ⁴Lammerts, W. E., and George F. Howe, 1974. Plant succession studies in relation to micro-evolution. *Creation Research Society Quarterly* 10(4):208-228.



Figure 2. This shows several plants common to vernal pools. Upper left: *Downingia pulchella* Torr. x 2. South coast ranges; Sacramento Valley; Sierra Co. n. to southern Oregon. Center lower lip white, deep bright blue. Upper right: *Downingia ornatissima* Greene, x 3. Low spots of plains, Sacramento and San Joaquin Valley. Squarish white center, otherwise very light blue. Lower left: *Downingia concolor*, Greene, x 3. Corolla blue, lower lip with velvety purple quadrate spot on white central field. Santa Clara Valley to Lake Co. and plains of Sacramento Valley. Lower right: *Downingia bicornuta*, Gray x 2. Corolla blue; lower lip white central field and two yellow spots. Lobes of upper lip violet purple. Low plains of Sacramento Valley; variety *Montana* with longer upper lip grows in mountains from 3,000 to 5,000 feet. These pictures are from the book *Manual of the Flowering Plants of California*, by Willis Linn Jepson, which has been out of print for a long time.

PROCESS CONSTRAINTS IN LIVING SYSTEMS

D. R. BOYLAN*

Received 21 April 1978

During the past ten years major advances have been made in understanding living systems. Of particular importance is the unfolding of the chemical nature of these systems. It is instructive, therefore, to examine living systems as ordinary chemical processes. Constraints known to be applicable to such processes should then be applicable to living systems. It is the purpose of this presentation to suggest a few such constraints.

Recently, the Office of Student Life sponsored a Religion and Life Seminar on campus. One of the topics was "Finding Our Roots: Created or Evolved." The subject is of timely interest, and much debate in regard to "roots" is current. Some of this debate centers on the age-old argument of creation vs. evolution. The issue will not be settled in this discussion, or in any other for that matter, since origins cannot be subjected to scientific scrutiny. Some will argue that evolution has been proved and, therefore, any other view is either not scientific or not worthy of serious consideration. Such an attitude is naive since *any* construction of origins must remain speculative. Neither creation or evolution can be proved, except possibly by inductive reasoning, as no life existed at the "beginning," and no extra-Biblical record is available of the event or the occurrence. We can examine only a small spectrum of the system and that only over a small segment of time.

Some Terms Defined

Since the subject of origins is highly controversial and often misunderstood, a few definitions are necessary. The words "creation" and "evolution" have different meaning for different people. In this presentation the words are intended to mean the following:

Evolution—the belief that the world in which we live, including the complexities of life, came about by natural causes.¹

Creation—the belief that natural causes or processes are impotent in themselves to effect either the origin or development of the complexities of life.

These definitions have been elaborated in a position paper on the teaching of creation/evolution in public schools by the Iowa Department of Public Instruction as:

Evolution

"The theory of evolution . . . states that modern biologic organisms descended, with modification, from pre-existing forms which in turn had ancestors. Those organisms best adapted, through anatomical and physiological modifications to their environment, left more offspring than did non-adapted organisms. The increased diversity of organisms enhanced their ability to survive in various environments and enabled them to leave more progeny"²

Creation

" . . . all permanent, basic life forms originated thousands of years ago through directive acts of a Creator independent of the natural universe. Plants

and animals were created separately with their full genetic potentiality provided by the Creator. Any variation, or speciation, which has occurred since creation has been within the original prescribed boundaries. Since each species contains its full potentiality, nature is viewed as static, reliable and predictable"³

It needs to be emphasized that these fundamental postulates are not "religious" in themselves. They do not involve worship. They are legitimate areas of investigation and constitute appropriate classroom inquiry. The fact that people who hold either belief may also be "religious" is only a testimony that people have a religious nature. Fortunate is the man or woman whose religious perspectives do not conflict with his or her scientific perspectives. Indeed, they need not conflict. The tendency to discredit creation views as only religious perspectives is obviously an attempt to minimize a growing mistrust in the evolutionary explanation of origins.

Development

Observations of the world about us show the development of increasing order in matter and cases of the apparent operation of abiogenesis, ontogenesis, and phylogenesis. These processes are sometimes referred to as the "facts of evolution". They are, in the same manner, the "facts of creation". Being observations of the present, they offer little to an understanding of origins, except by inductive reasoning. And it is just such reasoning that form the bases of any theory of origins. By examination of the processes of life on the basis of equilibrium, free energy and entropy, rather significant inference can be made however, in regard to the competing theories.

Application of Thermodynamics

To do this requires information gained from the application of thermodynamics to the life systems. That thermodynamics is applicable is asserted by Stull.

"The laws of thermodynamics and thermochemistry are linked and govern the behavior of all the matter in the Universe."⁴

"Combination of the energy and entropy with the absolute temperature yields quantitative information on the thermodynamic behavior and stability of chemical substances."⁵

Dr. Melvin Calvin has proposed a sequence of chemical reactions from hydrogen to present life in an article on chemical evolution. He states that

"Life is a logical consequence of known chemical principles operating on the atomic composition of matter."⁶

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A particularly important thermodynamic principle applicable to life systems seems to be the Second Law. Dr. L. Brillouin introduces his interesting and informative article on Life, Thermodynamics and Cybernetics by:

"How is it possible to understand life, when the whole world is ruled by such a law as the second principle of thermodynamics, which points toward death and annihilation?"⁷

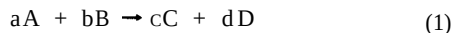
Later in the same article he states:

"Let us simply state at this point that there is a problem about "Life and the second principle" . . .

"Nobody can doubt the validity of the second principle, no more than he can the validity of the fundamental laws of mechanics . . . We do not know of any experiment telling against the second principle . . ."

Such a universal acceptance of thermodynamic principles is testimony to the soundness of those principles. Thermodynamic laws have been shown to apply to open as well as closed systems, unstable as well as stable systems, and irreversible as well as reversible systems. It is not always possible quantitatively to evaluate the various states of thermodynamic systems, but is possible to predict the probable state of a system from thermodynamic principles.

Therefore, let us consider life systems as processes. A typical process can be represented as



This general expression relates reactants A and B to products C and D. The small letters represent amounts. (Any number of reactants or products could be considered). The energies associated with the reactants and products are: internal energy, U , potential energy, X , kinetic energy, $v^2/2g_c$ and pressure-volume energy, PV . The "system" can absorb heat, Q , from the surroundings and do work, W , on the surroundings. In addition, the system may be subject to other work efforts, such as electrical, W_e , gravitational, W_g , magnetic, W_m , etc. If other than random work effects are present, appropriate additional terms must be included. Examples of non-random work are the separation of products, stacking a deck of cards, and the increase in system order in complex processes of life. Such processes require a work term, $-W_o$, to account for the work done on the system in directing the process outcome.

All of these energy terms can be included in a First Law expression for the process represented by Eq. 1. In general

$$dQ_i - dW_s = dE \quad (2)$$

where: Q_i = heat added to the system, W_s = work done by the system in expansion or shaft work, and E = total energy of the system. For open systems, the integral expression is

$$Q_i - W_s = E_2 - E_1 + \Delta U + \Delta PV + \Delta v^2/2g_c + \Delta X g/g_c \quad (3)$$

For steady flow $E_2 = E_1$ and only expansion or shaft work considered,

$$Q_i - W_s = \Delta U + \Delta PV + \Delta v^2/2g_c + \Delta X g/g_c \quad (4)$$

Where the other work effects are important, Equation 4 must be written as

$$Q_i - W_s = \Delta U + \Delta PV + \Delta v^2/2g_c + \Delta X g/g_c + W_e + W_g + W_m - W_o \quad (5)$$

since $U + PV = H$ (the enthalpy of the system)

$$Q_i - W_s = \Delta H + \Delta v^2/2g_c + \Delta X g/g_c + W_e + W_g + W_m - W_o \quad (6)$$

For systems where potential, kinetic, electromagnetic and gravity effects are negligible:

$$Q_i - W_s = \Delta H - W_o \quad (7)$$

$$\text{and } Q_i = \Delta H + W_s - W_o \quad (8)$$

If the system or process is not doing expansion or shaft work on the surroundings, the term W_s is zero, and

$$Q_i = \Delta H - W_o \quad (9)$$

For such a system the Second Law expression for the entropy (S) change is

$$\begin{aligned} \Delta S_{TOT} &= \int \frac{dQ_i}{T} = \int \frac{d(\Delta H - W_o)}{T} = \int \frac{dH}{T} - \int \frac{dW_o}{T} \\ &= \Delta S_R - \Delta S_o \end{aligned} \quad (10)$$

where: ΔS_{TOT} = total entropy change, ΔS_R = entropy change due to random effects, and ΔS_o = entropy change due to increasing order. The expression for the change in entropy is, therefore, the sum of the change in entropy due to the chemical reaction, i.e., the integral of dH/T , and the entropy change due to the increase in order or information in the system, ΔS_o .

Equation 10 in its later forms is useful in explaining complex processes having both random and non-random character. As an example, crystallization takes place partially by well defined change of state heat effects which are reversible and purely random. The crystal formation, however, is not random, and the atoms deposit themselves in a specific order. This order is so precise that many very sophisticated analytical techniques depend on crystalline structures being exactly ordered. The entropy of the random cooling process is quantitatively measured by the term $\int dH/T$. The non-random part of the process, or the ordering of the crystal, is represented by the term $\int -W_o/T$. It cannot be quantitatively measured for it represents the information contained in the atomic structure of the atom species. The second term effect is, however, clearly evident in the regularity of the crystal!

The final form is helpful in analyzing processes in which chemical effects are negligible and probability effects prominent. As an example, the process of "stacking" a deck of cards as opposed to a random "shuffle" involves $-W$, only and

$$\Delta S_{TOT} = 0 - \Delta S_o \quad (11)$$

In this case the $-\Delta S_o$ can be calculated from probability theory since $S = k \ln p$ where p = the probability of the "stacked" order, and k = Boltzman constant. It should be emphasized that the two entropy terms in the different forms of Equation 10 result from different "types" of energy transfer, and the interchange of

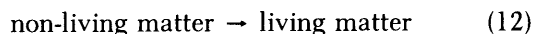
energy between the system and its surroundings in terms of entropy exchange must be of the same "kind". The argument that an "open" system will provide the necessary entropy sink for life systems is erroneous. The decrease in entropy due to increasing order cannot be financed by an increase in entropy in the sun or in any other random process in the surroundings. It can only be financed by energy from an equivalent "quality" source.

This can be illustrated by considering a process of putting a watch together. If the parts of a watch were arrayed on a table, "opening" the system to the sun, or to the universe for that matter, would not be effective in making a watch. Only the application of a certain "kind" of energy—intelligence or ordered energy—could do it. And, of course, we know that is just what happens. The watchmaker provides the $-W_0$ energy work on the system in accord with Equation 9.

The introduction of the $-W_0$ term into Equation 5 does not *a priori* imply a Creator. It does imply a certain kind of operation that must take place. The term, having been introduced, could be omitted once the proper understanding of energy interchange is achieved. Evolutionary theory claims that the term $-W_0$ is a result of natural selection, random chance, and long time spans. Creation theory claims that $-W_0$ comes from supernatural causes.

Development of Matter and Abiogenesis

Let us now examine the process of abiogenesis. The proposal (or allegation) is:



Dr. Calvin proposes possible processes (for abiogenesis) from what we know about present-day chemistry. (Figure 1).

"In the beginning most of the elements of the universe were in the form of hydrogen, which eventually had to undergo fusion reactions, giving rise to higher elements in the periodic table, particularly those important to living things: carbon, nitrogen, oxygen, sulfur, phosphorous, halides and certain metals, particularly iron, which are important catalytic functions in living organisms.

Then, the primitive (prebiotic, primeval) molecules were formed from the organogenic elements with which the earth was initially coated: methane, ammonia, carbon monoxide, water, carbon dioxide, hydrogen sulfide, and of course, hydrogen. These first three stages present no chemical problem, since the first two are nuclear and the third is simply the result of presence of carbon, hydrogen, nitrogen and oxygen at a low enough temperature to produce the small, primitive molecules.

The next stage of chemical evolution—from the organogenic molecules to the biomonomers—does present a chemical problem, and it has been an area of major progress in the last twenty years . . . The conversion of organogenic molecules into amino acids, sugars, nucleic acid bases, and other carboxylic acids (acetic acid and citric acid) has been achieved in the laboratory under the influence of a

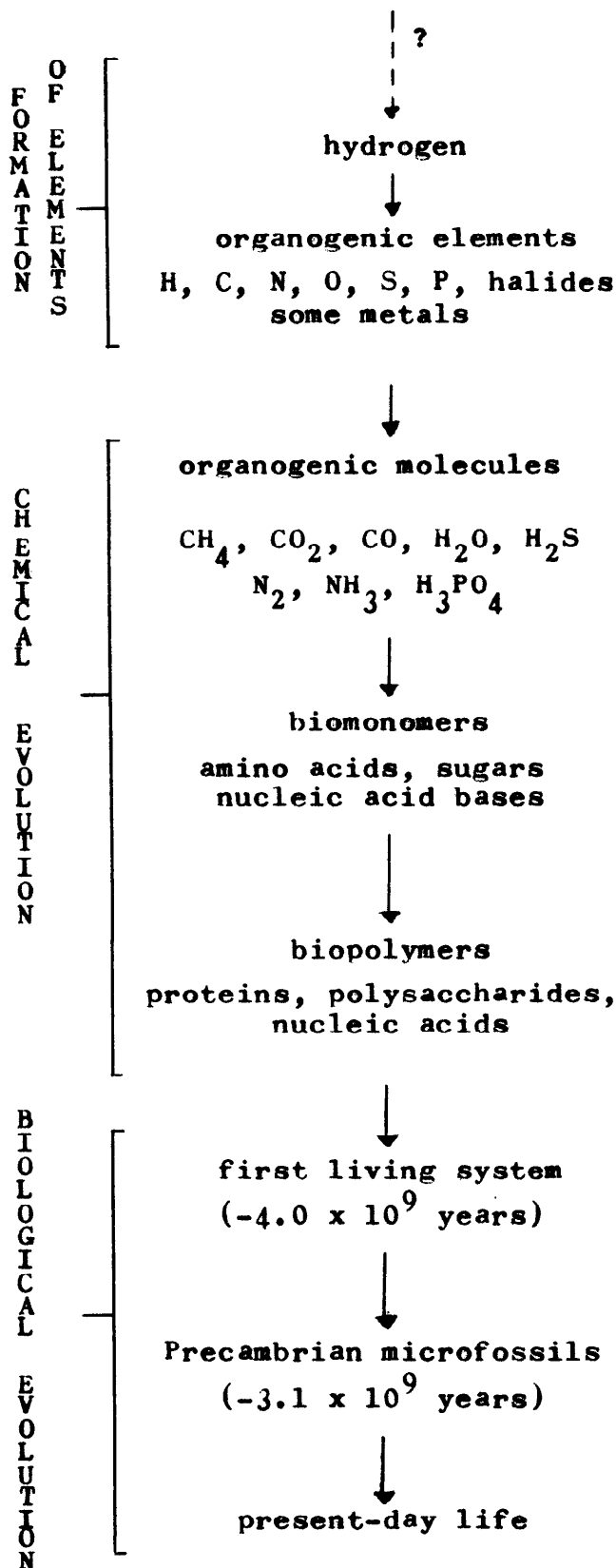


Figure 1. The time sequence of evolution (as commonly claimed), from the formation of the elements up to the present. After Calvin, reference 6, page 171.

wide variety of energy sources, ranging from the ultraviolet light of the sun to radioactive energy (in the form of ionizing radiation) to mechanical energy (in the form of meteoritic shock waves). All these energy sources give rise to the transformation of the organogenic molecule to biomonomers.

The next stage-the transition from biomonomers to biopolymers-is more difficult to achieve in terms of chemical evolution . . . which eventually gave rise to the first living organisms about four billion years ago.⁸

Calvin *assumes* existing hydrogen and the necessary conditions for a "fusion" reaction. Now, in the state in which there were no suns or stars for such reactions and certainly no fusion furnaces, could this fusion take place? Modern fusion work is testimony to the difficulty in "arranging" such reactions, even with sophisticated laboratories. The proposition that . . . "hydrogen had to undergo fusion reactions, giving rise to the higher elements in the periodic table . . ." is contrary to the Second Law. And, of course, the hydrogen had to come from somewhere. It was "created". The formation of higher elements in the periodic table from hydrogen is not a "natural" process. As Stull points out, the free energy difference is prohibitive.

The equilibrium for any reaction or process is derivable from heat quantities alone. These heat quantities are related as follows:

The Gibbs free energy, G , is defined as

$$G = U + P V - T S \quad (13)$$

where: U = is internal energy, P = pressure, T = temperature, and S = entropy.

Since $H = U + PV$ and $G = H - TS$, at constant temperature and standard states

$$\Delta G^\circ = \Delta H^\circ - T \Delta S^\circ \quad (14)$$

This free energy change is related to equilibrium by

$$\Delta G = -RT \ln K \quad (15)$$

where K is the equilibrium constant, given in terms of the things in Equation 1 by $K = C^c D^d / A^a B^b$. Combining Equations 14 and 15

$$-RT \ln K = \Delta H^\circ - T \Delta S^\circ \quad (16)$$

which can be written

$$\ln K = \frac{\Delta H^\circ}{RT} + \frac{\Delta S^\circ}{R} \quad (17)$$

According to Stull, these

". . . relationships clearly indicate that the atoms present in a reaction will prefer the molecular configurations in which the entropy is maximized and in which the energy is minimized (algebraically). The maximum entropy is associated generally with the molecular configurations having the largest number of states available to the system, thus providing more "freedom" for the system. The minimum energy is associated generally with the molecular structure in which its atoms are most strongly bound to each other (or the structures in which the atom will have the maximum stability)" . . . "At low temperatures the equilibrium is determined

largely by the value of ΔH° , the "stability" term, while at high temperatures the equilibrium is determined largely by the value of the ΔS° , the 'freedom' term."⁹

Calvin suggests that, higher elements in the periodic table eventually "evolve" into organogenic molecules by stages . . . "the first" . . . nuclear and the third simply the result of carbon, hydrogen, nitrogen, and oxygen at a low enough temperature. This process demands that simpler molecules evolve into more complex molecules. It is a classic case of increasing order. The Second Law expression, Equation 10, tells how this takes place, viz.:

$$\Delta S = \int \frac{dH}{T} - \Delta S_\circ = \Delta S_\circ - \Delta S_\circ \quad (18)$$

Since increasing order is the goal of the reaction, the process must have, in addition to the chemical heat effects, an energy source which can establish order. The molecules themselves must either be credited with intelligence (molecular predestination) or some other intelligent or order direction tapped. The limited success achieved in laboratory experiments is directly attributable to the order-directing force-the scientist. Calvin admits to this . . . "I designed an experiment . . ." This is just what the Second Law demands-a "creative" force. It is not evolution that Calvin describes. It is creation (in the limited sense).

Ontogenesis

The development of the embryo is many times taken as evidence of evolution. Here, the Second Law clearly requires a $-\Delta S_\circ$ term apart from the chemical process. A "direction" of energy is clearly evident. Brillouin recognizes this.

"There are many strange features in the behavior of living organisms, as compared with dead structures. The evolution of species, as well as the evolution of individuals, is an irreversible process. The fact that evolution has been progressing from the simplest to the most complex structures is very difficult to understand, and appears almost as a contradiction to the law of degradation represented by the second principle. The answer is, of course, that degradation applies only to the whole of an isolated system, and not to one isolated constituent of the system. Nevertheless, it is hard to reconcile these two opposite directions of evolution. Many other facts remain very mysterious: reproduction, maintenance of the living individual and of the species, free will, etc."¹⁰

". . . we must be prepared to accept a 'life principle' that would allow for some exceptions to the second principle" . . . "What about life and the second principle? Is there not, in living organisms, some power that prevents the action of the second principle?"¹¹

". . . a living organism is a chemical system in unstable equilibrium maintained by some strange "power of life" which manifests itself as a sort of **negative** catalyst."¹²

This "negative catalyst" is the $-\Delta S_\circ$ term of Equation 10 and which is the needed "power of life."

Phylogenesis

The development of species is generally considered to have occurred through random chance and long time spans. Random chance is supposed to provide the negative entropy necessary for the "upward mobility" in speciation. However, the only energy identified is random energy from the sun. As stated before, such energy cannot provide the energy of order ($-\Delta S_0$, of the last form of Equation 10). There must be an energy which can direct the speciation process. Much of this "direction" is found in the DNA coding. The coding in these molecules has been shown not to be randomly derived. Dr. L. Quinn¹³ has demonstrated by molecular modeling that the codon structure of proteins is not redundant and represents unique molecular instructions.

Prigogine proposes that "fluctuations" or "instabilities" in what he calls "dissipative" structures can generate higher order in an open system. He acknowledges, however, that there is no evidence that life originated by any such means.

"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"¹⁴

That random chance cannot be effective in DNA coding can be seen in an example of chance formation of a simple protein. Assume a hypothetical molecule consisting of 100 amino acids using 20 distinct amino groups. The number of possible arrangements of these amino acids is $20^{100} = 10^{130}$, and the probability that one essential arrangement would occur by random chance is 10^{-130} , which is a fantastically small number. It is fantastically small because 10^{130} is fantastically large. For comparison, consider that the total number of electrons in the universe (5 billion light-years radius) has been estimated to be 10^{80} . And the total number of seconds elapsed since the beginning of time (according to the evolutionary theories) is 10^{18} .

Thus, the number of possible arrangements which could occur by chance is so very great in relation to any number with meaning that the probability of any such molecule occurring by chance is for all practical purposes zero.

With such small probabilities it is necessary to propose long time spans for the "improbable to become probable." George Wald¹⁵ says:

" . . . the important point is that since the origin of life belongs in the category of at-least-once phenomena, time is on our side. However improbable we regard this event . . . given enough time it will almost certainly happen at least once . . . Time is in fact the hero of the plot . . . given so much time, the impossible becomes possible, the possible probable, and the probable virtually certain. One has only to wait; time itself performs miracles."

This statement is repeated frequently in defense of evolution. The idea of time being a "hero" was recently repeated by Dr. K. E. Boulding.

"That which has probability of one percent in a year, such as a 100-year flood, has a 66 percent

chance of occurring in 100 years and 99.9 percent chance of occurring in 1000 years."¹⁶

Such statements have some basis in fact for repeated and independent trials of an experiment with two outcomes-success and failure.

If p = probability of success and q = probability of failure, $q = 1 - p$. The probability of a number of successes, k , in a number of repeated trials, n , is $p^k q^{n-k}$. So, the probability of no successes, or $k = 0$, is q^n and therefore the probability of at least one success is $1 - q^n$.

Now, with numbers of the order of magnitude used by Dr. Boulding, the quoted statement is valid. For example, if the probability of an event is 1% ($p = .01$) and there are 100 trials ($n = 100$), the following probability of at least one success ($1 - q^n$) or occurrence in 100 years is $1 - q^n = 1 - (0.99)^{100} = 0.634$ or 63.4%. For 1000 trials (or 1000 years in Dr. Boulding's example) $1 - q^n = 1 - (0.99)^{1000} = 0.99996$ or 99.99%. But, for very small probabilities such as for random chance of protein formation, the inference of "time as a hero" is simply erroneous. Even at relatively large probabilities, as 1/10 %, the statement is erroneous. If $p = .001$ and $q = 0.999$ for 100 trials $1 - q^n = 1 - (0.999)^{100} = 0.0952$ or 9.52 %.

For $n = 1000$, $1 - q^n = 1 - (0.999)^{1000} = 0.6323$ or 63.23%.

With this ten-fold decrease in probability, repeated trials do not produce the certainty which Dr. Boulding's statement might lead one to believe. However, as for protein production by random chance, for even a very simple molecule of only 100 amino acids, the probability is not only small, it is **infinitesimally** small. As developed above, it is of the order of magnitude of $1/10^{130}$. For this case, then, $p = 1/10^{130}$, and $q = 1 - p = 1 - 10^{-130}$, which would be written: $q = 0.9999 . . . 999$, there being 130 nines altogether.

The probability equation for at least one success would be $1 - q^n = 1 - (1 - 10^{-130})^n$.

An expansion according to the binomial theorem, in which only two terms are retained, is legitimate here; and that gives for the result $n/10^{130}$.

Even if $q = 1 - 10^{-9}$ and $n = 1000$, $1 - q^n$ comes to only 0.0001%. And if $q = 1 - 10^{-130}$, as discussed above, the resulting $1 - q^n$ is small beyond all imagining.

Thus, the evolutionary theory demands long spans of time, which is another way of saying that many more repetitions than 100 or 1000 would be necessary. But even if repetitions occurred a billion times a second since the beginning of evolutionary time (30 billion years) the probability is still infinitesimally small.

In this case, $n = 10^{27}$, so if $q = 1 - 10^{-130}$, then $1 - q^n = 1 - [(1 - 10^{-130}) \text{ raised to the power } 10^{27}]$. Even a large computer could not readily work this out as a direct problem in arithmetic. However, the binomial theorem may be used again, to give for the result $10^{27}/10^{130} = 10^{-103}$. This number is still inconceivably small. So time is not a hero; it is simply impotent to make an impossible event (evolution) possible.

In conclusion, living systems seem to be negative entropy processes. It is evident that abiogenesis, ontogene-

sis and phylogenesis proceed from lower order to higher order. Application of the First Law to such systems shows that the entropy change must include a random and a non-random contribution. The random contribution explains the general demise of the system through aging. The non-random contribution explains growth and development. The non-random contribution, or the $-\Delta S_0$ term in Equation 10, is necessary to account for the increasing order of living systems.

Equation 12: *non-living matter* $\rightarrow$ *living matter* is therefore not correct. It has a missing term. This missing term is the $-W_0$ contribution to Equation 10. It is the required intelligence (coding, design, direction, etc.) that the scientist (or creator) provides to the process. Intellectual activity is the highest form of energy. By this people do things. They build. They make. They CREATE. Intelligence is seen in the DNA coding, in the assembly of a watch, in the design of a pump to get water to go uphill, and in any higher order energy requirement to finance the processes of life. Equation 12 therefore needs to be modified. The equation is then¹⁷

$$\text{matter} + \text{intelligence} \rightarrow \text{life} \quad (19)$$

This equation fits the universe in which we live. The key component in the transformation of non-living matter into living matter is intelligence. This intelligence must come from a source outside of "matter" itself. It must

reside in the scientist, the designer or, in the case of life, in the Creator.

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TRUE CREATIONISTS

WILLIAM J. TINKLE*

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The doctrine of social Darwinism is not popular nowadays. But it and Darwinism in nature should stand or fall together; those who reject the former and hold the latter are being inconsistent.

Indeed, even nowadays an occasional voice is heard in support of social Darwinism. Here, one such recent attempt serves to initiate a critical investigation of Darwinism generally.

Darwinism is still with us in the life sciences, I am sorry to say. As for the doctrine of social Darwinism, about which so much used to be heard, I had hoped that it had passed into a richly deserved oblivion. Evidently it has not, at least not entirely so; for a recent article¹ has expounded a doctrine which hardly differs from the social Darwinism of the last century, when it was in its heyday.

Charles Darwin believed in the inheritance of acquired characters; and to show how it worked he professed a belief called pangenesis. Heredity was supposed to be accomplished by gemmules which are brought from all parts of the body in the blood. Francis Dalton disproved the groundless belief by injecting blood from black rabbits into white rabbits with no change in the color of the offspring. Social Darwinism, too, like the

claims of Darwin himself, is lacking in scientific foundation.

The author of the article cited (he does not sign his name) claims that sociobiology is a new science. Really it is but slightly younger than the original Darwinism, which is 120 years old. It advocates individual selfishness, claiming that progress comes by self-effort, overcoming other individuals, working to rise by their fall. Even a little deceit is helpful; but too much may cause repulsion, it is claimed. The yardstick by which progress is measured is selfish gain. Thus this doctrine recognizes, indeed glorifies, one's lower impulses and condones yielding to them, just as Darwin said that struggle is the natural means by which the weak are eliminated, the strong become stronger and thus the average is raised. It may be true that natural selection eliminates crippled and diseased animals; but no genetic mechanism has been discovered by means of which fit animals become fitter at each reproduction. Darwin visualized what would now be called the genes chang-

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ing slightly in all directions at each reproduction, but this was only an idea; such results never have been observed. Snyder and David, in a much-used textbook say, "Most genes are exceedingly stable . . . The natural mutation rate is very low. Many species have remained much the same for long geologic ages."²

It was his justification of selfishness that sold all of the copies of Darwin's *Origin of Species* on the first day they were offered. English middle classes were gaining money and status by oppressing their employees, but they felt a bit conscience-stricken. When Darwin wrote that this oppression was found in plants and animals and indeed that this is the method of improvement they felt justified in advancing themselves by putting others down. They were glad to read Darwin's book and they made him a hero. But conversely, anything said against sociobiology can be said against Darwinism as it is supposed to apply to plants and animals.

People as Robots

The author of the paper cited above denies freedom of the will, claiming that we are robots controlled by our genes. The present author recognizes the intricate work of the genes, having specialized in genetics; but does not overlook a number of other factors which influence our actions. We should choose among the influences rather than yielding to the one which for the moment seems strongest, blaming the decision upon our genes. The author cited says that some scientists say we do not need to listen to the genes. This is true; we should be trained to make a choice among the calls.

Many critics of sociobiology say that it is racist, and indeed this it was from the beginning. Darwin wrote, "The so-called Caucasian races have beaten the Turks hollow in the struggle for existence. Looking to the world at no very distant date, what an endless number of the lower races will have been eliminated by the higher races throughout the world." Thomas H. Huxley, Darwin's chief ally, said, "No rational man, cognizant of the facts, believes that the average negro is the equal, still less the superior, of the white man."³

Genes as Codes

Instead of Darwin's guess that the genes are put together anew at each reproduction, geneticists are now agreed that they are in the nature of a code and have a construction resembling a word. The message of this code is determined by the *order* of its parts. To illustrate, using a word n-o-t carries a far different meaning from t-o-n, showing that the *order* of the letters is the determiner of its message. Even if life had been on the earth a million years (which we do not believe), the correct order of the parts of genes would never have been established by chance. Intelligence was needed and evidently employed by the Creator.

The author cited deserves credit for admitting that there are exceptions to selfish action. There are examples of a bird increasing its own danger by giving a cry that announces this danger to the flock. There are many examples of persons risking their own lives to save others from fire. This author even says, "Another common objection; human sociobiology is long on theory,

short on proof." The modification should start by dropping the unproved assumptions of its author, Charles Darwin. It is only because he is held as a hero that his reputation has endured.

Theistic Evolutionists

The main thrust of the Creation Research Society to the careless agnostic, if only he would listen, is that we should recognize God as the maker and ruler of the universe, especially the world and man. But only a few of that class read the *Quarterly*. Most of our readers are church members already; but some are void of, or shaky on, correct beliefs about God as Creator and Ruler, inclined to compromise and make peace with "science"; inclined to say "I don't care how God made the world, just so you say that He did it". They do not recognize that evolution, while approved by many scientists, is not proved science at all but a presupposition formulated while sitting in an armchair. People who have such an idea may be among our readers. Let us try to give the message of our *Quarterly* to such folk.

The thinkers who first formulated the stance of evolution, some of them calling themselves Christians, expressed a belief in chance and trial and error which, to say the least, does not remind us of God. Some of the leaders at present *emphasize* the lack of purpose and planning, contending that there is no planning, only result. Those who call themselves Christians, but deny God's efficacy in order to agree with "science", and thus to be popular, are not helping the cause of truth nor honoring Him who created them.

Which Model?

The fact is that both creation and evolution are not science but more a philosophy. In our opinion the model of creation is more nearly proved because it agrees with the observed facts of nature much better than the model of evolution. No human observed the beginning of the world, consequently we cannot say that either model is proved by direct observation; but the creation model agrees with present observed facts and with valued records. Moreover, belief in it builds persons of strong minds and hearts.

The models are useful in the same way the diagrams are useful which an instructor draws on the blackboard while teaching. They present graphically the nature of the world, leaving the details for later study. The creation model presents the universe as the product of a plan, formed by a wise and powerful God; created promptly* and preserved ever since against a tendency of loss and decay.

The evolution model calls for a long period of time, uncertain beginnings of matter, very small changes by chance among particles which somehow became alive. Some of them remained much the same while others slowly became larger and highly organized. This process is claimed to be going on today in the same manner and at the same rate. A philosophy of life is important; but these philosophies conflict. So each person must choose between them, rather than trying to believe both or find solid ground midway between.

Some Christians have had severe mental conflict until they seemed to reach a position midway between the two models. Actually they did not agree with either camp; but from that time onward they read the claims of evolutionists and agreed with them. But they forgot that they were doing violence to the greatest Book that ever was written. They said; "Christianity says that God created the world and science tells me how He did it."

Creationism Cast Off

These persons paid no heed to scientists such as Gregor Mendel, Louis Agassiz and Henri Fabre, who never accepted the theory of evolution. If they had read the articles by modern scientists in the pages of this *Quarterly* it would have made a difference. Gregor Mendel's paper on heredity in peas which had cost him seven years of work and observation was kept in obscurity 35 years while Darwin held the stage of interest; but Mendel is now recognized as the father of genetics. Louis Agassiz did more for the teaching of biology in the world than any other person, in that he introduced both field work and laboratory periods. Henri Fabre was recognized by Charles Darwin as "the inimitable observer."

"But these men lived too long ago to know much" some may say. They lived at the same time as Darwin and Abe Lincoln. No one says they were the product of a primitive age.

Theistic evolution which is the common attempt at compromise, is not founded upon a careful study of either the Bible or biology. No theistic evolutionist believes in the whole Bible, and I do not refer alone to the first eleven chapters of Genesis. In Matthew 19:4 our Master tells us that God made man in the *beginning*, not through the ages, and that He made them well formed, male and female. There is much more in the New Testament on creation.

Consider Youth

Many young persons have given up their Christian belief because of evolution, and many others have become only nominal church members with a humanist attitude. This attitude holds down the power of God and substitutes dependence on the weak ability of man. Too many church leaders consider creation only a minor doctrine. To join the popular crowd they are going against many hard-working scientists and even the Bible as well. Yes, I mean it; this is not a misprint. Church leaders are going against scientists who are creationists and we hope this awkward and regrettable situation will soon end. What will the rising generation do, prompted by these church leaders' conception of the world? You may live to be 90 years old and those who now are children will be running the world. Will they run it to suit you? Much depends upon what we are teaching them now about the nature of the world.

True Science

As already stated, both models of the world are philosophies and both must rely upon faith to an extent, yet we will not close this paper without reminding you

of some facts which have been observed. There is not room to explain them here, but all have been explained on the pages of the *Quarterly*. (a) The world is not old enough for our plants and animals to develop by evolution. Earth's magnetism is decreasing at a rate which would have depleted the supply long ago if the world were billions of years old.⁵ (b) Mutations are the material for natural selection to work on; but these changes are a loss of something, not a means to make improvements.⁶ (c) Changes made by selecting for size, speed, etc. give results for only a time and then reach a definite limit.⁷ (d) Fossils do not prove evolution because their alleged relative ages are based on evolution. Why do some people believe fossils do show these ages? Because they believe in evolution.⁸ (e) The second law of thermodynamics shows that the world is slowly but surely running down.⁹ All of these points are supported by observed facts, which have been reported and discussed in the *Quarterly*.

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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 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.

IS THE EARTH'S CORE WATER? PART ONE: THE BIBLICAL EVIDENCE

D. RUSSELL HUMPHREYS*

Received 3 May, 1978

Scientists believe, on good evidence, that part of the earth's core is fluid. This is the first of a series of articles proposing that the fluid is not molten iron as generally thought, but water under great heat and pressure. Here the author examines many scripture passages about the earth's interior and concludes that the Bible strongly suggests such a hypothesis. In later articles, the author intends to show that the hypothesis is consistent with the known experimental data about the earth and water under high pressures, and that it has important scientific implications, concerning (for example) the separation of the continents, the earth's magnetic field, and craters in the solar system.

1. Introduction

Scientists have long thought, on the basis of good evidence, that a portion of the earth's core is fluid, not solid like the crust and mantle above it. This portion, called the "outer" core, starts at a depth of 2900 kilometers below the surface and extends down to a depth of about 5000 km¹ (see Figure 1). On the basis of some questionable assumptions which will be discussed in the second article of this series, most scientists have conjectured that the material in the outer core is molten iron and nickel, although there have been some other theories.² This series of articles proposes as a working hypothesis that the outer core consists of water under great pressure and at a high temperature, over four million bars³ and greater than several thousand degrees centigrade. Water under such conditions is a fluid.⁴ It expands to fill its container like steam, but it has the density of a liquid, being two to three times denser than liquid water at ordinary pressures.⁵ Part two of the series will discuss the state of the water in greater detail.

This hypothesis of a water core for the earth does not rest upon mere conjecture. Rather, it stems from what the Bible says about the Earth's interior. Creationists regard the Bible as a scientifically accurate account given by the God who created the earth. This part of the series, therefore, seeks out what God says in the scriptures concerning the earth's physical structure, regarding it as data of the highest reliability. The author feels that the data point strongly toward a water core, but he invites the reader to come to his own conclusions. Part two applies the hypothesis to the known experimental data. If the hypothesis is a true representation of what the Bible says, we can be confident that all true scientific facts will fit neatly into it.

The water-core hypothesis should be of great interest to many creationists. It explains where the vast amounts of water for the Flood could have come from when "all the fountains of the great deep burst open" (Genesis 7:11, NASB⁶). It explains many puzzling scriptural expressions such as, "the deep that lies beneath" (Genesis 49:25, NASB). The nature and amount of electrical conduction in a water core could shed additional light on the earth's magnetic field.⁷ The violent bursting forth of water and other material from the deep interior could also have a bearing on such diverse topics as separation

of the continents, the mid-Atlantic ridge, mountain building, large salt deposits, the origin of comets and meteoroids, and cratering in the solar system. Part three will discuss these and other scientific consequences in more detail.

2. The Waters of Creation

The first two verses of the Bible describe the origin of all water on or in the earth:

In the beginning God created the heavens and the earth. And the earth was formless and void, and darkness was over the surface of the *deep*; and the Spirit of God was moving over the surface of the *waters* (Genesis 1:1, 2, NASB⁸).

These verses show the prominence of water⁹ on that first day of creation, but they do not directly say how much water was present. If there was only enough for the seas of the early earth (Genesis 1:9, 10) and its vapor canopy (Genesis 1:6-8), then there would not be nearly enough for the earth's core. But there is another passage of scripture which gives more details about these waters of creation:

For when they maintain this, it escapes their notice that by the word of God the heavens existed long ago and *the earth was formed out of water and by water*, through which the world at that time was destroyed, being flooded with water (2 Peter 3:5, 6, NASB).

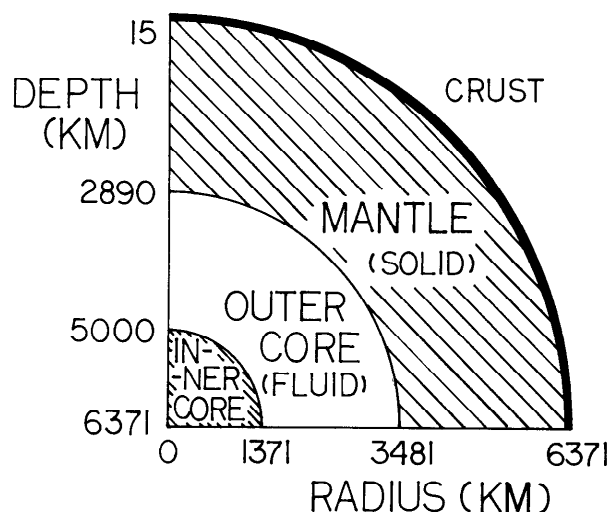


Figure 1. Main features of the earth's interior. Deduced from seismic wave data (Ref. 1).

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Notice that here God (through Peter) mentions water twice, thereby putting emphasis on, and distinction between, the two phrases "out of water" and "by water." The Greek word translated "formed" is *sunestosa*, which comes from a verb meaning "to place together, to set in the same place, to bring or band together."¹⁰ Perhaps this means God formed the nuclei of silicon, iron, and other elements out of water by banding together the various combinations of neutrons and protons from the nuclei of hydrogen and oxygen atoms of water (nuclear reactions). Then, perhaps, He banded together the various atoms scattered throughout the water into solid material (chemical reactions), as shown in Figure 2. The main point, however, is that this scripture says that water was the means by which God formed all the other materials of which the earth consists. This means that the quantity of water present at creation was very large. In fact, if God used the processes of nuclear and chemical transformation mentioned above, the mass of the water would be somewhat greater than the present mass of the earth, about 6×10^{24} kilograms¹¹ (or about seven billion trillion tons).

Such a quantity of water present at creation leaves open the possibility of the earth's core being water. Oceans and other water on the surface at present

amount to only about 0.03% of the earth's total mass.¹² The proportions are roughly the same as a thin film of moisture on an orange. If all the earth's water is at the surface, then 99.97% of the earth consists of materials other than water, which would mean that only a scant fraction of the original waters still remains. On the other hand, if the earth's core were water, it would comprise about 7% of the earth's total mass¹³ and about 16% of the earth's total volume. So the idea of a water core is more consistent with 2 Peter 3:5 than a core of some other material.

3. The Springs of Eden

Before the sixth day of creation, the familiar water cycle of evaporation and rain did not exist:

And no plant of the field was yet in the earth, and no herb of the field had yet sprung up; for Jehovah God *had not caused it to rain upon the earth*: and there was not a man to till the ground; but *there went up a mist from the earth, and watered the whole face of the ground* (Genesis 2:5, 6, ASV¹⁴).

In the absence of both rain and man, there was no point to God's making agricultural plants (plants of the field) right away.¹⁵ But in this parenthetical remark, God tells us that there was another mechanism for watering the earth in that period, a "mist" that "went up from the earth."

Notice that while the mist was not supplemented by rain prior to Adam's creation, it was abundant enough to water the whole land surface. If the early earth had as much land area and precipitation as it now has, the mist would have to supply about 80 trillion gallons of water per day.¹⁶ An ordinary fog or morning mist could not supply nearly this much water. A fog originates from wet surfaces and so cannot penetrate dry inland areas of a continent. Even where there are fogs or heavy dews, there is hardly enough water to wet the ground, not nearly enough to supply the needs of widespread, lush vegetation. Therefore the "mist" must have been something other than a fog.

The Hebrew word translated "mist," *'ed*, occurs only once elsewhere in scripture, in Job 36:27. There the word refers to the water vapor or droplets in clouds which condense into raindrops. So the mist could be a cloud of water droplets high in the air instead of touching the ground. Such a cloud would still differ from an ordinary raincloud in the manner of its origin; here the mist "went up . . . from the earth", whereas an ordinary cloud originates by evaporation from a large body of water.

There exists a mechanism today which forms clouds above the surface by a mist going up from the earth: geysers. In present-day geysers, water trickles down from the surface to a depth where the rocks are hotter than the boiling point. The water turns to steam and is thrown a few hundred feet into the air. The depths, temperatures, pressures, and amounts of water involved are small compared to what Genesis 2:6 describes. But if the steam originated from a large body of water at a great depth, a much larger amount of steam could be thrown thousands of feet into the air. The steam would form large clouds of mist which could water the sur-

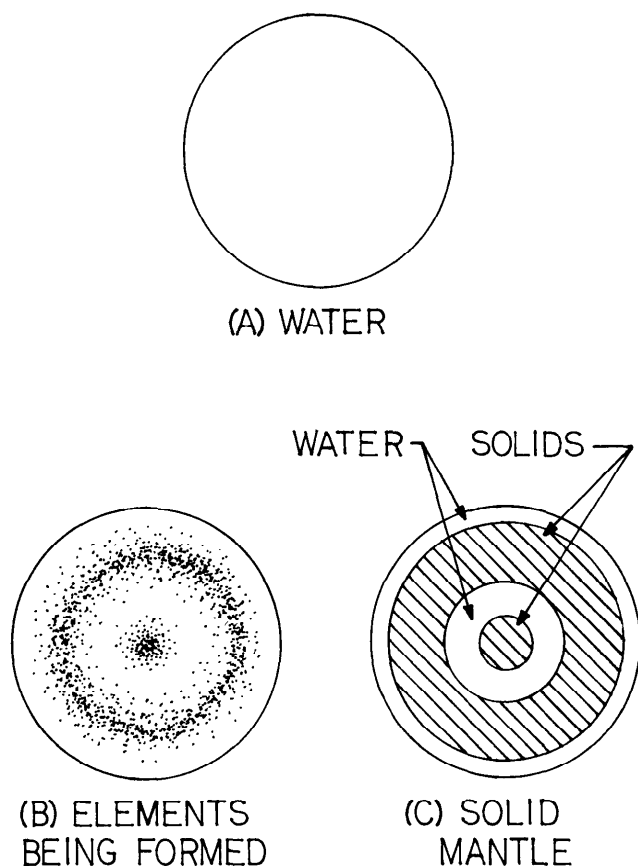


Figure 2. Possible steps in the formation of the earth "out of water and by means of water" (2 Peter 3:5). (A) Earth-sized sphere of pure water. (B) Nuclear, chemical, and physical transformations within the water. (C) Completely formed solid mantle under surface waters and containing core waters. These events could have taken place during the first day of creation (Ref. 9).

rounding areas as efficiently as any present-day raincloud. The water would be quite pure, except perhaps in the immediate vicinity of the geyser, where dissolved minerals could be deposited. A world-wide system of such "supergeysers" could provide the amounts of water required.

Some study of the rivers of Eden can shed additional light on these underground water sources:

Now a river flowed out of Eden to water the garden; and from there it divided and became four rivers. The name of the first is Pishon; it flows around the whole land of Havilah . . . And the name of the second river is Gihon; it flows around the whole land of Cush; and the name of the third river is Tigris; it flows east of Assyria. And the fourth river is the Euphrates (Genesis 2:10-14, NASB).

Although these rivers must have been destroyed by the Flood, Noah (or his descendants) apparently named two post-Flood rivers after the original Tigris and Euphrates. There must have been some similarities between the post-Flood rivers and their pre-Flood namesakes. The Euphrates today is the longest river in western Asia, about 1700 miles,¹⁷ while the Tigris is about 1150 miles long.¹⁸ It is difficult to imagine Noah or his sons naming two such large rivers after some remembered pre-Flood creeks or streams. It is likely, then, that the original Tigris and Euphrates were great rivers, of the order of a thousand miles long. The other two rivers, Pishon and Gihon, were probably also large, since they flowed around the "whole" lands of Havilah and Cush (see Figure 3).

The modern Tigris and Euphrates discharge over 100 billion gallons of water per day into the Persian Gulf at springtime.¹⁹ The four rivers from Eden must have had similar flow rates, so their existence points to an abundant source of water in Eden. Nowadays the ultimate source of river water is rain or snow, but neither of these could have provided the water during creation week, because: (a) no rain fell then (Genesis 2:5), and (b) the climate in Eden was too warm for snow, being temperature enough not to require clothing for Adam and Eve (Genesis 2:25). It is very likely, then, that the source of water for the rivers was the same as that of the gey-

sers, a large reservoir of water at great depth. The river water could have been runoff from the geysers alone, or there might also have been a supplementary system of springs.

In summary, both the mist and the rivers point to a large high-pressure, high-temperature source of water deep underground. The wisdom of God, personified, confirms this in an extensive passage about creation:

When there were no *depths*, I was brought forth, when there were no *fountains abounding with water* When he established the heavens, I was there: When he set a circle upon the face of the *deep*, when he made firm the skies above, when the *fountains of the deep* became strong (Proverbs 8:24-28, ASV).

This passage shows that fountains supplying water abundantly were an important part of creation, and it connects them with the same "deep" (Hebrew *tēhom*) as in Genesis 1:2. If the source of the water for the fountains were a huge reservoir at the earth's core of the primeval waters, we can see the appropriateness of the word "deep" to describe it. In the light of such an understanding, God's creation of such strong fountains becomes an awesome act, worthy of mention by the angel who will proclaim:

Fear God, and give him glory; for the hour of his judgement is come: and worship him that made the heaven and the earth and sea and *fountains of waters* (Revelation 14:7, ASV).

4. The Fountains of the Great Deep

Creationists are familiar with a verse which indicates the great size and depth of the underground waters supplying the fountains of the early earth:

In the six hundredth year of Noah's life, in the second month, on the seventeenth day of the month, on the same day, *all the fountains of the great deep burst open*, and the floodgates of the sky were opened (Genesis 7:11, NASB).

This verse described the sources of the great Flood which destroyed the earth in Noah's time. The Hebrew word translated "burst open" (*baqa'*) carries the idea of violent splitting and breaking forth,²⁰ which is the effect we would expect from the high temperatures and pressures at great depth. The vertical channels of the fountains, quite narrow to begin with, would only need a small fracture to start a rupturing process, allowing high-pressure steam to force its way upward. The rock containing the channels would split open in the directions of greatest weakness, probably toward other channels, and allow huge quantities of steam to burst violently out of the earth. If the core were indeed the source, the steam would penetrate to the upper atmosphere and beyond (see Figure 4), as the third article of this series will show. Much of the water would precipitate as heavy rain. It would also violently disrupt the vapor canopy and perhaps cause it to precipitate. Perhaps this is the reason scripture mentions the fountains of the deep before it mentions the "floodgates of the sky."

Notice that here God calls the source "great"; there might have been other deeps on or in the earth, but He

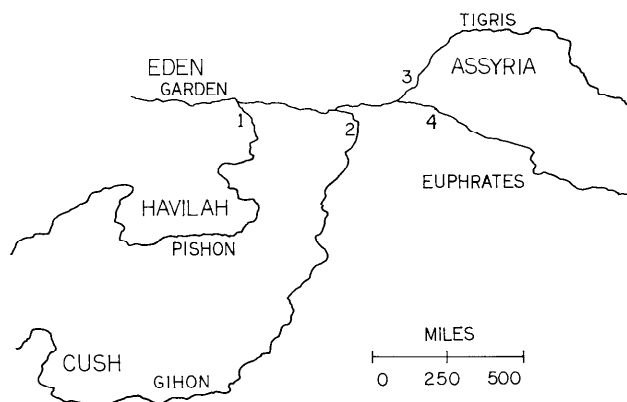


Figure 3. Pre-Flood rivers from Eden (writer's conception). Their existence points to an abundant source of water in Eden. Based on Gen. 2:10-14 and post-Flood locations of Assyria, Cush, Havilah (Gen. 25:18), Gihon (1 Kings 1:33), Tigris, and Euphrates.

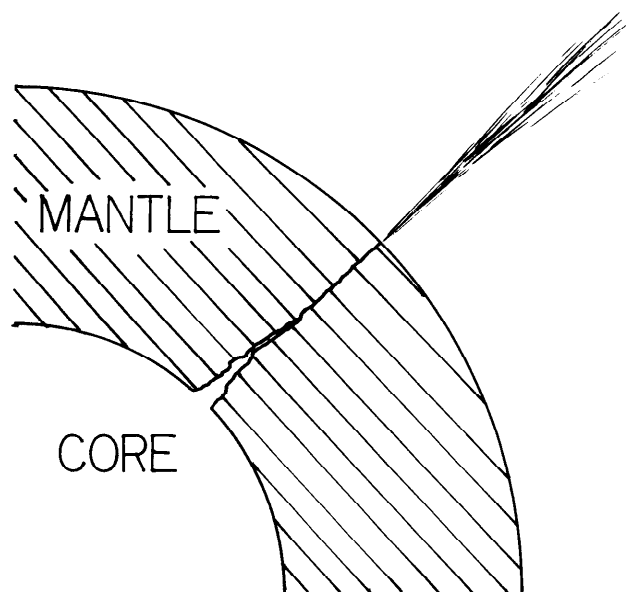


Figure 4. The bursting of the fountains of the great deep at the beginning of the Flood (Genesis 7:11).

calls one of them "the great deep." As Morris and Whitcomb point out,²¹ much (if not most) of the water in our present oceans came from the Flood. Much (if not most) of the new water must have come from the "great deep", since scripture puts it on an equal basis (at least) as the "floodgates of the sky"^{22, 23, 24} (Genesis 7:11 and 8:2). We can conclude that the fountains of the deep provided a large portion of the water in the seas of today. Since scripture says that the fountains of the deep "were closed" (Genesis 8:2), not "dried up", there is the implication that the great deep has more water left in it. And since ordinary fountains usually have a lot more water available from their sources than they ever pour forth at the surface, we could similarly expect that the fountains of the great deep had a source much larger than our surface oceans.

5. The Deep that Lies Beneath

It is important to pursue the implication of Genesis 8:2 that the great deep was not emptied by the Flood, but continued to exist afterwards. If there were huge quantities of water in the earth even after the Flood, then the water should still be there today, because scripture records no catastrophes on the scale of the Flood occurring after Noah up to the present time. And if the water exists today, it must lie deeper than the crust since underground water in the crust is not nearly as great as the waters of the oceans.

There are a number of scriptures which point to the continued existence of the great deep, some of them occurring in the most unexpected places. Jacob blessed Joseph as follows:

... With blessings of heaven above,
blessings of *the deep that lies beneath*,
blessings of the breasts and of the womb
(Genesis 49:25, NASB).

The word for "lies" (*ravats*) suggests lying in a stretched-out position,²⁵ which would imply that the

deep has some horizontal extent. The passage does not say explicitly what it is that the deep is lying under. But the previous part of the verse, "blessings of heaven above", helps us to understand. Usually when a man speaks of the heavens above, he is thinking of himself as the reference point; the sky is above him. But if Jacob is the reference point for the heaven above, then he should also be the reference point for the deep beneath. The heavens were above Jacob, and the deep was beneath him. One could suppose that he was speaking of the heavens above the oceans and the oceans beneath the heavens, but that interpretation is not as straightforward, being not the most normal way of speaking.

Taking the more straightforward interpretation, then, leads us to the conclusion that there was a subterranean deep in existence during the time of Jacob,²⁶ after the Flood. Some other possible references to subterranean water are: Exodus 20:4, Deuteronomy 5:8, Psalm 135:6, and Ezekiel 31:14-16 (ASV). The last reference, in speaking of a "deep" near "the nether [lower] parts of the earth" says that it has "great waters." Some of these verses have seemed obscure to some people, and the author will not attempt a detailed exposition of them here. But after careful study, most readers should share the author's opinion that one concept which would make these verses clearer is the idea of a great quantity of water physically existing deep within the earth, even to this day.

6. The Foundations of the Earth

The scriptures listed in the previous sections are not very clear about the location of the great deep. There are others which are more specific, but to understand them we must first understand some of the scriptural terms for the various parts of the earth.

Figure 5 shows the earth's outer structure as deduced from seismic-wave studies.²⁷ The crust, thin under the oceans and thicker under the continents, is quite different from the material underneath it, the mantle. This abrupt change in materials, called the Mohorovičić discontinuity,²⁸ occurs at depths varying from 5 to 60 kilometers, depending on the location. Scripture appears to similarly distinguish between the crust and mantle with the terms "earth" and "foundations of the earth", as the following verses will show.

While the Bible often uses the word translated "earth", *'erets*, in a general sense to mean the whole

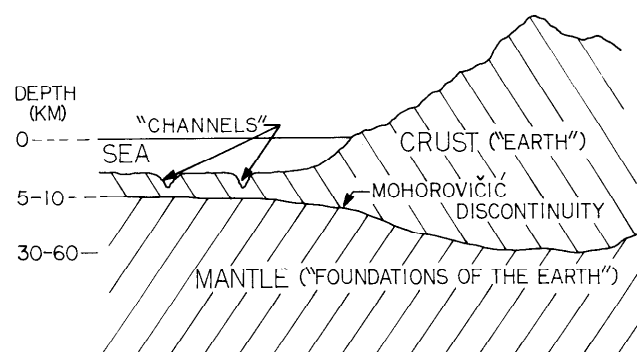


Figure 5. Crust and upper mantle of the earth (Ref. 27).

planet, God also defined the term in a more limited sense to mean the continents:

And God called the dry land Earth . . . (Genesis 1:10, NASB).

This would lead us to identify "the earth" in its limited sense with the continental crust,²⁹ and "the foundations of the earth" with the material which supports the crust, namely the mantle. The Holy Spirit, speaking by David, appears to confirm this idea in a song reminiscent of the Flood:

Then the channels of the sea appeared,
The foundations of the world were laid bare,
By the rebuke of the Lord,
At the blast of the breath of His nostrils
(2 Samuel 22:16, NASB).

The "channels of the sea" here seem to be the deepest canyons³⁰ of the ocean floor, some of which today penetrate to within only 5 km of the mantle.³¹ Since the Flood must have deposited much of the sediment and rock which now make up the ocean floor, the sea bottom before the Flood must have been even thinner than it now is. So it is very likely that, at the beginning of the Flood, the "channels of the sea" reached down into the mantle itself. Thus it was the mantle that was "laid bare", and we can identify the "foundations of the world" as including the mantle.³² Being thick and strong, the mantle well fits the scriptural description of the "enduring foundations of the earth" (Micah 6:2, NASB).

The question now arises as to how far down the "foundations of the earth" extend. Do they include the total interior structure of the earth down to its center? God answers this question by a question he asked Job about the earth's foundations:

Where were you when I laid the foundation of the earth!
Tell Me, if you have understanding,
Who set its measurements, since you know?
Or who stretched the line on it?
On what were its bases sunk?
Or who laid its cornerstone . . .
(Job 38:4-6, NASB).

These are not supposed to be unanswerable questions, since other questions in the list have definite answers (for example, Job 39:1, 2). Rather, they are questions which have answers, though Job may or may not know them. So the italicized question implies that there is some real material into which the bases of the earth's foundations were sunk, meaning that there is some depth at which the foundations cease and some other substance begins.

The general picture in this passage is that of the construction of a house. The word translated "bases" here (*eden*) is used mainly of the socketed metal bases which supported the pillars and boards of the tabernacle (Exodus 26:15-25, etc.). They supported the weight of the structure, giving it the strength and rigidity required, although the bases themselves rested on the soil. In general, a foundation rests on some softer material which can support the weight, if properly spread, but which cannot supply the needed rigidity. In the same way, then, we would expect the foundations of the earth to be

rigid themselves but resting on some less rigid substance. God asked Job: What is that substance?

7. Water Under the Foundations

God appears to answer his own question in one of David's psalms:

The earth is the Lord's and all it contains,
the world, and those who dwell in it.
For He has founded it upon seas,
And established it upon rivers
(Psalm 24:1, 2³³).

The Hebrew word for "founded" here is the same verb (*yasad*) translated as "laid the foundation" in Job 38:4. So God is saying that He laid the foundations of the earth, including the 1800-mile thick mantle, upon "seas" and "rivers", that is, upon water. The word translated "seas" (*yammim*) can refer to a single large body of water divided into arbitrary subsections, as it does in Genesis 1:10. The word for "rivers" (*n^eharoth*) can similarly refer to currents³⁴ within a large body of water, as in Jonah 2:3. We use similar terminology in English when we refer to the Sargasso "sea" and describe the Gulf Stream as an undersea "river." The fluid part of the earth's core certainly has great currents circulating within it due to heat convection and the earth's rotation, so it seems appropriate to think of it as being divided into seas and rivers.

In summary, Psalm 24:2 says that there is water under the foundations of the earth. This fact, plus the identification of the earth's mantle as the "foundations" in the previous section leads us to identify the fluid under the mantle as water. Figure 6 compares scriptural and geological terms for the various parts of the earth's interior.

Actually, when God asked Job what material the bases of the earth's foundation were sunk into (Job 38:6), He gave Job a broad hint that the substance was water, just a few verses later:

Or who enclosed the sea with doors,
When, bursting forth, it went out from the womb;
When I made a cloud its garment,
And thick darkness its swaddling band,
And I placed boundaries on it,
And I set a bolt and doors,

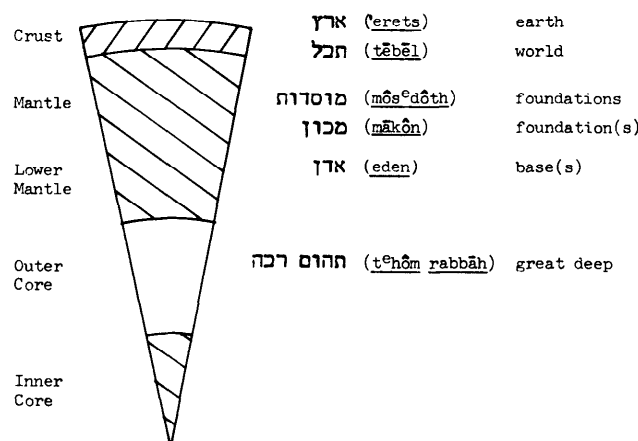


Figure 6. Scriptural and geological terms for interior parts of the earth.

And I said, "Thus far you shall come, but no farther;

And here shall your proud waves stop?"

(Job 38:8-11, NASB).

Since most of our present sea originated from the bursting of the fountains of the great deep (as remarked in section 4), we can see that these verses describe the Genesis Flood in poetic metaphors. Here God compares the bursting forth of waters from the womb of a woman in childbirth with the bursting forth of waters from the great deep (Genesis 7:11). It is an apt comparison for several reasons: (a) The amniotic fluid in the womb is warm, salty water; the waters in the great deep would be extremely hot and salty, as part two of this series will show. (b) The womb (Hebrew *rechem*) is a strong, muscular organ in the innermost parts of the body; the mantle is similarly a thick, strong enclosure for the fluid in the innermost parts of the earth. (c) The amniotic fluid often bursts forth with violence during birth pangs as did the fountains of the great deep. "Usually the bag of waters ruptures at the height of a strong pain and the fluid escapes with a gush . . ."³⁵ The violent bursting forth of waters (as steam) from the earth's core would wrap the earth in clouds like a garment, being so thick that it would swathe the newborn sea in darkness, just as verse nine describes. It was God himself who stopped the flow by closing up the ruptured fountains, verse ten. These verses establish the connection between the sea, the Flood, and subterranean waters so deep that God compares their location to that of a womb.

8. Conclusion

In the previous sections the writer examines in detail eleven passages of scripture which point to the idea that the earth's core consists of water. Many other passages, while not definitive by themselves, fit in better with the idea of a water core than with any other the author can think of. The concept removes a great deal of mystery from some otherwise incomprehensible verses, helps us to understand the tremendous violence of the Flood, and makes the power and majesty of God even clearer. If there is no scripture which weighs against it (and the author knows of none such), there is nothing to prevent us from adopting it as a working hypothesis for further scrutiny.

One of the first questions which comes to mind is: How well does the hypothesis fit in with the known experimental data about the earth's interior and about water at high pressures? The next article will deal with this question in detail, but it can be summarized by saying that there are no experimental data that the writer knows of which does not fit into the hypothesis of a water core. The third article of the series, as presently planned, will show the fruitfulness of the idea in the scientific realm by showing how it sheds light on some previously unexplained facts about the earth and the solar system.

I personally have found the idea to be fruitful in the spiritual realm. For example, I had always wondered what Old Testament scripture or idea Jesus was referring to when He spoke of the Holy Spirit flowing like water from the innermost being of a believer. Perhaps

He had in mind the womb of the sea and the rivers of Eden when He cried out to all:

If any man is thirsty, let him come to me and drink.

He who believes in Me, as the scripture said, *Out of his belly shall flow rivers of living water* (John 7:37, 38, NASB, margin³⁶).

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- ¹Bullen, K. E. 1977. Earth, interior of, in *Encyclopedia of science and technology*, Vol. 4. McGraw-Hill Book Co., New York, pp. 376D-381.
- ²Hazard, C. 1977. The earth's core, *Nature*, 267(5613):670-671.
- ³A "bar" is the standard unit of pressure, defined as one million dynes per square centimeter, and is about equal to one unit of atmospheric pressure, i.e., one atmosphere. More precisely, one bar is equal to 0.987 standard atmospheric pressure and is equal to 1.0197 kilograms-force per square centimeter.
- ⁴The word "fluid" in its technical sense can describe either a gas or a liquid, and so it is an appropriate word to describe water above its critical temperature, 374 °C, where there is no longer any distinction between liquid water and steam. A more technical word is "super-critical" water.
- ⁵Franck, E. U. 1968. Supercritical water, *Endeavour*, 27(101):55-59.
- ⁶All scripture quotations labeled NASB are from the New American Standard Bible, Lockman Foundation, 1971, Foundation Press Publications, La Habra, California.
- ⁷Barnes, T. G. 1972. Young age versus geologic age for the earth's magnetic field, *Creation Research Society Quarterly*, 9(1):47-50.
- ⁸All italics in the scripture references are added for emphasis by the author. Also see note 6.
- ⁹It is of interest to note that the Hebrew word translated "heavens", *shamayim*, contains in its second syllable the Hebrew word for "waters", *mayim*, correctly spelled. The first syllable, *sham*, occurring by itself means "there." So a root meaning of "heavens" could be "there, waters", or "a space containing waters." This would explain more fully the origin of the water; when God created the heavens, He created a space which surrounded and contained waters.
- ¹⁰Thayer, J. H. 1889. Thayer's Greek-English lexicon of the New Testament. Reprint. Associated Publishers and Authors, Inc., Grand Rapids, Michigan, p. 605.
- ¹¹Wilson, J. T. 1969. Earth, in *Encyclopedia Americana*, Vol. 9. Americana Corporation, New York, pp. 533-542.
- ¹²*Ibid.*, p. 539.
- ¹³This mass estimate is based on two assumptions: (a) that the entire core is water, and (b) that the density decreases linearly from 3 grams/cc at the center down to 2 grams/cc at the core-mantle boundary. The inner core occupies only about 6% of the total core volume, so the type of material in it does not greatly affect the estimate.
- ¹⁴All scripture references labeled ASV are from the American Standard Bible. 1901. Thomas Nelson and Sons, New York.
- ¹⁵Keil, C. F., and F. Delitzsch. 1971. Biblical commentary on the Old Testament, Vol. 1. W. B. Eerdmans Co., Grand Rapids, Michigan pp. 77, 78.
- ¹⁶The average annual rainfall in the United States is 29.22 inches (*Encyclopedia Americana*, *Op. cit.*, Vol. 23, p. 189), and the total land area of the world today is 148.892 million square kilometers (Howell, B. F. 1977. Earth, in *Encyclopedia of science and technology*, Vol. 4. McGraw-Hill Book Co., New York, pp. 362-367). Assuming similar conditions for the early earth then gives us a rainfall of 79.97 trillion gallons per day.
- ¹⁷Gresswell, R. K., and A. Huxley. 1965. Standard encyclopedia of the world's rivers and lakes. G. P. Putnam's Sons, New York, p. 93.
- ¹⁸*Ibid.*, p. 273.
- ¹⁹Lloyd, S. H. F. 1977. Tigris-Euphrates river system, in *Encyclopedia Britannica*, Macropaedia Vol. 9. Encyclopedia Britannica, Inc., Chicago, pp. 402-406.
- ²⁰Holladay, W. L. 1971. A concise Hebrew and Aramaic lexicon of the Old Testament. W. B. Eerdmans Co., Grand Rapids, Michigan, p. 46.
- ²¹Whitcomb, J. C., and H. M. Morris. 1961. The Genesis Flood. Baker Book House, Grand Rapids, Michigan, p. 121.
- ²²Actually, it is difficult to imagine any non-supernatural model for a vapor canopy having more than roughly thirty feet (equivalent thickness of liquid) of water, because of physiological limitations on the

atmospheric pressure and limitations on the amount of sunlight absorbed. For a more complete discussion of the physics involved, see reference 23. For a good discussion of the scriptures involved, see reference 24. It would seem that, while the original waters of the canopy could have supplied only a small fraction of the flood water, the spouting steam from the fountains of the deep could easily have supplied the rest of the rainfall.

²³Kofahl, R. E. 1977. Could the Flood waters have come from a canopy or extraterrestrial source? *Creation Research Society Quarterly*, 13(4):202-206.

²⁴Udd, S. V. 1975. The canopy and Genesis 1:6-8. *Creation Research Society Quarterly*, 12(2):90-93.

²⁵Holladay, W. L. *Op. cit.*, p. 331.

²⁶Keil, C. F., and F. Delitzsch. *Op. cit.*, p. 408.

²⁷Richter, C. F. 1958. Elementary seismology. W. H. Freeman and Co., San Francisco, pp. 252, 253.

²⁸*Ibid.*, pp. 252, 278. The discontinuity is named after the man who

established its existence in 1909.

²⁹Another scriptural term for the continents seems to be "the world", *tebel*, as in 1 Samuel 2:8. See Holladay, W. L. *Op. cit.*, p. 386.

³⁰Holladay, W. L. *Op. cit.*, p. 25, listed under 'aphiq.

³¹Bullen, K. E. *Op. cit.*, p. 376D.

³²Whitcomb, J. C., and H. M. Morris. *Op. cit.*, p. 221.

³³This is the same as the NASB translation, except that the author has left out the definite article before "seas" and "rivers", the articles not being present in the Hebrew text. The absence of the definite article leaves more room for the possibility that the seas and rivers being referred to may not be familiar sights to men.

³⁴Holladay, W. L. *Op. cit.*, p. 230.

³⁵Cooley, D. G., editor. 1973. Family medical guide. Better Homes and Gardens Books. New York, p. 893.

³⁶The present tense of the Greek verbs can include both the idea of an initial coming and drinking, and a continual coming and drinking repeated indefinitely. See marginal note, NASB.

A PRIMROSE WITH PERCEPTION

WILLIS E. KEITHLEY*

A flower with forethought? Or rational reasoning?

Well, I suppose there are some exceptional "green thumbs" who would agree that flowers have responsive personalities. And there are a few theorists around today who insist that plants are even psychic. But beyond that, we usually think of flowers being beautiful but dumb.

Yet in the desert, where the faculties for survival must be honed to a vital keenness, we find this little primrose. It seems absurd to expect sweetness in the harsh environment of the desert; yet the aroma of this flower permeates the barren wilderness with the redolent bouquet of its delicate fragrance. In fact its name *Oenothera caespitosa* says that it is a tufted plant with a wine-like odor.

But to return to its resources of reason. While it may be rather tenuous to attribute its powers of perception to intelligence, yet this amazing plant has the astonishing ability to measure rainfall to one tenth of an inch before its seeds will germinate. Then that moisture must come from above, not below, for it can even tell the direction from which that water must come!

While the secret of this insight may not lie in reflective thought, the real factors that influence its behavior are just as intriguing. Each seed is covered with a hard coating that inhibits germination, thus insuring that it will not sprout until the conditions favor its survival. As the rainfall slowly percolates through the soil, it leaches out the necessary chemicals that will dissolve the inhibitor coating. Obviously the water must come from above, and its cumulative effect may take several years before there is enough moisture to assure sustenance.

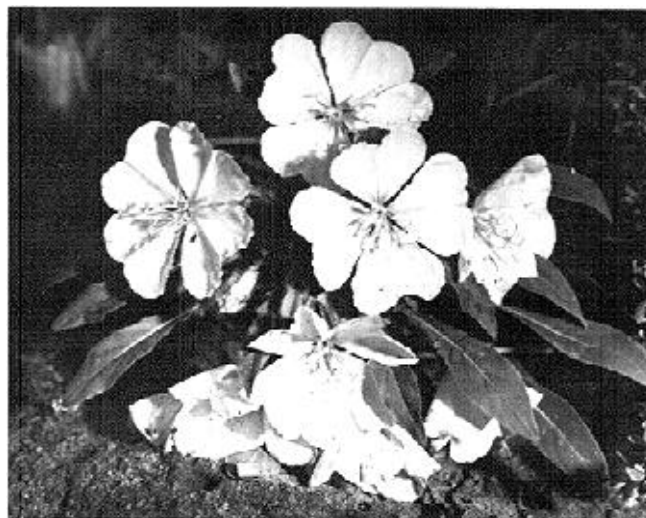
No, we cannot attribute soul or spirit to this bonny blossom, despite its powers of deduction; yet behind every living thing there has to be a Mind. For life could

not arise of its own volition. Thus every organism must be traced back to a Prime Intellect.

Were this not true, our only alternative would be to assign mental powers to the plant kingdom. We would be forced to assume this flower had a knowledge of chemistry; for even the much touted factors of selection and survival could have spelled disaster if the wrong formula were chosen for that seed coat. It could have been too soft, too hard or too toxic for survival. It had to be exact in formulary and formulation.

So far no one has produced any conclusive evidence that a vegetative seed has any powers of wit or wisdom. That platitude of prudence is glibly credited to some dubious "Mother Nature." And delegating to her that omniscience of God is surely pressing women's lib too far.

Absurd? No more than limiting the creative Mind of God to the hypothetical and the hypocritical.



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MECHANICS AND THERMODYNAMICS OF THE PRE-FLOOD VAPOR CANOPY†

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For years, the concept of a vapor canopy has met with great scepticism among some creationist scientists. The principle reason for such doubt has centered in the physics involved in maintaining vast amounts of precipitable water in the atmosphere. Our present atmosphere will only hold about 4.4 inches of water, and yet the vapor canopy idea requires many feet of water if it is to be the source of a global, 40-day rainfall. Also, this theory has been objected to on the grounds that intolerable hothouse conditions would result. In this article, an attempt is made to present a plausible support mechanism and to demonstrate that the surface temperatures may indeed have been quite mild.

For nearly 75 years, various theories of some kind of water canopy have been found in creationist literature.¹ As far as I have been able to determine, Morris and Whitcomb were the first to introduce the idea that this water canopy was in a specifically vapor form, i.e., superheated, invisible steam.² Others have shown the exegetical basis for belief in some kind of water canopy and that evidence will not be presented here.³

How much water did this canopy contain? For reasons detailed elsewhere, I believe that Moses intended to inform us that there is a conceptual tie between the waters above of Genesis 1:6-8 and the windows of heaven of Genesis 7:11.⁴ If that is true, then it follows that the amount of water in the canopy was only what was necessary to sustain a global rainfall for forty days and nights. Simple calculations will show that, given even the most fantastic assumptions, recycled volcanic steam could only account for less than 1 percent of the total flood rainfall.⁵ If we were to assume a moderate rainfall rate of 0.5 in/hr, this would mean that the canopy had to contain at least forty feet of precipitable water. In the following discussion, this minimum figure will be assumed.

The major problem associated with the vapor canopy hypothesis is simply that the atmosphere, as it is *presently* constructed, will not hold anywhere near the forty feet of water required to sustain a forty-day global rainfall. However, the ancient atmosphere would have been characterized by several unique phenomena that would have rendered it extremely stable. It will be necessary to explicate the factors generating this stable atmosphere configuration before explaining the proposed solution to the difficulty of maintaining the water vapor up above the ancient troposphere.

The Stability of the Pre-Flood Atmosphere

The geological record indicates that the topography of the ancient earth may have been considerably different from today's. One characteristic in particular that would have lent stability to the ancient atmosphere is the apparent lack of major mountain ranges. It is generally believed that most mountain building is a comparatively recent phenomenon connected (in conventional geology) with the Pleistocene. The Biblical statements

indicate that the major mountain building activity did take place during the flood and immediately after it (Genesis 7:11; Psalm 104:8). In the model to follow, it will be assumed, then, that during the pre-flood era, there were *no* mountains. Certainly, there may have been rolling hills, but no major mountains. Thus, the lower edge of the canopy (about 30,000 feet) would never be in danger of intersecting the landscape. Furthermore, the convective updrafts produced by wind blowing against the sides of steep mountains would have been severely limited. This would tend to reduce eddy diffusion.

The only way a vapor canopy could have been maintained above the ancient atmosphere would have been to eliminate convective turbulence and reduce eddy diffusion, which would have caused the canopy quickly to mix with the lower atmosphere and to diffuse downward to the surface in a matter of hours. Is there any known physics that would have resulted in such a stability, and would it occur as a result of the existence of the vapor canopy? In fact, there are two such physical mechanisms that would severely reduce eddy diffusion and convective turbulence and provide a stable regime in which the atmosphere could conceivably contain enormous amounts of water above what it is able to sustain today. These physical mechanisms are a temperature inversion and Taylor stability.

The Canopy-Produced Temperature Inversion

When God divided the waters, our present theory requires that He must have immediately distributed the "waters above" in hydrostatic equilibrium in the gravity field. What is meant by "hydrostatic equilibrium"?

If one were to imagine a column of air with a cross-sectional area of 1 cm² extending to the top of the atmosphere, the pressure at the bottom of that column (i.e., sea level) is simply equal to the weight of the air above it. Due to the force of gravity, any water vapor placed above the atmosphere will immediately be acted upon by gravity and pulled toward the surface of the earth. The water vapor would continue its gravity-induced descent until the molecules of the air below became so bunched together that they began to "push up" against the downward pressure of the weight of the molecules above. When the upward force equals the downward force at every level, the system is said to be in hydrostatic equilibrium. Any amount of water placed above the atmosphere will quickly distribute itself into this equilibrium configuration due to the forces of gravity. It is for this reason that it is impossible to posit vast

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amounts of water vapor up above the atmosphere "floating" and maintained by great temperatures. As long as the water vapor molecules are in contact with the gravity field, they will quickly sort themselves into this equilibrium distribution. Once this equilibrium situation has been achieved, the vertical variation of pressure with altitude is given by the hydrostatic equation:⁶

$$dp = -g\rho dz \quad (1)$$

where g is the gravity constant, ρ is the density at each level, and dz is the change in altitude.

A problem is encountered, however, with water vapor. The weight of all the water vapor above determines the pressure of the water vapor at the bottom level of the canopy, just as for any other gas. Unless the temperature is sufficiently high, that weight will result in a vapor pressure that exceeds the saturation vapor pressure of water vapor in the bottom increment, and it will condense out as rain. The saturation vapor pressure of water vapor is a function of temperature only and can be found by reference e.g. to the engineering steam tables.⁷ Thus, in order to keep the water vapor in vapor form, it is necessary to assume a temperature distribution throughout the canopy high enough to keep the saturation vapor pressure of the weight of the water vapor above that layer. If a canopy model of 40 feet of precipitable water is assumed, that means that the weight of water vapor above the bottom layer of the canopy is $40 \text{ ft} \times 0.4335 \text{ lb/ft}^2 = 17.34 \text{ lb/in}^2$. (About 1.2 atmosphere.) From the steam tables, it can be seen that, if this represents the saturation vapor pressure, the corresponding temperature must be 220°F at the bottom of the canopy. Any temperature below that will not support water in vapor form, and rain would result.

Thus, it must be assumed that, when God set the vapor canopy above the ancient troposphere, He also established an initial temperature distribution in which the bottom layer of the canopy was at a temperature of at least 220°F .

Is it physically possible that such a temperature could be maintained? It is not only possible, but quite likely. Water vapor is an extremely effective absorber of solar radiation. If the canopy were placed above the atmosphere, the canopy would absorb vast amounts of radiation and would be maintained at extremely high temperatures. Today, some infra-red and a lot of visible radiation and some short-wave radiation reach the surface of the earth where it is absorbed and re-radiated as infra-red. This re-radiated radiation is trapped under the atmosphere which is opaque to 95 percent of all re-radiated terrestrial radiation.⁸ Thus, in today's climate, the surface of the earth is the main heat source. (I.e., secondary; the sun, of course, is primary.) However, under a vapor canopy, the canopy itself would be the major heat source, and the heat would have been distributed in the upper atmosphere. As a result, there would not have been intolerable hothouse conditions on the surface of the planet. Full discussion of this phenomenon is reserved for the places around equations (10) and (19) below, where it is shown that the temperature of the canopy base would be 887°F . At this point, only the physical concepts involved are being surveyed.

Altitude of the Canopy

Where would the bottom of this canopy lie? The precise location is dependent upon calculation of the vertical temperature profile. However, a simple approximation that would not be too far off can be made by assuming that the vertical temperature profile is linear from 85°F (29.4°C or 302.4°K) at the ground to 887°F (475.0°C or 748.0°K) at the base of the canopy. (The variation is linear today.) In that case, the variation of pressure with temperature is given by:⁹

$$P = P_o(T/T_o)^{g/R\alpha} \quad (1')$$

where P is the atmospheric pressure at the canopy base = 1.18 atmospheres (wt. of 40 ft. of water); P_o is the surface pressure = 2.18 atmospheres; T = temperature at the base of the canopy, $748^\circ\text{K} = 887^\circ\text{F}$ (to be explained below, see Eq. 16); T_o = temperature at the surface of the earth, 302.4°K (also explained below, see Eq. 20); R = gas constant for dry air, $2.8704 \times 10^6 \text{ erg/gm} \cdot ^\circ\text{K}$; $g = 980.6 \text{ cm/sec}^2$; and α = the constant lapse rate of temperature, i.e., rate of change with altitude.

Rearranging and solving for α yields:

$$\alpha = \frac{g}{R} \frac{\ln(T/T_o)}{\ln(P/P_o)} \quad (2)$$

which comes to -50.4°C/km .

Since $T = T_o - \alpha z$, one can find z , the altitude of the base of the canopy:

$$z = \frac{T_o - T}{\alpha} \quad (3)$$

So $z = 8.8 \text{ km} = 5.5 \text{ miles} = 29,000 \text{ feet}$.

At the interface between the canopy and the troposphere, there would be an area in which some air was above the troposphere and in the bottom layer of the canopy. Also, there would be water vapor in the upper layer of the troposphere just below the canopy. This area might be called the pre-flood tropopause.¹¹

The "top" of the canopy can similarly be approximated by assuming that the canopy is isothermal (a reasonable assumption). Then the variation of altitude with pressure is given by:¹²

$$Z = (-H) \ln(P/P_o), \quad (4)$$

where H is the scale height of the canopy or RT_o/mg ; R = the universal gas constant, $8.3144 \times 10^7 \text{ erg/gm} \cdot ^\circ\text{K}$; T_o = the temperature at the canopy base which is assumed to be 748°K (887°F); m = the molecular weight of water vapor, 18.016; and $g = 980.6 \text{ cm/sec}^2$. Thus, $H = 35.2 \text{ km}$. In (4), P = the atmospheric pressure at the top of the canopy which, for practical purposes, will be assumed to be 0.01 of the pressure at the base. In other words, the "top" will be defined as the point at which the atmospheric pressure is reduced by 99%. (In a sense, since pressure decreases exponentially with altitude, there is no "top.") P_o = the pressure at the bottom of the canopy which is 1.18 atmospheres (i.e., the pressure produced by a column of water 40 feet high). Plugging these parameters into (4) gives for the height of the top of the canopy 162 km above the troposphere, or, from Equation (3), 170.8 km above the earth's surface, which is approximately 106 miles or

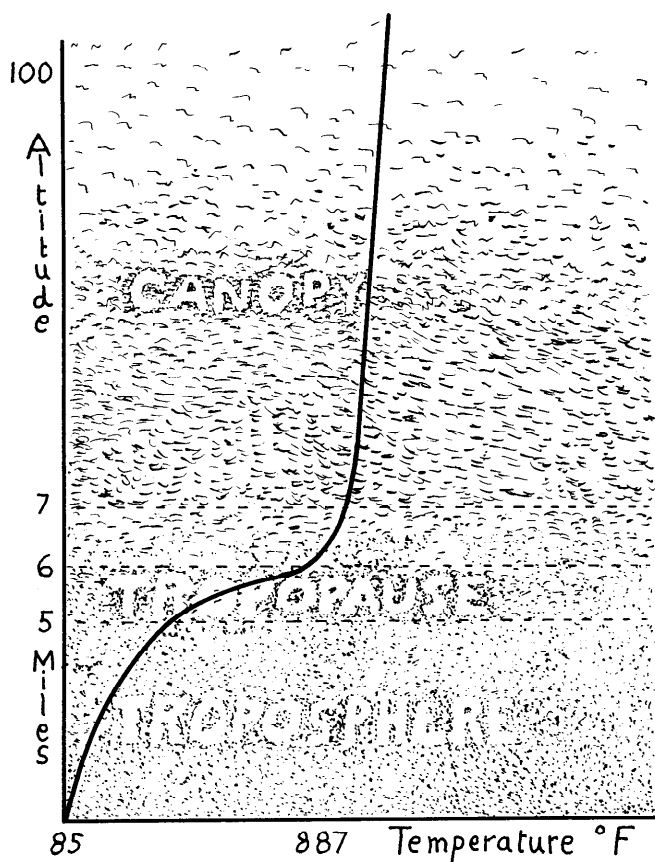


Figure 1. This shows the variation of temperature with altitude in the antediluvian world. Note that the scales are not uniform. Shading in ripple marks is intended to suggest water vapor in the canopy; in dots, air. The assumption here departs from the linear variation of temperature with altitude in the comment right after Equation (2). Rather, an exponential variation is represented as more likely.

560,000 feet. The assumed temperature profile is shown in Figure 1.

The Stabilizing Effect of a Temperature Inversion

Due to the absorption of re-radiated infra-red in the canopy by the water vapor, a strong temperature inversion would result in which the temperature of the ancient atmosphere increased with altitude. Due to the fact that in today's atmosphere the (immediate) heat source is the earth's surface, temperature normally decreases with altitude.

The relevance of all this discussion to the canopy model is simply this: such a strong temperature inversion would reduce eddy diffusion and convective turbulence at the tropopause and enable the atmosphere to maintain tremendous amounts of water above it.

The stabilizing influence of such temperature inversions are well known among meteorologists, and discussions of the physics involved can be found in any basic meteorology text.¹³ For a simple conceptual model of the physics involved, consider Figure 2. Imagine a parcel of air, A, that is suddenly jostled and moved downward into the troposphere. As it moves downward, it moves from a region of 900 °F heat to 800 °F heat. As

soon as it enters the lower region, it is now hotter than the surrounding 800 °F air. As a result, it is less dense and hence lighter than the surrounding air. This produces a buoyant force which drives the parcel back up into the canopy. In a similar way, if some cooler parcel was jostled from below and driven up into the hotter canopy, it arrives at a cooler temperature than the surrounding water vapor and is, therefore, heavier and more dense. As a result, it will immediately sink back into the troposphere. These stabilizing tendencies are further enforced by the expansion and contraction of the moving parcel. When our imaginary parcel moves from the canopy to the lower troposphere, it not only moves from a region of greater temperature to one of lower temperature, but it also moves from a region of lesser pressure to one of greater pressure. Pressure increases as the parcel moves downward because it is going deeper into the atmosphere and more atmosphere is above it. It is just like going deeper under water. As pressure on the parcel increases, the parcel is compressed, and a compression results in higher temperature inside the parcel. Thus, the parcel becomes even hotter than 900 °F and is even more forcibly restrained from penetration into the troposphere.

It is clear, then, that the canopy temperature inversion would result in an extremely stable regime at the interface of the canopy and the lower troposphere, significantly reducing any convective turbulence, and thus enabling much water to be maintained above the ancient atmosphere. In today's atmosphere, little water could be maintained, simply because there is no such global temperature inversion.

Taylor Stability

In the field of fluid mechanics, great attention has been given to the situations under which layers of fluids surrounding a rotating cylinder will remain in a lami-

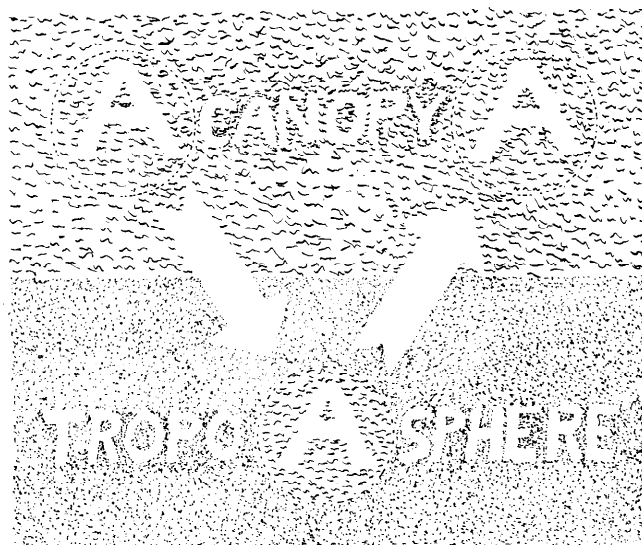


Figure 2. If a certain amount of vapor, in the canopy, were to sink into the troposphere, it would experience buoyant forces, as explained in the text, to cause it to return to the canopy. Thus there would be little tendency for mixing at the boundary, and the division into canopy and troposphere could be quite stable.

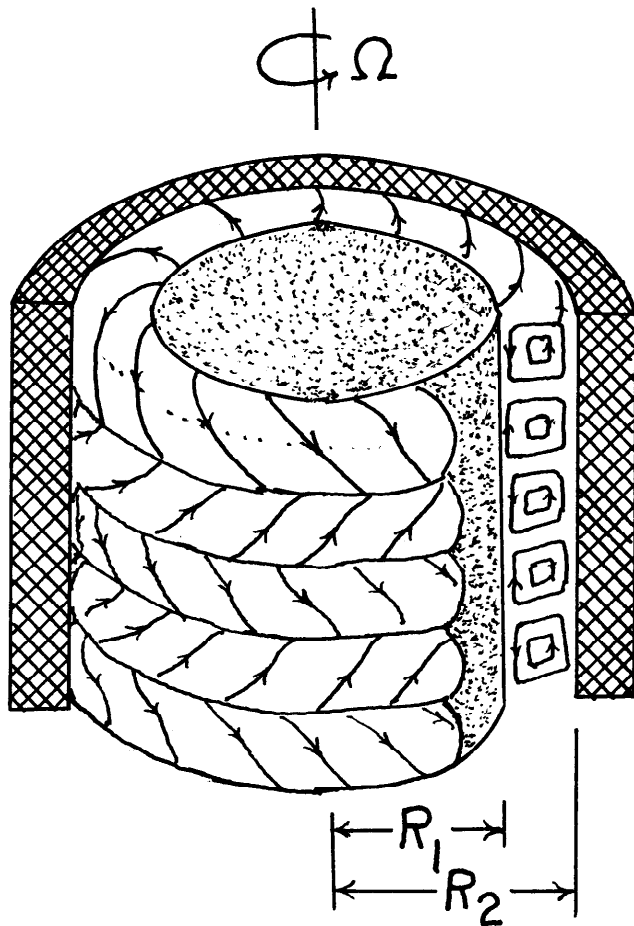


Figure 3. This shows an example of Taylor vortices between two cylinders, the outer at rest. The width of the gap $d = R_2 - R_1$. See also Reference 15.

nar flow. When the fluid remains in a laminar flow, it is said to be "stable." If mixing occurs between the layers of the fluid, so-called "Taylor instability" has developed, and Taylor vortices are observed (stable circular flows of fluid, see Figure 3). Taylor noted that when water in a tank was made to rotate steadily as a solid body, some interesting things occurred when ink was introduced into the system. The fluid would draw the ink into thin sheets, and these sheets always remained parallel to the axis of rotation. Taylor noted: "The accuracy with which they remained parallel to the axis of rotation is quite extraordinary."¹⁴ Since this is precisely the situation under the vapor canopy, a discussion of this phenomenon is pertinent.

The pre-flood atmosphere can be visualized as the "ink." It is layered between two concentric cylinders—the earth and the canopy bottom. Under certain conditions, the atmosphere will stay parallel to the axis of rotation. In other words, there would be no turbulent mixing at the interface of the canopy and the lower atmosphere. This would, of course, contribute significantly to the maintenance of the vapor canopy.

Taylor defined a Taylor number to correlate certain parameters of the two rotating cylinders involved into a

dimensionless ratio that could be used to determine when such a system would become unstable and the laminar flow disrupted. The Taylor number is defined as:¹⁶

$$K = \frac{4\Omega^2 R_1^4 (1 - \mu) (1 - \mu/\eta^2)}{\nu^2 (1 - \eta^2)^2} \quad (5)$$

where Ω = the angular velocity of the inner cylinder, or in the canopy model, of the earth; R_1 = the radius of the earth; μ = the ratio of the angular velocity of the outer cylinder (the inner rim of the canopy) to Ω ; η = the ratio of the radius of the inner cylinder, R_1 , to the radius of the outer cylinder, R_2 ; and ν = kinematic viscosity, or the coefficient of viscosity divided by the density of the fluid contained between the two rotating cylinders (the ancient troposphere). Figure 4 illustrates how the situation discussed could have applied to the ancient atmosphere.

Thus, the two cylinders correspond to the inner rim of the canopy and the surface of the earth. (Which, of course, are actually spheres; see later.) The fluid that is to be analyzed is the pre-flood atmosphere contained in between these two rotating plates. Modeling the outer rim as a solid plate is a common modeling technique in aerodynamics, even though no such plate actually exists. However, if the molecules of the fluid at the outer rim are everywhere parallel to the inner cylinder, then the effect is the same as if a literal solid plate existed. Due to the temperature inversion and the greenhouse effect, the bottom of the canopy would be very stable and would eliminate vertical and horizontal winds.

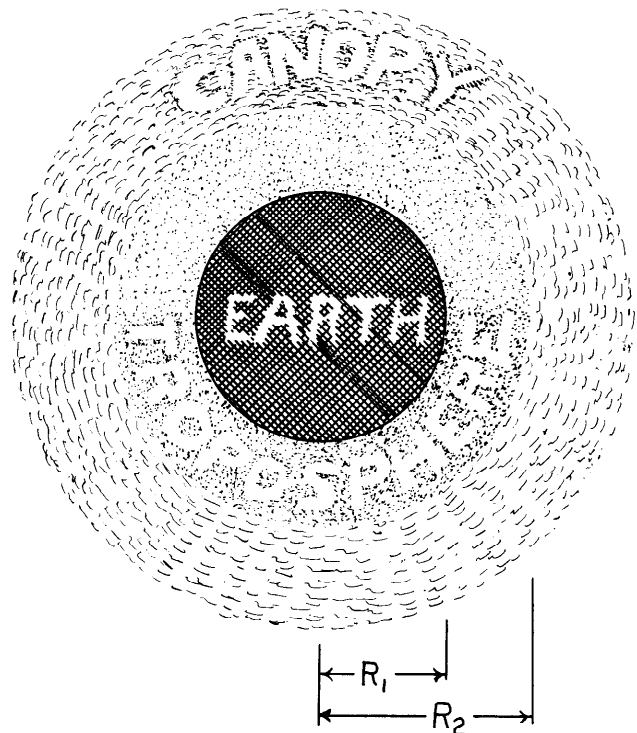


Figure 4. This shows how the notion of Taylor stability is applied, in the text, to the ancient atmosphere. This drawing, of course, is not to scale.

The kinematic viscosity is inversely proportional to the density and, hence, directly proportional to the temperature of the ancient atmosphere. This can be seen from the equation of state of an ideal gas.¹⁷

$$\rho = P(m/R) (1/T) \quad (6)$$

As long as the Taylor number remains below a certain critical Taylor number, K , the fluid contained between the rotating cylinders will remain in laminar flow, and there will be no convective turbulence. It would be of great interest to know what the critical Taylor number of the pre-flood atmosphere was. Unfortunately, while Taylor numbers have been defined for cylinders,¹⁸ they have not been defined for spheres. However, "The Taylor number for a sphere in a fluid will have the same type of dependency as for a cylinder in a fluid. It will be highly dependent on the viscosity, density, and 'atmospheric thickness'."¹⁹

Thus, even though the earth's atmosphere is not a cylinder but a sphere, the similar factors defined in the equation for the Taylor number of a cylinder apply to a sphere.

Dr. John Burkhalter, an atmospheric physicist with Auburn University, did his doctoral work on supercritical Taylor vortex flow.²⁰ He has suggested that when God created the earth's atmosphere, He would probably have started it out in an equilibrium state, Couette flow.

Now let us make the assumption that the earth and atmosphere were created in a perfect state (which I believe to be true). The initial flow field for the atmosphere in this perfect state would have been Couette flow for a sphere immersed in a uniform fluid. It is possible that this situation could have been maintained with the pressure gradient forces being slightly larger than the inertial forces. If the atmosphere were thicker than it is today, as one would logically conclude, then the critical Taylor number would have been fairly large.²¹

Assuming that the atmosphere was created in an equilibrium state, then the angular velocity of the inner rim of the canopy would be equal to the angular velocity of the surface of the earth, and from (5) the term $(1 - \mu)$ would equal zero. Thus, whatever the critical Taylor number was of the pre-flood atmosphere, it was clearly far above zero, and, as Burkhalter suggests, far above even today's values. As a result, it would appear that the atmosphere of the pre-flood world (i.e., the "fluid" between the plates) may have been in a very stable condition and lacked any turbulent mixing.

It is known that the Taylor number of today's atmosphere is above the critical value due to the fact that jet streams are apparent in the upper atmosphere. What would have caused the Taylor number of zero of the pre-flood world to rise above the critical value and induce Taylor instability and a global deluge?

A major factor would be a significant cooling. From (6) and (5), it is clear that the Taylor number varies inversely with temperature. Thus, a drop in temperature would raise the Taylor number. The activity of numerous volcanoes may have thrown a cooling volcanic cloud cover above the canopy and drastically reduced its temperature, precipitating extensive rainfall. As the

rain fell, ν would decrease (as density decreased), and therefore the Taylor number would be forced upward even more. A third factor may have caused a gradual decrease of the critical Taylor number downward, i.e., the loss of water vapor and dissociated hydrogen off the top of the canopy into outer space. Burkhalter continues,

As the earth continued to rotate in its infant stages (perhaps over a period of hundreds of years), it could have gradually lost some of its atmosphere to outer space as theorized for many other planets and moons. During this period, Couette flow would have been maintained as long as the Taylor number was below the critical value. As the atmosphere became thinner, the critical Taylor number decreased until at sometime in history, the atmosphere became inertially unstable. At this time, catastrophic phenomena would have taken place.²²

Thus, the Taylor number of the pre-flood atmosphere was increasing and the critical Taylor number was decreasing. At some point, a global instability would have set in.

The Couette flow would suddenly (hours, days, or weeks) have formed into toroidal shaped rings around the earth. Initially there would have been (perhaps) many rings which would have caused very large vertical air currents and consequent cooling, etc., of the vapor state atmosphere. Considerable condensation (rain) would have occurred, accompanied by strong winds. After some period of time, a specific pattern would have resulted in which the toroidal rings would have remained as long as the Taylor number was above the critical, as it apparently is today, and specific well-defined wind patterns would have resulted. It is a well-known and established fact that the cells or toroidal rings do exist on the earth today. There are three in the northern hemisphere and three in the southern hemisphere. As a matter of interest, the North East Trade Winds form a part of one of these cells.²³

Burkhalter concludes,

In conclusion, it is highly possible that the vapor state in the pre-flood era could have existed and the logical sequence of events described above could have occurred.²⁴

In order better to understand the physical forces involved in Taylor stability, it is helpful to visualize the atmosphere as located between two concentric cylinders, each with a width equal to the distance between the equator and approximately 30 degrees North and South latitude. These cylinders are rotating at exactly the same velocity. Furthermore, as described above, the earth is under the influence of a universal temperature inversion. The canopy causes a universal greenhouse effect. Toward the top of the canopy, there would have been much movement of water vapor from the equator toward the poles in order to balance the heat budget. Since the area of the canopy located over the equator receives much more solar radiation than the area over the poles, a movement from the high pressure over the equator to the low pressure over the poles would ensue. This transport of heat by atmospheric movement might

keep the temperature of the canopy over the equator and the poles nearly the same (precisely the same situation that prevails on Venus). Therefore, in the lower regions of the canopy, just above the atmosphere, there could well have been little atmospheric movement. The temperature of the bottom of the canopy radiating earthward from the poles would then be close to that radiating earthward at the equator. As a result, there would be a pole-to-equator temperature equilibrium and hence only minor air transport in the lower atmosphere or in the lower area of the canopy (the outer "rim" of the two concentric cylinders). The Taylor number would, therefore, have been near zero as mentioned above.

The only forces acting upon a parcel of air in the lower atmosphere would be the centrifugal force throwing air out and gravity produced pressure gradient forces pulling the air parcel in. At what point will an instability set in? An instability (and hence, turbulent mixing) will occur when a random disturbance is amplified instead of being dissipated.

The task of the stability theory consists in determining whether the disturbance is amplified or whether it decays for a given mean motion; the flow is considered unstable or stable depending on whether the former or the latter is the case.²⁵

Under what conditions is a disturbance amplified? This would occur when a parcel of air below a disturbance is "bounced" upward into the disturbance carrying a large amount of angular momentum. If the horizontal velocity of flow of the parcel of air is greater below than above, then when that parcel is raised to the upper level it carries with it a greater amount of angular momentum than the surrounding air. In order for angular momentum to be conserved, the energy associated with the momentum increase must be dissipated by viscous transport to the surrounding air (fluid). If the disturbance is able to dissipate the additional energy at a greater rate than that energy is being added to the disturbance, then the disturbance will not be amplified, but will be "damped," and the atmosphere will return to a stable state. Its ability to dissipate energy is dependent upon the viscosity of the surrounding air which is related to density and temperature. However, if the angular momentum of the particles moved into the area of the disturbance is such that a larger amount of energy is transferred than the disturbance can dissipate, then the disturbance will continue to grow in intensity, and a large-scale instability will result. It is obvious that a key to creating a global instability is to introduce a velocity profile such that the velocity of the layers differs significantly so that *continuous* transport of momentum between the layers will result in instability. Momentum is a function of the mass, velocity, and hence of distance of the parcel from the axis of rotation. A change in temperature will change the density and hence the mass of the parcel. Therefore, either a change of temperature or a change in the velocity or a change in radius of the "outer rim" could result in a change in stability.

Now the Taylor number is a dimensionless ratio that relates all of these factors—mass, velocity, viscosity,

radius, etc. Different masses and different velocities can exist in various layers of the atmosphere and the atmosphere still remain stable and laminar, provided the ratio of the masses, velocities, and radii is not such that the Taylor number which defines that ratio exceeds a certain critical value.

Burkhalter describes laboratory experiments in which he observed the introduction of a serious disturbance into the fluid located between two concentric rotating cylinders in which the Taylor number was sub-critical. He observed that, no matter how the fluid was stirred up, it would quickly return to laminar flow, and no turbulent vertical mixing would occur. The same situation may have existed in the pre-flood earth. Local and severe disturbances or variations in weather may have occurred, but it would have had no effect in generating a global instability and coincident convective turbulence and eddy diffusion. It seems likely then that, under these assumed antediluvian conditions, no local disturbances would be amplified but would be damped, and the atmosphere would remain stable without any vortices or vertical motions.

The Maintenance of the Vapor Canopy

It will now become clear how many feet of water vapor may have been maintained, perhaps indefinitely, up above the ancient troposphere. Due to the stabilizing influences of the global temperature inversion and of Taylor stability, the atmosphere below the bottom of the canopy would have been in an extremely stable, laminar state so that little convective turbulence or mixing would have occurred between the canopy and the ancient troposphere. Only molecular diffusion needs to be considered, and eddy diffusion would be minimal.

Molecular Diffusion

In order to calculate how long it would take for the canopy to diffuse down to the surface of the earth, it will arbitrarily be assumed that in the 1 km layer under the canopy the air is *completely* stable. This is a reasonable assumption based on observation of present day temperature inversions. Furthermore, since the temperature inversion extends all the way to the surface, it is likely that eddy diffusion would be insignificant most of the way down. Thus, assuming only a 1 km totally stable layer is conservative. There is absolutely no eddy diffusion or convective turbulence due to the temperature inversion and Taylor stability. However, as one gets closer to the surface, it is possible that eddy diffusion might begin to play a more prominent role. This is due to the fact that the albedos of various parts of the earth's surface vary from 0.1 for forests, 0.2 for oceans, and 0.45 for sandy areas.²⁶ As a result, differing amounts of radiation will be absorbed at the surface in these different areas, and different temperatures will result. In order to balance these slight temperature variations, gentle breezes and winds might prevail as they do today. There would be no major wind systems, however. Thus, once the vapor had diffused down through the first 1 km layer, it might diffuse more rapidly the rest of the way down to the surface, due to the mixing and gentle breezes there.

The calculation of molecular diffusion involves computer iterative techniques. In order to secure a reliable approximation, Dr. Larry Vardiman, a meteorologist with the Bureau of Reclamation, was consulted.

Vardiman starts out *assuming* without proof a certain temperature profile similar to Figure 1. A profile similar to this is necessary to sustain the canopy as it is presently being conceived. He also assumed 34 feet of precipitable water in the canopy and a surface pressure of 2026.6 millibars and surface temperature of 300 °K or 27 °C. The temperature at the interface between the atmosphere (air) and the canopy is set at 400 °K or 127 °C. This is sufficient to sustain over 40 feet of precipitable water in vapor form in the canopy. The pressure at the bottom of the canopy would be 1013 mb (34 ft. of H₂O = 1 atm. = 1013 mb.). Due to the temperature inversion, there is no wind or vertical mixing in the 1 km below the canopy, and hence the primary mode of diffusion downward will be molecular diffusion. This process is described by Fick's law.²⁷

$$\frac{dM}{dt} = -DA \frac{d\rho}{dz} \quad (7)$$

where: dM/dt = the flux of water vapor through a boundary in units of gm/cm² • sec, D = the diffusivity of water vapor through air in units of cm²/sec, A = an area through which water vapor is being diffused, assumed to be 1 cm², $d\rho/dz$ = the density gradient of water vapor in the vertical direction z in units of gm/cm³/cm.

Basically, this equation says that the rate of diffusion of water vapor through a unit area is proportional to the negative gradient of vapor density. Therefore, the largest rate of diffusion of water vapor downward will occur immediately below the interface at time zero. As vapor diffuses downward, the gradient below the interface will decrease, reducing the rate of diffusion. Thus, Vardiman assumes that the initial conditions involved a layer of water vapor and layer of air separated as if by an impenetrable membrane. As soon as the membrane is removed, vapor diffusion downward begins at time zero.

The equation for D is:

$$D = D_0(T/273^\circ\text{K})^{1.81} (1000 \text{ mb}/P) \quad (8)$$

where D = diffusivity at pressure and temperature of interest, D_0 = diffusivity of water vapor into air at T_0 , $P_0 = 0.241 \text{ cm}^2/\text{sec}$, $T_0 = 0^\circ\text{C} = 273^\circ\text{K}$, $P_0 = 1000 \text{ mb}$, and P = pressure of interest.

Because of the pressure and temperature dependence of the diffusivity, an exact solution is difficult, so a finite difference scheme was developed to integrate equations (7) and (8). Seventy 100-meter-thick layers were modeled from the surface to the air-water interface, as shown in Table 1. Layers are denoted by the numbers j running from 1 to 70. Seventy-one levels were modeled as denoted by the numbers i running from 1 to 71. A diffusivity was calculated at each layer.

Temperature, pressure, and diffusivity were assumed to remain constant with time.

Vapor was assumed to diffuse downward, but air was not assumed to diffuse upward. Neither was the upward diffusion of water vapor back into the canopy consid-

ered. If air and water vapor had been allowed to diffuse upward, it would have slowed the net diffusion of water vapor downward. Therefore, the present calculation will be conservative by overestimating the rate of diffusion downward.

The vapor density at level one ($i = 1$) is computed from the ideal gas law [Equation (6)] assuming vapor saturation at 400 °K.

Time steps of 10 years used in the integration were found to go unstable after about 300 years. These numerical instabilities have not yet been resolved, and, as a result, the calculations are only reported for 250 years. However, as illustrated in Figure 5, it is easy to extrapolate by graphical methods what the diffusion rate will be at the time of the flood, 1,656 years later. Methods are currently being investigated to extend the calculations beyond 1,656 years, thereby eliminating the need to base conclusions on an extrapolation.

Because of the assumption of no water vapor in the air below the canopy, no diffusion will occur below the first layer under the interface during the first time step. That is, no diffusion will occur between levels 1 and 2. At the second time step, diffusion occurs between levels 1 and 2 and between levels 2 and 3. At the end of 70 time steps, diffusion occurs through all 70 layers, although the rate at the lowest levels is extremely small. This "marching" of water vapor downward one layer at a time for the first 70 time steps is an artificiality of the initial assumptions, but does not affect the simulation after about five time steps from the time a layer has vapor in it.

The integration was run for a period of 300 years before numerical instabilities became evident. Figure 5 shows the rate of diffusion through layer 1 for the first 250 years in terms of an equivalent depth of liquid water. Since the rate of diffusion will always be greatest in layer 1, and since all water vapor must be diffused through this layer, this graph provides an estimate of the maximum rate of diffusion.

It can be seen from Figure 5 that the maximum rate of diffusion at the end of the first year is 0.77 cm/yr and it decreases rapidly to 0.2 cm/yr in about 120 years. If the curve in Figure 5 is extrapolated to 1,656 years, and the diffusion integrated over the entire 1,656 years, the

Table 1. This shows some of the divisions, there being 70 layers altogether, each 100 meters thick, used in investigating the diffusion of water vapor into and through the troposphere, by the method of finite differences. See the text.

$P(\text{mb})$	$T(^{\circ}\text{K})$	$H(\text{km})$	Level (i)	Layer (j)
1013	400.0	7.0	1	1
1022	398.6	6.9	2	2
1031	397.1	6.8	3	3
1040	395.7	6.7	4	4
1049	394.3	6.6	5	4
.....				
1982	302.8	0.2	69	69
2004	301.4	0.1	70	69
2026	300.0	0.0	71	70

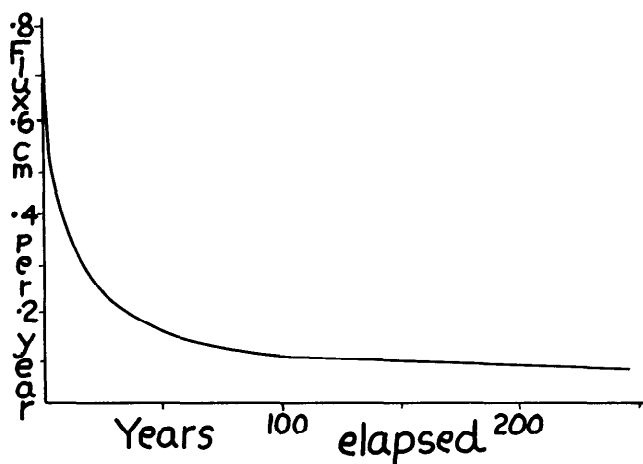


Figure 5. This shows the flux of water vapor through the nearest 100 meter layer beneath the canopy as a function of time, as is discussed in the text.

total water diffused through layer 1 is just over 1 meter of liquid water. This is less than 10 percent of the total 34 feet of water initially assumed to be in the canopy which has diffused through the first layer 100 meters under the canopy in 1,656 years! At this rate, it would take 12,190 years for the 40 feet of H_2O (1219 cm) to diffuse through the first 100-meter layer. Thus, it is evident that the canopy will take an extremely long time to diffuse to the surface.

The calculations show that the vapor initially diffuses downward rapidly then begins to slow as the gradient decreases. By 250 years, only 1 millibar of vapor (about 1 cm of liquid water) has reached the 5.75 kilometer level (about 1 km below the canopy). This is less than 0.1 percent of the total vapor pressure at the base of the initial canopy. At a rate of 1 cm/250 yrs, it would take 304,750 years for the canopy to diffuse through the 1 km level.²⁸

Vardiman concludes,

These results, based strictly on the molecular diffusion, show that with the assumed initial distribution of water vapor, air, and temperature, the vapor canopy is highly stable with time and could have easily remained in the upper atmosphere from its creation to the flood 1,656 years later.²⁹

It appears likely, then, assuming completely stable air for 1 km under the canopy, that the canopy could be maintained for a very long period of time. In 250 years, only 1 cm would have diffused down to the areas of the troposphere where eddy diffusion might begin to play a part.

Of crucial importance is the demonstration of the assumed temperature profile which Vardiman used. Is there any basis for believing his assumption is approximately correct?

The Temperature Profile Under the Canopy

In order to calculate what the temperature profile would have been under such a vapor canopy, an extremely complicated computer simulated global climate model would have to be developed. The calculation

of radiative heat transfer is very involved and is beyond the limits of this paper or my abilities.

The general procedure is as follows. First, a reasonable temperature-altitude profile is assumed. Then the hydrostatic equation (1) must be introduced to calculate the density and pressure of all the atmospheric constituents at each altitude. Fortunately, planetary atmospheric models are presently available for this purpose.³⁰ Then, knowing the density and pressure at each altitude, it is possible to compute the optical depth at that level and the reflectivity. The optical depth is simply the mass of absorbing medium per unit area normal to the radiation. From this, the absorption of the layer can be calculated for each wavelength. After each layer absorbs radiation, it will re-radiate it to the adjacent layers, $\frac{1}{2}$ up and $\frac{1}{2}$ down in the infrared. This radiation will be absorbed and will result in a new temperature profile slightly different from the assumed one.³¹ Once the new profile is established, new optical depths are computed, and new absorption percentages result for the adjacent layers, and a new temperature profile results once again. This process is repeated by computer iterative techniques until the final profile agrees within a pre-determined amount with the "next to last" profile. At that point, the calculation is ended.

However, with simple approximations, it is possible to show that the temperature of the canopy will be hot enough to maintain the water vapor in vapor form and to establish the idea of a temperature inversion. It is even possible to indicate that the surface temperatures could conceivably have been such that the earth would have been habitable.

The Temperature at the Base of the Canopy: The Importance of the Reflective Layer

Of crucial importance in the following approximations is the existence of a reflective layer at the interface of the canopy and the antediluvian troposphere. There is a possible mechanism that might produce such a reflective layer.

Because a rapid transition is being made from an atmosphere made up of water vapor to one made up of air, there would be a corresponding rapid change in the absorption of infrared radiation from above and below. Air absorbs infrared much less efficiently than water vapor. As a result, there would have been a sudden temperature change (in space) across the interface of the canopy and the lower atmosphere. This sudden temperature decrease might in turn produce a mist in this area through which good visibility could be maintained if it were formed only intermittently, but which would also significantly raise the albedo of that layer. In the areas where this mist formed, the canopy and the lower atmosphere have intersected (the pre-flood "tropopause"). Thus, these water vapor mists are mixed in an atmosphere of air, the density of which is probably higher than the density of the atmosphere today. The terminal velocity of fall of such mist droplets is very small and is given by:³²

$$V_t = (2/9) \frac{\rho L - \rho}{\eta} \quad (\text{gr}^2) \quad (9)$$

where, V_t = terminal fall velocity, cm/sec, ρL = density of liquid water at 30°C⁵ 0.99567 gm/ml, ρ = density of the air through which the droplets are falling³³ = $Pm/RT = (1000 \text{ mb}) (28.96)/(8.3143 \times 10^7) (600 \text{ °K}) = 3.6 \times 10^{-4} \text{ gm/cm}^3$, η = viscosity of air at 600°K = $31.23 \times 10^{-5} \text{ poise}$,³⁴ $g = 980.616 \text{ cm/sec}^2$, and r = radius of mist droplet³⁵ = $5 \times 10^{-5} \text{ cm}$. Therefore, $V_t = 1.74 \times 10^{-3} \text{ cm/sec}$.

This fall velocity is negligible. Byers comments, "It is seen that in the size range of cloud droplets, from 2 to 40 μm in diameter, the fall velocities are negligible, and the droplets are, for all practical purposes, suspended in the air."³⁶ This suspension is due to the slow fall velocity and the fact that a droplet that size will evaporate before it falls 10^{-4} cm .³⁷ Thus, these mists in the canopy would fall very slowly and then evaporate immediately. As they evaporated, depending on the temperature profile and the mixture of air and water vapor above, it might be possible to conceive of a system by which they would then diffuse back upward, and, as a result, these mists would essentially hover.³⁸

These mists could only occur irregularly if there were no condensation nuclei in the tropopause (and there probably were not). Thus, one is led to conceive of a sometimes misty, sometimes cloudy tropopause, but one which would be regularly much more reflective than today's atmosphere, with an albedo of 0.6 or higher.

Approximation for the Temperature of the Tropopause

With these assumptions in mind, it is possible to estimate the temperature at the base of the canopy just above this reflective layer. In order to do this, the approximations outlined by Goody will be used.³⁹ A simple estimate of the temperature of the radiative surface of the planet is given by:

$$T_b^4 = (1 + \text{optical thickness}) \times T_e^4 \quad (10)$$

where T_b is the temperature at the base of the canopy (the radiative surface due to the assumed reflective layer), and T_e is the effective temperature of the earth. The effective temperature of a planet is the temperature of its top radiating layer whose optical thickness is one.⁴⁰

$$T_e = \left[\frac{S(1 - A)}{4\sigma} \right]^{1/4} \quad (11)$$

where S = the solar constant, $1.94 \text{ cal/cm}^2 \cdot \text{min}$; A is the planetary albedo; and σ the Stephan-Boltzmann constant, $8.128 \times 10^{-11} \text{ cal/cm}^2 \cdot \text{min} \cdot \text{°K}^4$. The albedo of the earth today is about 0.36. Thus, 36% of incoming solar radiation is reflected. However, under the canopy, it is suggested that the global reflection may have been considerably higher, perhaps 80% and thus the global albedo might have been 0.6 or higher. Using these values, the effective temperature of the earth for all wavelengths under the canopy would be 221°K. (Today's effective temperature is about 253°K.)

However, that temperature assumes atmospheric absorption in all wavelengths. Equation (10) is valid assuming that no solar radiation is absorbed as the beam penetrates to the surface of the earth and that 100% of the infrared radiation re-radiates from the surface of the earth (the reflective layer in this approximation) upward into space is absorbed by the atmosphere. How-

ever, water vapor absorbs only in selective wavelengths. From about 4 to 8 microns, water vapor absorbs 100% of the radiation. There is a "window" between about 8 and 13.5 microns, and after 13.5 microns 100% of all infrared radiation is absorbed. Since (10) assumes absorption at all wavelengths, T_e must be modified in that at the base of the water vapor canopy upward, absorption occurs only in the water vapor bands. When the areas under Planck blackbody radiation curves are integrated, it is found that for virtually all temperatures between 200°K and 2000°K, the ratio of the area of the water vapor bands for total absorption to the other bands ranges from about 0.3 to 0.7.⁴¹ For this rough approximation then, it will be assumed that no matter what the temperature of the canopy is, about 50% of the infrared flux radiating upward from the cloud layer below the canopy base will be absorbed by the water vapor in the canopy. The upward infrared flux is given by⁴²

$$F = \sigma T_e^4, \quad (12)$$

and only 50% of F is actually absorbed by the water vapor. This has the effect of reducing T_e^4 by 1/2 so the real effective temperature of the earth in the water vapor bands, T_e' , is given by

$$T_e' = \left[\frac{T_e^4}{2} \right]^{1/4} \quad (13)$$

which comes to 186°K.

In order to solve (10), the optical thickness must be known. Imagine the entire canopy divided up into various layers. Each layer is just thick enough completely to absorb all of the infrared radiation passing through it. Layers are too thick if radiation is emitted and reabsorbed in the same layer. Layers are too thin if radiation transverses one or more layers before undergoing absorption. Each layer, therefore, is just thick enough to absorb the radiation falling onto it. The mechanism of radiation transfer is one of passing energy from one layer to the next; the radiation emitted from each layer is absorbed by its two nearest neighbors, which in turn emit to their nearest neighbors, and so on. "The total number of layers into which an atmosphere can be divided in this manner is called the optical thickness of the atmosphere."⁴³ It turns out that about 1 cm of precipitable water will result in total absorption of all infrared radiation in the bands in which water vapor absorbs.⁴⁴ Thus, the optical thickness is simply the number of centimeters of precipitable water in the canopy (40 ft = 1219 cm), and Equation (10) yields,

$$T_b = [(1 + \text{optical thickness}) (T_e')^4]^{1/4} \quad (14)$$

which comes to 1099°K.

Thus, the temperature at the base of the canopy, assuming radiative equilibrium and no convective heat transport, is 826°C or 1519°F. Since only 220°F was needed to sustain 40 feet of precipitable water in vapor form, it is clear that the trapping of heat by the canopy will create a strong temperature inversion.

It should be noted, however, that the temperature at the canopy base would never be as high as 1519°F. This is because convection will transfer tremendous quanti-

ties of thermal energy upward toward the cooler regions of the canopy, and global circulation will transfer it poleward where solar radiation levels are considerably reduced. This strong convection will work to keep the canopy approximately isothermal and will tend to keep the temperature of the base of the canopy over the poles at the same temperature as the base of the canopy over the equator.

While it is true that such a situation does not exist on the earth today, it may well have existed in the denser atmosphere of the pre-flood earth. A parallel with Venus is instructive. The Venus probes have revealed that even though larger amounts of radiation are obviously received at the equator than at the poles, the temperature at the poles on the equator is precisely the same. Goody comments, "... the temperature is the same at the equator as at the poles. Our theory still predicts that σT_e^4 is equal to the absorbed flux of solar radiation; although this is small at the poles and large at the equator, no variation in T_e is, in fact observed."⁴⁵ ($T_e = \sigma T^4$)

What, then, would be the isothermal temperature of such a canopy? This is given by:⁴⁶

$$T_{ave} = \frac{mgT_o}{\alpha R \left(\frac{mg}{\alpha R} + 1 \right)} \quad (15)$$

where, T_{ave} = the isothermal temperature of the canopy, °K, m = molecular wt, 18.016, g = acceleration of gravity, 980.6 cm/sec², T_o = temperature of the base of the canopy, $R = 8.3144 \times 10^7$ erg mol⁻¹ °K⁻¹, and α = the vertical lapse rate. McKnight chose 10 °C/km as a good estimate. Thus, $T_{ave} = 748$ °K.

The Surface Temperature

What about the surface temperature? Again, this is an immensely complex calculation. However, the Eddington approximation could be applied to give an approximate solution for conditions of radiative equilibrium.⁴⁷

$$T = \frac{(1 - A) S (2 + 1.5\lambda)}{8\sigma} \quad (16)$$

where λ is the optical depth of the ancient troposphere below the canopy. The optical depth varies with wavelength. For the atmosphere in general, it is approximately 3, and for absorption in the infrared bands a number of 2 is often used.⁴⁸ Assuming that the canopy albedo was 0.6, the following results.

There will be two radiative fluxes coming down upon the earth. S_1 = the radiative flux due to the high heat of the canopy, and S_2 = the (radiation represented by the) solar constant. S_1 is given by

$$S_1 = \frac{\sigma T_b^4}{2} \quad (17)$$

which comes to 12.72 cal/cm² • min.

Half of the radiative flux out of the bottom layer goes downward and half goes upward.

However, S_1 will be reduced considerably as it passes through the troposphere under the canopy due to the presence of several cm of precipitable water in the ancient troposphere. This water vapor under the canopy

acts as a "resistor," reducing the intensity of the "current" (i.e., infrared radiation, S_1) passing down through it from above. The same phenomenon was observed in reverse from the canopy base upwards. Each optical thickness of the canopy can be conceived as a resistor. Thus, while the temperature at the canopy base was computed to be 1099 °K, by the time the radiation had passed through 1219 optical depths, the temperature had been reduced to 186 °K at the top layer. This was the effective temperature of the earth. In a similar way, the radiative flux is reduced as the radiation travels downward through optical depths in that direction. Figure 6 illustrates this phenomenon. Because of the high temperatures in this area, it would be possible to contain 4 or 5 feet just under the canopy. In the calculations, it will be arbitrarily assumed that God placed 2 feet (60 cm) in the 1 km layer below the canopy.

Each resistor represents an optical thickness of the water vapor under the canopy. Since 60 cm were proposed, this amounts to 60 optical thicknesses or 60 "resistors." The radiative heat exchange with the surface of the earth is the flux difference divided by the sum of the resistances.⁴⁹

From the above discussion, it is clear that by the time S_1 reaches the surface of the planet, it has been reduced by a factor of 60. Thus, S_1 at the surface, $S_{1s} = S_1/60$ or $12.72/60 = 0.212$ cal/cm² • min. (Conceiving T_e this time as the temperature at the surface of the earth instead of as the effective temperature at the top of the canopy.)

The other source of radiation that penetrates to the earth's surface is the radiation that went right through the canopy and was not absorbed, scattered, or reflected by it, S_2 . Assuming that the albedo of the canopy is 0.6, then once the solar radiation has passed the canopy, it has been reduced by 60% and $S_2 = 0.4 \times 1.94 = 0.776$ cal/cm² • min.

From the Eddington approximation (15) and (12), it is clear that

$$F_1 = \frac{(1 - A) S_{1s} [(2 + 1.5(\lambda))]}{8} \quad (18)$$

which comes to 0.106 cal/cm² • min.

Similarly,

$$F_2 = \frac{(1 - A) (S_2) [(2 + 1.5(3))]}{8} \quad (19)$$

which comes to 0.504 cal/cm² • min.

In the above, it was assumed that the revised albedo is simply the albedo that S_1 and S_2 "see" after passing through the canopy; i.e., the albedo of the surface of the earth⁵⁰ which is normally taken as about 0.2.

The total flux at the earth would then be simply $F_1 + F_2 = 0.61$ cal/cm² • min.; and since radiative equilibrium is assumed, this same amount must be absorbed and re-radiated back into the atmosphere. Therefore, from (12), $T_e = (0.61/8.128 \times 10^{-11})^{1/4} = 294$ °K = 70 °F.

It should be strongly emphasized that these calculations do *not* prove the canopy temperature profile. They are much too simplistic. However, they do seem to indicate the plausibility of the proposed temperature inversion coupled with habitable temperatures on the sur-

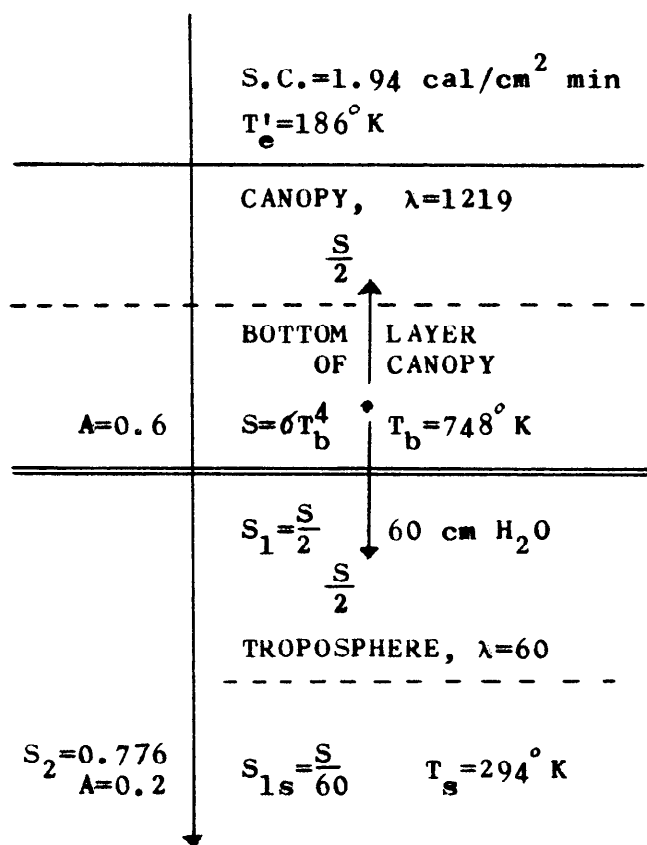


Figure 6. This illustrates the reduction in radiative flux from the base of the canopy to the surface of the Earth. The vertical dimensions in this drawing are not necessarily to scale.

face. The answer has been "bracketed" to a point that would justify further computer simulation to see if indeed surface temperatures would be this low.

It may seem perplexing that the base of the canopy at 6 miles altitude and at temperatures of 887 °F could result in such low surface temperatures. Robert Whitelaw has objected to the canopy hypothesis on these grounds: "In such a pressure-cooker world under a scalding 270 °F sky, life of course would be impossible."⁵¹ As the above calculations indicate, a scalding sky does not necessarily result in a scalding hot earth below. There are three factors that tend to render the surface of the earth cooler than the base of the canopy.

First, the high albedo of the tropopause would reflect a large amount of the solar radiation. The presence of mists and clouds would not necessarily obscure the view of the antediluvian heavens. The mists need not be continuous but, like those of today, broken, and on many days and nights over a given section of the earth, it is quite possible that there would be no clouds or mists at all.

Secondly, the presence of water vapor under the canopy acting as "resistors" will reduce the radiative flux considerably. This vapor acts as "insulation" just as asbestos wrapped around a hot pipe renders it "touchable" by human hands.

Thirdly, infrared cooling at the surface will reduce the surface temperature. As the radiative flux from

above, S_1 and S_2 hit the surface of the earth, they are re-radiated as F_1 and F_2 . The water vapor in the troposphere absorbs in only a portion of the solar spectrum. However, when the earth re-radiates back up, it re-radiates throughout the entire infrared spectrum and at greatest intensity in the water vapor "window" between 8μ and 13.5μ . Thus, the radiation that the earth radiates most intensely passes right through this window and is not trapped to heat up the earth below. As a result, the surface temperatures are cooler than they would be if it were not for this phenomenon.

Hess summarizes this phenomenon as follows:

From roughly 5 to 8μ , there is a strong absorption band of H_2O . Beyond 8μ , the absorption becomes smaller up to about 13.5μ . . . This relatively transparent window in the atmospheric absorption spectrum falls in the wavelength regions where the earth's surface radiates most strongly.⁵²

Conclusion

The canopy problems introduced in this presentation have been discussed at a very elementary level. Full solution to these possible support mechanisms and the proposed temperature profile await a computer-simulated global climate model which will incorporate the equations of radiative heat transfer and convective heat transfer and atmospheric dynamics. Thus, what has been described should not be taken as proof that the canopy problem has been solved. The above discussion only indicates that it may be solvable and that there are certainly some good possibilities as to how God maintained the "waters above."

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- ⁵*Ibid.*
- ⁶Byers, Horace Robert, 1974. General meteorology. McGraw-Hill Co., New York. Fourth edition. The hydrostatic relationships are discussed on pp. 82 & 83.
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- ⁹*Ibid.*, p. 83.
- ¹⁰*Ibid.*, p. 82.
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- ³⁶*Ibid.*, p. 365.
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PELEG'S DIVISION

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The Red Sea is a narrow strip of water extending south-eastward from Suez for about 1300 miles, separating the coast of north-east Africa from the coasts of Saudi Arabia and Yemen. "Its maximum width is 190 miles; its greatest depth 9,580 feet; and its area approximately 169,000 square miles. [It] occupies part of a large rift valley in the continental crust of Africa and Arabia."¹

"The Rift Valley begins in the lower spurs of the Taurus Mountains in Turkey and runs south from there through the Jordan Valley to the Gulf of Aqaba. It includes the natural wonder of the Dead Sea At

Aqaba the Rift is submerged beneath the waters of the Red Sea, to reappear on the African Continent in the Afar depression of northeast Ethiopia. At this point three rift valleys—the Red Sea, the Gulf of Aden and the African Rift—converge.

"It has been said of the Rift Valley that, although it may have its counterpart on another planet, there is nothing [else] like it on earth. There are other rift valleys, but none of these is so great in extent and variety . . . [However, a] rift valley is not really a valley at all; it only looks like one. Ordinary valleys are cut by rivers in their descent from mountains toward the sea; they may be steep-sided and narrow, but a big, old river valley often has a large flat alluvial plain on its floor and steep escarpments some distance back on either side . . . Rift

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valleys . . . differ from the other valleys in that they are the result of movements and fractures in the earth's crust rather than erosion by water or occurring by ice.

"Opinions still differ as to how rift valleys are formed, but the consensus is that they are sections of the earth's crust which have dropped to a lower level between two lines of cracks or faults. In dropping, these sections have often been shattered and formed into smaller steps and escarpments. Sometimes the minor cracks can still be seen running parallel to the main fault lines. Technically a rift valley may be called a graben, a term applied to any place on earth where a section of the surface has dropped into a hollow beneath the surrounding level. Volcanic craters are often grabens."²

"The Red Sea is considered a relatively new sea . . . [the trough of which] apparently formed in at least two complex phases of land motion."³

Although certainly not implied in the quote, the term "relatively new" can be reasonably read as "post-Deluge."

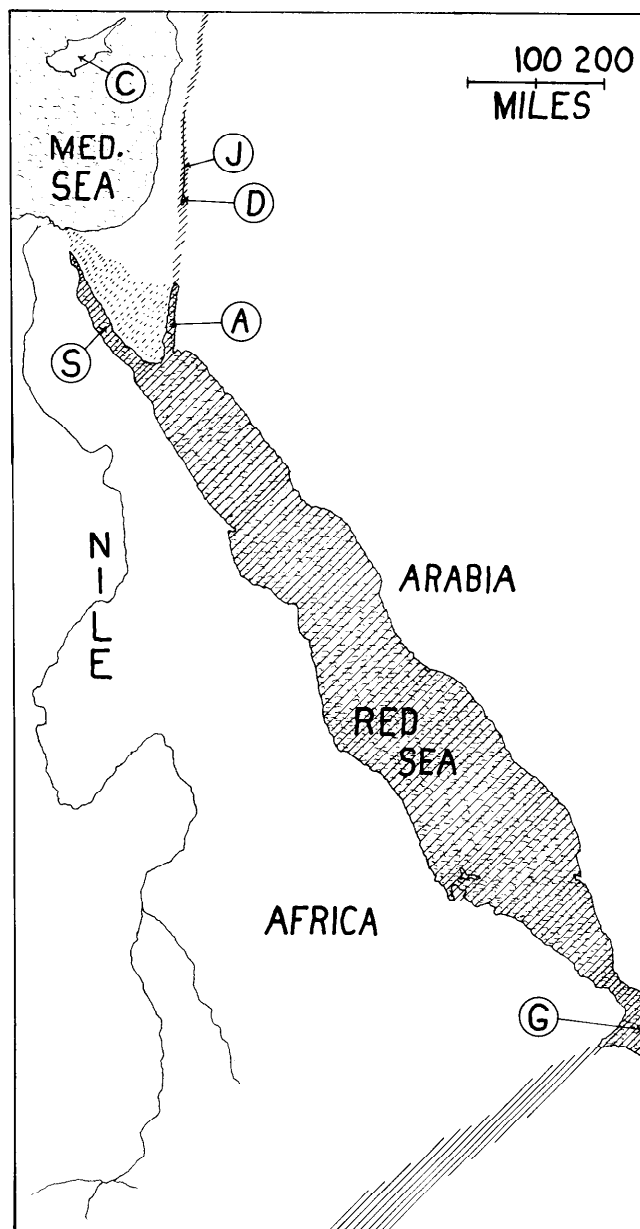
"No water enters the Red Sea from rivers, and rainfall is scant; but the evaporation loss, in excess of 80 inches a year, is made up by an inflow through an eastern channel of the Straits of Bab el-Mandeb from the Gulf of Aden [part of the same rift system]. It is estimated that there is a complete renewal of water in the Red Sea every 20 years."⁴ Until it was first filled, it would have appeared a gaping chasm in the earth's surface.

If there were no Red Sea Rift, and consequently no Red Sea, there would be a virtually uninterrupted land-mass comprising Africa and Asia. A land-bound inhabitant of the Middle East would know one seemingly endless body of land, bordered by major seas in two directions: the Mediterranean Sea and Indian Ocean (or Arabian Sea). Given such a topography, the occurrence of a rift in ancient times in the location and of the magnitude of that beneath the Red Sea would quite conceivably be described as a division of the earth. Might this not be what happened in Peleg's time? ". . . the name of one (son of Eber) was Peleg; for in his days [plural] was the earth divided . . ." Genesis 10:25.

Current scientific opinion has it that the Sinai Peninsula ". . . occupies an ancient block . . . which rose between [the] two rifted areas . . ."⁵ This of course implies that the initial separation of Africa and Asia was complete, which would fit in with the present suggestion.

It remains to be seen whether there is other literary evidence to support the interpretation suggested here. The cause also remains in question: possibly continued stabilization following the Deluge—whatever, it was not a "run-of-the-mill" earthquake to cause such a rift.

It is interesting to note that this is the only Old Testament upheaval not said to have resulted from God's judgment.



This map shows the Rift Valley, indicated by the diagonal shading, in Asia and Africa. It will be understood that where the rift is under water, it may be hard to tell the exact width; hence in such places the width indicated may be somewhat arbitrary. The broken shading, in the Sinai region, is to emphasize the suggestion that it may once have been part of the rift, and may have risen later.

The significance of the letters is as follows: A, Gulf of Aqaba; C, Cyprus; D, Dead Sea; G, Gulf of Aden; J, Jordan River; S, Gulf of Suez.

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THE ARK, ITS COURSE AND DESTINATION

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Commonly, the account in Genesis has been interpreted to mean that, at the end of the flood, the ark grounded on Mount Ararat and remained there. Here a different interpretation is proposed: that eventually the ark returned to a lower altitude, more suitable for Noah and his family to begin life again there. Such a destination seems more in keeping with God's providential care of the ark during its voyage.

In the light of this suggestion, several other suggestions and interpretations are proposed.

Introduction

A very excellent outline of an example of divine control of history on this earth was given recently by Kofahl, in which he had occasion to cover the period of the flood, and to discuss the canopy as a source of flood waters.¹

It is one purpose of this paper to repeat the importance of divine control during the period of the flood. Such control was very necessary for the protection of the ark and its passengers. I can do no better than to repeat Kofahl's words:

"There were numerous supernatural aspects of the deluge, notably the divine announcement and purpose, divinely given plans for the ark, the perfect timing and coordination of the various geological and atmospheric events, the voluntary gathering of the animals, the maintenance of these animals for a year on the ark, and the preservation of the ark and eight souls during a year of global violence unequalled in the history of the world since Creation."¹

One of the problems which may puzzle a person who is trying to analyze the motion of the ark over the world ocean is the statement in the Bible that the ark rested—upon the mountains of Ararat. (Genesis 8:4).

The interpretation has been for many centuries, and still commonly is, that the ark grounded on a mountain, or mountain range. The mountain is often taken to be the one now commonly called Ararat (actually, there are two peaks, about 17,260 and 13,000 feet high respectively), in Turkey, about half way between the Black and Caspian Seas.²

However, such an interpretation does not seem to fit in well with what has been said about divine control. The ark would have been in a very precarious position, and the situation would have been difficult and uncomfortable for the human passengers. They would have had to move all the domestic animals, their food, all farm equipment, tools, etc., down the mountain to the place where Noah was to take up farming. (Genesis 9:20.) But such a thing would have been unnecessary; God could use the same power which had raised the ark from its building-place, presumably at only a moderate elevation, to return it to a moderate elevation.

Furthermore, to assume that the ark was permitted to ground itself on top of a mountain would seem more to be expected of god as envisaged by the deists, who commonly limit divine activity to creation in the past. The deists' remote and indifferent god is hardly one who would have tender care for men. But we should accept

Jesus' teaching of God's creating and sustaining activity: "My Father is working still and I am working." (John 5:17.)³

The Course of the Ark

Genesis 7:11 tells us that in the six hundredth year of Noah's life, in the second month, the seventeenth day of the month, the flood began. We find the ark ready, its cargo and all its passengers on board, waiting on dry land. The ark was apparently built as the ancient Greeks built ships: in a cradle which must have been a huge construction; for the barge itself was big.⁴ The place of construction must have been the size of a modern football field. When a modern ship is being built, after the hull is finished, it is launched into the water, the hull is then pulled up alongside a dock and there the ship is completed. This is different from the method used to complete the ark. When the flood waters touched the big keel of this barge, it had to be ready to move. There was no shake-down cruise for the ark, a trial run given to all modern ships before acceptance.

We are told that the waters increased (Genesis 7:17) and the ark was lifted up above the earth. This reminds anyone who has ever gone through a canal of what happens in the locks: the rising water lifts the vessel to a higher level. We shall return later to this thought about locks in a canal.

Genesis 7:18 then tells us the ark went upon the face of the waters, actually floated out on a world ocean, on its journey to its port of disembarkation, on a new world.

For one hundred and fifty days we have no contact with the ark; nothing is recorded in the Bible, but we do know that she was floating on a world ocean, on which there were no lighthouses, beacons, no charted courses in latitude and longitude available. Such things would have been useless to Noah even if he was a navigator, because the barge had no rudder or propulsion. One visual characteristic of the surface of a world ocean that might have told Noah something was the ocean currents, circulating around the planet in the direction of its rotation. This is being done today by the mighty Antarctic circumpolar current in the Southern Hemisphere. There is no continent to stand in its way. It flows completely around the Antarctic Continent.⁵

We know that much happened during the first forty days of the one hundred and fifty day period. During this period I believe the ark was moved by divine control to a place of safety, i.e., one where the water was relatively quiet.

*Mr. John Schmich has been a marine engineer. He now receives mail at P.O. Box 273, Menard, Texas 76859.

During this period tectonic activity took place. Upheavals in the earth's crust that released juvenile waters also created tsunamis. These are produced, happily seldom, in the oceans today. The newspaper headline writers like to call them tidal waves, which they are not.⁶ During the forty days many could have been produced by earthquakes, volcanic activity, etc., in such a way that the mass of waters released could have been moving in different directions resulting in terrific collisions whenever they met. Also, great downpours of water from heaven are recorded in Genesis 7:11. Besides this was the gas, dust, fire and water poured forth by volcanoes developing beneath the surface of the waters. Incidentally, Mt. Ararat could have been one of them.⁷ I believe these conditions did not exist all over the earth; and, as I mentioned above, the ark must have been well protected, in some relatively tranquil place.

During the period following the forty days of the one hundred fifty day period, the forces of destruction were now being gradually reversed to become forces of suppression (Genesis 8:1) and in this paragraph we have a direct statement, "God remembered Noah," and there followed:

Genesis 8:1—God made a wind to pass over the earth to calm the waters.

Genesis 8:2—The juvenile waters from the fountains of the deep were cut off. The tsunamis produced by the tectonic upheavals also ceased.

Genesis 8:2—The windows of Heaven were stopped. (The torrential rains stopped.)

These actions were taken by divine control to calm the surface of the world ocean.

Genesis 8:3 and 8:5 tell us that the waters returned from off the surface of the earth, an indication that the earth was changing from a planet covered with water to a planet with oceans separated by continents, a condition we have today.⁸

Genesis 8:3 tells us that the calming effect on the waters was effective. The ocean basins were being formed very slowly to drain the flood waters to provide land suitable for human habitation.

It is my belief that the lowering of the sea level was done very slowly under divine control, because the draining of the waters into the ocean basins could have had a more serious effect on the planet's surface than did the flooding of the earth. Also, the safety of the ark had to be considered; it must not be swept out to sea.

The slow receding level of the sea, which may have taken centuries to reach its present level, would have provided some control over the expansion of the human race over the earth. Some delay was likely necessary to allow the surface to become suitable for cultivation, and to let plants and forests get a head start.

I believe that it is safe to say that the memory of the flood left the post-diluvian people with an actual dread of the sea, and caused them to watch the encroachment of high tides on the beaches with a great deal of anxiety. Such an attitude could have lasted for many generations.

It may be worth remarking, in that connection, that there is some evidence that centuries later, when the

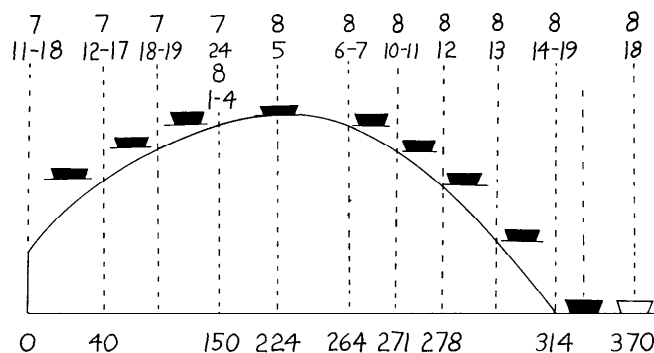
megalithic structures in western Europe were built, their purposes may have included the prediction of tides.⁹

The Actual Landing

On the seventeenth day of the seventh month, according to the record, the ark rested on the mountains of Ararat. This has commonly been taken to mean that it grounded. However, such an interpretation seems unnecessary.

I suggest that the ark stopped moving about over the mountains, which were still under water. A modern sailor might say that the ark was hove to and waiting for orders. This point is specifically mentioned in the record as the point of transition from the voyage upon the unbounded ocean to a voyage of another kind.

On the first day of the tenth month, the tops of the mountains were seen. It seems strange that it would have taken two and one half months for that much to happen if the ark were already grounded; and commentators have sometimes proposed rather strange explanations. I suggest that the ark continued to float as the



This is intended to show how the depth of water (vertical coordinate) increased and decreased with time (horizontal) during the flood; but it is not necessarily to scale. The numbers at the top are references to Genesis, by chapter and verse. The numbers along the bottom indicate the days elapsed. I have assumed a conventional calendar, of months of thirty days each. However, see the interesting suggestion in *The New Bible Commentary*, second edition, 1954-1960. Wm. B. Eerdmans Publishing Co., Grand Rapids, Michigan. Pages 84 and 85.

About the depth, Haber, reference 8, points out that there is enough water in the oceans to cover the surface of the earth, were it smooth, to a depth of about 7,500 feet.

About the days indicated along the bottom, the following remarks may be added:

0-40. There was likely great tectonic activity at this time.

150. This marks the end of the period of increasing ocean. God remembered Noah, and—(a) Caused a wind to calm the water, (b) The tectonic forces were reduced, (c) The rain was reduced (Genesis 8:3).

Then the ark rested upon the waters which were upon the mountains of the Kingdom of Ararat.

224. The tops of the mountains were seen (Genesis 8:5.) The waters decreased.

264. Noah opened the window and sent forth a raven and a dove. The dove returned. The waters abated.

271. This time the dove, when sent forth, returned with an olive leaf.

278. This time the dove did not return.

314. He removed the covering. The ground was dry.

370. God spoke to Noah. Go forth, Thy wife, sons, and their wives.

water went down, and now it was found to be inside a circle of mountains. God may have placed the ark thus to protect it from the violent motion of the water which was still going on outside.

The water continued to subside, and, of course, the ark was lowered with it. Then, I suggest, the ark went out of its lagoon, through a passage, into another, rather lower, landlocked basin. And so on for several stages. As already suggested, the process was much like a passage through a canal with locks.

In the way described, the ark was lowered from a considerable altitude to a place likely only a little above the sea level of the time. Thus Noah, his family, and the animals, could disembark in a place where the soil, supply of water, and other considerations, were suitable to them to begin their new life. In this, as in everything, God remembered the ark and its passengers, both man and beast.

Genesis 8:13-18 tells us that in the first month, first day of the month, Noah removed the covering. He saw the face of the ground was dry. The ark had settled down on the soft mud of a valley. God had thus provided Noah with a home on a destroyed planet.

Again God showed that He remembered Noah and the ark. Genesis 8:14 to 18 tells us that God spoke unto Noah saying, "Go forth out of the ark, thou, and thy wife, thy sons and their wives with thee." Only God could have opened the great door on the side of the ark, because it had been sealed before the ark was lifted up.

Now Noah was to be a farmer, and if so, he required a location with good soil, fresh water (the ocean water must have been contaminated), sunshine and a temperature suitable to raise farm products for his family and the animals before the supply he carried in the ark was depleted. And here, too, I believe God remembered Noah.

This was the start of the post-flood era of the planet's history.

The Destination of the Ark

Somewhere in the mountains of the Kingdom of Ararat in one of the valleys will be found evidence of the landing of the ark and the first settlement of man on the post-flood world.

How will we identify this location? I do not believe there will be anything left of the ark, except possibly the great keel. Even that may have disintegrated, unless sections became petrified. However, there is the possibility that stone ballast was used, in which case one could look for a 300 foot line of broken stone. There should also be artifacts in this deposit of stone. It is possible

that the stone used for ballast also could give some very useful information.

Then there is the altar on which Noah made his important sacrifices. The ancients were instructed by God to make their altars out of stone which had not been touched by the tools of men (Exodus 20:22-26).

A memorial could also have been erected by Noah, although there is no record of it in the Bible.

The memorials would have been built the same way the altars were, but no burnt offerings would have been made on them. (Jos. 22:26-29.)

It is possible that other remains of this ancient settlement might exist in the form of stone foundations, artifacts of metal, and pottery brought by Noah from the antediluvian world. Noah and his direct descendants likely had to make tools of stone, and they then became the first men of the so-called stone age, for both the arts of metallurgy and the location of the mines were likely lost for a time.

If Noah's descendants had the characteristics of men of history, it is possible that for several generations an attempt was made to commemorate the location of the first settlement including the ark, and to honor Noah.

It is a well known historical fact, however, that succeeding generations can be forgetful of history and be ruthless in destroying the work of past generations to save themselves the labor of obtaining materials to build their own homes. I believe if we are to find evidence of Noah's presence, it will only be by the will of God, Who may have taken steps to conceal these important memorials to be recalled to man only at a time set by God Himself.

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THE ORIGIN OF YOSEMITE VALLEY

JOSIAH DWIGHT WHITNEY

FOREWORD BY DR. WALTER E. LAMMERTS

In my article "Trees Indicate Recent Origin of Yosemite Valley"¹ brief reference was made to the explanation, by J. D. Whitney, a former California State Geologist, of how Yosemite Valley was formed. After showing why this beautiful valley could not have been formed by erosion, he suggested that the entire floor of the valley had suddenly subsided.

Josiah Dwight Whitney lived from 1819 until 1896, and was state geologist from 1865 until 1882. He wrote a number of important books, including: "Metallic Wealth of the United States" (1854); "Mountain Heights in the United States" (1862); "The Yosemite Book", a beautifully illustrated rare book, (1868); and the more practical "The Yosemite Guide Book" (1874).

The following is an excerpt from The Yosemite Guide Book, pages 114-122. Besides giving Whitney's opinion as to how the valley was formed, it is most interesting because of the evidence given for the recency of the erosion of the Sierra Nevada mountain chain. The Table Mountain lava on each side of the Stanislaus River at Abbey's Ferry was of recent origin, as is shown by fossils under the volcanic mass. Yet the Stanislaus canyon is over 2,000 feet deep.

Whitney's opinion that John Muir was wrong in thinking that the valley was formed by erosion by ice, whereas in fact there is no proof that glaciers ever occupied the valley, is also very interesting. Maybe our Research Committee could encourage further investigation of this matter.

Asia and South America seem poorly provided with waterfalls; at least, there are few described which can be mentioned in comparison with those of Europe and North America. The recently discovered Kaieteur, in British Guiana, seems, however, worthy to be placed in the same rank with Niagara and the Zambesi. We are disposed to believe that a majority of cultivated lovers of natural scenery would admit the Yosemite Fall to surpass any in the world, as presenting the most perfect combinations of all the elements of the picturesque. Certainly, taking the whole region of the Yosemite together, with its five great falls, the lowest 400 feet and the highest 2,600, it must be allowed that, in this particular kind of scenery, it is a locality without a rival in the world.

Although the Valley is, at present, almost inaccessible in the winter, and, indeed, entirely so to those who are not up in travelling on snow-shoes, it is not unlikely that the time will soon come when a visit to it at that season will be considered as the "regular thing" for tourists, and when proper facilities for getting there will be provided. The views, at the time when the snow is still lying deep on the surrounding plateau, and thundering down in frequent avalanches from the domes and over the walls of the Valley; or, a little later, when the streams are filled to repletion and pour themselves over the cliffs in literally unnumbered cascades; when the Merced becomes a mad torrent, and hurries down its 2,000 feet of vertical descent in one wild mass of spray-enveloped waters,—all this is, as described by those who have seen it, of surpassing grandeur. The accumulation of ice at the base of the upper part of the Yosemite Fall is also spoken of as a most impressive feature in the winter view. The frozen spray forms a vast conical mass, rising sometimes to the height of a hundred feet or more, from which the falling water, rebounding, is shot off in graceful curves, forming an immense bouquet, each drop of which sparkles like a diamond in the sun.

All will recognize in the Yosemite a peculiar and unique type of scenery. Cliffs absolutely vertical, like the upper portions of the Half Dome and El Capitan,

and of such immense height as these, are, so far as we know, to be seen nowhere else. The dome form of mountains is exhibited on a grand scale in other parts of the Sierra Nevada; but there is no Half Dome, even among the stupendous precipices at the head of the King's River. No one can avoid asking, What is the origin of this peculiar type of scenery? How has this unique valley been formed, and what are the geological causes which have produced its wonderful cliffs, and all the other features which combine to make this locality so remarkable? These questions we will endeavor to answer, as well as our ability to pry into what went on in the deep-seated regions of the earth, in former geological ages, will permit.

Most of the great canons and valleys of the Sierra Nevada have resulted from aqueous denudation, and in no part of the world has this kind of work been done on a larger scale. The long-continued action of tremendous torrents of water, rushing with impetuous velocity down the slopes of the mountains, has excavated those immense gorges by which the chain of the Sierra Nevada is furrowed, on its western slope, to the depth of thousands of feet. This erosion, great as it is, has been done within a comparatively recent period, geologically speaking, as is conclusively demonstrated in numerous localities. At the Abbey's Ferry crossing of the Stanislaus, for instance, a portion of the mass of Table Mountain is seen on each side of the river, in such a position as to demonstrate that the current of the lava which forms the summit of this mountain once flowed continuously across what is now a canon over 2,000 feet deep, showing that the erosion of that immense gorge has all been effected since the lava flowed down from the higher portion of the Sierra. This event took place, as we know from the fossil bones and plants embedded under the volcanic mass, at a very recent geologic period, or in the latter part of the Tertiary epoch, and after the appearance of man on the earth.

The eroded canons of the Sierra, however, whose formation is due to the action of water, never have vertical walls, nor do their sides present the peculiar angular

forms which are seen in the Yosemite, as, for instance, in El Capitan, where two perpendicular surfaces of smooth granite, more than 3,000 feet high, meet each other at a right angle. It is sufficient to look for a moment at the vertical faces of El Capitan and the Bridal Veil Rock, turned down the Valley, or away from the direction in which the eroding forces must have acted, to be able to say that aqueous erosion could not have been the agent employed to do any such work. The squarely cut re-entering angles, like those below El Capitan, and between Cathedral Rock and the Sentinel, or in the Illilouette canon, were never produced by ordinary erosion. Much less could any such cause be called in to account for the peculiar formation of the Half Dome, the vertical portion of which is all above the ordinary level of the walls of the Valley, rising 2,000 feet, in sublime isolation, above any point which could have been reached by denuding agencies, even supposing the current of water to have filled the whole Valley.

Much less can it be supposed that the peculiar form of the Yosemite is due to the erosive action of ice. A more absurd theory was never advanced than that by which it was sought to ascribe to glaciers the sawing out of these vertical walls, and the rounding of the domes. Nothing more unlike the real work of ice, as exhibited in the Alps, could be found. Besides, there is no reason to suppose, or at least no proof, that glaciers have ever occupied the Valley or any portion of it, as will be explained in the next chapter; so that this theory, based on entire ignorance of the whole subject, may be dropped without wasting any more time upon it.

The theory of erosion not being admissible to account for the formation of the Yosemite Valley, we have to fall back on some one of those movements of the earth's crust to which the primal forms of mountain valleys are due. The forces which have acted to produce valleys are complex in their nature, and it is not easy to classify the forms which have resulted from them in a satisfactory manner. The two principal types of valleys, however, are those produced by rents or fissures in the crust, and those resulting from flexures or foldings of the strata. The former are usually transverse to the mountain chain in which they occur; the latter are more frequently parallel to them, and parallel to the general strike of the strata of which the mountains are made up. Valleys which have originated in cross fractures are usually very narrow defiles, enclosed within steep walls of rocks, the steepness of the walls increasing with the hardness of the rock. It would be difficult to point to a good example of this kind of valley in California; the famous defile of the Via Mala in Switzerland is one of the best which could be cited. Valleys formed by foldings of the strata are very common in many mountain chains, especially in those typical ones, the Jura and the Appalachian. Many of the valleys of the Coast Ranges are of this order. A valley formed in either one of the ways suggested above may be modified afterwards by forces pertaining to either of the others; thus a valley originating in a transverse fissure may afterwards become much modified by an erosive agency, or a longitudinal flexure valley may have one of its sides raised

up or let down by a "fault" or line of fissure running through or across it.

If we examine the Yosemite to see if traces of an origin in either of the above ways can be detected there, we obtain a negative answer. The Valley is too wide to have been formed by a fissure; it is about as wide as it is deep, and, if it had been originally a simple crack, the walls must have been moved bodily away from each other, carrying the whole chain of the Sierra with them, to one side or the other, or both, for the distance of half a mile. Besides, when a cliff has been thus formed, there will be no difficulty in recognizing the fact, from the correspondence of the outlines of the two sides; just as, when we break a stone in two, the pieces must necessarily admit of being fitted together again. No correspondence of the two sides of the Yosemite can be detected, nor will the most ingenious contriving, or lateral moving, suffice to bring them into anything like adaptation to each other. A square recess on one side is met on the other, not by a corresponding projection, but by a plain wall or even another cavity. These facts are sufficient to make the adoption of the theory of a rent or fissure impossible. There is much the same difficulty in conceiving of the formation of the Valley by any flexure or folding process. The forms and outlines of the masses of rock limiting it are too angular, and have too little development in any one direction; they are cut off squarely at the upper end, where the ascent to the general level of the country is by gigantic steps, and not by a gradual rise. The direction of the Valley, too, is transverse to the general line of elevation of the mountains, and not parallel with it, as it should be, roughly at least, were it the result of folding or upheaval.

In short, we are led irresistibly to the adoption of a theory of the origin of the Yosemite in a way which has hardly yet been recognized as one of those in which valleys may be formed, probably for the reason that there are so few cases in which such an event can be absolutely proved to have occurred. We conceive that, during the process of upheaval of the Sierra, or, possibly, at some time after that had taken place, there was at the Yosemite a subsidence of a limited area, marked by lines of "fault" or fissures crossing each other somewhat nearly at right angles. In other and more simple language, the bottom of the Valley sank down to an unknown depth, owing to its support being withdrawn from underneath during some of those convulsive movements which must have attended the upheaval of so extensive and elevated a chain, no matter how slow we may imagine the process to have been. Subsidence, over extensive areas, of portions of the earth's crust, is not at all a new idea in geology, and there is nothing in this peculiar application of it which need excite surprise. It is the great amount of vertical displacement for the small area implicated which makes this a peculiar case; but it would not be easy to give any good reason why such an exceptional result should not be brought about, amid the complicated play of forces which the elevation of a great mountain chain must set in motion.

By the adoption of the subsidence theory for the formation of the Yosemite, we are able to get over one difficulty which appears insurmountable with any other.

This is, the very small amount of *debris* at the base of the cliffs, and even, at a few points, its entire absence, as previously noticed in our description of the Valley. We see that fragments of rock are loosened by rain, frost, gravity, and other natural causes, along the walls, and probably not a winter elapses that some great mass of detritus does not come thundering down from above, adding, as it is easy to see from actual inspection of those slides which have occurred within the past few years, no inconsiderable amount to the *talus*. Several of these great rock-avalanches have taken place since the Valley was inhabited. One which fell near Cathedral Rock is said to have shaken the Valley like an earthquake. This abrasion of the edges of the Valley has unquestionably been going on during a vast period of time; what has become of the detrital material? Some masses of granite now lying in the Valley—one in particular near the base of the Yosemite Fall—are as large as houses. Such masses as these could never have been removed from the Valley by currents of water; in fact, there is no evidence of any considerable amount of aqueous erosion, for the canon of the Merced below the Yosemite is nearly free from detritus, all the way down to the plain. The falling masses have not been carried out by a glacier, for there are below the Valley no remains of the moraines which such an operation could not fail to have formed.

It appears to us that there is no way of disposing of the vast mass of detritus, which must have fallen from the walls of the Yosemite since the formation of the Valley, except by assuming that it has gone down to fill the abyss, which was opened by the subsidence which our theory supposes to have taken place. What the depth of the chasm may have been we have no data for computing; but that it must have been very great is proved by

the fact that it has been able to receive the accumulations of so long a period of time. The cavity was, undoubtedly, occupied by water, forming a lake of unsurpassed beauty and grandeur, until quite a recent epoch. The gradual desiccation of the whole country, the disappearance of the glaciers, and the filling up of the abyss to nearly a level with the present outlet, where the Valley passes into a canon of the usual form, have converted the lake into a valley with a river meandering through it. The process of filling up still continues, and the *talus* will accumulate perceptibly fast, although a long time must elapse before the general appearance of the Valley will be much altered by this cause, so stupendous is the vertical height of its walls, and so slow their crumbling away, at least as compared with the historic duration of time.

Lake Tahoe and the valley which it partly occupies we conceive also to be, like the Yosemite, the result of local subsidence. It has evidently not been produced by erosion; its depth below the mountains on each side, amounting to as much as 3,000 feet, forbids this idea, as do also its limited area and its parallelism with the axis of the chain. The Lake is still very deep, over 1,000 feet; but how deep it was originally, and how much detritus has been carried into it, we have no data for even crudely estimating.

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(Editor's note.) Another valley which may have been formed in the same way, by the sinking of a block of the Earth's surface, is the Rift Valley in Asia and Africa. Some discussion of that valley, and how it may be associated with events after the Flood, will be found in the article by Strickling, elsewhere in this issue of the *Quarterly*.

QUOTABLE QUOTE

"There are those who deny with enthusiasm the existence of a God and are happy in a hobby which they call the Mistakes of Moses . . . it seems that the chief mistake . . . was that he neglected to write the Pentateuch. The lesser errors, apparently, were not made by Moses, but by another person equally unknown. These controversialists cover the very widest field, and their attacks upon Scripture are varied to the point of wildness. . . . A superficial critic might well imagine that there was not one single sentence left of the Hebrew or Christian Scriptures which this school had not marked with some ingenious and uneducated comment. But there is one passage . . . upon which they have never pounced . . . I mean that singular arrangement . . . by which light is created first and all the luminous bodies afterwards. One could not imagine a process more open to the elephantine logic of the Bible-smashers than this:

that the sun should be created after the sunlight . . . it would sound like saying that children existed before a baby was born. The idea . . . like many other ideas which are alien to most modern thought, is a very subtle and a very sound idea . . . there is a very real metaphysical meaning in the idea that light existed before the sun and stars The idea existed before any of the machinery which made manifest the idea. Justice existed when there was no need of judges, and mercy existed before any man was oppressed. . . . Brightness existed before anything was bright."

—G. K. Chesterton, in his introduction to the Everyman's Library Edition of the Pickwick Papers, about 1907. Mr. David Harris, Principal of the Kawartha Christian School, Peterborough, Ontario, Canada, called this item to my attention.

THERMODYNAMICS, ENERGY, MATTER, AND FORM

H. L. ARMSTRONG*

(Continued from page 121, September)

Appendix: Conservation of Mass and of Energy

It is convenient, in discussing conservation both of mass and of energy, to consider how these notions arose.

Conservation of Mass

This notion belongs really to chemistry, and was established by experiments such as the following.

Suppose that a suitable vessel were divided, internally, into two compartments. A suitable reagent might be put into each compartment, the vessel sealed, and the whole weighed. Then the reagents would be let mix, maybe by tipping the vessel. When the reaction had finished, the whole would be weighed again, and it would be found that the weight had not changed. In other words, it was conserved.

Conservation of Energy

It is sometimes said that energy is ability to do mechanical work. Here mechanical work is taken in the usual sense: the magnitude is given by the product of the force acting on something, and the distance which the thing moves while the force is acting.

However, the word "ability" is perhaps not entirely felicitous; also, such a definition may leave room for difficulties due to the limitations expressed in the second law of thermodynamics. It is suggested that it is better to say that the energy of an object or of a system in a given situation, state, position, etc., is equal to the work which was done, or might have been done, to get it into that state, etc..

If the state is one of motion, the work done, against inertia, in getting it into motion at a certain speed, is called the kinetic energy, as is well known. Whereas energy which an object can have although stationary is called potential. Such, for instance, is that associated with the work done in raising an object against gravity.

Suppose, then, that an object were held at some height above the ground. It would be said to have a certain potential energy: 1,000 foot-pounds, for instance, for a 100 pound object 10 feet above the ground. This figure could be converted into other units, as desired. The kinetic energy, in this situation, would be zero, since the object was at rest.

Now let the object be let fall. As it fell, the potential energy would decrease. But it would speed up its motion, so the kinetic energy would increase. And, both kinds having been expressed in consistent units, it would be found that the sum, potential and kinetic, remained constant at the original 1,000 foot-pounds. The sum might be called the total energy, and it remains constant: it is conserved.

Of course, the argument used here would apply only until the object struck the ground. Then it would be necessary to take heating, for instance, into account.

It could be said that there is nothing remarkable here in the conservation. For the things concerned, especially the kinetic energy, were set up so as to be conserved. As Ritz remarked, in another connection: "... *la conservation de l'énergie n'est plus une loi, mais une convention.*"⁸

The utility comes in when it is found, by experiment, that the principle extends much more widely. It is found that a certain amount of mechanical work, wasted against friction, will always cause a certain amount of heat, expressed in calories, for instance. Conversely, a certain amount of heat used (if it can be used; the second law of thermodynamics comes in again) in a heat engine, causes a certain amount of mechanical work, done by the engine. So heat can be identified with energy, and conservation applies to that energy.

Likewise, mechanical work may be done by chemical, electrical, etc., actions, and vice versa; and it is found that there, too, there is a fixed relation between the amounts. So chemical, electrical, etc., energy may be identified; and it is found that conservation applies to these forms of energy too.

So the real reason why the conservation of energy is an important principle lies in its extremely wide range of applicability.

Examples Cited for Joint Conservation

It is often said that in nuclear reactions, for instance, conservation of mass and of energy do not apply separately, but only when both are considered jointly. Actually, as Warren has pointed out, there is nothing unique about a nuclear reaction in this respect.⁹ The same effects would happen with a chemical reaction, although in that case there would probably be no hope of measuring them. But, in fact, (and Warren noted this, too) the whole notion needs investigation.

A typical reaction might be that in which uranium 235, when bombarded by neutrons, breaks up into lanthanum and bromine, and more neutrons. The fact that more neutrons come out than went in is what makes a chain reaction possible.

Suppose that one gram of uranium 235 were used. Ideally, 0.00429 gm. of neutrons would be needed to bring about the complete reaction. The result would be: 0.6295 gm. of lanthanum, 0.3611 of bromine, and 0.01287 of neutrons.

Thus for 1.00429 gm. of reagent put in, so to speak, only 1.0035, (rounded a bit) would come out. Apparently 0.0008 gm., approximately, disappeared.

This, as is well known, is identified with the energy produced by multiplying it by the square of the speed of light. Thus this says that 7.2×10^{17} ergs, about 20,000

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kilowatt-hours, of energy would be released, by the disintegration of the gram of uranium 235.

Notice, though, that the masses of the resulting materials were, presumably, determined when those results were at rest, or not moving very energetically. Suppose, now, that the reaction could be accomplished in a sufficiently strong vessel, one, moreover, which was well insulated thermally. Immediately after the reaction, the fragments, the lanthanum, etc., would be flying around at great speeds inside the vessel. And they would be heavier because of that motion, according to the theory of relativity. In fact, the amount by which each fragment would be heavier than if at rest would be given by its kinetic energy divided by the square of the speed of light. So the results altogether would be heavier by an amount equal to the total kinetic energy divided by the square of the speed of light. But the total kinetic energy is just the 7.2×10^{17} ergs mentioned above. And this amount, from what was said, is equal to the (apparent) loss of the 0.0008 gm. multiplied by the speed of light. So when this is taken into account, the mass in the vessel remains exactly what it was before the reaction: the mass was indeed conserved.

So, of course, was the energy. The 7.2×10^{17} ergs would be there, in the form of kinetic energy of the rapidly moving fragments. So it appears that mass and energy have been conserved separately. The 7.2×10^{17} ergs could, before the reaction, have been considered a sort of nuclear chemical energy of the uranium.

Of course, no insulation is perfect. Eventually, the vessel and its contents would cool off. From a microscopic viewpoint, the fragments from the reaction would slow down in their motion. In so doing, they would, according to the theory of relativity, become lighter. And indeed, eventually the contents of the vessel would be found to be lighter by the 0.0008 gm mentioned previously; and the 7.2×10^{17} ergs of energy would have radiated away. It might appear that the transformation of mass into energy was only delayed.

But the loss of energy, by radiation, (probably infrared), needs to be examined a little more closely. According to the present views, the radiation comes off in quanta, or photons. Associated with each photon is a certain amount of energy. There is also associated with it a certain amount of mass, just as if it were a material object; and the magnitude of the mass is given by that of the energy divided by the square of the speed of light. (Which number, in terms of centimeters and seconds, is 9×10^{20} .) So the mass of the radiation radiated by the experiment in cooling would be 7.2×10^{17} divided by 9×10^{20} , which gives 0.0008 gm.. So the mass, which was at first supposed to be missing, was neither destroyed nor converted into anything else. It was merely scattered around in radiation. So even in the long run mass and energy were separately conserved. Here it is necessary to consider the radiation to see that both are conserved, that is all.

An Analogy

The following analogy may be of some interest. Suppose that, to determine the heat of reaction (say) of some chemical reaction, one were to let it proceed in an in-

sulated vessel. The idea would be to measure how much the temperature rose, and to calculate the heat of reaction by the usual methods of calorimetry. Suppose that the reaction was one in an aqueous solution. Suppose also that the vessel were open to the air at the top, although direct loss of heat might be prevented by shields and baffles.

Immediately after the reaction, it would be found that both mass and energy had been conserved. I.e., the mass would be the same as before; and the thermal energy, found by calorimetry, would be equal to the chemical energy represented by the reagents before the reaction. Such, of course, is the result expected in such cases.

A while later, however, things would be different. The contents of the vessel would have cooled somewhat; hence it might appear that energy had been lost somehow.

Moreover, it would be found that the contents of the vessel were now a little lighter.

Would one say, then, that in this case mass had been transformed into something else? Of course not. What happened was simply this. Because of the heating, some of the water evaporated. And in escaping as vapor, it took with it energy, in amount given by the latent heat of evaporation of the water. I.e., along with each gram of water which escaped as vapor, energy amounting to about 550 to 600 calories of heat escaped, as latent heat of vaporization. (The latent heat depends somewhat on the temperature, being about 540 calories per gm., at 100 °C, and somewhat more at lower temperatures.)

So here, too, mass and energy were separately conserved, but they came away together. Is the situation with the radiation not analogous? Only there the figure connecting mass and energy is not a latent heat (although perhaps it might be called one, by stretching the analogy a bit), but it is rather the square of the speed of light, as has been noted.

Conclusion

It is concluded, then, that even in nuclear reactions, mass is not converted into energy. Both are separately conserved, as in other cases. But they come off together in radiation, always a certain amount of mass along with a certain amount of energy.

A Caution

There has been some discussion, as to whether the relation between mass and velocity, used above, applies universally, or only for charged elementary particles. For something of the sort can be shown by electromagnetic theory to apply to charged particles, without any need to appeal to relativity.¹⁰

As for the present discussion, either the relation mentioned applies generally or it does not. If it does, the conclusions reached would seem to be valid. If not, then the problem disappears; there never was any reason to suppose that mass and energy were not conserved separately.

It might be remarked, also, that the relation between radiation and mass may at least be made plausible from
(Continued on inside back cover)

PANORAMA OF SCIENCE

Dissatisfaction with Darwinism

It is noteworthy that many people, who perhaps would not necessarily consider themselves Creationists, are yet becoming increasingly dissatisfied with Darwinism. Thus, one has written, in part, that: "... evolutionists ... merely ... take the theories of Darwin and try to compress the data to fit them." Further on, this writer remarked that survival of the fit is only a tautology.¹

Clearly, such dissatisfaction can provide opportunities for Creationism.

Fish Becoming Older and Older?

The text-books and semi-popular accounts used to tell us that during the Cambrian age, and for some time thereafter, the only animals living were invertebrates. All of this seems to have changed.

It is reported, to be exact, that a fossil fish has been found in Upper Cambrian rocks. This discovery, it is said: "... extends back the age of the earliest known vertebrate fossils by approximately 40 million years".²

A Creationist may doubt all those years. But he will agree that vertebrates, fish in particular, are about as old as any other animal. If their fossils are found mainly higher in the rocks than fossils of invertebrates, that is due, not to age, but rather to the circumstances of their burial.

"Fossil Trees" Turn Out to be Sandstone Pipes

There have been many examples of misinterpretation of fossils; and a favorite example, often mentioned in text books, was by the Swiss diluvialist J. Scheuchzer, who in 1709 mistook the remains of a giant salamander for those of a man drowned in the deluge.

Cylindrical structures found in a conglomerate known as the Roxbury Conglomerate, in Massachusetts, were in 1900 interpreted as casts and molds of trees. Based on these supposed "fossils," a late Paleozoic age was assigned to the conglomerate.

Now, however, this interpretation of the cylindrical structures has been questioned. The objects are composed of sandstone, and resemble sandstone pipes that have been reported from other regions. It was suggested that the cylinders are in fact sandstone pipes, and not fossil trees at all.³

Since a couple of these cylindrical objects were the only examples of fossils (?) that were found in the formation in more than 150 years of geological investigation, the reinterpretation removes all grounds for age determination. Creationists recognize that the basis for age dating of rocks is very tenuous, as this example of misinterpretation illustrates.

The origin of pillars or pipes in sandstone and drift was discussed in a recent issue of the *Quarterly*, and it was suggested that these may have resulted from rock disintegration due to a rapid release of pressure, as rocks were elevated from the depths of the flood waters.⁴

—This item contributed by Douglas E. Cox

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BOOK REVIEWS

Ape-Men—Fact or Fallacy? by Malcolm Bowden. 1977. Sovereign Publications, P.O. Box 88, Bromley, Kent, BR2 9FF. England. 196 pages. £3.30. (About \$7.00)

Reviewed by David J. Tyler.*

Many of the primary documents relevant to the search for ape-men are to be found in journals which are practically inaccessible to all but serious students of the subject. The result has been a general acceptance of traditional opinions because few have had the time or the inclination to carry out a critical appraisal of the facts. Malcolm Bowden's book submits the evidence claimed to show that man came from ape-like creatures to a very thorough examination, and is one of the most revealing and thought-provoking publications that has

appeared on this subject. It is intended to sweep away the dust of decades that has tended to obscure the facts; critically to review the discoveries that have been made; and to observe the scientists in the process of formulating their theories.

Bowden works his way through the maze of Piltdown Man, Peking Man and Java Man, arguing that the finds have revealed more about the excavators and their very dubious methods of "discovery" than anything else. Other subjects covered are: the fossilized remains of human beings in geological strata considered to be contemporary with or earlier than the ape-men, Neanderthal Man, the African ape-men, and a general critique of the methods used to analyze the fossil remains of ancient hominoid bones.

Those who think that little more can be usefully said on the subject of Piltdown Man will be surprised by this section of the book, which reads like a detective story.

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Bowden has reexamined the plethora of often-conflicting data and provides strong evidence that the hoaxer was Teilhard de Chardin. Furthermore, he implies that the fraudulent activity that is associated with Piltdown Man was not confined to the staining, shaping and planting of bones, but it also included a cover-up operation to conceal the identity of the faker.

The reviewer found the section on Pekin Man to be the best in the book. Popular accounts of ape-men always have a reference to Pekin Man knowing how to use fire, and illustrations frequently show a small brushwood fire surrounded by a group of slouching apemen. However, when the Abbe Breuil visited Choukoutien, he found ashes, not of small brush fires, but of furnaces: Bowden shows that the facts about the enormous ash heap, the bone tools and the other evidences of human habitation were virtually suppressed by the excavators of the site. Everything points to genuine *human* occupation rather than the presence of ape-men. Indeed, human remains were discovered at this site, but the details were not given until five years later in an obscure Chinese publication.

The poorly defined and fragmentary nature of the Java Man finds are discussed to show that the motives of the experts significantly influenced the way that they worked and the conclusions to which they came.

The major role played by Teilhard de Chardin in the Piltdown Man, Pekin Man and Java Man discoveries is delineated very clearly, and it would appear that this man put into practice the principle often attributed to the Jesuits: the end justifies the means. Teilhard believed that men did evolve from ape-like creatures, and his behavior whilst searching for ape-men remains indicates that he was not too concerned about the means he used to "prove" the existence of missing links.

All the topics discussed in the book are well-researched, clearly illustrated and fully referenced. It is a source book for students interested in the subject; and the general reader will find the book informative and stimulating. It deserves to be required reading for all lecturers and teachers who have to deal with the subject of human evolution, for it thoroughly discredits the widely accepted theories of man's origin and makes it clear that not one of the many fossils discovered can be accepted as providing any evidence for links between man and the animal kingdom.

Lord Kelvin and the Age of the Earth by Joe D. Burchfield. 1975. Science History Publications, New York. 260 + xii pages. \$15.00.

Reviewed by Harold S. Slusher.*

This book gives a rather excellent account of the great battle between the very famous Lord Kelvin and the uniformitarian geological establishment of the late 1800's concerning the use of arguments from certain principles of physics to establish a maximum or upper limit to the age of the earth. It was a confrontation that

was carried on for nearly 50 years with much vehemence and great anger and frustration on the part of the uniformitarians.

The geologists of the middle 1800's (and some today) were not very well up in mathematics; and, consequently, were very hazy in their concept of time; except to believe that things were very old. From Hutton and others, especially Lyell, they had the maxim: "no vestige of a beginning, no prospect of an end," for the earth. Uniformitarian geology was, and still is, based on the *a priori* assumptions that things have always been pretty much the same, and that given enough time present causes could account for all that has happened in the history of our world.

Kelvin, even as early as his student days, worked to establish a time scale for the earth based on physical arguments. He used two approaches based on principles of physics for this attempt to establish a maximum for the time scale: the calculation of the time for which the earth's primordial heat could supply the outward flow observed at the surface (actually the temperature gradient at the surface); and the calculation of the lifetime of the sun assuming it generated its energy by gravitational collapse. Kelvin used very few but very plausible assumptions in these calculations; and most of the physicists of the day were convinced of the upper limit on the age of things established by Kelvin's approach. Most geologists felt that Kelvin was a meddler and should stick strictly to physics, especially in light of the results he obtained.

Kelvin in his early calculations got 100-400 million years for the upper limit of the age, assuming the earth cooled from a molten state. This alarmed the geologists, but being perhaps unused to using arithmetic they did not go into a state of panic, since it seemed a rather large value (though vastly smaller than their evolution hypothesis of that day demanded). However, using the data that the American geologist, Clarence King, supplied, Kelvin brought these estimates down to around 22 million years as the upper limit. The battle began in earnest with that. Kelvin was one of the greatest of physicists, and the geologists found it most difficult to argue against so brilliant a man who, along with Newton, Faraday, and Maxwell, discovered so many of the principles of physics. The uniformitarians even led out Darwin's old bulldog, Thomas Huxley, who had gone "about as a roaring lion" devouring bishops, for a debate with Kelvin. Expectedly Kelvin "devoured" Huxley who promptly retired from the field of battle. Darwin had in his writings made time estimates (for which there were no real bases) of certain geological events in excess even of 400 million years; so the gauntlet was down for the battle between the physicists and the uniformitarian geologists.

This book very admirably tells of this famous encounter. Not only does it tell of the principals in the conflict but also men such as Lord Salisbury, T. J. J. See, Clarence King, Frank Harris, Rutherford, are referred to. The conflict and ideas are set forth in this book so that one can get a very good historical view of the development of ideas of earth history. Here was a real encounter of stratigraphy and physiography as interpret-

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ed by the evolutionists with theoretical physics. The uniformitarian geologists were not able to present any convincing numerical calculations for their huge values of time in those days. It is of major interest, of course, that the uniformitarian geologist, thinking himself the victor in what appeared then as a complete and humiliating defeat through the eventual discovery of radioactivity, was really wrong all along, since the upper limit Kelvin established for the age is only doubled to about 44 million years with consideration of radioactive heat sources in the earth in the calculations.

The continued battle, resulting from the discovery of radioactivity, is described. Kelvin's argument regarding the age of the sun went unchallenged for about 30 years longer.

The author of this book generally makes no statements as to who was right or wrong, though his preference for evolution eventually shows through. The author does not always point out with clarity the reasons Kelvin picked some of the values he used in his calculations, making the choices appear arbitrary. It certainly makes a difference what the initial temperature of the earth was. Certainly this book is to be recommended strongly for those studying the earth and for all that want a view of one of the most important battles to establish the upper limit to the earth's age. Kelvin set the stage for heat-flow studies today that (even after the consideration of radioactivity) indicate a "young" upper limit to earth's age, vastly smaller than the present evolutionary estimates.

The Creation-Evolution Controversy by Randy L. Wysong, Doctor of Veterinary Science. 1976. Inquiry Press, P.O. Box 1766, East Lansing, Michigan 48823. 455 pages. Price, \$4.00.

Reviewed by William J. Tinkle.*

Good creationist books are being written by teachers of science, and it is fitting to have one by a practicing scientist. Much is mentioned in the literature recommending the discussion of both sides of the controversy, and this is just what Dr. Wysong is careful to do. Along with this plan it is easy to see that he himself favors the creation model. This is good; students tire of a professor who discusses the views of scholars and never makes clear what he himself believes.

The controversy's importance is presented in a clear and strong manner, followed by methodology and definitions. Origin of protein and DNA show what nature would have to accomplish if life arose of itself. Being a book of the 20th century it does not start with Thomas R. Malthus and end with Charles Darwin; it explains recent research in biochemistry and genetics along with their effect upon the development of living things. The author explains in detail how spontaneous generation was disproved and dropped by scientists, then later accepted without further proof and used by another name as the method of the beginning of life on earth.

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Some say that Wysong might have given more on radiometric methods; yet the book is excellent, with clear statements, graphic illustrations, and many references. It deserves a wide reading.

Création et Évolution: Problèmes d'Origines, by Jacques Nesbitt, 1976. Editions MEAF "La Colline" 26160 La Bégude de Mazenc, France. Available from the author at 5, rue du 19 août, 74000 Annecy, France. 93 pages. Price 3.50 French francs, about \$1.00.

Reviewed by H. L. Armstrong.*

Since the modern Creationist movement flourished first, for the most part, among English-speaking people, naturally the literature was mostly in English. Later some was translated into other languages, and that was good. Now original Creationist literature is being written in other languages, and this is yet better. This work, in French, is an example.

It is pointed out that one can believe either of two accounts of origins: Creation or evolution; and the choice is really an act of faith, no matter which way one choose. Of the evidence often alleged to support evolution, some, such as comparative anatomy, vestigial organs, and embryonic recapitulation, has lost any force which it may once have had. As for paleontology, it certainly is not evidence for continuous, gradual change from amoeba to man; and arguments from thermodynamics definitely support the Creationist position.

There is considerable stress on the weaknesses of the dating methods alleged to show great ages for the Earth and things in it—and the same may be said about the uniformitarian interpretation of fossils.

Chapters on the interpretation of Genesis, and on problems, or apparent problems, which may arise, are very helpful.

Anyone who reads French will find this book well worth while.

Evolution of Living Organisms by P-P. Grasse. 1977. Academic Press, New York. 297 + x pages. Price, \$19.50.

Reviewed by W. Frair†

In 1973 Grasse published his *L'Évolution du Vivant*; and this current work is a translation with some updating. After the Preface are nine chapters, followed by three appendixes ("Natural" Classification of the Animal Kingdom, Geological Time Scale, and Glossary of some terms used in the text). The book concludes with a Bibliography and Subject Index. Individual chapters include progressive, regressive and creative evolution; "evolution—a discontinuous historical phenomenon"; chance; natural selection; adaption; necessity; and genes. Style is generally lucid. There is plenty here for

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the professional biologist, but an intelligent adult reader will have no trouble understanding the arguments and conclusions.

In his preface Grasse indicates that he will "attempt to prove that the traditional interpretations assigned to evolution are not the only ones offered the biologist or natural philosopher." He later reveals his own tentative conclusions based primarily upon paleontological and molecular biological data from animals; but he makes clear the enormity of the task.

From the almost total absence of fossil evidence relative to the origin of the phyla, it follows that any explanation of the mechanism in the creative evolution of the fundamental structural plans is heavily burdened with hypotheses. This should appear as an epigraph to every book on evolution. The lack of direct evidence leads to the formulation of pure conjectures as to the genesis of the phyla; we do not even have a basis to determine the extent to which these opinions are correct. (p. 31)

Grasse is not excited as he considers the Lamarckian troop primarily of yesteryear with its stress upon need leading to change. But why does he not thrill today as the Darwinian "evolutionary biology" parade comes marching with its bands and banners telling all that chance, mutation and natural selection are *the* answer? Now Grasse is not just an observer of the scientific enterprise. He is the man T. Dobzhansky several years ago termed "the most distinguished of French zoologists, the editor of the 28 volumes of *Traité de Zoologie*, author of numerous original investigations and ex-president of the Académie des Sciences." Like so many other biologists, he has been coached by followers of Darwin, but he becomes uneasy about the rules. He has, I think, what many specialists speak of today as a "gut feeling", and Grasse's is that Darwinism does not work. But what can replace it? He is not quite sure, but he is afraid of teleology and very hesitant to side with supernaturalists of any sort; although after discussing the mechanism of evolution, he ends the book with an upward look, saying, "Perhaps in this area biology can go no farther: the rest is metaphysics."

As countless anthropologists on the basis of extensive data have pointed out, "man is a worshipping creature"; and Grasse exemplifies this in his book not only by suggestion in the concluding statement but also by others such as the following in which he refers to a prevalent unfortunate condition wherein chance becomes something to worship: "Directed by all-powerful selection, chance becomes a sort of providence, which, under the cover of atheism, is not named but which is secretly worshipped." (p. 107)

Grasse goes on to say that the goal of science should be determination of the laws governing living beings. When it comes to their origin, he feels that after constant "recourse to paleontology, the only true science of evolution" he has found evolution to be "fact and not hypothesis". His

picture of the great evolution is not exactly that of a tree but rather that of a rather short stem which, at each node, sends out a whorl of unequal lateral branches. The thicker branches, which represent

the classes, send out secondary twigs (orders), tertiary twigs (suborders), and quaternary twigs (superfamilies or families). The leaves represent the species. (p. 75)

Contrary to the feelings of many biologists today, including myself, he thinks that Ernst Haeckel's fundamental biogenetic law has not lost any of its value.

For Grasse there are lines of descent leading to forms or types known as idiomorphons. Once achieved these remain in a stabilized condition uninfluenced in an evolutionary sense by mutations which serve merely to increase the variability. Examples could include what he calls phachronic forms ("old or very old species or groups which reproduce without major change") such as sponges ("a permanent challenge to evolution", p. 81), bacteria, protozoans, jellyfishes, corals, opossums, worms, sharks, many insects including *Drosophila*, and even the human body.

So Grasse is a macroevolutionist, but he is an uncomfortable one. He realizes the intricate balance between the nucleic acid genome, enzymes and hormones, and also that the odds are against random production of new types by mutations acted upon by natural selection.

After discussing complexity of the eye, ear and brain, he says, "In mammals all sense organs evolved almost simultaneously." And then with a touch of irony adds:

If one considers the great number of simultaneous, timely mutations satisfying existing needs involved in their genesis, one can not fail to be confounded by so much harmony, so many lucky coincidences, due entirely to omnipotent chance. (p. 105)

Subtitle of the book is *Evidence for a New Theory of Transformation*, and this new theory would involve the attainment of the idiomorphons. With this concept I sense that Grasse is feeling his way back toward early 19th century views of variability among living things or possibly toward what 20th century creationists (after F. L. Marsh) are referring to as baramins or created kinds.

The First Genesis—A New Case for Creation, by William F. Dankenbring. 1975. Triumph Publishing Co., Altadena, Calif. 359 pages. Price: \$7.95.

Reviewed by Douglas E. Cox.*

This book presents the view that creation occurred, but that it happened over vast periods of time. It covers a wide range of topics, such as the structure of the cell, courting and mating rituals, the fossil record, astronomy, the human brain, and much more. The facts are fascinating, and the style of writing reflects the author's training in journalism.

Some original contributions to the body of evidence for creation, especially from the facts of biology, make this book a challenge to evolutionists. Of a certain species of termite, for example, we read of the remarkable ingenuity of the design of ventilated mounds, their cultivation of fungus on compost, and even efficient

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waste disposal systems, all pointing to the existence of a Divine Architect.

The inter-dependence of all life is discussed in a chapter revealingly titled "Evolution hopelessly entangled in the web of life." This inter-relationship is evidence for the creation of the entire spectrum of life at one time, but provides an argument against the progressive creations proposed by the author.

While endeavoring to prove creation, the book is sharply critical of Creationist research involving the reinterpretation of geology, which assigns much of the fossiliferous strata to the Noachian flood. Dankenbring treats the geologic column as a reality, apparently not discerning that a progression of life was *assumed* by Lyell and other early geologists in its formulation. He uses this hypothetical column as an argument against a young earth:

"Now that a massive geological column has been pieced together, what does it show? Could the entire column be the result of one flood during the time of man? If so, then consider: That global flood had to account for sediment 100 miles deep! Could one deluge, lasting just one year, do the trick?"

The evidence for the deluge, Dankenbring suggests, is found in the raised shorelines and clay deposits around the earth that followed the glacial period. Fossil whales occur in abandoned beaches around the Great Lakes, and indeed such fossils may be assigned to the deluge.

Dankenbring accepts the glacial theory, and supposes that the Ice Ages correspond with the "tohu and bohu" of Genesis 1:2. Pleistocene extinctions "may be alluded to in the first few verses of Genesis."

The gap theory provides the time necessary for the interpretation of the geologic record, and protracted celestial conflicts between God and Satan and the angels in early geologic history caused catastrophes resulting in extinctions, and mass burial of dinosaurs.

The author's defence of radioactive decay techniques of dating leads him to the identification of human fossils, thought to be millions of years old, with pre-Adamic men. He supposes that Neanderthal man preceded Adam, and lived down into the pre-flood era, even intermarrying with the race of Adam.

Chapters on the human brain and mind offer outstanding support for creation, and reveal some of the major difficulties faced by evolutionary theory in accounting for the origin of man. A purpose in the creation of man is that man ultimately become divine members of the God family and be like God.

The book is both a challenge to evolutionists, and to Creationists who favor a conservative interpretation of Genesis.

One of the assumptions of many people, who cite radioactive decay rates as evidence for a great age of the earth, is that the decay began only when the earth was formed; but is this warranted? If the earth was formed from pre-existing material, within the earth's crust we might find masses of radioactive minerals such as uranium, associated with decay products, which could make some rocks seem older than the earth itself.

A basic problem with Dankenbring's proposed harmonization of modern geology with the Bible is that the

effects of the Genesis flood are minimized. Unconsolidated sand and gravel, and vast deposits of loess on the continents, would have been readily washed away by the flood waters, and would certainly show more signs of disturbance than is evident, if a flood followed the glacial period.

Recently in the *Quarterly*, another book which adopted a stance in which the Bible "is interpreted through the grid of what present-day science deems possibly" was discussed, and many of the points made by the reviewers would be applicable here. Notice the following discerning comment:

"If the Bible teaches a cataclysmic flood a few centuries before Abraham, and if geological interpretation refuses to admit such a flood, then immediately a major conflict has been generated irrespective of what one does with the Genesis 1 days. At precisely this point the classical "gap theory" strategy of placing the geological ages before Genesis 1:2 failed because once the strata had been assigned to the creation period, there was no strata left to confirm the flood."

This reviewer finds a straightforward approach to Genesis leads one to a greater insight into geology than is possible in terms of uniformitarianism. The value of "*The First Genesis*" to Christians is severely limited by its dogmatic affirmation of the geologic time scale.

Reference

Clough, C. A. and L. E. Fredricks, 1978. Creationist science: a challenge from Professor Young. *Creation Research Society Quarterly*, 15 (1) 47-52. (See especially page 50.)

QUOTABLE QUOTES

"... often a theory has been disproved ... before it is published. Understanding, we are told repeatedly, is just around the corner—only when we get round the corner we find that the view is different from what we expected. And so we go on increasing our mastery over nature, but without a proper understanding of what we are doing. This is a prostitution of science which in the long run would lead to disaster.

"... mumbo-jumbo was substituted for reasoning and the faithful were forbidden to seek to understand; they were to accept the cant handed out by the high priests and not ask awkward questions.

"... I could not accept the advice ... that I 'mustn't think like that'. Why not I wondered? Why shouldn't I think any way I please, as long as my premises are not obviously false and my logic is sound? And so I ignored all the great names ... and went back to nature."

—Waldron, R. A., 1977. The wave and ballistic theories of light: a critical review. Fredrick Muller, Ltd., London. P. xii.

The author was here commenting on physics. But is this not an appropriate comment on the theory of evolution, and also on how it is too often presented to students?

NOTICES OF BOOKS

How to Scientifically Trap, Test, and Falsify Evolution by R. G. Elmendorf. 1978. Available from the author at his business address: Elmendorf, Inc., Baird-ford, Pennsylvania 15006. Price, \$2.50.

This is a popular work, setting forth in simple terms the impossibility of evolution. It contains also suggestions for a number of illustrations and demonstrations, which anyone could use. (And which I have seen the author use with great effect.) It should be useful to anyone who is troubled by the claims of evolution, or who has occasion to advise others who are so troubled.

Evolution: the Incredible Hoax by Homer Duncan. 1978. Missionary Crusader, 4606 Avenue H, Lubbock, Texas 79404.

This little book sets forth some of the evidence against evolution. That evidence includes such things as the

lack of transitional fossils, the second law of thermodynamics, the mathematical improbability of evolution, the impossibility that symbiosis could have evolved, the inability of natural selection to produce anything new, and various other points. There is good documentation, and the book could be read and understood by any intelligent person. Anyone interested in the case for creation, rather than evolution, will find this work helpful.

Prairie Tree, Early Days on the Northern Illinois Prairie, by Frank Lewis Marsh. 1978. Vantage Press, Inc., New York. 304 pages. Price, \$9.75. This is not a book on Creationism, but it is by a well known Creationist. It is not only of general interest to anyone seeking information about pioneer living, but also it has much information about the natural history of the district, written from the viewpoint of a Creationist; and also there is information about social history.

LETTERS TO THE EDITOR

Was the Earth Created with a Canopy?

These considerations were suggested by Dr. Dillow's article on the pre-Flood canopy,¹ which, in turn, calls to mind Mr. Patten's larger work on *The Biblical Flood* ²

It seems commonly to be taken for granted that the pre-Flood canopy and the Edenic (i.e., before the Fall) canopy are continuous one with the other in their existence; and that they were similar or identical in nature. A better model, it appears, would require a discontinuity at the Fall.

Genesis 1:31 and 2:1 suggest that Creation was perfect when finished; as, indeed, would be expected of the work of an omnipotent God. Acromegaly and other abnormalities, as suggested by Patten and others under the pre-Flood canopy, are surely inconsistent with a perfect Creation in Eden.

The fact that the sun and moon were apparently visible from the fourth day on suggests that the Edenic canopy was transparent, unlike the pre-Flood canopy which some have suggested. Dillow, I grant, has largely avoided difficulties in this connection.

Genesis 2:5-6 suggests to me that it was only during the first days of Creation that there was no rain; although many, including Patten, have supposed that there was none until the Flood, and that the absence was associated with the later pre-Flood canopy. But the canopy might have been more dense and abnormal after the Fall, as a result of the disorder in nature.

Since I have mentioned Patten's work, may I remark on *The Long Day of Joshua* . . . ?³ There it is suggested that there may have been another catastrophe before Noah, "And one (perhaps more) before the creation of Adam".

Such an idea does not fit in with the perfect Earth which had recently been created. Exodus 20:11. That idea, of course, is the gap theory, emphasized in the 1917 Scofield Bible and neatly by-passed in the 1970

edition. Whitcomb and Morris,⁴ and more recently and at greater length Fields,⁵ have shown the unbiblical nature of the idea. For, if taken to its logical conclusion, it suggests that God was creating by trial and error, as it were; and almost, since each trial ended in a rebellion, that He made the same mistake twice.

I suggest that the Fall of man and the Fall of Satan were coincident. They were The Fall, involving not only man but the whole universe, even the stars in their courses.

The Fall, then, was the first physical catastrophe. All of nature, even the heavenly bodies, was disorganized. Thus, since meteors are fragments, there was no meteoric dust over Eden. Likewise, bombardment by lethal cosmic radiation, and the production of carbon 14, began with the Fall, not with Creation.

Can we extrapolate and ask, if the sun was visible in Eden, and rain occurred in a perfect and ideally ordered ecology (possibly with the Earth's axis oriented at right angles to the sun) how much canopy was really needed in Eden?

References

- ¹Dillow, Jody, 1977. The attenuation of visible radiation in the vapor canopy. *Creation Research Society Quarterly* 14(3):139-146.
- ²Patten, Donald W., 1966. The Biblical flood and the ice epoch. Pacific Meridian Publishing Co., Seattle, Washington.
- ³Patten, Donald W., 1973 (With Hatch and Steinhauer). The long day of Joshua and six other catastrophes. Pacific Meridian Publishing Co., Seattle.
- ⁴Whitcomb, John C., Jr., and Henry M. Morris, 1961. The Genesis Flood. The Presbyterian and Reformed Publishing Co., Philadelphia. See especially p. 93.
- ⁵Fields, Weston C., 1976. Unformed and unfilled. The Presbyterian and Reformed Publishing Co., Nutley, New Jersey.

Yours faithfully,
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Griffith, New South Wales
Australia
Received 7 July 1978

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.

Board of Directors *Biochemistry*: Duane T. Gish, Ph.D., Institute for Creation Research, 2716 Madison Avenue, San Diego, CA 92116. *Biological Sciences*: Wayne Frair, Ph.D., Secretary, The King's College, Briarcliff Manor, NY 10510; George F. Howe, Ph.D., President, Los Angeles Baptist College, Newhall, CA 91321; John R. Meyer, Ph.D., University of Louisville, KY 40208; Wilbert H. Rusch, Sr., M.S., LL.D., Membership Secretary, Academic Dean, Concordia College, Ann Arbor, MI 48105. *Engineering*: D.R. Boylan, Dean, College of Engineering, Iowa State University, Ames, Iowa 50011; *Genetics*: John W. Klotz, Ph.D., Academic Dean, Concordia Seminary, St. Louis, MO 63105; Walter E. Lammerts, Ph.D., Freedom, CA 95019; William J. Tinkle, Ph.D., Timbercrest Home, North Manchester, IN 46962. *Geology*: Clifford L. Burdick, M.S., D.Sc., 924 N. 6th Avenue, Tucson, AZ 85705. *Geophysics*: Harold Slusher, M.S., D.Sc., University of Texas at El Paso, TX 79902. *Physical Sciences*: Harold Armstrong, M.S., Publications Editor, Queens University, Kingston, Ontario, Canada; Thomas G. Barnes, D.Sc., University of Texas at El Paso and Consultant to Globe Universal Sciences, Inc., El Paso, TX 79902; Richard G. Korthals, M.S., Treasurer, Dean, Concordia Teachers College, River Forest, IL 60305; Henry M. Morris, Ph.D., Institute for Creation Research, 2716 Madison Avenue, San Diego, CA 92116; George Mulfinger, M.S., Bob Jones University, Greenville, SC 29614; Emmett L. Williams, Jr., Ph.D., Vice-President, Bob Jones University, Greenville, SC 29614. *Science Education*: John N. Moore, M.S., Ed.D., 136 Brody Hall, Michigan State University, East Lansing, MI 48824.

REWARD UNCLAIMED

We hear that, as was expected, still no successful claimant has appeared to collect the reward of \$5,000 offered by Mr. R. G. Elmendorf for a scientific proof that evolution is possible.

To show that evolution is possible it is necessary to show that somehow a system, or thing, can go, without help from outside, from disorder to order, or from disorganization to organization. In other branches of science, of course, nobody expects such a thing to happen; the impossibility is, from one viewpoint, what the second law of thermodynamics is about. But the evolutionary dogma seems to have its own rules, different from those of other sciences.

But to make a statement is one thing; to prove it is another. We expect that Mr. Elmendorf will have the \$5,000 for a long time yet.

More information about this is available from Mr. Elmendorf at his business address: Elmendorf, Inc., Bairdford, Pennsylvania 15006.

Thermodynamics

(Continued from page 168)

electromagnetic theory, without any need to appeal to either relativity or quantum theory.¹¹

References

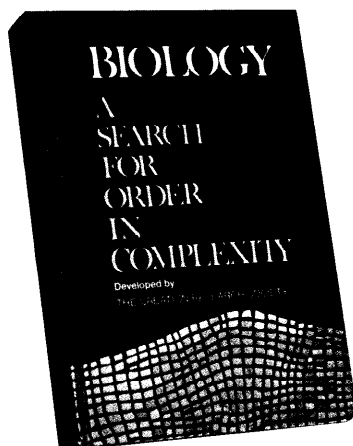
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⁹Warren, J. W., 1965. The teaching of physics. Butterworths, London. Pp. 15-17.

¹⁰O'Rahilly, Alfred, 1938. Electromagnetics. (Reprinted 1965 by Dover as Electromagnetic Theory). Volume 1, pp. 234-262.

¹¹*Ibid.*, p. 317.

BOOKS AND REPRINTS AVAILABLE



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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Zondervan Publishing House, Grand Rapids, Michigan

ANTHOLOGIES

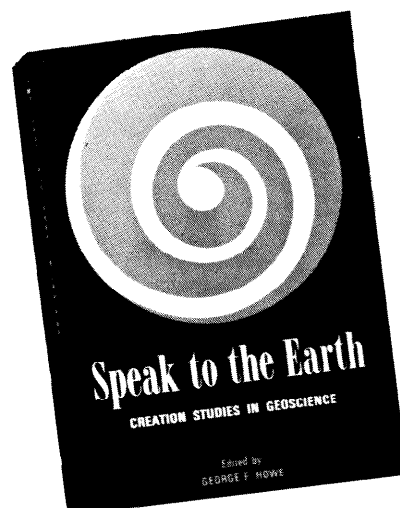
SPEAK TO THE EARTH (*Creation Studies in Geoscience*)

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.