

# Creation Research Society Quarterly

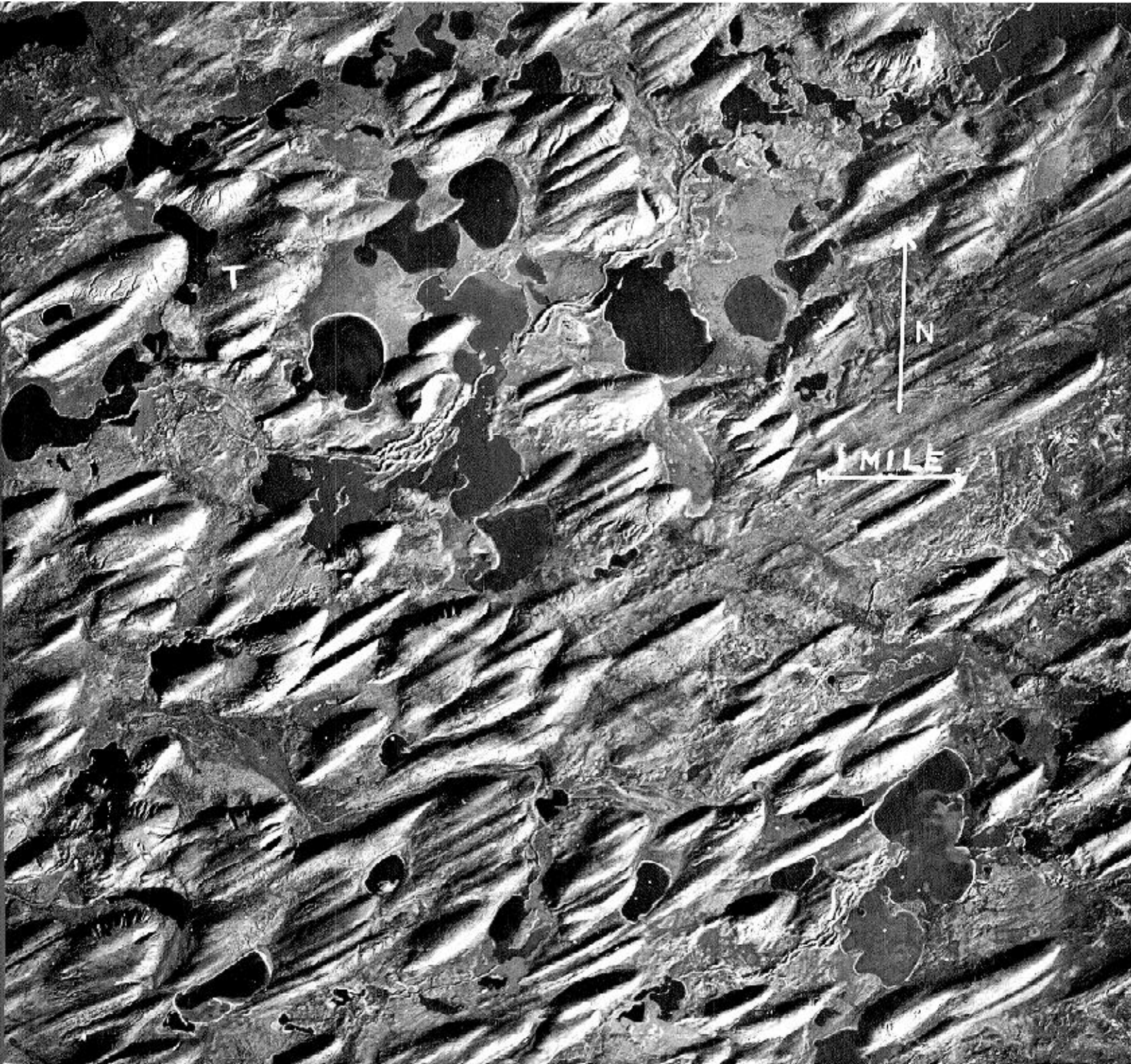
Haec credimus:

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

VOLUME 16

DECEMBER, 1979

NUMBER 3



# CREATION RESEARCH SOCIETY QUARTERLY

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VOLUME 16

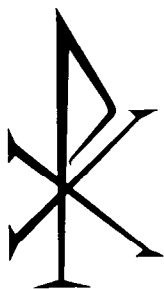
DECEMBER, 1979

NUMBER 3

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*Creation Research Society Quarterly* is indexed in the *Christian Periodical Index*.

## COVER ILLUSTRATION

The front cover shows an aerial photograph of drumlins near Snare Lake, Saskatchewan, Canada, at about north latitude 58°30', west longitude 107°30'. The original photo was supplied by the Surveys and Mapping Branch, Department of Energy, Mines, and Resources of the Dominion of Canada, Ottawa, Ontario, Canada, and is used here by permission. Mr. Douglas E. Cox attended to getting the use of this picture for the *Quarterly*.

Drumlins, geological features found in many places, are discussed in an article by Mr. Cox, elsewhere in this issue of the *Quarterly*. They are often ascribed to the action of glaciers; but Mr. Cox argues that currents of water, likely associated with the Flood, are a more probable cause. At this particular place, the current would have been approximately from the east-north-east, as is shown by the orientation of the drumlins.

The lake, in the north-west corner, marked with a white "T", fills a trough at the north-east end of a

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drumlin, as can be seen. This seems to resemble the feature described by Charlesworth, often found in the crags and tails near Edinburgh, which is mentioned in Mr. Cox's article. It is also similar to the features found at the stoss side of pebbles or boulders in streams.

## C.R.S. OUTLET FOR BOOKS

The C.R.S. has now established its own outlet for books. It is:

Creation Research Society Books  
5093 Williamsport Drive  
Norcross, Georgia 30071

*Why Not Creation?*, an anthology of articles from the *Quarterly* for the period 1964-1969, is now available at \$4.95, postpaid and prepaid. Please make checks payable to Creation Research Society Books. Payments from outside the United States should be by a check drawn on a U.S. bank, or by international money order.

Other titles will be added; and the additions will be announced in the *Quarterly*.

## DOES AN EMBRYO CLIMB ITS TREE?

WILLIAM J. TINKLE\*

Received 4 January, 1979.

*The notion of recapitulation by a developing embryo has been soundly discredited for years. Indeed, even when it was in favor it was maintained only by ignoring contrary evidence, and even by outright forgery of evidence. But still the notion reappears now and then, chiefly in text-books, or semi-popular writings, the readers of which are not in a good position to learn the truth from other sources. Thus, it seems worth while to point out once more that the notion is a completely false one, and is not held by knowledgeable biologists themselves.*

One of the most remarkable claims of the evolutionists was that embryos did not find the genes from parents adequate for their guidance in development but must go through the stages which their distant ancestors had as adults; they must recapitulate or repeat their ancestral forms. As one person has worded the process, the embryo climbs its own ancestral tree. We creationists prefer as a figure a row of diverse trees growing on the same level rather than one tree to represent all life.

This recapitulation hypothesis flourished during the years when Mendelism in the form of Gregor Mendel's famous paper was lying on a shelf, namely 1865-1900; about a quarter century ago it was given up by a majority of biological scholars, even though many of the scholars still hold to other suggestions of evolution. In recent debates strangely, the idea has been dusted off and advocated as one of the chief evolutionary doctrines.

\*William J. Tinkle, Ph.D., taught biology, genetics, and related matters for many years. He is now retired, and lives at Timbercrest Home, North Manchester, Indiana 46962.

## NOTICE OF OPEN MEETING

### Notice Regarding Research Reports

An open meeting of the C.R.S. Board will be held beginning at 1:00 p.m., Friday, April 18, 1980, at the Concordia College, Ann Arbor, Michigan.

The 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 the 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., 5093 Williamsport Drive, Norcross, Georgia 30071, submitting a one-page abstract of the data and conclusions to be shared. The abstracts may be printed for circulation at the meeting. Dr. Williams will coordinate the session and will include as many papers as time permits. Those wishing to attend are cordially invited.

General announcements and progress reports will also be given on Friday, possibly at a session held Friday evening, beginning at 6:00 p.m.

On Saturday morning, April 19, 1980, the Board of the C.R.S. will go into closed session.

### Scientists Question

A number of questions have been asked by serious scholars.

First, if the developing embryo is supposed to reenact the stages in the evolutionary history of the race, why are so few stages included? Why should we find some of them appearing in the wrong order? Why should we not find thousands of steps instead of only a few? Why does the embryo go through some steps that could not possibly have been included in the history of the animal? How can such stages as the egg, larva, pupa, and adult of a butterfly be explained? Why do some parts of an embryo show recapitulation and other parts never show it?<sup>1</sup>

Another biologist, writing a year later, sings the swan song of the famous fabrication:

This law has been so seriously questioned and so obviously inapplicable in many instances that as a law it is now of historical interest only.<sup>2</sup>

If further obituary is needed for recapitulation, this testimony is added:

According to it, ontogeny, the development of the individual, recapitulates phylogeny, the development of the race . . . In this form the theory runs into so many difficulties it clearly cannot be true. An immediate problem is presented by the fetal membranes, the umbilical cord, and other fetal structures that cannot represent adult structures of any period. Furthermore, mutations have been shown to modify all stages of development, not just the final ones.<sup>3</sup>

Thus, one by one are snapped the guy wires which support the tottering tower of evolution. Recapitulation is flung into limbo to keep company with acquired characters, spontaneous generation, gradually developing genes, and progressive mutations.

## PLACEMENT SERVICE

Do you know of academic vacancies to which creationists might be directed? The Creation Research Society would like to be in the position to inform creationist scientists of such vacancies. If you know of such positions will you please inform Dr. John W. Klotz, 5 Seminary Terrace North, St. Louis, MO 63105 describing the position, the academic requirements and training required and any other information that might be available. You will be helping provide students with information on the position which you yourself share.

### Examples Cited

Let us look at some structures which are cited from nature as evidence. One-celled animals were mentioned to typify a fertilized egg cell in diagrams to typify evolutionary order, in a diagram called a phylogenetic tree. Diagrams, when used properly are very useful in teaching and understanding zoology or botany.

So the lowest animal in the phylogenetic tree, representing the oldest animal, was a one-celled creature, a Protozoan. These animals have structures and abilities for catching and digesting food which a cell of a larger animal does not have; nevertheless one was drawn to represent the other. The succeeding stage in the diagram was Hydra, which has some resemblance to an early stage in the development of a starfish, a double sac called a gastrula. But Hydra is much more than a double sac; its system of assault, e.g., consists of many nematocysts which it shoots out to pierce or entangle other creatures.

Seeing that Hydra is not entirely primitive but specialized, it usually is not now given a place so low in the tree of life; but this place and the whole trunk are not assigned to any real animal. The twigs, however, bear the names of well-known species; the twigs are real but the trunk and big limbs which are supposed to bear them up are hypothetical; figments of the imagination; a poor ladder for climbing!

Now look at Figure 1, A and B, and you will see another example, notable because Ernst Haeckel used it when he promoted this famous guess. Calling it the Phylogenetic Law, he chose to make much of what he liked and left the rest of nature without explanation. Fig. 1, A is a cross section of the gastrula stage of rabbits and other mammals while Fig. 1 B is a cross section of the gastrula of starfish. They are formed by different methods and are like very few adult animals; and they certainly prove nothing about common ancestry.

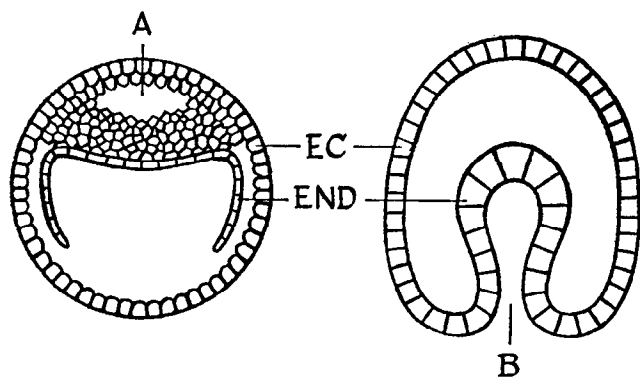


Figure 1. Contrasting types of embryo. Left, rabbit. Right, starfish. A, amniotic cavity, B, blastopore, END, endoderm. Later stages of the two kinds differ still more, for the starfish goes through a complicated larva stage which the rabbit does not have. These are not diagrams but realistic drawings of cross sections.

Those who think the rabbit and starfish developed from a common ancestor are fond of noting a few likenesses, while they pass by a number of differences.

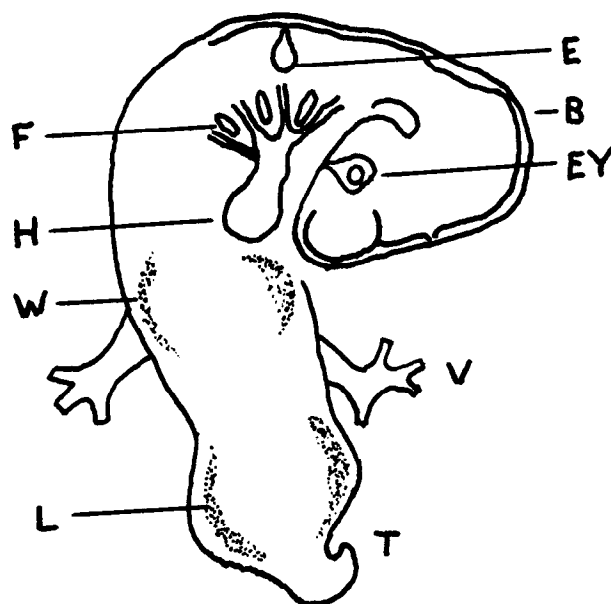


Figure 2. Chick embryo after three days of incubation. F, furrow where skin sinks between blood vessels, H, heart, W, wing bud, L, leg bud, E, inner ear, B, brain, EY, eye, V, vein to yolk, T, tail. Can you see why embryologists have given up the idea that a chick embryo resembles a fish? Drawing from specimen.

### The Most Popular Alleged Recapitulation

The claim of recapitulation that has been repeated most often was that man's descent from a fish was illustrated by man's possession of gill slits. A fish breathes by taking water into the mouth and forcing it out past the gills, which are located beside slits in the neck. But human embryos have no gill slits nor even gills or the beginning of gills, at any time.

Human embryos are like chick embryos in this respect. There are alternating ridges and furrows in the neck region, traversed by arches of the aorta artery, some of these blood vessels developing and others closing like the early blood tubes in general. A. F. Huettnner, in his "Embryology of the Vertebrates" states on p. 273, "Thus we have gill pouches in the mammalian embryos, but they no longer open to the outside but are closed by thin membranes." These membranes could be broken by inept handling and thus give an impression of a gill slit as in a fish.

A chick embryo never has gills or the shape of a fish, as we might expect if one developed from the other. (See Figure 2) Relative sizes of parts are different from the adult; and this may be explained. The head is relatively large because the brain and eyes are to become very complex, needing an early start. The heart is large because the embryo needs blood very early for its fast growth; even at the age shown here there is adequate circulation of blood. For a like reason, wing and leg buds are small because limbs are not needed until after hatching. Thus we account for growth regulation by teleology, for which science should make no objection and we no apology; the world shows formation according to plan.

### Order Important

The circulatory system also has been claimed to illustrate recapitulation. It was said that the heart of a mammal or bird develops in the same order that those animals developed on the earth in evolution; a fish has a heart of a single tube, a frog's heart is partly double, having two atria and one ventricle, while birds and mammals have two atria and two ventricles. (They were careful to choose examples that suited their conclusion, not mentioning the earthworm, *Lumbricus*, which has five pairs of hearts.)

See Figure 3 which is two realistic drawings of a chick's heart, a few hours apart. The heart starts with a rising of the embryo and folding together of the heart muscle and lining which have been spread out on the yolk. Note that at first there are two tubes which soon coalesce to form one; this is not the order from simple to compound as was claimed to form a basis for recapitulation; it is from 2 to 1, not 1 to 2. In the mammal the order is the same, although there is no changing from a flat embryo to a cylindrical one.

There has been some attempt to bring in also the skeletal materials in this development. In a developing mammal the bones are formed of cartilage and later osseous matter is brought in, gradually changing most of the cartilage to bone. A young shark has a skeleton of cartilage, but it remains cartilage as long as the shark lives. Geologists tell us that trilobites in oldest fossil-bearing rocks, the Cambrian, furnish a large part of the calcium of those rocks; they had true bone.

Actually, the meaningful resemblances are found, not between embryos and their supposed ancestors, but between adult individuals of different species. Such resemblances are viewed by Creationists as only what is to be expected, seeing that the different species were made by the same Creator.

### Conclusions

As we have attempted to explain in this paper, not only Creationists, but even a majority of evolutionists, have given up this alleged principle of an embryo's having to recapitulate the morphologies of its ancestors. Careful studies have shown that the order of growth in an embryo is wrong for such a principle. Again, the

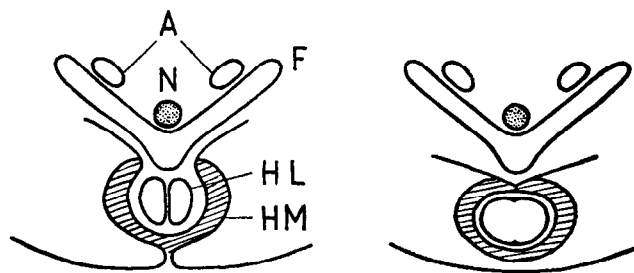


Figure 3. Early stages of heart in the chick embryo. Left, 27 hours of incubation. Right, 29 hours. A, arteries, N, notochord, F, fore gut, H L, heart lining, H M, heart muscle. Note that the inner tube of the heart is double at first but soon becomes single. If this double heart showed what ancestor the chicken developed from it would not indicate a fish, for the fish has a heart of a single tube. Scientists have decided that such structures do not show what ancestors the animal had.

Drawing from specimen.

alleged principle is not good science, because it rests on selected data, ignoring other data which are opposed to it. The growth of an embryo is directed by its genes. Much has been learned about such matters in the last 25 years, and recent studies in embryology have come to our aid. By getting rid of beliefs which are supposed to have a scientific basis but do not, Creationism is winning over evolution, and purifying science in the bargain.

### Acknowledgements

*Scientific Creationism*, by Henry Morris, published by Creation-Life publishers, San Diego; and *Heredity*, W.J. Tinkle, published by St. Thomas' Press, Houston; were helpful in the preparation of this article.

The illustrations are from the book *Heredity*, pp. 115-117.

### References

- <sup>1</sup>Reno, Cora, 1953. Fact or theory. Moody Press. P. 69.
- <sup>2</sup>Breneman, W.R., 1954. Animal form and function. Ginn. P. 407.
- <sup>3</sup>Moment, G. B., 1958. General zoology. Houghton Mifflin. P. 201.
- <sup>4</sup>Huettnner, A.F., 1949. Comparative embryology of the vertebrates. Macmillan. P. 273.
- <sup>5</sup>Britannica Macropedia, volume 1, pp. 1052 and 1053: "Rummah-Batin carries vast loads of sediment from the the interior towards the Persian Gulf."
- <sup>6</sup>Davis, *op. cit.*, p. 188. Also Britannica Macropedia 1977, volume 16, p. 277. Also New Westminster Dictionary, p. 239. See Baly, Denis, 1963. Geographic companion to the Bible. McGraw-Hill, New York. P. 173.
- <sup>7</sup>Britannica Macropedia, reference 16, p. 276.
- <sup>8</sup>Davis, *op. cit.*, p. 188.
- <sup>9</sup>1962. Columbia Lippincott Gazetteer of the World. P. 745.
- <sup>10</sup>Woolley, C. Leonard, 1965. The Sumerians. W.W. Norton Co., New York. P. 2.
- <sup>11</sup>1978. Times Atlas of World History. Hammond Inc., Englewood, New Jersey. The map on p. 55 shows the upper Persian Gulf as only a lagoon. See also Baly, *op. cit.*, p. 105.
- <sup>12</sup>1972. Webster's New Geographic Dictionary. G. and C. Merriam Co., Springfield, Mass. Pp. 591, 1207, and 381 respectively.
- <sup>13</sup>Gellhorn, Eleanor C., 1965. Guide to the Middle East. David McKay Co., New York, p. 125, states: "Al Qurna, 40 miles north (of Basra) is a legendary site of the Garden of Eden".

## Rivers of Eden

(Continued from page 170)

<sup>82</sup>2 Kings 19:12; Isaiah 37:12; Ezekiel 27:23.

<sup>83</sup>See footnotes on Genesis 2:13 in the Berkeley, New American, and New International Versions. Also New Catholic Encyclopedia volume 5 p. 102. Also Jamieson, Fausset and Brown, One Volume Commentary, Associated Publishers, Grand Rapids, Michigan. P. 18.

<sup>84</sup>New Jewish Encyclopedia, Behrman House Inc., New York. P. 159. also Davis, *op. cit.*, p. 792.

<sup>85</sup>Davis, *op. cit.*, p. 188. Also 1957. Unger's Bible Dictionary. Moody Press, Chicago. P. 231.

<sup>86</sup>Douay-Challoner, King James, and Lamsa versions.

<sup>87</sup>Berkeley, Geneva, Good News, Jerusalem B, Living B, New American Standard, New English, New International, New World, Revised Standard, and Smith and Goodspeed.

<sup>88</sup>Davis, *op. cit.*, p. 188. Also 1970, New Westminster Dictionary of the Bible. Philadelphia. P. 239.

## DRUMLINS AND DILUVIAL CURRENTS

DOUGLAS E. COX\*

Received 25 July, 1979. revised from 22 September, 1978.

*An explanation for the origin of drumlins has not been discovered in the context of the glacial theory, yet many people assume they were formed by ice movement. In this article, it is proposed that drumlins can be more readily explained in terms of effluvial action. Streamlining of sediments would result from currents of flood waters generated by uplifts of the earth's crust at the end of the flood. The internal composition of the drumlins can be explained by the disintegration of rock upon the release of pressure, which resulted in drumlins of varying composition in drumlin fields.*

### Introduction

The origin of drumlins has long been a problem in the glacial theory. Since 1865, when the drumlins of Ireland were attributed to glacial movement by H. M. Close, almost all writers on the subject of drumlins have assumed they are of glacial origin.

The writer has suggested that a glacial period is not necessary in a creationist reinterpretation of earth history, and in this article an explanation for the drumlins in terms of currents of the deluge is developed. These streamlined landforms, (see Figure 1, and the front cover) when considered in this context, reveal a great deal of information about the way in which the flood waters retreated from the continents.

### Drumlins a Difficulty for the Glacial Theory

It is generally admitted that the true explanation for drumlins has eluded glacialists: "Although many studies have been made of so-called ice-molded landforms, drumlins, drumlinoids, and flutings, their mode of genesis remains unsolved."<sup>1</sup>

Drumlins are sometimes said to provide evidence for glaciation, but the problems in accounting for their structure and distribution may also be said to provide negative evidence, or an argument against the glacial theory.<sup>2</sup> In any theory proposed to explain drumlins, the following characteristics, which are antagonistic to a glacial origin, must be considered.

1. Drift and bedrock would be eroded differently by an ice sheet, yet drumlins of both types may occur in the same drumlin fields, having similar form and orientation.

2. Cross stratified sand and gravel in drumlins is believed to have been deposited during the melting of the ice sheet, but if this were so, the ice sheet would no longer be available to shape the surface of the drift into drumlins.

3. The pattern of stratification in the sand and gravel in many drumlins has not been disturbed by the weight of a vast ice sheet scraping over it.

4. The direction of orientation of drumlins in some regions shows that the direction of flow was uphill. This is explained in the glacial theory as due to the greater thickness of ice at the rear, causing a lateral thrust of the ice sheet. But the drumlins at higher levels are more intricately streamlined and show a faster rate of flow, which could not occur if the ice sheet was being pushed against gravity.

5. Rock basins occur in some drumlinized areas, such as the Finger Lakes of New York. The excavation of deep rock basins probably could not be accomplished by ice erosion,<sup>3</sup> and the concept is inconsistent with the ice simultaneously flowing over the drift without disturbing the patterns of stratification in sand and gravel.

6. The bedrock below the drift is striated but usually has not been streamlined. The striations are attributed to moving ice, but it seems inconsistent to believe the ice slid over both the surface of the drift, and the surface of the bedrock at the same place.

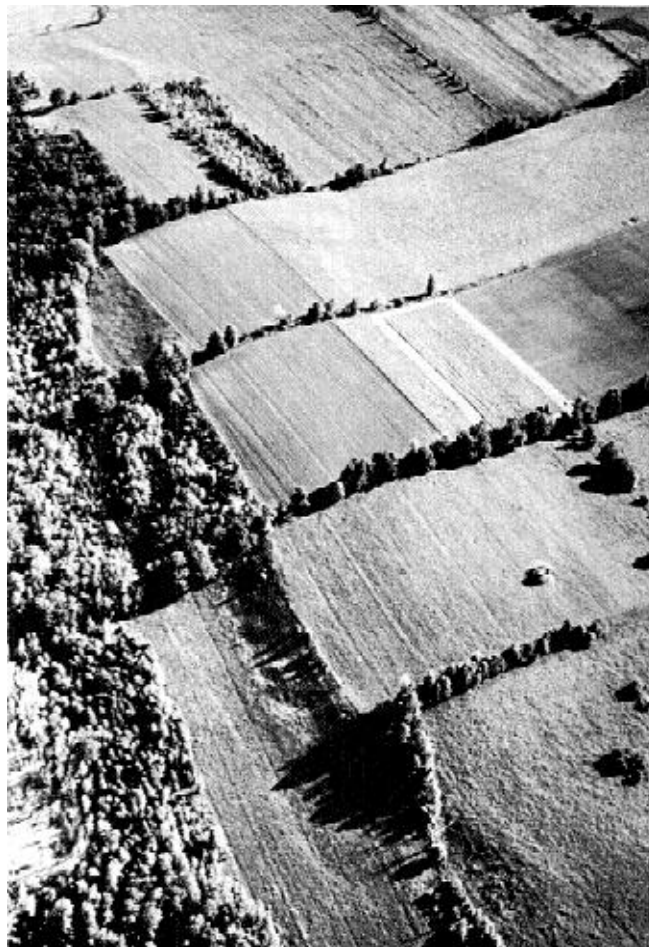


Figure 1. This is an aerial view of a typical drumlin, which is part of a drumlin field between Meaford and Owen Sound, Ontario. These drumlins are oriented approximately north-south, and the direction of flow was toward the south. The view is toward the north-east, in the early morning.

\*Mr. Douglas E. Cox receives mail at P.O. Box 18, Petersburg, Ontario, Canada.

7. Drumlins in some regions have been modified by a change in the direction of flow of the agent of streamlining. Crossing patterns of orientation also occur. Even a small change in the direction of motion of a glacier would most likely have obliterated previously formed drumlins.

8. The drumlin form seems inconsistent with ice erosion, which would tend to have a leveling effect rather than molding the country into streamlined hills.

9. There are no deposits of the ice sheet lying above the streamlined surface in drumlin fields, that could have been deposited during the melting of this last ice mass. Yet many drumlins are attributed to erosion by the ice sheet, which would tend to result in accumulation of debris in the glacier.

10. Existing ice sheets do not form drumlins. J. K. Charlesworth stated: "An appeal to modern glaciers is unavailing, since drumlins *in statu nascendi* are unknown though accumulations somewhat resembling them have been described from time to time."<sup>4</sup>

#### Mysterious Properties Attributed to Ice

To account for drumlins by the action of ice sheets, some physiographers have attributed a mysterious "rhythmic" property to the ice sheets of the past, which caused the molding of drumlins from both bedrock and drift as the ice moved across the countryside. It is proposed that this rhythmic quality caused erosional processes to shape drumlins from hard bedrock, while depositional processes formed drumlins having the same shape and orientation at the same time.

This idea of a wave motion in the ice sheet was popularized by O. D. von Engeln, who developed a concept proposed earlier by Otto Flückiger. The movement of the ice, it was said, was analogous to fluid flow, and "the interior ice flow proceeds in a series of great waves."<sup>5</sup>

This proposal was severely criticised by Max Demorest. He pointed out that the viscosity of ice is so high that the critical velocity of an ice current, at which vortices or other turbulent effects such as waves might be formed, had been calculated to be of the order of the speed of light! Demorest concluded: "... one can hardly believe in the correctness of Flückiger's assumption that the ice is or can be undulatory in its motion."<sup>6</sup>

The existence of rhythmic wave properties in the ice sheets was supported by Gravenor and Meneley in a paper on glacial flutings in bedrock in Alberta, and it was suggested that this had caused the regular transverse spacing of parallel ridges, due to the lateral movement of the ice in the troughs. These authors stated:

The wavelength must . . . be controlled by some physical property of the glacier ice which gives rise to periodic variations in erosive capacity in a direction transverse to the direction of flow. Until more is known about the physics of ice flow it is impossible to suggest a reason for the periodic variation of the erosive capacity of ice.<sup>7</sup>

A recent report on glacial flutings in bedrock in Greenland cited this proposed mechanism, and referred to the possibility of ice flow in tubular vortices.

To operate the lateral transport of material in the ice, or the rhythmic variation in the intensity of

erosion, Shaw invoked ice flow in tubular vortices, which could possibly be generated by the lateral pressure gradient arising from longitudinal crevassing in the glacier.<sup>8</sup>

Smalley and Unwin developed a theory of drumlin formation which depended upon the properties of till, rather than the ice itself. They pointed out that most theories assume "some unspecified process" has operated in the ice sheets of the past:

Few, if any, of the so-called theories are actually theories, if a theory is required to account for the formation of a streamlined hill of till or rock. Most "theories" are really suggestions for boundary conditions within which some unspecified process operates, and the stipulated conditions may be remarkably imprecise . . . Although much has been written on drumlins, very little hard fact has emerged.<sup>9</sup>

In an attempt to explain the formation of drumlins, S. Aronow suggested "recourse must be had to 'something' in the now vanished ice sheet."<sup>10</sup> A transcendental quality seems to be imputed to the ice of the glacial theory, by such statements. Sir Henry H. Howorth denounced this approach in no uncertain terms:

It has been my continual complaint for years (Cassandra's voice I know it has been) that the glacialists who appeal to a transcendental ice period have never attempted to show what is the first element in the problem, namely, that ice is capable of the effects which they deduce from it.<sup>11</sup>

The bankruptcy of the glacial theory is evident in the acknowledged failure to explain drumlins after more than a hundred years of investigation.

J. Menzies stated, in a recent review of the problem of drumlin origin: "Drumlins remain a major problem in glacial geomorphology such that no satisfactory explanation to their mode of origin exists."<sup>12</sup>

A new approach to the problem of the origin of drumlins is provided by the mechanism of drift formation, due to a process of *in situ* rock disintegration, which has been proposed by the writer. The currents of the deluge can explain many of the erosional effects which have been attributed to the ice sheets, and the streamlining effects of currents can account for the drumlins in a remarkable way.

#### A Diluvial Interpretation

Streamline effects of currents are evident in the beds of streams. One of the earliest scientific accounts of drumlins was a study of the parallel ridges of Edinburgh, Scotland, in which these landforms were compared with sand bars and sediment accumulations behind obstacles in the beds of streams.

These streamlined hills of the crag-and-tail type were investigated by Sir James Hall, a friend and admirer of James Hutton, author of the theory of the earth that has come to form the basis of modern geology.

Hall suggested that catastrophic waves from the sea, caused by rapid uplifts of the earth's crust, accompanied by earthquakes, had swept across Scotland and formed the streamlined ridges.<sup>13</sup>

It was claimed that these diluvial waves not only formed streamlined hills, but swept along great

volumes of drift, with erratic boulders derived from sources in the north, and deposited this load of debris behind the rock outcrops in Scotland. Hall believed these revolutions could be reconciled with the Huttonian Theory.

J. K. Charlesworth has described these crag-and-tail structures in Edinburgh as follows:

The impact side, which is scraped bare, is commonly steep or precipitous and, as at Castle Rock, has a horse-shoe shaped valley half encircling its base and extending leewards as lateral grooves which gradually diminish in cross-section . . . The frontal groove, sometimes undercut or occupied by a rock-basin, may be missing if the obstacle had a lifting effect . . . The tail frequently descends from the very summit of the hill in a smooth, gentle slope whose length depends upon the height of the boss: it may range from several kilometres to only a few metres . . . The tail may be solid or may consist of drift . . . Tails of drift are very common; crags resemble boulders in a river bed with tails of sediment pointing downstream—the resemblance led Sir J. Hall to invoke strong currents for the Scottish crags and tails.<sup>14</sup>

The diluvial explanation proposed by Hall was well suited for the streamlined hills of Edinburgh, but it could not also account for the presence of parallel grooves and striations on the rock surfaces under the drift, and it was these that some thirty years later were to lead to the adoption of the theory of ice sheets transporting and depositing the drift of the British Isles.

### Streamlining Action of Currents

Sir James Hall noted the similarity of the parallel ridges he described to snowdrifts formed by strong winds in winter storms, a similarity which has been also noted by other investigators:

Drumlins, as experimental evidence confirms, are streamlined; they present their steeper face to the moving medium, in order to offer the minimum resistance to the flow by hindering the formation of vortices in the rear (which act as a drag on the moving body). Similar adjustment is seen in snow forms, in certain dunes and sandbanks in rivers, in the shape of torpedoes or fishes . . .<sup>15</sup>

The shape of drumlins indicates that fluid flow and sediment transport has been involved in their formation. The process of streamlining in the formation of sandbars and snowdrifts involves both deposition and erosion. The erosion occurs at the stoss end while deposition occurs at the lee end of the bed form.

V. R. Baker showed that hundreds of streamlined loess hills in eastern Washington were formed subfluviably by catastrophic floods. These resemble drumlins in shape, average 40 meters in height and were formed by currents with a velocity of 12-15 meters per second in a depth of 60 meters of water.<sup>16</sup>

These streamlined hills occur in a region where giant current ripples, with heights of 50 feet and spacing of 500 feet, and other evidence of fluvial action show rapid currents that are attributed to floods resulting from the failure of an ice dam which ponded about 500

cubic miles of water in glacial Lake Missoula. Baker wrote:

Because the Missoula floods involved the largest discharges of fresh water that have been documented in the geologic record, the study of these events will establish some upper limits to our knowledge of the short term erosive and transport capabilities of running water.<sup>17</sup>

Large scale landforms in eastern and central Washington and other regions have been identified with the effects of diluvial currents by J. L. Cunningham.<sup>18</sup> He noted these so-called glacial deposits were similar to the effects of currents, and questioned their supposed glacial origin.

Streamlining of hills into the drumlin form is demonstrated from observation of the effects of the catastrophic floods on the Columbia Plateau in eastern Washington. The drumlins in other areas may have an origin similar to that of the drumlin-like loess hills reported by Baker. They would thus have been formed from unconsolidated material.

It is proposed that bedrock drumlins were formed when the rock was unconsolidated. This would be reasonable if these sediments were deposited during the flood, and eroded when the continents were elevated at the end of the flood.

Evidence for the unconsolidated condition of the sedimentary formations in the Great Lakes area, at the time of erosion of the basins of the Great Lakes, was presented in a previous article.<sup>19</sup>

R. L. Folk showed that stream flow can cause either transverse or longitudinal vortices, that minimize friction at the bed surface. Where longitudinal vortices occur, considerable sediment transport is possible. In this type of flow, the shape of the stream bed is congruent with the water surface.<sup>20</sup>

The troughs between drumlins may have been the sites of longitudinal vortices in the currents. (see Figure 2) Folk described the vortices as not remaining fixed in position, but "they wander back and forth like a swarm of slithering snakes."<sup>21</sup>

The mobility of the vortices would have the effect of rounding the crests of the drumlins.

As the depth of water decreased, the vortices would tend to be concentrated in the troughs, where erosion would be intensified. Material from the troughs would be deposited on drumlins located downstream. The role of longitudinal vortices was crucial in the formation of drumlins, in this fluvial interpretation.

It seems obvious that where flood waters flowed rapidly over flat plains of unconsolidated sediments, a streamlined bed would develop. Rapid currents have momentum, and patterns of drumlins are due to the momentum of the currents. The form of drumlins is one which minimizes turbulence.

It also seems evident that momentum and minimizing turbulence would not be significant factors in anything as slow moving as an ice sheet, as noted by physicist A. T. Waterman in a comment on von Engel's hypothesis of a wave motion in the glaciers: "I cannot conceive of anything as slow as a glacier producing effects . . . which depend primarily upon momentum."<sup>22</sup>

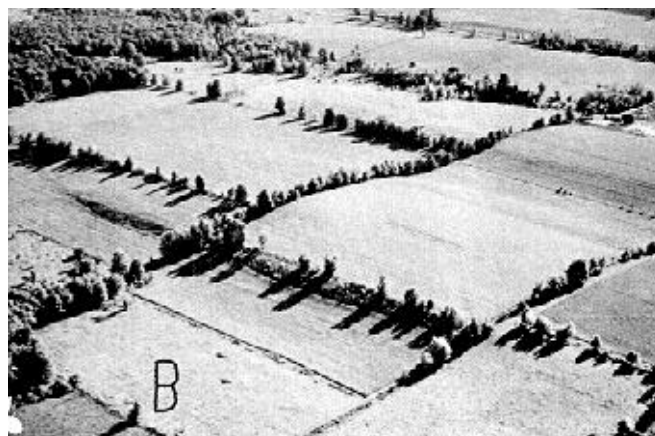
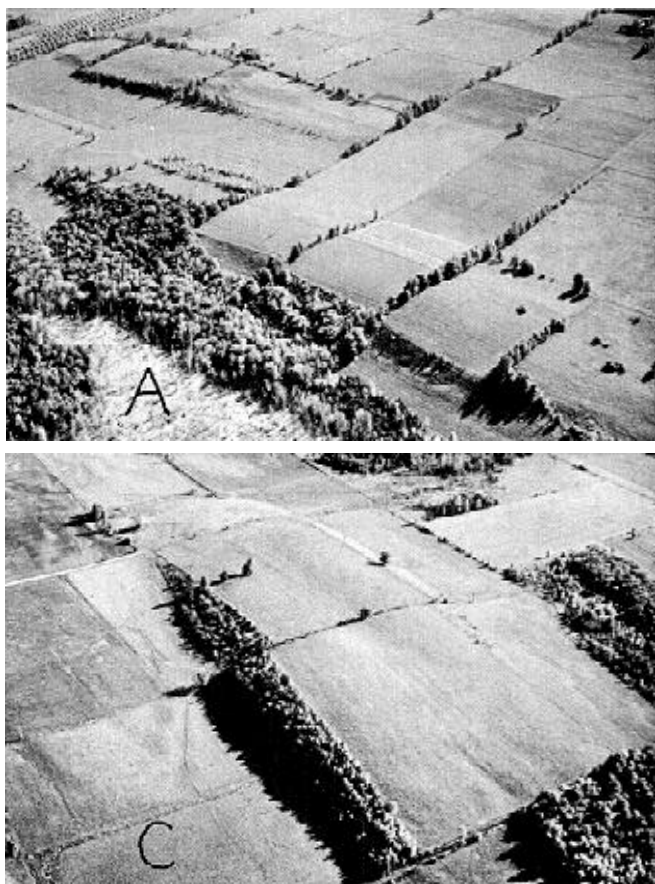


Figure 2. A: This is another view of the drumlin shown in Figure 1. Another drumlin can be seen in the upper left of the picture. It is suggested that the troughs between the drumlins were the sites of longitudinal vortices during the formation of the drumlins by rapid currents.

B: Another view of drumlins in the same region, showing the troughs between drumlins. It is necessary, in any explanation of drumlins, to account for the formation of the parallel troughs, just as much as for the form of the drumlins themselves.

C: This picture shows a modified drumlin, in which two separate crests can be distinguished. It is suggested that this feature of drumlins can be explained by decreasing depths of water, and decreasing size of the vortices in the currents, which tended to produce multiple drumlins on an already streamlined sediment surface.

In their efforts to explain drumlins in terms of the glacial theory, investigators may have confused effects which are actually indicative of rapid fluid flow with effects that moving ice may produce due to its rigidity. It is suggested that the drumlins are the product of rapid flow-of water, not of ice.

### Drumlin Structure

The required context for drumlin formation is that unconsolidated sediments were swept by currents. These could have been generated by uplifts of the earth's crust at the end of the flood. The flow would be radially away from the centers of uplift, and the direction of these currents would be indicated by the patterns of drumlin orientation.

An explanation for the variety of composition of drumlins is provided by the proposed mechanism of drift formation by in situ rock disintegration. This mechanism was outlined in a previous article.<sup>23</sup>

The lithification of the streamlined sediments would form bedrock drumlins. Most of these were subjected to disintegration, resulting in drift drumlins. Intermediate types, containing part drift and part bedrock, occur where the process of shattering penetrated only part of the drumlin.

Erosion may have followed disintegration in some areas, resulting in the redeposition of drift along the flanks of the drumlins.

The concept of *in situ* disintegration thus provides an explanation for the varying structure of drumlins in a

single drumlin field. All the drumlins in the field were initially molded in the same way. Flint has written:

There seems to be a complete gradation, independent of outward form and within a single field, from rock to drift. This suggests that any one group was molded contemporaneously under a single set of controls<sup>24</sup>

Studies of the bedrock profile in drumlin fields show a marked contrast between the streamlined surface topography and the irregular shape of the bedrock. (See Figures 3 and 4.) Geologic sections showing the erratic shape of the bedrock below a drumlinized area were illustrated by S. Aronow, in a study of drumlins in North Dakota.<sup>25</sup> The depth to bedrock in the region varied from 0 to 200 feet.

The structure of drumlins in southeastern Wisconsin has been studied by W. C. Alden.<sup>26</sup> Records of wells drilled on or around drumlins showed a great variation in the structure of the drumlins. Some consisted mostly of drift, others were mostly bedrock, covered with a thin veneer of drift. The depth of the drift in the area was variable, in places reaching as much as 300 feet.

From the point of view of the glacial theory, the surface of the bedrock below the drift ought to have been streamlined and worn smooth by the movements of the ice sheet, rather than the surface of the drift. But in drumlin regions the opposite conditions exist.

The erratic shape of the bedrock below drumlins is explained by the varying degree of penetration of the surface of shattering. The contrast between the bedrock surface and the drift surface is due to each surface being formed by different processes. One surface was formed by a rock shattering process, the other by the streamlining action of currents.

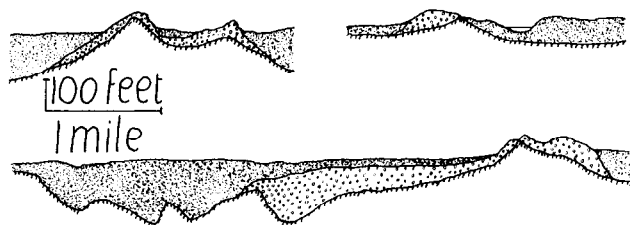


Figure 3. These are geologic sections in a drumlin field, in the Warwick-Tokio area, North Dakota. The erratic shape of the bedrock is in sharp contrast with the nearly level surface of the streamlined drift. This is drawn after Aronow's work, Reference 10. Note that the vertical scale is exaggerated. Shading with dots indicates outwash; with little circles, till.

Drumlins may show some signs of faulting and movement of the drift within, which can be explained by the effects of expansion of the drift during the disintegration. Eskers may occur in drumlin fields, and these have been interpreted in terms of the effects of expansion.<sup>27</sup>

In some drumlins that have been exposed in cross section by erosion or in road cuts, a concentric layering is present. Fairchild found this concentric structure in drumlins along the south shore of Lake Ontario, that had been severed by wave action. He interpreted this as evidence for a "plastering on" of material from the ice sheet.<sup>28</sup>

This concentric structure within some drumlins can be explained in terms of the disintegration process. The surface of disintegration may have penetrated down into the drumlin in planes conforming with the shape of the drumlin.

The idea of rock disintegration *in situ* forming the drift solves the enigma of the varying composition of the drumlins. Erosion by ice sheets would not form hills of bedrock with the same form and dimensions as hills of drift being deposited at the same time.

Stratified drumlins are explained by erosion in the glacial theory, and require a resurgence of the ice sheet over the drift deposited by the melting ice. The mixed-up sequence of events, which requires the existence of moving ice after it had melted, is an obvious flaw in the glacial explanation of drumlins.

The complicated events required to explain drumlins in terms of glacial action suggest their formation by these causes would be highly improbable, and that drumlins would be rarely found. But multiple thousands of drumlins have been mapped in Europe and North America. H. L. Fairchild wrote:

It is apparent that the drumlin-building process involved many factors, and most of them indeterminate. The problem is exceedingly complicated, including not only the difficult subject of the behavior of plastic solids but the action of the plastic ice under a complexity of geologic conditions.<sup>29</sup>

The vast numbers of drumlins in drumlin fields, and their similar features in different continents, argue against a complex mechanism of formation. The explanation of drumlin formation is relatively uncomplicated when they are considered in the context of the conditions existing at the last stage of the flood.

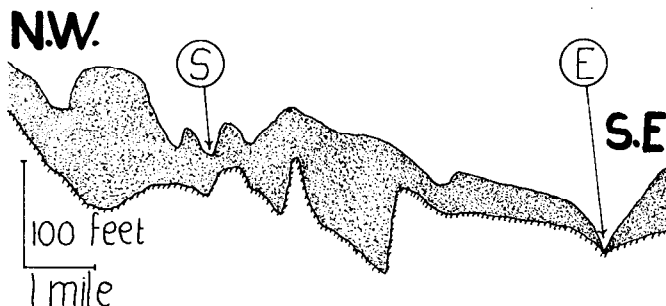


Figure 4. This is a profile showing the drift thickness (much exaggerated) and the shape of the bedrock along a line between Guelph and Rockwood, Ontario. The section is almost parallel to the direction of drumlin orientation. The data are from the depths of wells, reported on the drift thickness sheet, Guelph area, by M. A. Voss, 1969. Ontario Dept. of Mines. S indicates the Speed River, E the Eramosa River.

### Patterns of Drumlins

The patterns of drumlins reveal the immense scale of the events which caused them. For the drumlins to have been formed with parallel alignment, they must have been contemporaneous. Vast areas of the world have been swept by streamlining currents of the flood.

Drumlins show a trend of the current flow from the north, that can be explained by rapid elevation of the polar regions at the end of the flood. Flow of the waters across the continents, and locally down valleys towards the oceans, caused streamlining of the landscape.

One of the largest and most remarkable drumlin fields in the world is in central New York, where the drumlins number about 10,000. About 7,000 drumlins occur in southern Ontario.

East-central Wisconsin has about 5,000 drumlins; in south-central New England there are about 3,000, many of which consist of rock. In Nova Scotia, there are 2,300 drumlins.

Flutings across the plains of western Canada and northern United States may outnumber these regular drumlins. Flint stated: "Large groups of remarkable long narrow forms occur in various parts of the Great Plains in Canada and northern United States. Some are chiefly bedrock; others are chiefly drift. Possibly such forms outnumber 'conventional' drumlins."<sup>30</sup>

One of the most curious facts about patterns of drumlins is the uphill orientation in many areas, that shows flow of currents over hills, escarpments, and from out of the sea.

In north central New York the direction of flow was from out of the region of Lake Ontario, uphill towards the Allegheny highlands to the south.

A group of drumlins east of Owen Sound, Ontario, shows that flow was from out of Georgian Bay, uphill towards the Niagara Escarpment. A fan shaped pattern of drumlins south of Green Bay, Wisconsin, shows a similar uphill flow.

In Ireland, patterns of flow attest to diluvial action, rather than glacial movement. Flow direction was from out of the sea at Belfast Lough, over rising ground to the south.

Complex, arcing patterns of flow characterize the vast drumlin fields in Ireland. The patterns show a concentration of currents in low regions. Charlesworth wrote:

The drumlins of North-East Ireland belong to what appears to be the most remarkable drumlin assemblage in the world, far exceeding in extent of ground and numbers those of any other British area or even those of Western Central New York . . . It comprises tens of thousands of drumlins, and covers an area which can scarcely be less than 4,000 square miles.<sup>31</sup>

The direction of flow of the currents which shaped the drumlin field in Northern Germany was from out of the Baltic, fanning out across the lowlands.

These patterns of flow all show spilling of the waters to the south as the crust of the earth was rapidly elevated towards the north. The warping of ancient shorelines in all these regions corresponds with the inferred crustal depression towards the north, and subsequent uplift.

### Variations in Drumlin Form

The drumlins vary in form from oval hills to very long, low profile flutings. There may be a transition from one kind to another in a drumlin field.

The variations in the form of drumlins in north central New York were studied by J. W. Miller Jr. He found that the drumlins on the low plains near Lake Ontario were large, flat topped, and poorly streamlined.<sup>32</sup>

Further south they became better streamlined, and tended to be grouped in clusters. Still further south, on the rising slopes of the Allegheny Upland, the drumlins were smaller, more intricately streamlined, with steep sides and narrow crests. In the region of the Cayuga trough the drumlins became elongated flutings.

These variations in drumlin form show the agent of streamlining was faster at the higher altitudes to the south. Such an increase in the rate of flow would not be possible if the drumlins were shaped by an ice sheet being pushed uphill by a thicker ice mass to the north, which could not move faster than the ice mass causing the push. But the increase in speed is what would be expected if the drumlins were shaped by diluvial currents.

The continuity of stream flow requires the velocity of the currents increases where the bed is rising. The form of the New York drumlins shows this increased rate of flow where the depth of water was less.

The principle of continuity is illustrated in the flow of a stream. Where the bed is deep, the flow is slow. Near the shores of Lake Ontario the drumlins are large due to slow and deep current flow. Where the bed of the stream is shallow, there is rapid flow, so the flow of the currents would be faster at the higher elevations of the Allegheny Uplands, creating the intricately streamlined drumlins.

### Modified Drumlins

In the diluvial environment, there was a continual decrease in the depth of the waters as the continents emerged. Successively lower shorelines in many regions attest to the lower water levels. Drumlins also record

the effects of the decreasing depth of the flood waters as they were formed.

In some regions the drumlins have been modified by currents subsequent to their original formation. Examples of multiple drumlins, consisting of several small drumlins clustered on the same base, were reported by Alden<sup>33</sup> in Wisconsin, and by Fairchild in New York.<sup>34</sup> The form of the initial drumlin can be detected in these clusters.

These have been referred to by F. T. Thwaites as "overridden drumlins" and were described by him as follows:

In some regions the direction of ice movement changed markedly after the formation of drumlins . . . Many such drumlins have been overridden without any marked change in shape; some have had their new tails aligned to the new direction . . . in some instances a long drumlin has been changed into several whose long axes cross the old axis at a high angle.<sup>35</sup>

Modification of drumlins in this manner has also been reported from central Scotland. Large drumlins have been reshaped into clusters of smaller ones at an oblique angle to the original drumlin. As many as nine drumlins have been detected on a single base.<sup>36</sup>

In the diluvial environment, changes in the depth of the water as the continents emerged would cause the vortices to become smaller, resulting in the reshaping of large drumlins into smaller ones. The changes in the direction of flow of the currents could have resulted from shifting of the centers of uplift, spilling the waters in a different direction.

Changes in the direction of flow of the currents could also have been caused by the elevation of highlands above water level, forcing the currents into new channels. This may have occurred in central New York as the Allegheny highlands were elevated above the water level.

The emergence of the highlands would prevent further flow towards the south, causing the waters to flow around the highlands. Drumlins at the western end of Lake Ontario show a different direction of flow from those north and south of the lake, indicating a flow towards the west. Those at the eastern end of the lake have been modified by a flow towards the Hudson valley in the southeast.<sup>37</sup>

If the drumlins had been overridden by ice sheets after their original formation, it seems likely that they would have been removed entirely rather than modified by deflection of their tails.

### Evidence for Crustal Uplift

There are several indications that vertical movements of the earth's crust may have been a major aspect of the flood. Present ideas about the earth's composition do not provide an easy mechanism for the amount of vertical movement which is indicated by the earth's surface features.

In the central Great Lakes region the sediments thicken away from the Canadian Shield. The formations are tilted toward the sedimentary basins in the region. Erosion of these sediments has formed cuestas with steep escarpments around the Michigan Basin.

The orientation of the drumlins in New York and southern Ontario shows the direction of current flow which caused the drumlins was in the direction of dip of the sedimentary strata, which could indicate the uplift which tilted the strata also initiated the currents that shaped the drumlins.

Many of the drumlins in the vicinity of the Niagara Escarpment are oriented normal to the trend of the escarpment. This would be expected if the currents which formed the drumlins also eroded the escarpment.

Relationships between drumlin orientation and the dip of sedimentary strata would not be expected from the point of view of the glacial theory. Since it is believed that the escarpments were eroded long before the glacial period, there would be no correspondence between the supposed direction of ice motion and the structure of the sedimentary rocks beneath. Actually the escarpments would form a barrier to the ice movement.<sup>38</sup>

In the diluvial theory, the escarpments and drumlins were formed by the same events, so there is a natural relationship. Major patterns of drumlins were determined by differential uplifts of the earth's crust which are evident in the tilt of sediments originally deposited horizontally.

Warping of abandoned shorelines is another clear indication of crustal uplift. The regions of maximum uplift can be determined by following the ascending shorelines. In the Great Lakes region it seems to be a general rule that these areas were sources of the flow indicated by the patterns of drumlins.

The shorelines record the last and lowest stages of the flood, and were probably formed after the shaping of the drumlins in deeper waters. Many of the abandoned shorelines are found on the sides of drumlins.

### Conclusion

Creationists believe there was a world wide flood in which significant geologic effects would have been inevitable. These effects included sediment deposition and erosion, and it is likely that streamlining would occur in the right conditions.

The glacial explanation of drumlins suffers from major contradictions and flaws, and an alternative interpretation in terms of rapid water flow provides more consistent and reasonable answers. Currents of flood waters shaped previously deposited sediments while these were unconsolidated.

The process of rock disintegration *in situ* forming the drift, frequently exhibiting the pattern of cross stratification, is crucial in understanding the structure of drumlins. Since not all drumlinized areas were affected by the disintegration, drumlins of bedrock occur together with other types consisting of drift or part drift and part bedrock. The conditions in which the shattering process is believed to have occurred are compatible with the events proposed for the formation of drumlins.

Patterns of drumlins show the courses of flow of the currents which caused the streamlining of sediments. These patterns conform with the locations of upwarped shorelines and with the direction of dip of the sedimentary formations in many areas, indicating that differen-

tial uplift of the earth's crust probably initiated the rapid currents which shaped the drumlins. The new explanation of the drumlins provides a means by which the conditions which existed in the final stages of the flood can be more fully understood. These conditions existed over considerable areas in Europe and North America. The currents of flood waters may have caused different kinds of effects in other regions, and the possible effects of these currents should be considered in accounting for the surface features of the earth.

### Appendix: Drumlins Associated with Giant Ripple Marks

On the Bruce Peninsula in Ontario, a pattern of linear ridges is evident, which is a striking feature on topographic maps and aerial photographs. The ridges resemble giant ripple marks trending transverse to the axes of drumlins on the Bruce Peninsula. See Figures 5-7.

A series of these ridges and troughs occurs northeast of the group of drumlins near Sky Lake, and exposures can be seen along highway 6 about 2 miles north of the village of Mar. The ridges are sinusoidal in section, crests are 12 to 20 feet in height, and the spacing between crests is about 250 feet. They are thus about half

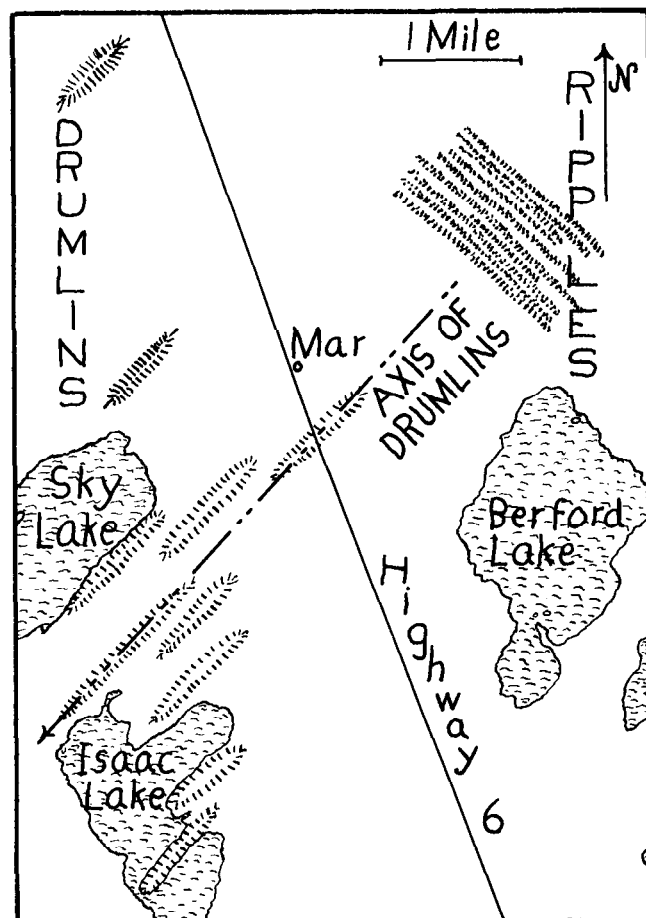


Figure 5. This map shows the location of the ripples, close to drumlins, on the Bruce Peninsula, Ontario. The location is about 44°45' north latitude, 81°10' west longitude.

the size of the giant ripples described by Baker. (Reference 16.)

These features, unlike those reported by Baker, are composed of dolomite bedrock. The pattern of the ridges transects the boundaries of the Paleozoic Guelph and Lockport formations. This suggests they are not reefs, but more likely are erosional features.

Their association with drumlins, and orientation normal to the axes of the drumlins and the axis of the Colpoys Bay "reentrant" in the Niagara Escarpment, indicates they may have been formed at the time of the formation of the drumlins on the Bruce Peninsula.

The uplift of the Shield area east of Georgian Bay at the end of the flood may have generated the currents which spilled across the Bruce Peninsula and formed these linear ridges. It is believed that tectonic uplift at

this time was also responsible for the present dip evident in the sedimentary rocks in southern Ontario, and the warping of the ancient shorelines around the basins of the Great Lakes.

Erosion of the unconsolidated limestone sediments would result, and the giant ripples developed in the unconsolidated dolomite formations where the depth of the water and current velocity favored the formation of transverse vortices. A transition to longitudinal vortices could have occurred in deeper waters to the southwest where the drumlins were formed.

The Sky Lake area drumlins were subsequently subjected to disintegration, as many of these drumlins contain cross stratified sand and gravel.

Another example of transverse ripple-like features occurs near the eastern shore of Owen Sound, south of the large bedrock drumlin known as Coffin Hill.



Figure 6. This is an aerial view of ripples, not far from the region shown in Figure 5. The right and left edges of the picture are oriented in the direction indicating north-south; and the total extent north-south of the part shown is about one mile. The heavy white line, running approximately NNW-SSE is Ontario Highway 6.

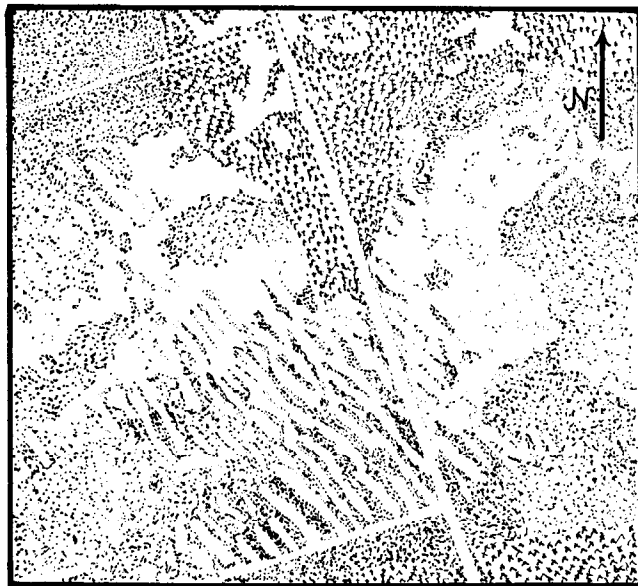


Figure 7. This is a drawing, made from an aerial photograph, of ripples near those shown in Figure 6. Again, Ontario Highway 6 is seen running NNW-SSE.

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- <sup>36</sup>Rose, J., and J. M. Letzer. 1977. Superimposed drumlins. *Journal of Glaciology*, 18(80):471-480. (See especially p. 474.)
- <sup>37</sup>Miller, J. W. Jr., *Op. cit.*, p. 421.
- <sup>38</sup>Cox, D. E. 1979. *Op. cit.*

## Appearance Does Not Prove Descent

(Continued from Inside Back Cover)

Do you follow my argument?

If an evolutionist cannot prove the existence of a common ancestor even for hares and rabbits, *how much less* has he any right to claim that man and monkey have a common ancestor even if some creature were *known* to exist that walked on two legs and possessed a brain capacity of (say) 900 cc?

In other words, I believe we can afford to treat Leakey's discoveries with complete disdain because they prove absolutely nothing about genetic descent *even if all he claims for them were true*. As Bible-

believers, all we are required to teach is that the human race was created *de novo*, genetically distinct from all other animals. I do not see that we are required to teach that no creatures have ever existed which might have *looked* more like humans than do any modern anthropoids.

Comments invited.

Yours sincerely,  
David C. C. Watson  
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Received 14 May 1979

## PILLBOX PARADOX<sup>†</sup>

WILLIS E. KEITHLEY\*

Does God create contradictions? Well, there's always some smug spook around who is dedicated to the delusion about slips in Scripture.

While we believe the Book is inerrant, it seems that God delights in reminding us of man's negative nature by ordering incredible circumstances so as ultimately to prove His own credibility. Consequently some of His more unconventional creatures seem to reflect an inconsistent caprice. Yet those very eccentrics simply point with candid conviction to the supernal nature of this singular creation.

Begin with a half-atom made of glass, yet almost indestructible; it is fireproof, yet makes dynamite; has explosive properties, yet is used in mines to reduce explosions; used in toothpaste, yet tastes like fish oil; with no apparent means of locomotion, yet seems to move by straining its own cytoplasm through one window then out the other. And all this in a microscopic capsule that has been described as a pillbox that reproduces by growing a new lid on the box, then the lid grows a new box.

Yes, the diatom is indeed a contradictory creature. Found in over 5000 different species, this amazing member of the algae family can live comfortably in a thimble with 14 million others like it. It moves in the water with animal-like agility; yet as a plant, manufactures chlorophyll. But its photosynthetic product is not sugar as is true of most other plants; but in manufactures the oil that makes fish taste fishy. Yet its skeleton is used to refine sugar! The three diatoms, shown here, illustrate something of the variety which they display.

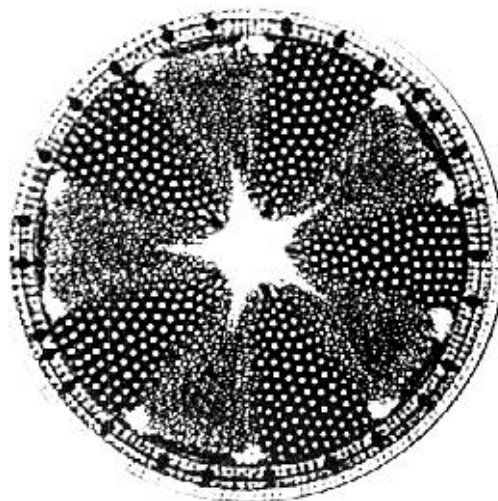
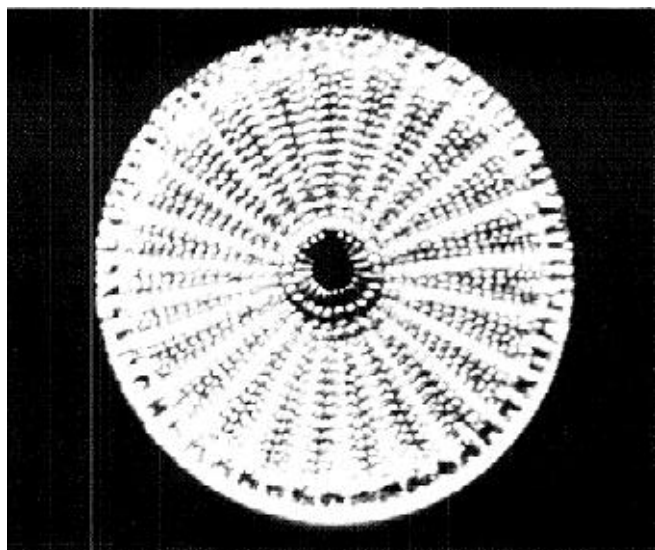
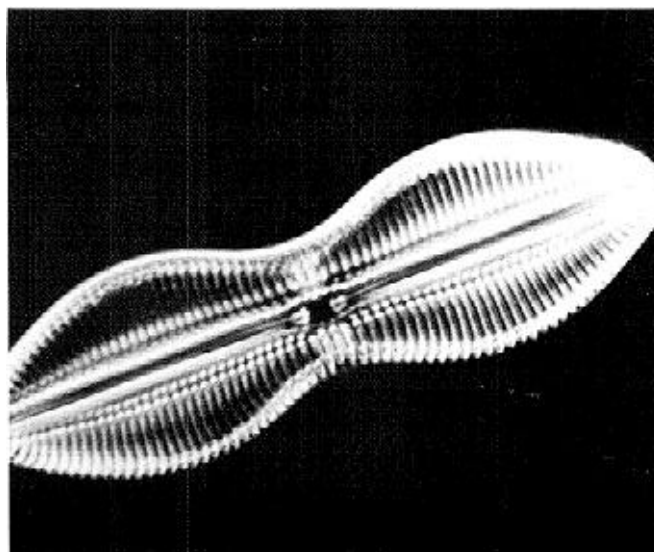
Although this mini-molecule is one of the smallest of the one-celled organisms, it recycles 90% of the oxygen we breathe, provides the largest part of the diet of fish

and whales; makes up the well-known whale blubber, and may be one of the sources of petroleum. While it is considered one of the simpler forms of life, yet it is so precisely complex that its shells are used to test the resolving power of microscope lenses. Truly a paradox in a pill box!

Yes, man may try to contradict God; but He quickly confounds the skeptic, even with the unseen. "For the invisible things of Him from the creation of the world are clearly seen, being understood by the things that are made, even His eternal power and Godhead; so that they are without excuse."<sup>1</sup>

### Reference

<sup>1</sup>Romans 1:20



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<sup>†</sup>An account, similar to this, is given on pages 96 and 97 of Mr. Keithley's book, *Portraits on Nature's Palette*, which is available from the author at the address given.

## CAN THE CANOPY HOLD WATER?

GLENN R. MORTON\*

Received 28 May, 1979.

*Calculations of the surface temperature of the Earth with a water vapor canopy, under the assumption of radiative equilibrium, yield temperatures too high for life to exist. Moreover, when the results about radiation are combined with the barometric law, only certain solutions to the physical description of the canopy are found to be possible for a given set of assumptions; and those solutions generally either lead to impossible environmental conditions or else do not fulfil the purpose for which the canopy was proposed. It appears that some new thinking about the antediluvian climate, and the cause of the Flood, is due.*

In the past twenty years since the vapor canopy model first became widely accepted among creationists, remarkably little work has been done on the physics of a world with a canopy. A work was recently published by Dillow<sup>1,2</sup> which attempted a fairly comprehensive physical treatment of the canopy; and although he directly stimulated this author's interest in these problems, we have come to opposite conclusions as to the validity of the canopy model. This paper is not intended to deny the Biblical account of the flood, nor anything which the Bible teaches about the world before the flood. The intent is, however, to challenge some of the beliefs about the canopy in order to show that new answers to our questions about the flood must be sought.

Two conditions must be fulfilled if the vapor canopy hypothesis is to be successful. First, the surface temperature of the Earth must be near 300 °K. Much more than a 25 °K variation from this would eliminate the possibility of life. Second, the canopy must be above the boiling point of water at all levels. The boiling point will vary with the pressure.

For a canopy of any appreciable thickness these two criteria mean that the Earth's atmosphere must have had a tremendous temperature inversion. Table 1 shows the pressure and temperature at the base level for canopies of various thicknesses. Since these values are the boiling points of water at the given pressure, if the temperature of the canopy base dips below these values the canopy would become supercooled and hence very unstable. From this one can easily see that the canopy base must be hotter than the Earth's surface.

The effect of this temperature inversion is that no large-scale vertical convection could have taken place. The reason for this is that as cooler air is forced upward into a warmer layer the cooler air is denser and hence heavier than the surrounding air. Thus the colder air sinks back to its own layer. Since convection can not remove any excess heat from the surface of the canopied Earth, and conduction of heat is not only slow but also the wrong direction (heat always flows from a warmer to a cooler object), the only avenue for heat transport away from the surface is by radiation.

Regardless of the type of atmosphere one is dealing with, the variation of pressure with altitude can be expressed as,<sup>3</sup>

$$\frac{dP}{dZ} = -\rho g \quad (1)$$

where  $P$  is the pressure,  $Z$  is the altitude,  $\rho$  is the density of the gas and  $g$  is the acceleration of gravity.

The density can be expressed as,

$$\rho = \frac{P}{RT} \quad (2)$$

where  $R$  is the gas constant divided by the molecular mass of the atmosphere, and  $T$  is the temperature.

Therefore,

$$\frac{dP}{dZ} = -\frac{Pg}{RT} \quad (3)$$

Assuming that the change of temperature with altitude is linear (as is about true today) then we can define the lapse rate as:

$$\frac{dT}{dZ} = \lambda \quad (4)$$

Substituting this into Equation (3), rearranging, and integrating, we find,

**Table 1. Pressure, and boiling point of water, for canopies containing various amounts of water. (Expressed in terms of the depth of liquid water, in feet, to which the canopy would amount.)**

| Feet of Water | Base of Canopy |                | Surface      |                |
|---------------|----------------|----------------|--------------|----------------|
|               | Pressure PSI   | Temperature °K | Pressure PSI | Temperature °K |
| 50            | 21.68          | 384            | 36.37        | 401            |
| 45            | 19.51          | 381            | 34.21        | 399            |
| 40            | 17.34          | 378            | 32.04        | 397            |
| 35            | 15.17          | 374            | 29.87        | 394            |
| 30            | 13.01          | 370            | 27.70        | 392            |
| 25            | 10.84          | 365            | 25.54        | 389            |
| 20            | 8.67           | 359            | 23.37        | 386            |
| 15            | 6.50           | 352            | 21.20        | 383            |
| 10            | 4.33           | 342            | 19.03        | 380            |
| 5             | 2.17           | 327            | 16.87        | 377            |
| 1             | .43            | 297            | 15.13        | 374            |

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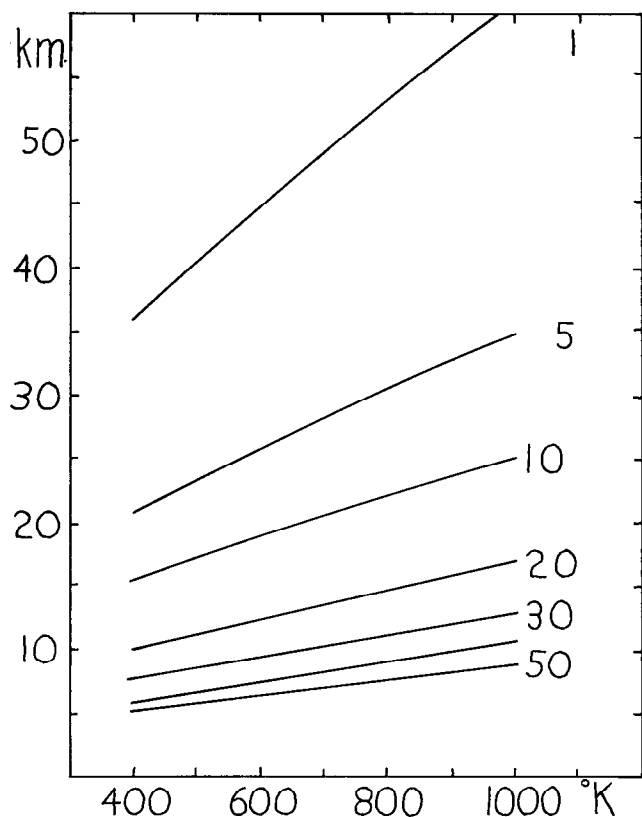


Figure 1. The height, in km., of the canopy, vs. basal (i.e., at the base of the canopy) temperature, in °K. The surface temperature is assumed to be 300°K. The various curves are for different amounts of water, (expressed in terms of depth in feet of liquid water to which the canopy would amount) in the canopy.

$$\lambda = \frac{g \ln \frac{T_o}{T_c}}{R \ln \frac{P_c}{P_o}} \quad (5)$$

where  $T_o$  and  $P_o$  are the surface temperature and pressure respectively. Equation (5) when combined with the integration of Equation (4) yields the height of the canopy base.

$$Z_c = \frac{R \ln \frac{P_c}{P_o} (T_c - T_o)}{g \ln \frac{T_o}{T_c}} \quad (6)$$

where  $Z_c$ ,  $P_c$ , and  $T_c$  are the canopy height, pressure and temperature.

Figure 1 and Table 2 shows the basal height for canopies of various sizes and various basal temperatures, assuming a 300°K surface temperature. (By "basal" is meant "of or at the base of the canopy.")

Under the assumption of radiative equilibrium only certain solutions are physically realizable for a given set of parameters.

#### The Radiation Solution

Since, as was pointed out earlier, radiation is the only means by which heat can escape from the surface of a

Table 2. The height of the canopy for various amounts of water, and various basal (i.e., at the base of the canopy) temperatures (in °K.) The temperature at the surface is assumed to be 300°K.

| Feet of Water | Minimum Height (km) | 400   | 500   | 600   | 700   | 800   | 900   | 1000  |
|---------------|---------------------|-------|-------|-------|-------|-------|-------|-------|
| 50            | 5.24                | 5.24  | 5.91  | 6.53  | 7.12  | 7.69  | 8.23  | 8.77  |
| 45            | 5.66                | 5.70  | 6.42  | 7.09  | 7.74  | 8.36  | 8.95  | 9.53  |
| 40            | 6.20                | 6.25  | 7.04  | 7.78  | 8.48  | 9.16  | 9.82  | 10.45 |
| 35            | 6.84                | 6.91  | 7.77  | 8.60  | 9.38  | 10.13 | 10.85 | 11.56 |
| 30            | 7.58                | 7.68  | 8.65  | 9.56  | 10.43 | 11.26 | 12.07 | 12.84 |
| 25            | 8.37                | 8.51  | 9.59  | 10.60 | 11.56 | 12.48 | 13.38 | 14.24 |
| 20            | 9.86                | 10.06 | 11.33 | 12.52 | 13.66 | 14.75 | 15.80 | 16.82 |
| 15            | 11.72               | 12.01 | 13.53 | 14.96 | 16.31 | 17.62 | 18.87 | 20.09 |
| 10            | 14.60               | 15.04 | 16.94 | 18.73 | 20.43 | 22.06 | 23.63 | 25.16 |
| 5             | 20.19               | 20.91 | 23.55 | 26.04 | 28.40 | 30.67 | 32.86 | 34.98 |
| 1             | 34.51               | 36.02 | 40.57 | 44.85 | 48.92 | 52.83 | 56.60 | 60.25 |

habitable canopied Earth, it is to that problem that we must now direct our attention.

The model proposed by Dillow in his thesis assumes a three-layer atmosphere. The top layer is the water vapor canopy. Beneath this he proposes a cloud layer with anywhere from 2 to 5 feet of precipitable water. It is not proposed to be a continuous cloud cover. This

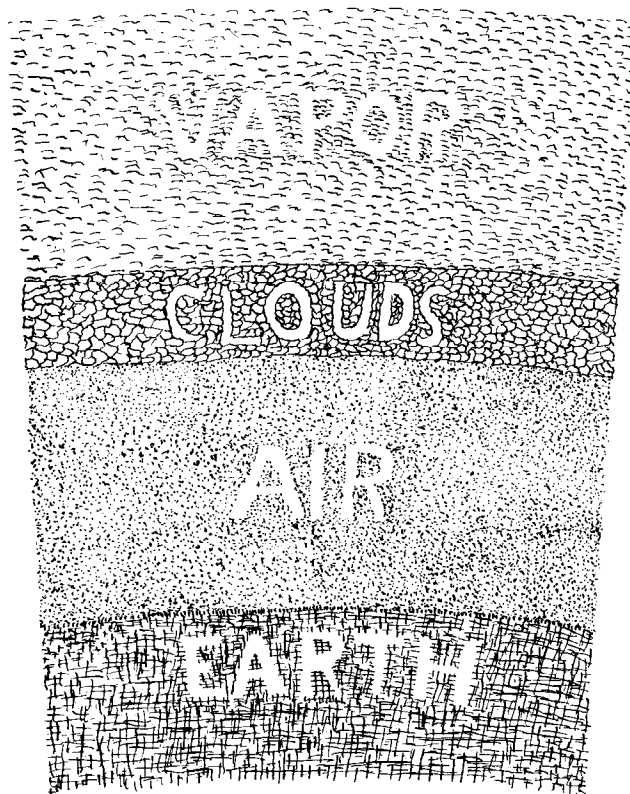


Figure 2. The model of the canopy and the underlying atmosphere, as used by several authors, was mostly recently by Dillow, in References 1 and 2. Not necessarily to scale.

means that some of the direct and diffuse solar radiation will be absorbed at the earth's surface. This means that there cannot be a temperature inversion under the canopy as can easily be shown. Finally the lowest layer is an atmosphere identical to the one surrounding the earth today. Thus this model is simply today's atmosphere surrounded by clouds and a vapor canopy. (see Figure 2)

This model will be used as a starting point. Two things will be investigated: 1) the temperature distribution of this atmosphere and, 2) the validity of the model itself; i.e. can clouds form underneath the canopy?

In any study of the thermal radiation in an atmosphere several assumptions must be made. These are as follows.

1. It is assumed that the atmosphere is optically stratified. This means that we can treat the atmospheric radiation by dividing the atmosphere into layers.

2. It is assumed that the emission of the atmospheric gases does not depend upon the direction. This is known as the Eddington approximation.

3. Energy from the sun is assumed to be absorbed only at the Earth's surface. This assumption is nearly the case today for a cloudless atmosphere, since only a small percentage of the incident solar radiation is absorbed directly by the atmosphere. Ignoring the atmospheric absorption in calculating the temperature profile tends to yield temperatures which are cooler than they should be. The reason for this is that some of the energy absorbed by the atmosphere would be re-radiated to the surface, thus making it hotter. Ignoring the atmospheric absorption is equivalent to raising the albedo of the earth by an amount which will make the earth reflect the same quantity of energy as the atmosphere absorbs. This assumption greatly simplifies the calculations.

4. It is assumed that radiative equilibrium is achieved. More accurately, the method of Emden which will be used calculates the temperature profile once equilibrium has been achieved.

5. The final assumption is that the atmosphere acts as a gray absorber. This simply means that the absorption coefficients can be considered constant over the spectral range being considered.

Consider a beam of electromagnetic radiation traveling through the atmosphere with an initial intensity  $I$ . A small portion of it is absorbed by each element of mass through which it passes. This portion is defined as,  $dI = Jk da$  where  $k$  is the absorption coefficient,  $J$  is the source function and  $da$  is the mass per unit area along the ray's path. The source function is the energy contained in the mass element which is capable of emission. This includes not only radiation absorbed by the mass element but also energy contained in the rotational and translational motions of the individual atoms.

The optical depth of a medium is defined as,  $d\beta = kda$ , so  $\beta$  is found by integrating  $kda$  between  $A$  and  $B$  where  $\beta$  is the optical depth of the travel path from point  $A$  to  $B$ .  $\beta=0$  is defined to be at the top of the atmosphere since it can be safely assumed that there is no significant amount of matter to absorb the radiation in space.

It can be shown that for a medium in radiative equilibrium <sup>4</sup>

$$\frac{dJ}{d\beta} = \frac{3}{4\pi} F \quad (7)$$

where  $F$  is the flux of radiation. It is related to intensity by  $F = \pi(I^* - I^-)$  where  $I^*$  and  $I^-$  are the upward and downward intensities of the radiation.

It can also be shown<sup>5</sup> that for a medium in radiative equilibrium with blackbodies  $B^*(0)$  and  $B^*(\beta^*)$  emitting at the top and bottom respectively that

$$\frac{F}{2\pi} = B^*(\beta^*) - J(\beta^*) = J(0) - B^*(0) \quad (8)$$

where  $B^*(\beta^*) = \sigma T^4/\pi$  and  $\beta^*$  is the total optical depth of the atmosphere measured at the surface.  $\sigma$  is Stefan-Boltzman's constant.

For a planetary atmosphere  $B^*(0)$  is zero since there is no blackbody above the atmosphere. Any energy that passes the upper boundary of the atmosphere leaves the earth altogether.

Therefore,

$$J(0) = \frac{F}{2\pi} \quad (9)$$

Rearranging and integrating Equation (7) we find,

$$J(\beta) = \frac{3}{4\pi} F\beta + C \quad (10)$$

where  $C$  is defined by Equation (9). Hence,

$$J(\beta) = \frac{3}{4\pi} F\beta + \frac{F}{2\pi} \quad (11)$$

At the lower boundary  $B^*(\beta^*)$  is the emission from the earth's surface. Rearranging Equation (8) we find,

$$B^*(\beta^*) = \frac{F}{2\pi} + J(\beta^*) \quad (12)$$

Now from Equation (11),

$$J(\beta^*) = \frac{3}{4\pi} F\beta^* + \frac{F}{2\pi} \quad (11^*)$$

so,

$$B^*(\beta^*) = \frac{F}{2\pi} \left( 2 + \frac{3}{2}\beta^* \right) \quad (13)$$

This equation defines the surface temperatures of the Earth given the flux of long wave radiation escaping into space and the total optical depth of the canopied atmosphere.

In order to determine what the flux is one needs to find the amount of energy which is absorbed at the Earth's surface. Each element of area of the surface absorbs  $dE_a = \pi R^2 S(1-A) \cos L \sin \theta d\theta dL$  where  $R$  is the radius of the earth,  $S$  is the solar constant,  $\theta$  is the solar height,  $L$  is the latitude and  $A$  is the albedo. Integrating over the sunlit half of the Earth we find that the energy absorbed is

$$E_a = \pi R^2 S(1-A) \quad (14)$$

Each surface element at the top radiating layer emits  $F$ . Multiplying this by the total surface area of the Earth yields

**Table 3. The surface temperature, in °K, for various amounts of water in the canopy, and various albedos.**

| Feet of Water | Albedo |      |      |      |      |      |      |      |     |
|---------------|--------|------|------|------|------|------|------|------|-----|
|               | .1     | .2   | .3   | .4   | .5   | .6   | .7   | .8   | .9  |
| 50            | 1574   | 1528 | 1478 | 1422 | 1359 | 1285 | 1196 | 1080 | 908 |
| 45            | 1533   | 1488 | 1439 | 1385 | 1323 | 1251 | 1165 | 1052 | 885 |
| 40            | 1488   | 1445 | 1398 | 1345 | 1285 | 1215 | 1131 | 1022 | 859 |
| 35            | 1440   | 1398 | 1352 | 1301 | 1243 | 1175 | 1094 | 988  | 831 |
| 30            | 1386   | 1345 | 1301 | 1252 | 1196 | 1131 | 1053 | 951  | 800 |
| 25            | 1324   | 1285 | 1243 | 1196 | 1143 | 1081 | 1006 | 909  | 764 |
| 20            | 1252   | 1215 | 1175 | 1131 | 1081 | 1022 | 951  | 859  | 722 |
| 15            | 1165   | 1131 | 1094 | 1053 | 1006 | 951  | 885  | 800  | 672 |
| 10            | 1053   | 1023 | 989  | 952  | 909  | 860  | 801  | 723  | 608 |
| 5             | 886    | 860  | 832  | 801  | 765  | 723  | 673  | 608  | 511 |
| 1             | 596    | 578  | 559  | 538  | 514  | 486  | 452  | 409  | 344 |

$$E_e = 4\pi R^2 F \quad (15)$$

For radiative equilibrium  $E_a = E_e$  thus,

$$F = \frac{S(1-A)}{4} \quad (16)$$

Substituting this into Equation (13) we have the surface temperature,

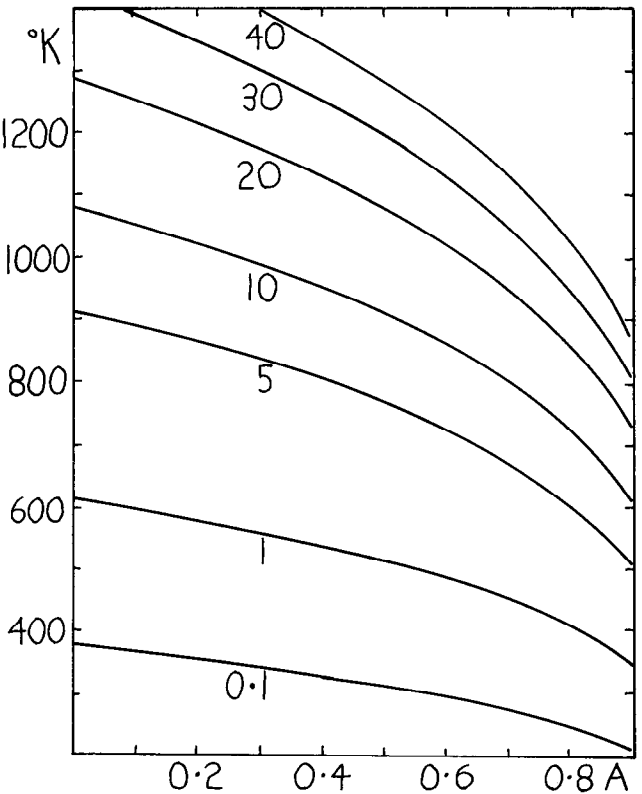


**Figure 3. The surface temperature, in °K, vs. the albedo. The curves again indicate different amounts of water in the canopy, in feet of liquid water as previously.**

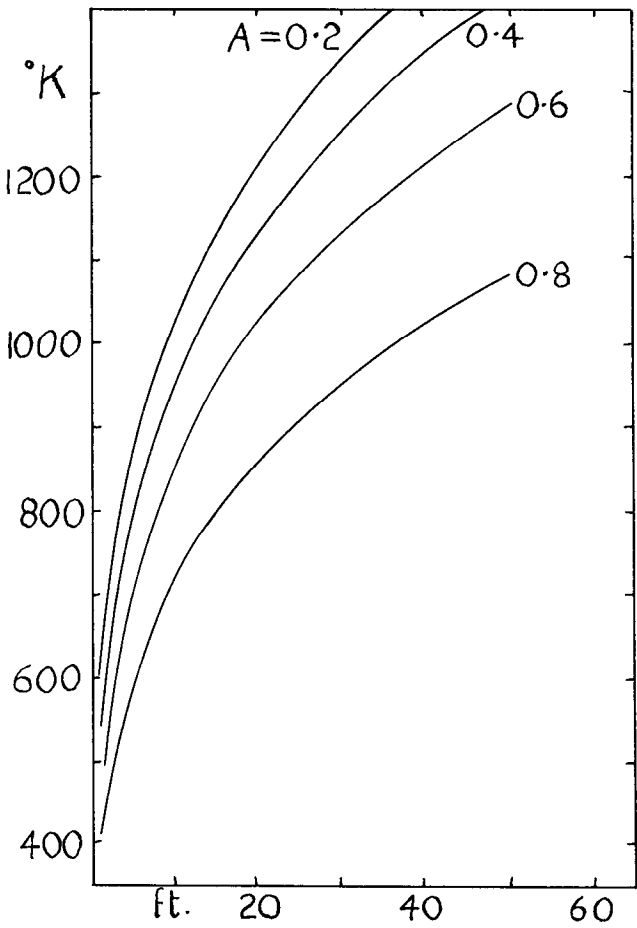


**Figure 4. The surface temperature, in °K, vs. the depth of the canopy, expressed in feet of precipitable water. The curves are for various albedos, indicated by A.**

$$T^4 = \frac{S(1-A) \left(2 + \frac{3}{2}\beta\right)}{8\sigma} \quad (17)$$

In order to find the atmospheric temperature profile as a function of optical depth we can represent  $J(\beta) = B(\beta)$ . Using Equation (11) we have

$$T^4 = \frac{S(1-A) \left(1 + \frac{3}{2}\beta\right)}{8\sigma} \quad (18)$$

Thus Equations (17) and (18) give us a total description of the temperature of the atmosphere and the Earth's surface as a function of optical depth. Using the approximation that one centimeter of precipitable water is equal to one optical depth over most of the infrared region, Table 3 lists the surface temperatures derived from the radiation solution (Equation 17). Figures 3 and 4 show how this temperature varies with albedo and canopy thickness. Figure 5 and Table 4 illustrate how the temperature of the canopy base varies with canopy thickness and albedo. These calculations, derived from Equation (18), assume that the lower layer of the canopied atmosphere is 3 optical depths thick.

As can be seen from inspection of Tables 1 and 3 the only parameters which will allow clouds to form under

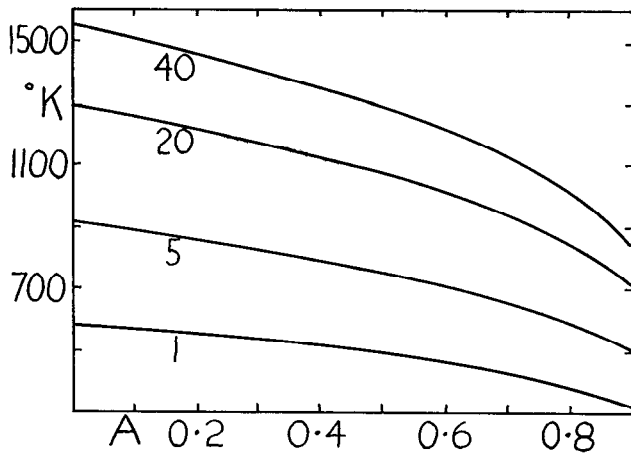


Figure 5. The temperature at the base of the canopy, in °K, vs. albedo. The curves are for various amounts of water in the canopy.

the canopy are a one-foot canopy with an albedo of 0.9. A canopy which only has one foot of precipitable water in it could hardly have produced a worldwide flood of a year's duration. Thus Dillow's model has a serious flaw in that clouds could not form under a very thick canopy. Thus ignoring the atmospheric absorption in our calculations turns out to be fairly close to the actual situation in a canopied atmosphere since very little of the direct solar radiation will be in spectral ranges which water vapor strongly absorbs. Had the clouds been able to form the situation would have been different because the clouds would have absorbed a fair amount of the incident solar energy and the temperatures derived from Equation (17) would have been cooler than actually would exist.

As mentioned previously only certain canopy heights are realizable given the radiation solution. Since Equation (17) defines  $T_0$  and Equation (18) defines  $T_c$  these can be substituted into Equation (6) to show the variation of the canopy height with canopy thickness and the

Table 4. The temperature, in °K, at the base of the canopy, for various amounts of water in the canopy, and various albedos.

| Feet of Water | Albedo |      |      |      |      |      |      |      |     |
|---------------|--------|------|------|------|------|------|------|------|-----|
|               | .1     | .2   | .3   | .4   | .5   | .6   | .7   | .8   | .9  |
| 50            | 1573   | 1527 | 1477 | 1421 | 1358 | 1284 | 1195 | 1080 | 908 |
| 45            | 1532   | 1487 | 1438 | 1384 | 1322 | 1251 | 1164 | 1052 | 884 |
| 40            | 1487   | 1444 | 1397 | 1344 | 1284 | 1214 | 1130 | 1021 | 859 |
| 35            | 1439   | 1397 | 1351 | 1300 | 1242 | 1174 | 1093 | 988  | 830 |
| 30            | 1384   | 1344 | 1300 | 1251 | 1195 | 1130 | 1052 | 950  | 799 |
| 25            | 1322   | 1284 | 1242 | 1195 | 1141 | 1079 | 1004 | 908  | 763 |
| 20            | 1250   | 1213 | 1174 | 1129 | 1079 | 1020 | 949  | 858  | 721 |
| 15            | 1163   | 1129 | 1092 | 1051 | 1004 | 950  | 884  | 798  | 671 |
| 10            | 1050   | 1020 | 986  | 949  | 907  | 857  | 798  | 721  | 606 |
| 5             | 881    | 855  | 827  | 796  | 760  | 719  | 669  | 604  | 508 |
| 1             | 577    | 561  | 542  | 522  | 498  | 471  | 439  | 396  | 333 |

Table 5. The height, in km., of the canopy, according to the radiation solution, for various amounts of water in the canopy, and various albedos.

| Feet of Water | Albedo |      |      |      |      |      |      |      |      |
|---------------|--------|------|------|------|------|------|------|------|------|
|               | .1     | .2   | .3   | .4   | .5   | .6   | .7   | .8   | .9   |
| 50            | 23.8   | 23.1 | 22.4 | 21.5 | 20.6 | 19.5 | 18.1 | 16.4 | 13.8 |
| 45            | 25.2   | 24.5 | 23.7 | 22.8 | 21.8 | 20.6 | 19.1 | 17.3 | 14.5 |
| 40            | 26.7   | 26.0 | 25.1 | 24.1 | 23.1 | 21.8 | 20.3 | 18.4 | 15.4 |
| 35            | 28.5   | 27.7 | 26.8 | 25.8 | 24.6 | 23.3 | 21.7 | 19.6 | 16.5 |
| 30            | 30.7   | 29.8 | 28.8 | 27.7 | 26.5 | 25.0 | 23.3 | 21.0 | 17.7 |
| 25            | 33.2   | 32.2 | 31.2 | 30.0 | 28.7 | 27.1 | 25.2 | 22.8 | 19.2 |
| 20            | 36.3   | 35.2 | 34.1 | 32.8 | 31.3 | 29.6 | 27.6 | 24.9 | 20.9 |
| 15            | 40.3   | 39.1 | 37.8 | 36.4 | 34.8 | 32.9 | 30.6 | 27.7 | 23.3 |
| 10            | 45.6   | 44.2 | 42.8 | 41.2 | 39.3 | 37.2 | 34.6 | 31.3 | 26.3 |
| 5             | 53.1   | 51.5 | 49.8 | 47.9 | 45.8 | 43.3 | 40.3 | 36.4 | 30.6 |
| 1             | 61.0   | 59.2 | 57.3 | 55.1 | 52.7 | 49.8 | 46.4 | 41.9 | 35.2 |

albedo of the Earth. The results are illustrated in Table 5, Figure 5 and Figure 7. Figure 8 shows how the atmospheric temperature varies with optical depth for an albedo of 0.4.

### Conclusions

The temperature profile for a canopied Earth appears to be too high for life to have existed. One might argue that since there is a "window" in the absorption spectrum of water vapor between  $8.5$  and  $13.5\mu$  that the excess heat at the Earth's surface can escape via those wavelengths. The Earth today radiates most effectively at those wavelengths. However, for a canopy of any appreciable thickness the optical depth for even the most weakly absorbing part of the window is still enough completely to block the direct escape from the surface of radiation of those wavelengths. For a forty-foot canopy the optical depth of this part of the window is approximately 122. If one insists upon retaining the

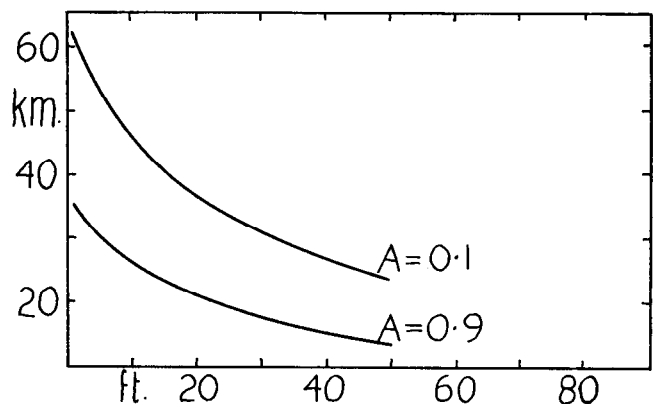


Figure 6. The height, in km., of the canopy, vs. the amount of water, in feet of precipitable water. The curves are for different albedos.

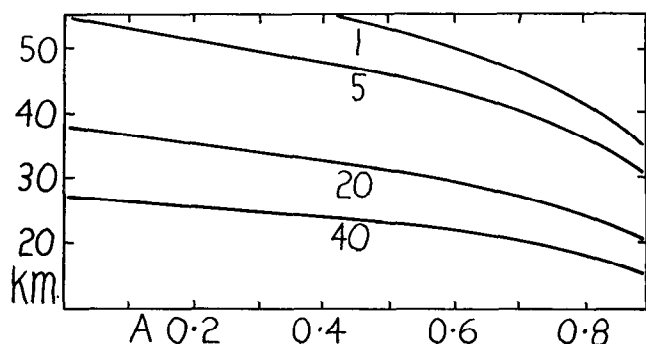


Figure 7. The height of the base of the canopy vs. albedo. The curves are for different amounts of water in the canopy.

clouds under the canopy even this argument fails. Since clouds are made up of water droplets, and liquid water absorbs very strongly in this window, the escape of heat via the window would be slowed considerably.

Obviously this result leaves quite a problem in interpreting Genesis 1:7. As shown here the waters spoken of can not be in the gaseous phase; neither can they be in the liquid form. That leaves only ice, or no canopy at all. A solid ice canopy can easily be shown to mechanically unstable;<sup>6</sup> so there remains only one alternative. That is that the Earth before the flood had a set of rings like Saturn's or Jupiter's, only made up of ice particles.

This author in conjunction with another plans to publish in the near future a new flood model based upon an expansion of the Earth due to a change in the permittivity of free space. The expansion of the Earth and its atmosphere is proposed as the explanation of why these rings no longer exist.

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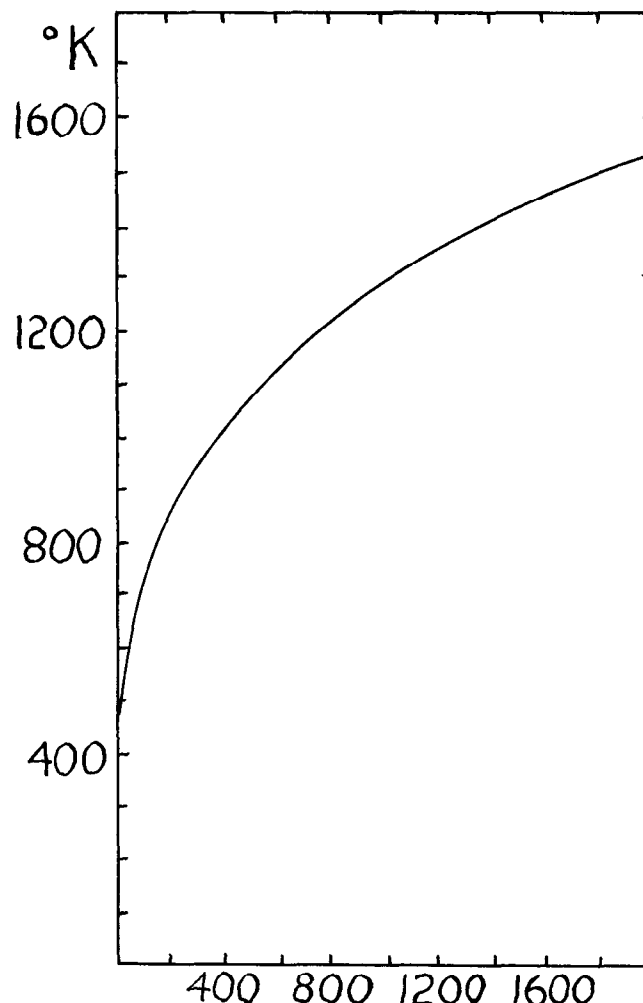


Figure 8. The atmospheric temperature, in °K, vs. optical depth (see the text). It is assumed that  $A = 0.4$ . Here  $A$  indicates the albedo.

<sup>6</sup>Kofahl, Robert E., 1977. Could the Flood waters have come from a canopy or extraterrestrial source? *Creation Research Society Quarterly* 13(4):202-206. See especially the end of p. 203 and the beginning of p. 204.

## THE RIVERS OF EDEN

GEORGE BEDIGIAN\*

Received 27 April 1979, revised from 2 March 1979

About the only geographical information about the antediluvian world is that given in Genesis 2:10-14. Some have suggested that the Flood so changed the face of the Earth that the present topography has no relation to that before the Flood. No doubt the Flood did cause great changes. But commonly in the early books of the Bible changes, such as different names for cities, are

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mentioned. So in this case the fact that no change is mentioned may suggest that the topography in Moses' time had at least some resemblance to that before the Flood.<sup>1</sup> This present investigation is an attempt, supposing that the above suggestion is true, to reach some conclusion about the location of the Garden of Eden, and the identity of the four rivers mentioned.

First, the Bible does not compel one to understand one source pouring into four outlets. For example, the

New International Version: "A river watering the garden flowed from Eden, and from there it divided; it had four headstreams. the name of the first is the Pishon; it winds through the entire land of Havilah, where there is gold. (The gold of that land is good; aromatic resin and onyx are also there.) The name of the second river is the Gihon; it winds through the entire land of Cush. The name of the third river is the Tigris; it runs along the east side of Asshur. And the fourth river is the Euphrates." (Gen. 2:10-14).

If the source was pouring out, yet had four heads, it was something like an artesian spring. It must have been in the highlands, perhaps in a lake like Lake Sevan<sup>2</sup> in Soviet Armenia.<sup>3</sup> It then received as tributaries in its course Araxes<sup>4</sup> in the Caucasus, Euphrates in Mesopotamia, Nile<sup>5</sup> in Egypt, and Indus<sup>6</sup> in India. Different nationals may substitute their own favorite river. Then, Flood-concurrent orogeny, and in subsequent centuries continental drift, separated the Edenic streams. This may be fanciful, or from lack of prior geographical knowledge. In which case, no map can cast sure light on this aspect of Bible history.

However, another interpretation has it that the river watered the garden by overflowing its banks,<sup>7</sup> in style of the Nile. When this concept is accepted, then we can face the question, where was Eden?

From Bible passages, we can get clues by association that it was in Mesopotamia.<sup>8</sup> So concur commentaries.<sup>9</sup> Then we turn to geography of the area itself.

Bible students readily accept that alFurat (Arabic, cf. the Hebrew Parath) is Euphrates, and Hiddekel is Tigris, and both have their confluence in lower Iraq. The other two rivers have been puzzlers. The Gihon (according to Strong's Concordance, ghee-khone from go-akh, to gush forth) may correspond to the Karun<sup>10</sup> river (the Ulai of Dan. 8:2) in Khuzestan province of Persia, rising from the Zagros mountains to the east, and "gush"-ing down. In history Khuzestan<sup>11</sup> was the land of the Kassites or Kashshu or Cosseans. In three versions Gihon<sup>12</sup> is located in Ethiopia, but twelve other versions state it as Cush<sup>13</sup>; and that resembles Khuz. Some commentaries<sup>14</sup> also support Khuzestan for Cush.

Pishon (Strong; "dispersive") has been the deepest mystery. From Gen. 25:18 it is between Egypt and Assyria. And a look at the map shows it may correspond to Wadi al Batin<sup>15</sup> meandering from the southwest Arabian desert, passing the town of Ha-il. Ha-il also is a region<sup>16</sup> of 75,000 square miles (also known as Jabal Shammar) in northern Arabia. Toward the west the watercourse is buried in sand awhile, then continues west toward the Hejaz<sup>17</sup> hills as Wadi Rummah<sup>18</sup> and Wadi Faishan.<sup>18</sup> And Arabia has been known to produce gold, incense and precious stones.

When syllables of a word are separated by vowels, the tendency is to insert a consonant between. For example, going become go-wing. Thus Ha-il is also known as Hayel<sup>19</sup>, conceivably the inserted consonant could be a "v" making it Ha-vil. In English the single syllable George is from the Greek three-syllable Ge-org-os (hard g), which in Armenian becomes Kevork.

Wooley<sup>20</sup> may further substantiate Batin, "Just by the modern town of Muhammerah in Persia . . . the river Karun empties into the Shatt-al-Arab. Almost opposite



to it is the Wadi al-Batin, now dry but once a great river running up from the heart of Arabia. The Karun brings down from the Persian hills as much silt as do the waters of the Tigris and the Euphrates combined, and the old al-Batin stream, though more sluggish, must have been almost as rich in silt . . ."

Some may point out that the Persian Gulf was not yet silted<sup>21</sup> at this point; that the four rivers, though close together, flowed directly into the upper Persian Gulf, which has only since filled. However, according to the canopy theory, the ocean level prior to the Flood was some score of feet lower than now, by reason of the amount of water in the canopy in the upper atmosphere. Thus all four streams would be allowed to flow together.

Here at the confluence of four great streams: Batin (about 800 miles), Karun, Tigris and Euphrates<sup>22</sup> (528, 1180 and 2235 miles respectively), may well be the site of the historic Garden of Eden. And just incidentally, the Biblical writer has listed them in order counter-clockwise, entering from the south, east, north and west.

It is suggested, then, that the Garden of Eden might have been around what is now the head of the Persian Gulf, about the middle of the map shown here.<sup>23</sup>

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(Continued on page 153)

## SCRIPTURE DOES NOT RULE OUT A VAPOR CANOPY

JOSEPH C. DILLOW\*

Received 2 February, 1979

*Although the subject of the vapor canopy has been discussed for years, some creationists remain unconvinced of its existence for both scientific and Scriptural reasons. This article is an attempt to refute two common objections from Scripture which opponents of the vapor canopy theory have frequently used: Genesis 1:14-17 and Psalm 148:1-10.*

For a number of years the idea of a water vapor canopy has been derived by creationists from Genesis 1:6-8. In this writer's opinion, the evidence for such a canopy is quite good and clearly arises out of a plain reading of the related texts. This evidence has been carefully developed elsewhere and will not be repeated here.<sup>1</sup> It is likely that Genesis 1:6-8 teaches the existence of a literal oceanic mass raised up above the ancient earth during the creation week. It is proposed by this writer that this liquid ocean was arranged in a water vapor phase by the Creator immediately after it was lifted above the atmosphere. Although there is not statement to this effect in the Bible, a vapor form (i.e., superheated invisible steam) is the only form in which such a vast canopy could be maintained without appeal to special miracle. The physics by which this canopy was maintained is a serious problem; but a plausible theory has been developed.<sup>2</sup> The purpose of this article is to consider briefly two exegetical arguments commonly used by opponents of the vapor canopy theory to refute its Scriptural basis: Genesis 1:14-17 and Psalm 148:1-10.

### Does a Literal Emphasis on "above" in Genesis 1:6-8 Require a Canopy Beyond the Stars?

For some time it has been observed that there is a definite literary structure around which Moses presents his account, which from one viewpoint is a polemic. In showing us how the God of the Hebrews is superior to the pagan gods, Moses tells us that His creative activity involved giving of structure to that which was "formless," and filling of that which was empty. The problem that Yahweh had to overcome (to view the matter as an engineer might) was that the earth was "without form and void" (Gen. 1:2). Moses neatly divides the acts of creation into two groups: the first three days correct the "without form" condition, and the second three days correct the "void" condition,<sup>3</sup> as is shown in Table 1.

Waltke summarizes:

The parallelism of the last three days with the first three is apparent. Whereas on the first day there is light, on the fourth day the light is localized into luminaries; whereas on the second day there is separation of water and sky, on the fifth day there are created the fish to fill the seas and the birds to fill the skies; whereas land and vegetation were created on the third day, on the sixth day the land animals and man are formed who lived on the land and are sustained by its vegetation.<sup>4</sup>

This literary structure reveals to us that Moses intends to tell us something as to the "structuring" of that

**Table 1. The correspondence between days 1-3 and 4-6.**

| <i>The creative acts.</i>                   |  |                                  |  |
|---------------------------------------------|--|----------------------------------|--|
| To correct the "without form" condition     |  | To correct the "void" condition. |  |
| Three acts of                               |  | Three acts of                    |  |
| Day dividing.                               |  | Day furnishing.                  |  |
| 1 Light from darkness                       |  | 4 Luminaries                     |  |
| 2 Upper waters from lower waters. (Expanse) |  | 5 Fish and birds                 |  |
| 3 Lower waters from dry land.               |  | 6 Beasts and man.                |  |

which is formless on the first three days and the filling up of that which was empty (Heb. *bohu*, void, empty) on the second three days. This observation of the literary structure helps resolve an apparent difficulty in taking the *above* in a literal mechanistic sense in 1:7 and yet switching to an "observer true" sense when interpreting *in* in 1:15, "Let them be for lights *in* the expanse of the heavens . . ." Robert Whitelaw, e.g., has argued:

Those who insist on ultra-literalism in vs. 1:7-8 to teach a specific body of water above the firmament, should be equally literal in vs. 14-17 where God puts the sun, moon and stars *in* (not *above*) this same firmament. Taken literally then, if the canopy is taught here it lies beyond the stars.<sup>5</sup>

But WHY should one who is literal in 1:7-8 in regard to the "above" be "equally literal" in vs. 14-17 in regard to "in"? Whitelaw does not say. Literature is full of illustrations of authors using both "observer true" and "mechanistically true" language in the same paragraph. There is no known precedent for Whitelaw's assertion. Context must determine such things and not some arbitrary, inflexible principle. Furthermore, in this particular section, the context informs us that Moses himself may have had just such a distinction in mind. Structuring the unformed by "dividing" is the emphasis on the first three days, and "filling" the empty is the force of the last three. Since the intent of the placing of the stars is for observation, it seems justifiable to press for an "observer true" use of *in* in 1:15. But the purpose of the expanse was to divide between two bodies of liquid water in 1:7, hence a mechanistic use of *above* is probable.

If the *same* "firmament" is referred to in vs. 7 and 14 (i.e., the atmospheric heavens), then in vs. 7 the text speaks of water which is actually above the "firmament" (mechanistically true), and in vs. 14 it speaks of

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lights which “appear to be in” the firmament (observer-true). On the other hand it may be that the heavens of vs. 7 are atmospheric and the heavens of vs. 14 are intergalactic. It is clear that the Hebrews *did* sometimes use the word *shamayim* for intergalactic space. The phrase, “heaven of heavens,” or the uppermost of the *created* heavens, distinguished it from the lower heavens just as the “holy of holies” is distinct from the “holy place.” The heaven of heavens is not the abode of God in that it was created (Neh. 9:6 and Ps. 148:5), and God does not dwell there (I Kings 8:27). The phrase is used seven times (Deut. 10:14, I Kings 8:27, 2 Chron. 2:6, 6:18, Neh. 9:6, Ps. 68:33, 148:4). Also, if 2 Corinthians 12:2 speaks of the abode of God (i.e., the *third* heaven), would not the *second* heaven refer to interstellar space?

Furthermore a glance at Table 1 reveals another clearly delineated structural feature mentioned above: there is a movement in both sets of three days from heaven to earth. A spatial sequence is implied. God first creates light somewhere “out there” above the earth. Next in the spatial sequence are the waters above the expanse, then the expanse and the waters below the expanse (1:7-8). Finally, *below* the “waters above” and *below* the expanse, is the earth. Clearly the sequence suggests that the “waters above” of the second day are *below* the light created on the first day and *above* the earth created on the third. If this is granted from the apparent structural intent of the author, then would it not follow that the luminaries of the fourth day which correspond to the light of the first day are, like that light, also *above* the “waters above”? This would reinforce the “observer true” interpretation of the “in” of 1:15, while allowing the “mechanistically true” interpretation of the “above” in 1:7. This is reinforced by the apparent correspondences between days 2 and 5 (fish and birds “fill” the expanse and lower waters); and between days 3 and 6 (man, animals, and vegetation “fill” the dry land).

#### Are the “Waters Above” Still Present Today? (Psalm 148)

A second text has often been used as Scriptural evidence against the vapor canopy: Psalm 148. In this Psalm of David, the psalmist calls upon the “waters that are above the firmament” to give praise to God. Coffin maintains that, since the psalmist lived long after the flood and is still referring to the “waters above the heavens,” that the parallel phrase in Genesis 1:7 cannot refer to a liquid ocean (or a vapor canopy) because that would imply it was still up there in David’s time; thus, the Genesis passage must refer to clouds.<sup>6,7</sup>

1. Praise the Lord  
Praise the Lord from the heavens;  
Praise Him in the heights!
2. Praise Him, all His angels;  
Praise Him, all His hosts!
3. Praise Him, sun and moon;  
Praise Him, all stars of light!
4. Praise Him, highest heavens,  
And the waters that are above the heavens,
5. Let them praise the name of the Lord,  
For He commanded and they were created.

6. He has also established them forever and ever;  
He has made a degree which will not pass away.
7. Praise the Lord from the earth,  
Sea-monsters and all deeps;
8. Fire and hail, snow and clouds;  
Stormy wind, fulfilling His word;
9. Mountains and all hills;  
Fruit trees and all cedars;
10. Beasts and all cattle . . . (Psalm 148:1-10, NASB).

Psalm 148 falls naturally into two divisions. In verses 1-6, psalmist gives us his praise of God “from the heavens,” and his focus is on the glories of the creation—the creation of the sun, moon, stars, angels, etc. In verses 7-12, the psalmist shouts his praises to the Lord “from the earth,” and his focus is on God’s sovereign control over wind, fire, beasts, cattle, kings, old men and children. In verse 4, the psalmist declares:

Praise Him, highest heavens,  
And the waters that are above the heavens!

The phrase, “waters that are above the heavens,” is similar to the phrase, “the waters above the expanse,” of Genesis 1:7. These waters are associated with the *heavens*, and are declared to be above them. Furthermore, they are set in contrast, with the hail and snow, i.e., “waters,” which are associated with his praise of the Lord “from the earth” in verses 7-12. In verse 8, he says:

Fire and hail, snow and clouds;<sup>8</sup>  
Stormy wind, fulfilling His word.

The “waters above the heavens” of the creation week seem to be distinct in the psalmist’s mind from the hail and snow of earth which God sovereignly controls today.

In regard to the phrase, “the waters that are above the heavens,” in verse 4, Perowne says:

This is usually explained of the clouds, though the form of expression cannot be said to favour such an interpretation, nor yet the statement in Genesis, that the firmament or expanse was intended to separate the waters above from the waters below. Taken in their obvious meaning, the words must point to the existence of a vast heavenly sea or reservoir.<sup>9</sup>

Typically, the liberal commentators tend to see this text as proving that David in 1000 B.C. believed in the existence of the vast heavenly reservoir. Dahood observes, “Above the visible vault of heaven there was believed to be a reservoir, the source of rain.”<sup>10-12</sup> Conservative commentators generally take the traditional view that both Genesis 1:6-8 and Psalm 148:4 refer to clouds.<sup>13-14</sup> One difficulty with the cloud interpretation of this passage is that it contradicts a normal exegesis of Genesis 1:6-8.<sup>15</sup> On the other hand, if the critical view, i.e., a heavenly sea, is valid, then it would follow that not only did the Hebrews believe in a celestial ocean prior to the flood, but they also embraced the world view of the metallic dome and present existence of the celestial sea held by the Canaanites! The latter view contradicts the inerrancy of Scripture and fails to note the differences in Israel’s cosmology from Canaanite myths.<sup>16</sup>

In favor of the cloud interpretation of Psalm 148:4 (and therefore by implication, Genesis 1:6-8) is the fact that the "waters that are above the heavens" are called on *in David's time* to praise God. Therefore, David, it is argued, must have assumed their present existence or he would not have asked to give praise. However, to press this highly figurative language to imply *present* existence of the heavenly ocean simply because this ocean is being addressed in the present and called to do something, i.e., praise God, in the present, is clearly unwarranted. Technically, this figure of speech is called "apostrophe," that is, "a turning aside from direct subject-matter to address others."<sup>17</sup> A characteristic of this figure of speech is that the person or thing being addressed and called upon to do something in the present *may not exist in the present, but may have existed in the past or may exist in the future*. For example, David laments over the departed Saul and addresses him as if present (2 Sam. 1:24, 25). The prophet Ezekiel addresses some hailstones that are to come upon the false prophets in the *future* as if those hailstones existed right then (Ezek. 13:11). Poetic language is characterized by "license." The poet is free to address anyone from the past as if he is present right now and to call upon him to do something. The point of such a figure must be determined by who is called upon and what it is he (or "it," in this case) is asked to do. By examining that question, clues are yielded up that reveal the intent of the author in using the apostrophe.

Now, in Psalm 148:4, it is quite clear that the actual presence of the "waters above" is irrelevant. They represent the chaos that God conquered (i.e., the deep). As those who have done battle with Yahweh and lost, they are called upon now to praise His name! ("... that at the name of Jesus, every knee should bow..." Phil. 2:11). In the battle myths, the Chaos monster never praised her conqueror, but the chaos of creation has no choice—order has been imposed.

It has also been asserted that the fact that it says that God established these waters above "forever and ever" and "made a decree which will not pass away," suggests that if "waters above" refers to a celestial reservoir, then why did they "pass away" at the Flood? The phrases, "forever and ever" and "a decree which will not pass away," are commonly understood in the Biblical mentality to refer to God's providential control of creation. Thus, they will not pass away or change unless God permits; i.e., all is under His control. As Briggs says, "He established His law in the heavens... all have to submit to it. This is the nearest approach to immutable laws of nature that is known to Hebrew literature."<sup>18</sup> Hengstenberg points out that this decree, "... excludes all change in what has been made, that would be contrary to the will of the Creator, from Whom the different parts of Creation can never emancipate themselves to all eternity."<sup>19</sup> The fact that the Hebrew word, *ad*, "forever and ever," often means for a long period of time (or until God decides to change the situation) is well established.<sup>20</sup> Hence, nothing can be made of the fact that the waters will never pass away as evidence that clouds must be meant. This is highly poetic and metaphorical.

The phrase seems to parallel Genesis 8:22, and a

chronological sequence is implied. The psalmist takes us from the first created beings, the angels (148:1), through the creation week with the creation of the sun, the moon, the stars, etc. (148:2, 3), and the "waters above" (148:4); then, he pronounces the final decree establishing the uniformity of nature after the flood (compare Genesis 8:22 and Psalm 148:6). At that point, he turns his attention to the present era and begins praise of the Lord *from the earth*.

Several factors seem to weigh in favor of this interpretation.

(1) The psalmist tells us that the first six verses describe a creation context: "for He commanded and they were created" (148:5). Thus, he is telling us of the creation of the heavens and the imposition of order upon them.

(2) The psalmist clearly distinguishes between the "waters of heaven" in verse 4 and the hail and snow which are connected with the waters found in the clouds in verse 8.

(3) This view allows us to take the phrase, "the waters that are above the heavens," in its normal literal force of a heavenly reservoir without requiring its continued presence in David's time, and thus harmonizing with a normal exegesis of Genesis 1:6-8.

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## THE PONDERINGS OF AN OPTIMISTIC EVOLUTIONIST

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Received 17 July, 1979

*As I was sitting in my chair,  
I knew it had no bottom there,  
Nor legs, or back, but I just sat,  
Ignoring little things like that.*

Though the poem is not original, it does show the precarious position that evolutionists put themselves in when sitting on the chair of the General Theory of Evolution.

The bottom of the chair is the fossil record. The evolutionist sits comfortably on the fact that fossil organisms appear to be more complex as the geologic column is ascended. The rocks are dated by their position in the column as well as by radiometric dating. It was found that usually the "older" rocks contained the simpler fossils. He knows that the record does not contain the transition fossils he predicts, and that most of the assumptions of radiometric dating are invalid. He also knows that fossils have been found out of position (i.e., "older" lying over the "younger"), but still he sits comfortably with the faith that these things, in time, will pass.

The legs of the evolutionary chair is composed of the premise of there being no Creator. The evolutionist sits very securely on this premise for these legs support the entire chair. Since no Creator has existed, all things must have come into being through naturalistic and materialistic processes. Evolution, therefore, must have occurred, for after all, we are here, are we not? The introduction of a Creator into the scientific realm is next to heresy. Of course, the evolutionist knows that his model can not explain where the first mattergy came from. The First Law says that mattergy could not be

created out of nothing. If mattergy has existed for eternity, the Second Law says that the universe would have undergone "Heat Death" long ago. He knows that the effect can not be greater than the cause, yet he sits with great confidence and security upon the legs of the evolutionary chair.

I believe the back of the evolutionist chair, upon which he leans, is the back of extrapolation. Evolutionists lean heavily on extrapolation, from variation to macro-evolution and from present geological processes to uniformitarianism. He knows these extrapolations are invalid because experimental evidence shows that there is a definite limit to change, for no one has ever observed one kind of organism changing into another kind. The evidence also shows that the earth's change in geological history has not been uniform in rate or degree. But still he leans firmly against the chair.

The evolutionist probably envisions his chair to be more like a throne sitting high and magnificent. and he, on the throne, judging all biological and paleontological data by his evolutionary philosophy, crushing all who have the audacity to oppose him. He smiles over the fact that he has won over the minds of men and their disciplines to his philosophy of religious humanism.

A creationist happened to see this evolutionist in his reverie and was curious as to how the evolutionist could be suspended without support. "Well, if faith can move mountains," the creationist thought, "it most certainly can support an evolutionist." And that's exactly what's supporting them today.

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## THE NATURAL WORLD: STRUGGLE OF THE STRONGEST OR BALANCE OF ALL — BOTH THE STONG AND WEAK

JERRY BERGMAN\*

Received 6 June, 1979

For the last 100 years, the Darwinian view of survival of the fittest—picturing fierce struggles within nature—has dominated our view of the natural world. This view sees nature as cold and ruthless—eliminating those who are for some reason "less fit" to survive, or, in some way weaker. Pictures of ferocious lions devouring helpless antelopes, or even ruthless bacteria ravaging innocent does, have predominated in both our view

of the natural world, and our literature and scientific research.

Another view, though, seems to be more and more accepted. For example, Dr. Lewis Thomas, currently President and Chief Executive of the famous Memorial Sloan-Kettering Cancer Center in New York City, and a medical doctor, biologist, researcher, and professor in many of the leading American universities, in his latest book *The Medusa and the Snail* argues that the overwhelming tendency in nature is toward symbiosis, union, and harmony! Thomas concludes that the post-

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Darwinian view of life as a constant murderous struggle as immortalized in Tennyson's "red in tooth and claw" view of nature is simply not an accurate picture of reality.

Most animals only kill what they need to live—and then the killing is quick and to a large degree painless. In addition, we are finding that this killing is necessary in order to maintain the balance in the natural world. If predators, such as lions and wolves, were destroyed in large numbers, many animals would reproduce at such fast rates that they would soon use up the food supply—and die anyway. Thomas, relying upon his own experiences, and the research by people such as Paul Moody of those people who were clinically dead and then revived, concludes that when death is imminent the brain apparently realizes that pain can no longer be useful as an alarm to spur escape. The result is that pain is turned off and replaced by "kind of blissful surrender"—thus we have numerous reports of the experience before death as being a very peaceful experience. Thomas concludes that "If I had to design an ecosystem in which creatures had to live off each other and in which dying was an indispensable part of living, I couldn't think of a better way to manage."

From the title of his latest book, Thomas discusses the case of the Nudibranch (a sea slug or snail) and the Medusa (a jellyfish) that live in the Bay of Naples. The Medusa lives permanently on the snail, parasitically attached near its mouth. In time, the Medusa reproduces; its offspring swim and become normal adult jellyfish. In the meantime, the snails, though, are not digested by the jellyfish but they begin to eat the jellyfish, browsing away at first at the jellyfish's radial canals. The snails progressively eat the jellyfish—until the snail outgrows its host. In the end, the jellyfish are once again tiny parasites, except that they now live off of the snail! The whole cycle then is repeated. This Thomas terms an underwater dance, and the implications of this symbiosis follows throughout the book. Life, in other words, is not a matter of to eat or be eaten—but being both eaten and eating.

### QUOTABLE QUOTE

"As sacred doctrine is based on the light of faith, so is philosophy founded on the natural light of reason. Hence, it is impossible for items that belong to philosophy to be contrary to those that pertain to faith; but the former may be defective in comparison with the latter. Yet, they contain some likenesses and some prolegomena to the latter, just as nature is a preamble to grace. If any point among the statements of the philosophers is found contrary to faith, this is not philosophy but rather an abuse of philosophy, resulting from a defect in reasoning. So, it is possible, from the principles of philosophy, to refute an error of this kind either by showing that it is an impossibility, or by showing that it is not a necessary conclusion. Just as items of faith cannot be proved demonstratively, so items that are contrary to them cannot demonstratively be shown to be false; yet, it is possible to show that they are not necessarily convincing.

Looking at the natural world as a whole, cooperation and not competition may be the rule of the day—indeed, competition may be our misunderstanding of what is truly cooperation. The implications of this are clear. The entire Darwinian view of life may be an inaccurate and narrow distortion of reality. Indeed, the key to the whole science of ecology is *balance*, not competition where one animal increases its gene pool, or expands its population in direct proportion to its ability to "eat and avoid being eaten" or outdo its competitors.

Nature enthusiasts, especially those who have travelled to parts of the world where there is a large number of wild animals, have noticed that the vast majority of time animals are at peace with one another and the world around them. Even the stereotypic predators, such as lions, tigers, wolves and other large carnivorous animals, spend most of their time lazily lying in the sun, tending their young, sleeping or playing. True, it is occasionally necessary for carnivorous animals to hunt their prey, but once a victim is killed, there is typically enough food for days, and the animal then is at peace with the world around it. It is not necessarily the animal that runs the slowest, or is somehow "least fit" that becomes prey to a predator. Typically, chance is the most important factor—the animal that happens to be in the wrong place at the wrong time. In hunting, place and time are extremely important—and both of these factors are highly influenced by chance, not "fitness." True, the extremely sickly may be prone to be caught; but many animals will not attack sick animals, and many sick animals die before they are caught. In addition, the elimination of sick animals likely serves to ensure that the species stay at the same level of fitness; but it does not advance the species. Selection may be an important mechanism only for preserving the status quo, and not for so-called advancement.

### Reference

Thomas, Lewis, 1979. *The Medusa and the snail*. Viking Press.

And so, we can use philosophy in sacred doctrine in three ways: (1) to demonstrate items that are preambles to faith . . . (2) to make known those items that belong to the faith by means of certain similitudes . . . and (3) to oppose statements against the faith, either by showing that they are false, or by showing that they are not necessarily true."

St. Thomas Aquinas, *Exposition of Boethius on the Trinity*, translated by V. J. Bourke.

This is contained in *The Pocket Aquinas*, edited by Vernon J. Bourke, 1960. Washington Square Press, New York. Pp. 292 and 293.

Note that in this quotation philosophy includes what would now be classified as science.

### Scripture Does Not Rule Out

(Continued from page 173)

<sup>18</sup>Briggs, *op. cit.*, p. 539.

<sup>19</sup>Hengstenberg, *op. cit.*, volume 3, p. 550.

<sup>20</sup>Cf. Psalms 21:4, 6; 37:29; and 9:5; Habakkuk 3:6; Job 19:24, and 20:4; etc..

## THE EXPANSION OF THE UNIVERSE: A STUDY OF THE INITIAL CONDITIONS

G. RUSSELL AKRIDGE\*

Received 19 February, 1979

*The big bang model of the universe, frequently alleged to prove that the universe is billions of years old, is examined using first classical Newtonian mechanics and then general relativity. The model is, in fact, found to be incapable of determining the age of the universe, and does not prove the age usually associated with the model. A recent Creation is just as consistent with the laws of physics of the model as the big bang followed by the vast times needed for evolution. A modified Hubble's law is thus derived. This modified Hubble's law shows, among other things, that the quasars, for instance, are not as distant as previously believed. This reduction in the distance to quasars should aid the understanding of the energy which they radiate.*

### Introduction

The expanding universe is a world view popularized especially by George Gamow<sup>1</sup> and generally accepted by astronomers as being the history of a 15 billion-year-old universe. This article is an analysis of the expanding universe.

Simplified, this world-view states that each galaxy in the universe is moving away from all the other galaxies at a speed directly proportional to the distance between galaxies. As seen from our galaxy, the Milky Way Galaxy, all other galaxies appear to be moving radially away from us, as illustrated in Figure 1.

The experimental evidence supporting the expanding universe is an indirect chain of observations. It is not my purpose to examine that evidence<sup>2</sup> in this article. However, the final step in this chain of observations is a correlation of two sets of data. First, the radial velocity of a galaxy can be inferred from a measurement of its Doppler shift. Second, the distance to the galaxy can be measured by an independent method. Plotting these two

measurements for many galaxies gives the graph illustrated in Figure 2. The experimental points in such a figure clearly describe a straight line through the origin, the equation of which is

$$v = Hr, \quad (1)$$

where  $v$  is the radial velocity of another galaxy,  $r$  is the distance to that galaxy, and  $H$  is a constant of proportionality known as Hubble's constant. Equation (1) is the solid line in Figure 2. From the graph, the numerical value of the Hubble constant, the slope, is found to be approximately

$$H = 10^{-5} \text{ miles/sec light year.} \quad (2)$$

The Hubble equation (1) can only be checked out to a distance of one or two billion light years, because for distances believed to greater than that, the actual distance to the galaxies are not known. Thus, equation (1) should actually read

$$v = Hr, \quad r < 2 \text{ billion light years.} \quad (3)$$

However, since the equation works so well for  $r < 2$  billion light years, it is assumed to hold true for distances greater than 2 billion light years. For these great distances, Equation (1) is used to determine the distance of a galaxy from its measured Doppler shift velocity and the known value of the Hubble constant.

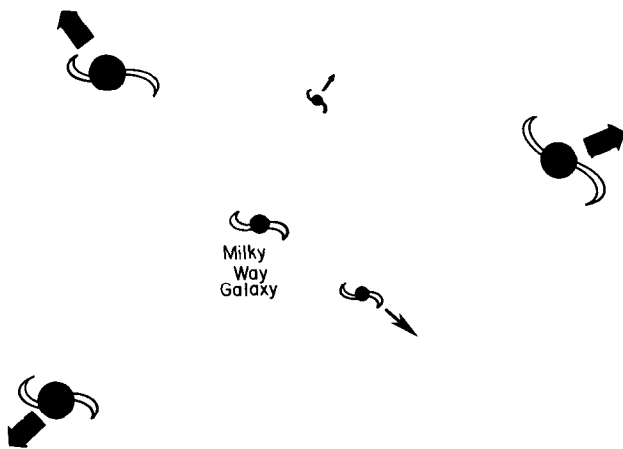


Figure 1. The expanding universe as seen from the Milky Way Galaxy.

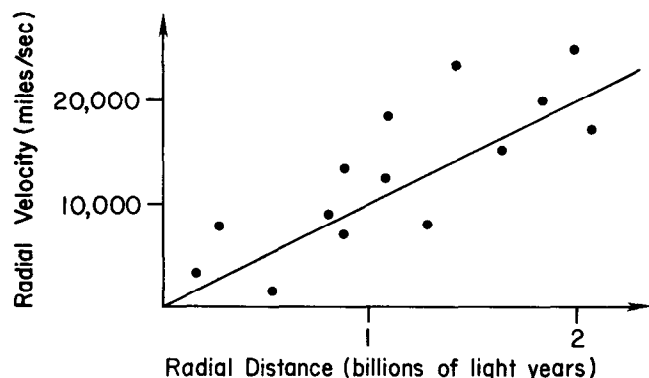


Figure 2. The graph of velocity vs. distance for galaxies. The distances and velocities are the observed ones.

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The motion described by Equation (1) is similar to the motion of the fragments of an explosion in which all the fragments started from the same place. The more distant fragments are further from the point of the explosion, only because they move faster; the velocity is proportional to the distance. Assuming the velocities to be more or less constant,  $v = rt$ , where  $t$  is the time since the explosion. Using this constant velocity equation in Equation (1) gives<sup>3</sup> for the time<sup>4</sup> since the explosion,

$$t = \frac{1}{H} \approx 18 \text{ billion years} \quad (4)$$

Thus, it appears that approximately 18 billion years ago all of the matter in the universe was concentrated together in a relatively small volume, exploded and has been expanding ever since. This summary describes Gamow's Big Bang theory of the origin of the universe.

Thus, it seems that the experimentally verified Equation (1) and the Hubble constant prove the universe to be 18 billion years old. Such a simple, but seemingly factual demonstration puts a Creationist in an awkward situation if it is true.

This article shows that the Hubble constant does *not* determine the age of the universe, even if equations (1), (2), (3) and (4) are correct. Rather, this article shows the Hubble constant is a very slowly varying function of time that determines the present *density* of the universe, not its age.

### Equation of Motion

This section examines the motion of the universe after the big bang. All of the results are obtained under the assumption of classical Newtonian mechanics. Relativistic considerations are discussed in Appendix A.

Suppose that prior to time  $t = 0$ , the universe consisted of one uniform<sup>5</sup> sphere of radius  $R_0$ . At time  $t = 0$ , the big bang occurred, and all parts of the sphere began

moving radially outward with speed  $v_0(r)$  as shown in Figure 3. The uniform mass density of the sphere at  $t = 0$  is  $\rho_0$ . The resulting motion of the universe after the big bang is determined by the initial conditions and by the law of gravity. All other forces will be neglected. The simplest non-trivial initial condition described all matter as having energy  $E = 0$  immediately after the big bang. This initial condition also yields a result in agreement with the apparent state of motion of the universe as described by astronomers today. Currently, astronomers believe the universe is expanding radially outward. They also believe that it is on the borderline between (a) continuing its expansion to infinity forever, and (b) stopping its expansion and beginning to contract sometime in the distant future. The condition  $E = 0$  in this section of the article yields a universe which just barely expands to infinity in an infinite time. This model is called the flat model of the universe. Any more energy, and the universe would continue to expand at a significant rate forever. The second model is called the open model of the universe. Any less energy, and the universe would stop its expansion at some finite time in the future, and contract after that time. This third model is called the closed model of the universe. Only the flat model is considered here because it seems to lead to the observed motion of the universe.

The thin spherical shell of thickness  $\Delta r$ , a distance  $r_0$  ( $0 < r_0 < R_0$ ) from the origin at time  $t = 0$  as shown in Figure 3, would have energy  $\Delta E = 0$ , so that

$$\frac{\Delta m}{2} v_0^2(r_0) - \frac{G \Delta m M_0(r_0)}{r_0} = \Delta E = 0 \quad (5)$$

In Equation (5),  $\Delta m$  is the mass of the thin spherical shell,  $M_0(r)$  is the mass *within* the spherical shell, and  $v_0(r)$  is the initial radial velocity of the spherical shell. The first term in Equation (5) is the kinetic energy. The second term is the usual gravitational potential energy due to only the mass within  $\Delta m$ . It can be shown that for this spherical distribution the gravitational effects of the mass outside of  $\Delta m$  cancel.<sup>6</sup> The mass within  $\Delta m$  is the uniform density at time  $t = 0$  times the volume within  $\Delta m$  at time  $t = 0$ , or

$$M_0(r_0) = \rho_0 \frac{4}{3} \pi r_0^3. \quad (6)$$

When Equation (6) is substituted into Equation (5) the radially outward velocity at time  $t = 0$  is found to be proportional to  $r_0$  according to

$$v_0(r_0) = \left( \frac{8\pi\rho_0 G}{3} \right)^{1/2} r_0 \quad (7)$$

Equation (7) is a kind of Hubble law at  $t = 0$ , since  $v_0$  is proportional to  $r_0$ .

After  $t = 0$ , each shell will expand radially outward, no shell passing any other shell. This expansion will be governed by a conservation of energy equation with  $\Delta E = 0$  similar to equation (5).

$$\frac{\Delta m}{2} v^2(r) - \frac{G \Delta m M(r)}{r} = 0. \quad (8)$$

In Equation (8)  $\Delta m$  and  $M(r)$  are constant; their values the same as they were at time  $t = 0$  since mass is conserved in Newtonian mechanics. Thus, Equation (6)

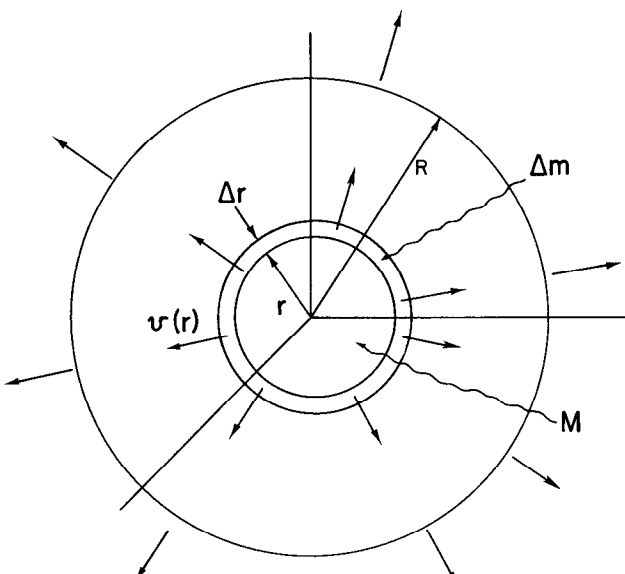


Figure 3. The geometry of the big bang model.

can be used for  $M(r)$  to yield,

$$v = \left( \frac{8\pi\rho_0 G r_0^3}{3} \right)^{1/2} r^{-1/2} \quad (9)$$

As a check, note that Equation (9) reduces to Equation (7) at time  $t=0$  when  $r=r_0$ . When the calculus definition  $v=dr/dt$  is used in Equation (9), the differential equation that results can be integrated from  $r_0$  at time 0 to  $r$  at time  $t$  to give:

$$r = [(6\pi\rho_0 G)^{1/2} t + 1]^{2/3} r_0. \quad (10)$$

The density of the expanding universe can now be found from the requirement of mass conservation. All of the mass  $4\pi\rho_0 r_0^2 \Delta r_0$  in a thin spherical shell at  $r_0$  of the thickness  $\delta r_0$  at time 0, must be in the volume  $4\pi r^2 \Delta r$  in the thin expanded spherical shell at  $r$  of thickness  $\delta r$  at time  $t$ . So  $4\pi\rho r^2 \Delta r = 4\pi\rho_0 r_0^2 \Delta r_0$ ; thus  $\rho = \rho_0 (r_0/r)^2 (dr_0/dr)$ .

When Equation (10) is substituted into this equation, the resulting mass density  $\rho$  at any time  $t$  after the "big bang" is

$$\rho = \frac{\rho_0}{[(6\pi G \rho_0)^{1/2} t + 1]^2} \quad (11)$$

When Equation (10) is solved for  $r_0$ , and that result used for  $r_0$  in Equation (9), the velocity of the mass at a distance  $r$  from the origin at time  $t$  is found to be

$$v(r,t) = \frac{2}{3} \frac{r}{(t+T)}, \quad (12)$$

where  $T$  is a time constant, an abbreviation for

$$T = (6\pi G \rho_0)^{-1/2}. \quad (13)$$

Equation (12) appears to be a Hubble's law ( $v$  proportional to  $r$ ). One adjustment must still be made. Speeds of the galaxies at time  $t$  are given by equation (12), but light seen at time  $t$  at a distance  $r$  would have been emitted at time  $t-r/c$ . So  $v_{\text{observed}}(r, t) = v(r, t-r/c)$ . When the  $t$  in Equation (12) is replaced by the earlier time  $t-r/c$ ,

$$v_{\text{observed}}(r,t) = \frac{2}{3} \frac{r}{(t - \frac{r}{c} + T)} \quad (14)$$

where  $t$  now stands for the observer's time. This final result is *not* exactly a Hubble's law as usually stated, because  $r$  appears in both the numerator and the denominator. However, Hubble's law is known to be correct only for  $r$  small in comparison to the size of the universe. This limit on Hubble's law is expressed in Equation (3). Thus, it is not necessary to arrive at an equation for which  $v=Hr$ , only an equation in which  $v \rightarrow Hr$  as  $r \rightarrow 0$ . This small  $r$  of Equation (14) is

$$v_{\text{observed}}(r,t) = \frac{2r}{3(t+T)}, \text{ when } r \ll ct, \quad (15)$$

and it is a Hubble law in the region where Hubble's law is known to be valid. It is the slope of this equation near the origin as shown in Figure 4, which is equal to the Hubble constant,  $H = 2/[3(t+T)] \approx 10^{-5}$  miles/sec. light year  $\approx 10^{-9}/18$  per year. So

$$t+T = \frac{2}{3H} = 12 \text{ billion years} \quad (16)$$

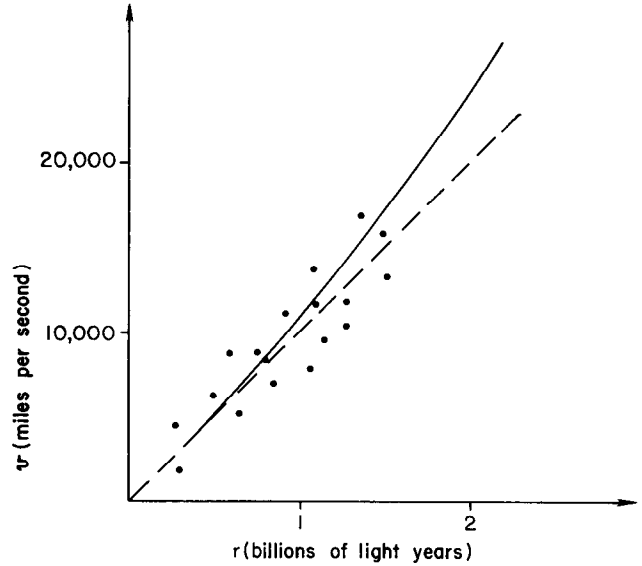


Figure 4. The theoretical relation,  $v$  vs.  $r$ . The solid line is the exact Equation (14). The dotted straight line is the approximation for  $r$  small, as expressed by Equation (15). The dots represent the same known data points as were shown in Figure 2.

When  $T$  is replaced from Equation (13), the above equation becomes

$$t + (6\pi G \rho_0)^{-1/2} = \frac{2}{3H} = 12 \text{ billion years.} \quad (17)$$

The importance of this simple result is that the Hubble's constant alone does *not* give the age of the universe  $t$ . Rather, the Hubble constant will determine the age of the universe  $t$  only if the initial mass density  $\rho_0$  is assumed to be known. Thus, only if one assumes he knows the initial state of the universe, can he calculate its age.

An evolutionist convinced that the initial density of the universe at the time of the "big bang" was essentially nuclear density would use equation (17) to calculate the age of the universe as follows:

Nuclear density<sup>7</sup> is taken as that of a neutron, i.e. mass divided by volume, about  $2.3 \times 10^{17}$  kg./m<sup>3</sup>. When this value is substituted into Equation (17) the resulting age of the universe is<sup>8</sup> about 12 billion years, as often stated, the term involving the square root being negligible.

On the other hand, a Creationist who thinks that the age of the universe is  $t=10,000$  years (just to use a round figure) could use the *same* equation (17) to calculate the initial density of the universe at its creation as follows:  $\rho_0 = [6\pi G]^{-1} [(2/3H) - t]^{-2} = 4.7 \times 10^{-30}$  gm/cm<sup>3</sup> when the appropriate numbers are put in. This would also be approximately the current density of the universe, because the universe changes relatively little over only 10,000 years. It is assuring to note that the Creationist can check his result by comparing his theoretical value of mass density for the universe with the measured mass density for the universe as quoted by astronomers. Although there is a large uncertainty in

the value of universe mass density, a value of  $5 \times 10^{-30}$  gm/cm<sup>3</sup> is suggested by cosmologists Adler, Bazin, and Schiffer.<sup>10</sup> This best measured value is almost identical to the Creationist's prediction of  $4.7 \times 10^{-30}$  gm/cm<sup>3</sup>.

The fact that the age of the universe cannot be determined until one *assumes* the initial state of the universe can be expressed another way mathematically. Eliminating  $t$ , the age of the universe, between equations (11) and (17) gives

$$\rho = \frac{3H^2}{8\pi G} \quad (18)$$

as the mass density for the universe at any time  $t$ . This relation does not mean that  $\rho$  is constant.  $H$  is time-dependent as can be seen in Equation (17). What the Hubble constant *does* give is the present mass density in the universe, *not* the age of the universe. From Equation (17) the age  $t$  of the universe is

$$t = \frac{2}{3H} - (6\pi\rho_0 G)^{-1/2} \quad (19)$$

One must assume an initial mass density  $\rho_0$ , in addition to knowledge of the Hubble constant, in order to determine the age of the universe. Therefore, the Hubble constant alone does *not* determine the age of the universe.

With a value of 18 billion years for  $(3/2)(t + T) = 1/H$ , a value both Creationists and evolutionists should agree on, equation (14) becomes

$$v_{\text{observed}} = \frac{r}{(5.68 \times 10^{17} - 5 \times 10^{-9}r)} \quad (18)$$

using  $r$  in meters and  $v$  in meters/sec. When  $v$  is expressed in miles/sec and  $r$  in billions of light years Equation (18) becomes

$$v = 10,000 \frac{r}{(1 - \frac{r}{12})} \quad (19)$$

A graph of this function appears in Figure 5. The graph shows that over the first billion light years the velocity is essentially a linear function of the distance, so that Hubble's law does hold. However, beginning at about 1 billion light years from the origin, the velocities as given by Equation (19) are 9% larger than predicted on the basis of a simple Hubble law. As the distances increase, the deviations from a linear Hubble law become larger. In terms of the Doppler velocity shift, any velocity of 15,000 miles per second or greater is too high to use the linear Hubble law to determine its distance. For objects having velocities in excess of 15,000 miles per second, the graph in Figure 5, or Equation (19), should be used to determine the distance of that object at the time it emitted the radiation we observe today.

As an example of the use of Figure 5, consider the quasar QQ172 with a Doppler shift velocity of 91 percent of the speed of light. According to the linear Hubble's law, the straight dashed curve in Figure 5, the distance of QQ172 corresponding to its velocity is about 16 billion light years. However, when the accurate Hubble's law given by Equation (19), or the solid

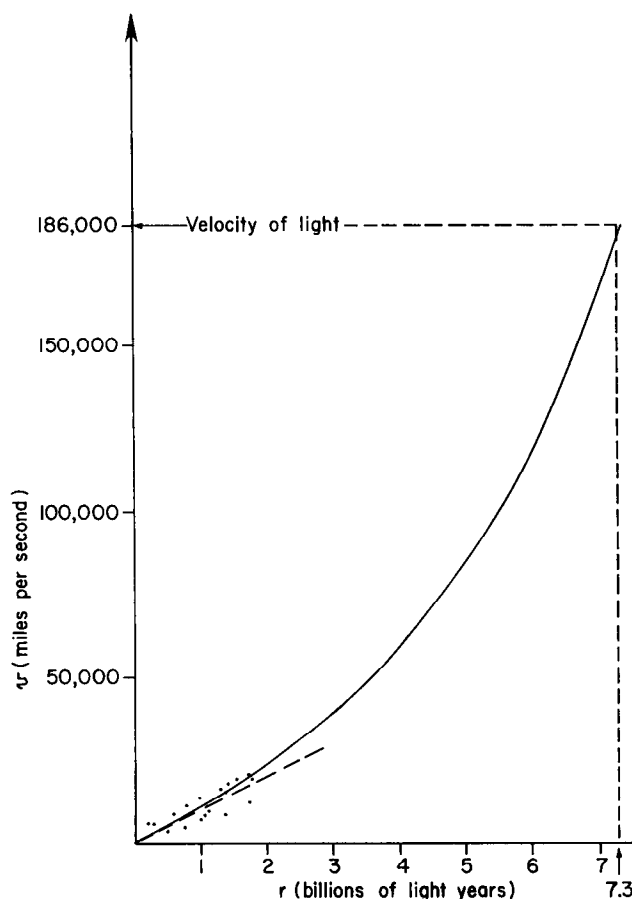


Figure 5. Equation (14). The points represent the galaxies, the smooth curve is Equation (19), the dashed straight line is the Hubble's law linearization of Equation (19), and the asymptotes indicate the limits set by the finite speed of light.

curve in Figure 5, is used, the distance to QQ172 corresponding to its velocity is found to be about 7 billion light years, roughly half as far as previously estimated. Since it is only 7/16 as far as previously estimated, and since the apparent luminosity varies as the square of the distance, QQ172's absolute luminosity would need to be only  $(7/16)^2 \approx 20\%$  of the absolute luminosity previously ascribed to it. This reduction in the absolute luminosities of quasars would greatly aid in explaining the nature of quasars, since a major problem is the excessive absolute magnitudes of quasars.

Figure 5 was obtained using classical Newtonian mechanics. This figure is not expected to be accurate for velocities  $v$  approaching the speed of light  $c$  or for distances  $r$  large enough to include a significant portion of the mass of the universe. These two restrictions can be removed only by using the general theory of relativity to solve the problem. This general relativity solution is presented in Appendix A. Unexpectedly, the general relativity solution is identical to the classical Newtonian solution. Therefore, any doubt as to the validity of the results obtained classically should be removed, and Figure 5 should be considered accurate over its entire range.

### Conclusions

Great care is required to give proper consideration to initial conditions in a cosmological model. The simplified model presented in this article shows that the Hubble constant by itself does not determine even a ball-park figure for the age of the universe, although it may determine other features of the universe such as present mass density. An initial creation only 10,000 years ago is just as consistent with the Hubble constant and density of the universe as is the "big bang" model which dates creation billions of years ago. Therefore, one must be able to demonstrate what the actual initial conditions at creation where; or one must acknowledge that the time and initial state of creation can vary within the wide limits stated.

The Hubble law is shown to be linear over a relatively small distance of approximately a billion or two light years, corresponding to a Doppler velocity of up to 15,000 miles per second. Doppler velocities greater than this can still be used to determine the distance the light source was at the time it emitted its light. However, the non-linear relation given by Equation (14) or Figure 5 must be used. The general effect of this non-linear distance determination is to reduce the distances to the mysterious objects that present us with unusually large Doppler shifts.

### Acknowledgement

I greatly acknowledge the kind assistance of Dr. Harold Slusher, Physics Department, University of Texas, El Paso, Texas, for reviewing this manuscript and for the suggestions he offered.

### Appendix A

#### General Relativity Effects

This appendix will examine the effects general relativity would have on the previous results. The previous results seem to be restricted to velocities much less than the speed of light  $c$ . They also seem to be restricted to distance  $r$  small enough so as not to contain enough mass to significantly affect the curvature of the space-time structure of the universe within  $r$ . The restriction on the speeds could be removed by using the concepts of special relativity. However, the formalism of general relativity is required to accurately account for both the high speeds and the large masses encountered in the problem of the expanding universe. The reader who is not equipped to follow the mathematics of general relativity will at least want to read the concluding paragraph of this appendix to see the corrections required by general relativity, since it obviously *must* be dealt with.

The reader who is equipped to follow the mathematics of general relativity needs to be introduced to the terms used here. The derivation will begin with the Einstein equations and the Robertson-Walker metric. This metric will have a zero cosmological constant  $\Lambda$ , since it is the static universe theories that require a non-zero cosmological constant. The form of the Robertson-Walker metric used is the metric for the flat expanding universe. For this choice of metric the universe expands with classical zero potential energy plus kinetic energy

as in the body of this article. The equations used are taken from chapters 12 and 13 of *Introduction to General Relativity* by Adler, Bazin, and Schiffer. Chapter 12 is "Descriptive Cosmic Astronomy," and chapter 13 is "Cosmological Models." Using their notation, the zero cosmological constant is expressed by  $\Lambda=0$ , and the flat expanding universe is expressed by  $k=0$ . The model considered assumes all galaxies have only radial motion. Hence, the pressure is  $P=0$ , because the pressure would be due to the average random motion of galaxies. Adler, Bazin, and Schiffer ultimately resort to  $P=0$  too, although some of their initial equations allow a non-zero pressure.

Finally the symbol for the universal gravitational constant is  $k$  in the equations of Adler, Bazin, and Schiffer, but will be written as  $G$  in this appendix.

The metric is defined for the model under consideration by the differential line element in four-space (Equation (12.56) of Adler, Bazin, and Schiffer),

$$(ds)^2 = c^2(dt)^2 - \frac{R^2(t)}{r_0^2} (dr)^2 = \sum_{\alpha,\beta} g_{\alpha\beta} dx^\alpha dx^\beta$$

since only radial motion is considered.  $R(t)$  is an unknown function of  $t$  and  $r_0$  is an undetermined constant. Adler, Bazin, and Schiffer give the Einstein field equations

$$G^\mu_\mu + \Lambda g^\mu_\mu = - \frac{8\pi G}{c^2} T^\mu_\mu$$

in their equations (13.18a) and (13.18b). The  $T^0_0$  component of the Einstein equations is

$$\frac{8\pi G}{c^2} \rho = 3 \left( \frac{\dot{R}}{cR} \right)^2 \quad (A.1)$$

and the  $T^1_1$  component of the Einstein equations is

$$0 = \left( \frac{\dot{R}}{cR} \right)^2 + \frac{\ddot{R}}{c^2 R} \quad (A.2)$$

All other components are  $0=0$ . A combination of Equations (A.1) and (A.2) yields  $(d/dt)(\rho R^3) = 0$ . Thus the total mass of the universe is constant,

$$M = \frac{4}{3} \pi R^3 \rho = \text{const.} \quad (A.3)$$

Equation (A.2) can be rearranged to give

$$\frac{d}{dt} (R^{1/2} \dot{R}) = 0$$

so that

$$\dot{R} = \frac{D_0}{R^{1/2}} \quad (A.4)$$

where  $D_0$  is a constant of integration. When Equation (A.4) is substituted into Equation (A.1), the constant  $D_0$  can be evaluated,

$$D_0 = \left( \frac{8\pi G \rho R^3}{3} \right)^{1/2} = (2GM)^{1/2} \quad (A.5)$$

The general solution of Equation (A.4) is

$$R = (R_0^{3/2} + \frac{3}{2} D_0 t)^{2/3} \quad (A.6)$$

where  $R(0)=R_0$ . Since,  $R^3 \varrho$  is constant from Equation (A.3),  $D_0$  could be written

$$D_0 = \left( \frac{8\pi G \varrho_0 R_0^3}{3} \right)^{1/2} \quad (\text{A.7})$$

When the expression for  $D_0$  is used in Equation (A.6) and the resulting equation solved for  $R_0$ , we get

$$R(t) = R_0 \left( 1 + \frac{t}{T} \right)^{2/3} \quad (\text{A.8})$$

or

$$R_0 = \frac{R(t)}{\left( 1 + \frac{t}{T} \right)^{2/3}} \quad (\text{A.9})$$

where  $T$  is the time constant previously defined by Equation (13.)

The motion of one of the galaxies is defined by the geodesic

$$\frac{d^2 x^1}{ds^2} + \{\beta^1{}_\gamma\} \frac{dx^\gamma}{ds} \frac{dx^s}{ds} = 0 \quad (\text{A.9a})$$

Since the only non-zero  $\{\beta^1{}_\gamma\}$  is

$$\{\beta^1{}_1\} = \{\beta^1{}_0\} = \frac{\dot{R}}{cR} = \frac{2}{3(t+T)} \quad (\text{A.10})$$

the geodesic equation becomes

$$\frac{d^2 x^1}{ds^2} + \frac{4}{3c(t+T)} \frac{dx^1}{ds} \frac{dx^0}{ds} = 0 \quad (\text{A.10a})$$

or

$$\frac{d}{dt} \left( \frac{dr}{ds} \right) + \frac{4}{3(t+T)} \left( \frac{dr}{ds} \right) = 0 \quad (\text{A.10b})$$

This geodesic equation can be manipulated into the simpler form

$$\frac{d}{dt} \left[ (t+T)^{4/3} \left( \frac{dr}{ds} \right) \right] = 0 \quad (\text{A.10c})$$

Integrating gives

$$\frac{dr}{ds} = \frac{A}{(t+T)^{4/3}} \quad (\text{A.10d})$$

where  $A$  is a constant of integration.

A possible solution occurs when  $A=0$ , yielding

$$r = \text{constant}. \quad (\text{A.11})$$

It will become obvious that this is the choice for  $A$  which corresponds to the non-relativistic solution in the body of this article. Note that  $r$  is the coordinate point, while the physical distance  $dr_p$  between nearby radially separated points is given by  $g_{11}^{1/2} dr = (R/r_0) dr$ , or

$$dr_p = \frac{R_0}{r_0} \left( 1 + \frac{t}{T} \right)^{2/3} dr. \quad (\text{A.12})$$

so that the universe is physically expanding. Equation (A.12) is easily integrated to give the physical distance to a galaxy at our time (i.e., the observer's time),  $t$ .

$$r_p = \frac{R_0}{r_0} \left( 1 + \frac{t}{T} \right)^{2/3} r. \quad (\text{A.13})$$

When Equation (A.13) is differentiated, the physical velocity  $v_p$  at time  $t$  is

$$v_p = \frac{2R_0 r}{3r_0 T} \left( 1 + \frac{t}{T} \right)^{-1/3} \quad (\text{A.14})$$

The constant coordinate distance  $r$  can be eliminated between Equation (A.13) and (A.14) to yield

$$v_p = \frac{2r_p}{3(t+T)} \quad (\text{A.15})$$

Equation (A.15) is the prototype of Hubble's law, and it should be compared with Equation (12) in the body of this paper.

The final effect to be accounted for is the time required for light to travel the physical distance  $r_p$  back to the observer. Light travels along the null world line  $(ds)^2 = 0$  or  $c^2(dt)^2 - (R/r_0)^2(dr)^2 = 0$ . By combining Equations (A.8) and (A.12), this null geodesic becomes  $|dr_p| = c|dt|$ . Thus, light travels with the constant velocity  $c$  between the two physical points  $r_p$  and the origin. Therefore, the replacement  $t \rightarrow t - (r_p/c)$  in Equation (A.15) accounts for the time of travel of light. The final equation, accurate in the strictest sense of *general relativity* relating the distance of a galaxy to its observed velocity at observed time  $t$  is

$$v_p = \frac{2}{3} \frac{r_p}{\left( t + T - \frac{r_p}{c} \right)} \quad (\text{A.16})$$

This relationship from general relativity is identical to the corresponding relationship given by Equation (14) in the body of this article. Also, the solid curve in Figure 5 should now be considered accurate over its entire range.

As before, the Hubble constant  $H$  is the ratio of  $v_p$  to  $r_p$  when  $r_p$  is small compared to the size of the universe.

$$H = \lim_{r_p \rightarrow 0} \frac{v_p}{r_p} = \frac{2}{3(t+T)} \quad (\text{A.17})$$

Since Equation (A.17) is identical with Equation (16) in the body of this article, it is still true even in the sense of general relativity that the age of the universe is *not* determined by the Hubble constant. Rather, one must assume he already knows the initial state of the universe by specifying the density  $\varrho_0$  at Creation (equivalent to specifying  $T$ ), before he can calculate the time  $t$  at which that initial state existed.

Hubble's constant still does determine the density of the universe according to Equation (18) in the body of this article. This relation is shown by using the solution (A.8) and the definition (A.17) in the first Einstein tensor equation (A.1) to obtain

$$\varrho = \frac{3H^2}{8\pi G} \quad (\text{A.18})$$

which is identical to Equation (18).

The conclusion of this appendix on general relativity is that the results and comments in the body of this article are true even in the light of general relativity. No correction is required to allow for relativity.

(Continued on outside back cover)

## FLOODTIME CHANGES IN THE EARTH'S HEATING AND LIGHTING

V. LUTHER WESTBERG\*

Received 20 June, 1979

Few people are aware of the significant changes in the Earth's system of heating and lighting which have taken place within the last few thousand years. But a close study of the Creation (in six day of twenty-four hours each) as recorded in Genesis Chapter 1; and of the Flood, as recorded in Genesis Chapters 6 to 9, points them out clearly. Genesis 1:1, I suggest, is a short foreword. Then come the accounts of the work of the six days; and it is noteworthy that the account of every day except the second carries God's approval: "that it was good". These accounts are not myths; they are sober history; Moses, who wrote them, was inspired by God. Very likely besides that Moses had records available, going back to the very events. It must not be forgotten that the life-spans of over 900 years mean that, for instance, Adam's and Methuselah's lifetimes overlapped; and Methuselah's, in turn, overlapped with Noah's, who lived until well after the Flood.

As recorded in Genesis 1:2 God made light on the first day. Then: "He made the greater light to rule the day and the lesser light to rule the night". (Genesis 1:16) "The stars also" seems almost as if it was written as an afterthought; maybe because the stars were not visible until after the canopy fell. The pre-flood canopy, I suggest, was composed of crystals of ice; and it filtered the Sun's rays, allowing perfect lighting without any dangerous radiation. If the ice was in the form of long, needle-like crystals, they could have acted as light pipes, according to the principles of fiber optics. In that way, the light could have been transmitted through many miles, as in the new applications of fiber optics to telephone service. Vapor would have scattered the light; and tests show that 100 feet of water absorb 95% of the light. See Figure 1. The antediluvian provision of heat must also be considered. It will be recalled that heat is transmitted in three ways: by radiation, conduction, and convection. The fact, noted in Genesis 2:25, that Adam and Eve needed no clothes would indicate a perfect climate, at least in Eden; and maybe that condition existed over much of the world until the canopy collapsed at the time of the Flood. Genesis 8:22 would seem to indicate that the present regime of weather began at that time.

Incidentally, the antediluvian centuries of ideal climate, with the resulting easy, workless living, evidently served only to let man become exceedingly sinful, as recorded in Genesis 6:1-7. Compare Ezekiel 16:49.

The changes, then, from this ideal climate, are closely associated with the collapse of the canopy. In what follows, I am glad to acknowledge much help from the work of the late Prof. Theodore Schwartz;<sup>1</sup> and other work now more than 100 years old.<sup>2</sup>

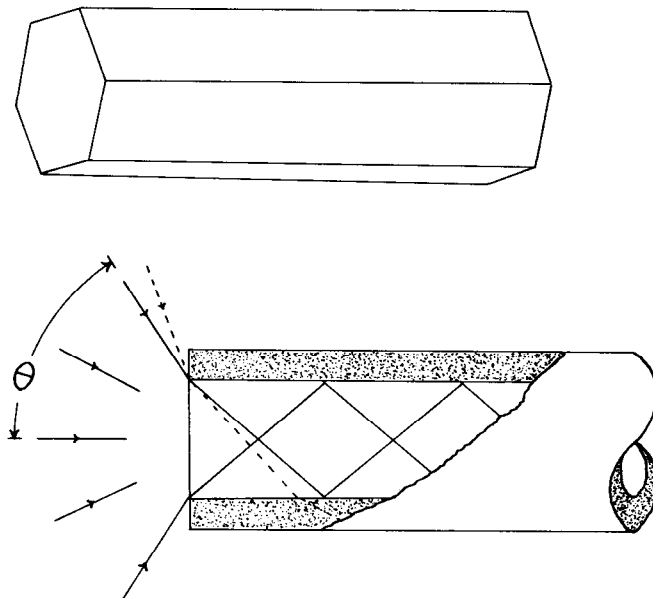


Figure 1. The upper part shows a possible shape of a crystal of ice: a hexagonal cylinder. Such a crystal might act as a light pipe, according to the principles of fiber optics. The lower part shows a possible light pipe, here a circular cylinder for simplicity. Light entering the pipe on an angle to the axis no greater than the angle  $\theta$ , as shown by the solid rays, will be totally internally reflected at the sides of the pipe, and thus transmitted. Rays entering it at a greater angle, as shown by the broken ray, will be refracted into the cladding (here shown shaded; of course, the cladding might be only air or even vacuum) and lost.

This drawing is not necessarily to scale. However, the angles correspond approximately to those determined by the index of refraction of ice, about 1.3, the index of the cladding being close to 1.0.

The omission of "that it was good" on the second day provides a clue. God, foreseeing that the canopy, in falling, would be an instrument of destruction, could not call it "good".

When water was created on the Earth, I suggest, the surface was quite hot, and the resulting explosions of steam sent the water blasting skyward. Anyone who has ever seen water poured onto a ladle of molten metal can appreciate the force of the explosion. High in the frigid stratosphere, the water froze into the crystals already mentioned. These formed the canopy, which may have been supported partly by the mechanical strength of the ice (it is granted that mechanical strength alone would not suffice) and partly by the centrifugal effect, i.e., it was partly in a condition of weightlessness. If God distributed water uniformly over the Earth, the canopy would have been blasted skyward as a complete spherical shell, the polar remnants collapsing to form our present polar ice caps. See Figure 2.

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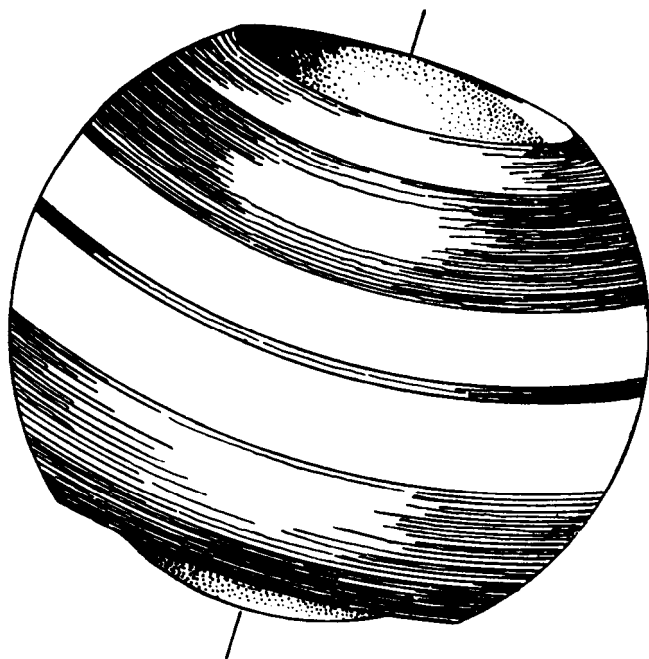
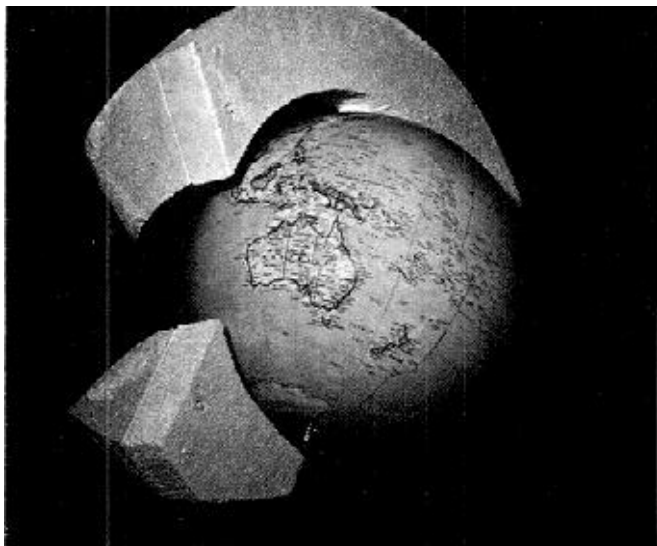


**Figure 2.** The upper part shows the suggested arrangement of the canopy of crystals of ice. It is shown partly cut away, so that the inside may be seen. This illustration is from the author's tract: *The Master Architect*.

The lower part shows an arrangement of the canopy evidently suggested by Vail. This picture has been used in *The Stonehenge View-point*, and it is used here by permission.

There are several evidences which allow us to estimate the size and altitude of the canopy. Many scientists, including the late George McCready Price,<sup>3</sup> agree that the level of the ocean rose considerably,<sup>4</sup> maybe 600 feet, above the continental shelf, at some time in the past. If this was due to water from the canopy, since the Earth's surface is three quarters

ocean, the canopy would have amounted to about 450 feet of liquid water over the whole Earth. If the 7 days, of Genesis 7:4, represent the time for water from the bottom of the canopy to reach the Earth, and the speed of falling is estimated at 20 miles per hour, the bottom would have been about 3,000 miles above the Earth. Again, if it took an additional 40 days for water from the top to fall, the top of the canopy would have been at an altitude of about 22,000 miles. It is true that these estimates depend very much on the assumed conditions under which the water fell. The initial breakthrough, at the equator, might have been initiated by an oversized sunspot, for instance; and then the two halves of the canopy, once separated, settled down at the poles with their fringed rims at perhaps the 45° latitudes.

As for theories of the Flood which attempt to dispense with much water from above, the words: "... all the high hills under the whole heaven ..." eliminate any local flood theory. If tidal sources are proposed, it is hard to see how any soil could remain if there were scouring jets at maybe 100 miles per hour. Again, there is no evidence that there ever were underground sources of water large enough for them, as the "fountains of the deep", to contribute significantly to the Flood. I believe, as Prof. Schwarze did earlier, that the fountains of the deep may have been fountains, not of water but of lava. Pillow lava, which hardened under water, covers large regions in many parts of the world, such as the western states.

The canopy, when it existed, was, I suggest, so efficient a reflector of heat, as distinct from visible light, that little heat from the Sun penetrated it. In this respect the canopy of ice was quite different from the proposed vapor canopy. Most of those who believe that there was formerly a vapor canopy believe that it contributed to keeping the Earth relatively warm, by the greenhouse effect. While I do not question that in laboratory experiments carbon dioxide and water vapor do absorb infra-red radiation of certain wavelengths, I have come to doubt whether they would have much effect on the scale involved in considering the world's climate. I have conducted tests, having to do with the development of an Auto Fuel Analyzer, in which the thermal behaviour of gases was studied with very sensitive equipment, involving a platinum resistance thermometer in a Wheatstone's bridge. In the tests, carbon dioxide or water vapor did not show up much differently from air of the ordinary composition.

The reader may have noticed buildings in which the windows are made with heat-reflecting glass, which can be told by its golden or reddish appearance. It lets visible light through quite well, but reflects much of the heat, i.e. the infra-red. The canopy, I suggest, was even more efficient in this respect.

Heat for the antediluvian Earth, then, came from the interior to the surface. There is still plenty of heat in the interior, where temperatures are estimated to be from 3,000 to 5,000 degrees; the current interest in geothermal energy testifies as to what is available. Besides, heat is being produced by radioactivity.

The result of all of this was to give ideal climatic conditions, which presumably lasted until the Flood. A few comments may be cited. Rehwinkel remarked: "It is dif-

ficult for us to imagine a world as just described, a world in which there was neither Arctic nor Antarctic and no steaming jungles of the equator".<sup>5</sup> Price wrote: "But it is needless to go through the systems one after another, for they testify that a warm climate in former times prevailed over the whole globe".<sup>6</sup> Finally, according to Wallace: "There is but one climate known to the ancient fossil world as revealed by the plants and animals entombed in the rocks, and the climate was a mantle of springlike loveliness which seems to have prevailed continuously over the whole globe. Just how the world could have thus been warmed may be a matter of conjecture; that it was warmed effectively and continuously is a matter of fact".<sup>7</sup>

But the Flood changed all of that. Many events happened rapidly as the canopy separated at the equator and the caps, i.e. the parts toward the poles, started to settle as the centrifugal support became no longer adequate to overcome gravity. Their fall was cushioned by warm air, which had to move toward the equatorial perimeters, to pass from beneath the ice to above it. In the process, the warm air melted much ice, contributing greatly to the rain. It may be that this great motion of air caused the wind mentioned in Genesis 8:1, which, being world-wide, was no ordinary wind.

There are still various pieces of evidence of such a fall of ice. The numerous ice caves, in the Northwest states, at latitudes around 40° to 45°, suggest that the fringes of the northern cap terminated there after the forty day's rain. The ice caves are dormant volcano vents filled with ice, which is still mined from some of them. No ordinary fall of snow, or such happening, could ever have filled those vents.<sup>8</sup>

Another piece of evidence is the pingos, submerged hills of fresh-water ice, on the Arctic continental shelf.<sup>9</sup> These have been studied recently as a hazard to shipping, since they may be only a few feet beneath the surface, and are not easily detected. No uniformitarian theory seems to be able to explain their origin, but a sudden dumping of much ice might easily cause such things.

Again, falling ice at certain places might explain the many geological differences between the land north and south of about 45° latitude. Mass graves of fossils change to individual graves; and canyons like those of the Grand or Snake river do not exist. The most likely origin of the canyons seems to be a rapid one, due to the action of a huge amount of water, perhaps released from the canopy. (That is, an ice canopy; a vapor canopy could never have contributed so much water.)

Also, the falling ice could have been the means whereby mammoths were frozen practically as they stood, and preserved until this day. No uniformitarian explanation has really been satisfactory for them.

An incidental, but spectacular and drastic, result of the collapse of the canopy, and thus the first rain since Creation, occurred when the water, penetrating fissures, came into contact with hot lava. The resulting tremendous underground steam pressure blew out volcanoes all over our globe; likely the first in the nearly 2,000 years of history. The land, in places, was forced up into mountains; maybe Mt. Ararat itself was forced up under the Ark. Even today, there is reason to believe

that seepage of water has a connection with earthquakes.

Incidentally, it is likely that the rise would have been especially prominent around the rim of the Pacific, where earthquakes and volcanoes are still common. Our studies of the conduction and convection of heat show the reasons for this "Ring of Fire", as the heat and pressure of lava can penetrate rocks, but could hardly act through five miles of the cold circulating water of the Pacific Ocean, the world's largest temperature stabilizer. Islands, in particular, such as the Galapagos, may have raised and drained in only a few days. The distinctive marine animals, then, might have re-settled them very quickly. Continental regions, on the other hand, would have taken much longer to drain. Besides, they might have experienced subsequent smaller catastrophes, as inland seas, formed by trapped Floodwaters, burst their confines and re-flooded vast regions. Had Darwin, upon visiting the Galapagos, considered these points, he might have seen the truth, instead of being led astray into evolution.

### Conclusion

It has been suggested how, at the time of the Flood, the Earth's system of lighting changed from one mediated by a canopy, through the principles of fiber optics, to direct illumination. The system of heating, too, changed: from heating by geothermal energy to the present combined system, in which heat from the Sun plays an important part. One can not doubt that the present system is inferior to the perfect system instituted at the Creation. However, we are assured, for instance in Acts 3:21 and 2 St. Peter 3:13, that the original perfection will be restored when the Lord returns.

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- <sup>3</sup>Price, George McCready, 1923. The new geology. Pacific Press, Mountain View, California.
- <sup>4</sup>See the author's tracts: The Master Architect, and, Mystery of the Buried Redwood.
- <sup>5</sup>Rehwinkel, A. M., 1951. The Flood. Concordia Publishing House, St. Louis.
- <sup>6</sup>Price, *op. cit.*
- <sup>7</sup>Prof. Albert Wallace, in Price, *op. cit.*
- <sup>8</sup>See Patten, Donald W., 1966. The Biblical Flood and the ice epoch. Pacific Meridian Publishing Co., Seattle, Washington. Pp. 120-124.
- <sup>9</sup>See, e.g., Ives, Jack D., and Robert G. Barry (Eds.), 1974. Arctic and alpine environments. Methuen and Harper and Ros. Pp. 180 and 181. It is true that this reference, probably because of the purpose of the book, has to do more with pingos on land than with those under water. See also Yvonne Herman Arctic Oceanography AAAS 11/19/71.

### QUOTABLE QUOTE

"All that is made seems planless to the darkened mind, because there are more plans that it looked for."

C. S. Lewis, in his book *Perelandra*.  
This quotation was suggested by Mr. Charles Dye.

## PANORAMA OF SCIENCE

### Voyager Scientists on Dilemma's Horns<sup>1</sup>

The more that is discovered regarding the design and makeup of the various bodies of the solar system the more difficult it is for the "thinkers" to invent theories to explain how and when the solar system came into being. Bradford Smith, a Voyager scientist, during a news conference made statements to the effect that:

The theory that explained how Saturn's rings could persist through 4.6 billion years of solar system evolution also explained why Saturn was the only planet that could have a ring. Then those theories had to be revised to account for the rings of Uranus. The revisions implied that Jupiter would not have a ring. Now Jupiter has been found to have a ring and we have to *invent a theory to explain it* (Emphasis added)

Each time something new and unexpected is discovered the sterility of the evolution model is shown to be true by its lack of predictive power. It only works *ad hoc*-ly.

It would seem that the calculated short life-time for Jupiter's rings would indicate that Jupiter and the solar system must have been created only, at most, a few thousand years ago for according to Bradford Smith:

dust and grain-sized particles can be ruled out as major constituents of the ring. The intense radiation in Jupiter's magnetic field would sweep them out (in a short time).

The one lone picture taken by Voyager indicates that the ring is composed of a small amount of material—it didn't show the size of any of the particles and I'd predict that when the ring of Jupiter is viewed at close hand or sampled that some of the particles will be much smaller than anticipated.

The Voyager scientists are perplexed to explain how the ring structures of Saturn, Uranus, and Jupiter can persist over geologic time when they see no possibility of recent origin. To quote:

No theory has yet been developed that explains how all three of these planets could have rings for so long. There is now no possibility that these rings are recently created structures. (That) for each planet to have a ring at this point in time means that they must be very long lived, perhaps dating from the planet's origin.

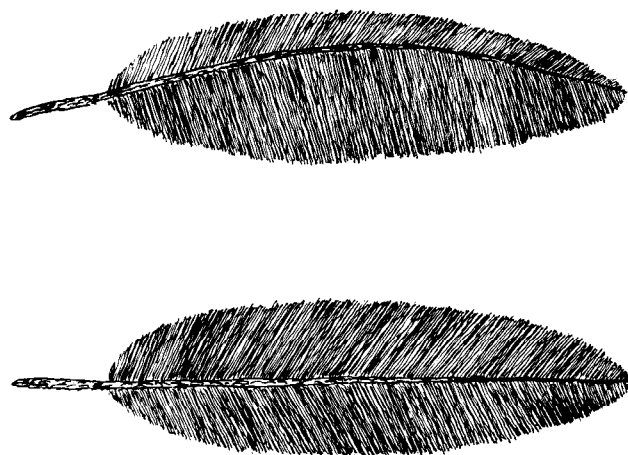
Now I can agree with the idea that the rings probably date from the planet's origin but only a time scale of a few thousand years, not billions.

The creation model for the solar system, while possibly not predicting a ring around Jupiter, and in the future, Neptune, at least allows for that possibility and surely doesn't need to be revised to make room for "rings". Rings that are short lived must of necessity be of recent origin but evolution requires that they persist for very long periods of time. It can't be both.

Contributed by Mr. Mark W. Tippetts

### Archaeopteryx Aerodynamics

About 150 million years ago, the reptile was evolving into the bird, according to the evolutionary theory. The fossil link in this process is supposed to be the *Ar-*



*chaeopteryx*. In the evolutionary scheme, the *Archaeopteryx* is a feathered reptile, a sort of half-reptile and half-bird. There exist several fairly good fossils of this animal which have been available for over 100 years.<sup>2</sup> If he had been only a half-bird, he would have been a poor flier, or unable to fly at all.

The well-preserved *Archaeopteryx* fossil feathers were carefully re-examined recently by Alan Feduccia of the Dept. of Zoology of the University of North Carolina, and by Harrison B. Tordoff of the Bell Museum of Natural History at the University of Minnesota.<sup>3</sup> Feduccia and Tordoff first note that the *Archaeopteryx* fossil feathers are very asymmetrical. The rachis (the long tapered center support in the feather) was very near the leading edge of the primary flight feather, rather than in the center.

They explain that the primary flight feathers of living birds have varying degrees of asymmetry. The stronger fliers, such as falcons, have very asymmetric feathers, like the upper one in the illustration; while the poor fliers or flightless birds, such as the ostrich, have symmetrical primary flight feathers, like the lower one. The asymmetry of the rachis, near the leading edge of the primary flight feathers, provides the aerodynamic structure needed for the best fliers among living birds.

This structural evidence from fossils known for 100 years shows that the *Archaeopteryx* was a flier equal to the best of modern birds. The true *Archaeopteryx* was a far cry from the awkward half-birds in the alleged evolutionary phylogeny.

### Amazing Argon

The inert gas argon comes in several isotopes, of which Ar36 and Ar40 are of interest here. Ar40 is called radiogenic argon, because it is the result of the radioactive decay of the naturally-occurring radioactive potassium, K40. Ar36 is called primordial argon, and is not known to be produced by the decay of any isotope.

The different sources of the two isotopes have led evolutionary theorists to predict the relative amounts of them on the various planets of the Solar System. According to the theory, Ar36, which is not now produced by the decay of some other isotope, must be primordial:

left from the argon present when the planet was formed. On the other hand, Ar40 in a planet's atmosphere, it is said, likely came from the decay of K40 inside the planet. Then, during the billions of years of the planet's existence, that argon outgassed through the surface and became part of the atmosphere.

The closer a planet is to the Sun, continues the argument, the hotter it would be, in general; and the more quickly it would outgas. On the other hand much of the original Ar36 would have diffused away into space. So the planets closer to the Sun should have a higher proportion of Ar40 in their atmospheres. The planets farther from the Sun, however, having outgassed more slowly, should have a smaller ration of Ar40 to Ar36.

So much for theory. What are the facts?

On December 9, 1978, the gas chromatograph on the Pioneer Venus sounder probe measured for the first time the concentrations of both isotopes of argon. The ratio Ar40/Ar36 found on Venus was 1.0. On the Earth, the ratio is well known to be 240. And on Mars it has been found<sup>4</sup> to be 2,500.

Thus, the ratio of Ar40 to Ar36 is found to *increase* going outward (i.e., away from the Sun) in the Solar System from Venus to Earth to Mars. This variation is just the opposite of that predicted on the basis of an evolutionary theory of the origin of the System. Dr. T. M. Donahue, whose mass spectrometer also measured

isotopic concentrations on board the same Pioneer Venus sounder probe,<sup>5</sup> said of the argon data: "The cosmological implications on the formation of the Solar System are staggering".<sup>6</sup>

Incidentally, the same radioactive decay of K40 to Ar40 is the basis of the potassium-argon dating method. The fact that measured concentrations of Ar40 vary in a way opposite to that predicted casts a dark shadow onto this method.

Above two items contributed by  
Dr. G. Russell Akridge

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## BOOK REVIEWS

*God Beyond Nature*, by R. E. D. Clark, 1978. Pacific Press Publishing Association, Mountain View, California. 110 pages, \$2.50. Paperback.

Reviewed by Wayne Frair\*

On the cover of this book is the question, "Can an honest thinking person believe in a Creator today?" In answering this question British scientist Clark (Ph.D. in chemistry from Cambridge) reasons from nature to theism to Christianity. Writing on science and Christianity is nothing new for R. E. D. Clark who already is well-known for his cogent books including *Science and Christianity—a Partnership*, *Darwin: Before and After*, and *The Universe: Plan or Accident?* In *God Beyond Nature* a strong case is made for "design" in nature, and Clark believes that science points to certain truths including that there is a Creator-God.

Beginning with an interest-catching story about a burning candle, the text moves to consideration of the character and origin of the universe. Subsequent chapters cover "Chance or Design", "Agnostics' Arguments", "On Humility and Impotence in Science", "Evil", "Some Evolutionary Fallacies", "Limitations of Natural Selection", and "What a Young Agnostic May Be Thinking". Then follow eight pages of "Notes and References".

Interestingly Clark shows that "it is difficult to resist the conclusion that intelligence has been at work." (p. 27) In considering unique properties of elements essen-

tial for life, carbon atoms are building blocks of the organic world, nitrogen unique as in its role in proteins and nucleic acids, and hydrogen his "zip fastener" atom.

Throughout the book I had the feeling that Clark is reaching for the uncommitted mind (especially of young people). He discusses, for instance, how an agnostic sets up what a physicist calls a "'principle of impotence'—a rule that by the nature of things you can not do this or think about that." (p. 46) His examples from science include mapping the back of the moon. So he concludes:

... We ought not to be intimidated by impotence rules. They should set us thinking rather than the reverse! When we hear it said that man is impotent to think about the origin of the universe, or to draw conclusions about the order it contains, our suspicions should be aroused! (p. 47)

Scientific explanations are impossible unless we assume that reality can be understood, at least in part, by what is within our experience. Yet, oddly enough, some people forget this fact when they are thinking about the creation, though they would not dream of ignoring it in other connections. The fact is that the world outside us shows evidences that it has been thoughtfully made. (p. 53)

In the evolutionary fallacies chapter is a discussion of various ways the term "evolution" has been used. Clark opposes "the classical scheme of evolution by natural selection" (p. 78) but he allows for limited changes such

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as apparently happened with moth varieties in industrial England.

While not attempting to bully his readers, Dr. Clark justified his theoretical and academic presentation by saying that he is attempting to build a foundation for a religion based on more than emotion. In the concluding chapters Clark becomes more frontally Christian and gives good reasons why those who are hesitating should commit themselves to God and follow Christ.

*God Beyond Nature* is a small inexpensive paperback which reads easily. The main objections to the work would be its lack of depth, and some gaps, which are understandable in view of its scope. But I feel it is an important book which should be read widely especially by young people (as of high school or possibly early college ages). It could be used in groups which include non-Christians and would serve as a good basis for discussions. I intend to buy some extra copies to give to visitors at my laboratory.

*Early Man and the Ocean. A Search for the Beginning of Navigation and Sea-Borne Civilization.* By Thor Heyerdahl, 1979. Doubleday. \$12.95.

Reviewed by John E. Schmich\*

The author, no doubt, wrote this book as a result of his experiences with rafts and reed boats. The reader, if he is a Creationist, will find much which may suggest what happened during the dispersion of mankind, and of arts and crafts, over the Earth after the Flood.

Where did people come from? When, how, and why? These seem to be the questions asked in the book.

They came in paper, i.e. reed, ships, from the direction of the rising Sun. They followed the Sun during the day as long as some traces of its rays were seen, and sailed directly into that red ball where it dropped over the precipice (man's idea of the Earth). This notion illustrated man's faith in what he could see, and it may be one of the reasons why the Sun became, in the minds of many, the thing to worship.

The problem of the creation of the Sun, and of the Earth, apparently had not yet occurred to these people. They had not yet begun to wonder why the Earth existed, and why that red ball of light remained firmly associated with it.

These men, living some time after the Flood, had received the knowledge of their Creator from the original eight people who were on the Ark. But the knowledge was forgotten in their eager desire to fill the empty void—the post-diluvian Earth—before them.

Over the millennia mankind came to the limits of Europe. Some walked; some, perhaps, sailed along the Mediterranean, maybe in reed boats. They came as adventurers, hunters, and farmers, and in time began to form groups, to settle down, and to build houses and towns.

At the shore of the Atlantic, a problem presented itself. The vast ocean stretched in front of them, as far as they could see. How were they to use it, to get to the place where the Sun seemed to set?

The effects of such a great expanse of water on man's migrations is very nicely explained by the author. Man could not just follow the Sun, for instance, or go wherever he wished, with the techniques of navigation available at the time. There were the winds, and the great and powerful, although invisible, rivers, i.e. currents, in the ocean. These currents, which are caused by the winds and affected by the rotation of the Earth, could be either a help or a hindrance.

Heyerdahl gives examples of the patience of sailors, trying to make a return voyage by the same route as they used on the way out, and frustrated by these currents and winds. Not until the eighteenth century or so were navigators able to pick routes at will.

On the other hand, sailors found paths which they could use, for instance the Canary current, used by Columbus. The author calls these currents ocean conveyors. Now this current arrives at the Americas around Mexico.

The Spanish conquistadors, in the Americas, found, much to their surprise (and the account will also surprise the reader) great and civilized nations. Moreover, these nations had many of the cultural traits characteristic of the pre-European civilizations of Asia Minor, Egypt, Cyprus, and Crete, traits which, in fact, could be considered to unite those regions into one cultural area. Fifty-three of these traits common to the Old and New Worlds are listed. This list is impressive evidence to show that at some time in the distant past white men came from the Mediterranean area, and imparted to the people of Mexico and South America the knowledge of such cultural items.

According to legends, these white men were bearded and tall. After some time, they are said to have left, sailing westward toward the setting sun, never to return. However, there was a firm expectation that they would return eventually. Thus when the Spanish arrived they were at first greeted with open arms, as the bearded white men returned. It was this identification which helped them to take over Mexico and Peru almost without a battle. Heyerdahl speaks of the original white men as the Bearded Gods before Columbus.

As well as Columbus, the Vikings visited North America in historical times. Heyerdahl evaluates their voyages, and points out that both Columbus and the Vikings sailed to America as Christians of the same church. Our tendency to compare the two navigators as if they were competitors leads to a distorted view of Leif Erikson. He seems a fierce pagan Viking in an open boat, in contrast with the splendor of Columbus in his graceful caravel. We must remember that almost half a millennium separates the two expeditions. It is not generally known that Leif Ericson took a Catholic priest on his ship, and the express purpose of his trans-Atlantic crossing was to bring Christianity to the pagan settlements in Greenland.

So it appears that there have been crossings of the Atlantic Ocean since ancient times. How about the Pacific? Heyerdahl points out the difficulty of going eastward, say from Asia to Polynesia, as it is often supposed happened. The reason is again the currents and winds. On the other hand, there is good evidence that the Incas of Peru, and their predecessors, sailed exten-

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sively in the Pacific; and indeed they directed the Spanish to the islands of the Pacific. Much of this navigation was on balsa rafts. The people of the Pacific coast of South America were very expert in the construction of these rafts, and they had learned to sail and to tack them.

Among the islands of the Pacific, the Galapagos are well known to Creationists; and there is evidence that the people of South America visited them before Columbus' time. (Might some of the creatures which Darwin found there, then, have been introduced only a few centuries ago?) But Heyerdahl will always be associated with Easter Island, which he calls the world's loneliest meeting-place. The Polynesian name is *Te-Pito-o-Te-Henua*: The Navel of the World. This island, for all its remoteness (especially from Asia), has impressive and extraordinary remains of a former high culture. Heyerdahl, as is well known, traces this culture to South America.

In conclusion, the author presents much evidence to show that there has been travel, of men and of their

culture, since before historical times; and that even oceans were not impassible barriers. The view of antiquity which this suggests may make the ancient history which we learned in school seem rather tame, but it fits in well with the Creationist belief that already cultured people spread out fairly quickly from the region in which the Ark landed.

## NOTICES OF BOOKS

*Before the Beginning* by Dr. G. Grebens and K. Grebens, 1979. Available at 323 Franklin Bl., So. Suite 804/K20, Chicago, Illinois 60606. 63 pages.

This work is an anthology of essays and poems, with some illustrations drawn by one of the authors. It is not a work on, nor an apologetic for, Creationism. Nevertheless, it has some good things to say about the Creationist position. Also, it is likely to provide some apt and useful quotations.

## LETTERS TO THE EDITOR

### Historical Accuracy Too?

Most Creationists believe in the scientific accuracy of the early parts of Scripture, and in particular of Genesis, in the account of beginnings. One may ask: "How about historical accuracy?"; i.e., accuracy in stating when things happened, as well as what happened. In other words: "Are the first chapters of Genesis coherently historical as well as scientifically accurate?" The one idea appears to be a corollary of the other.

The history is often given through genealogies. Many writers, including many Creationists, are committed to the presupposition that we cannot, e.g., trace the genealogy of Jesus from Adam with some numerical exactness; and their arguments seem designed to support such a view. If that is true, we cannot prove, in a genealogical way, that Jesus actually descended from Eve, for we cannot bridge or delimit certain gaps in the record. In that case, there is justification in claiming that: "There is nothing in the Bible to indicate how long ago man was created". The resulting vagueness seems to be a flaw in a common interpretation of Genesis.

If, as we believe, the universe was created in six real days, and Adam within those same six days, the events were coincident, and on the same level of factuality. Then the question, whether the Bible gives a clue as to when it all began, becomes an important one. Either God has given us a determinable starting date, or everything begins in a primeval mist. But it would seem somewhat strange if Scripture should be very explicit about the "how?" of Creation, and say nothing determinate about the "when?"

Evangelicals believe that God's revelation is given within the frame of reference of time and history, not saga and suprahstory. Then, surely, all of the essential data should be correlated as to time.

It has become the fashion among many to believe that Bishop Ussher was wrong; and thus also several who

have followed his trail, such as Martin Anstey.<sup>1</sup> There may be some points not fully clarified by Ussher and Anstey; but many modern writers throw away everything, cite apparent gaps in the genealogies, and regard the absence of a completely coherent chronology as a closed matter. I have been glad, however, to notice one well known Creationist who is much less dogmatic on this point.<sup>2</sup>

I suggest that the whole question might well be reexamined. A starting-point might be the statement by Philip Mauro: "There is one complete genealogy, and only one, from Adam to Christ in the Bible".<sup>3</sup>

### References

- <sup>1</sup>Anstey, Martin, 1974. The chronology of the Old Testament. Kregel Publications, P. O. Box 2707, Grand Rapids, Michigan 49501.
- <sup>2</sup>Morris, Henry M. (Ed.) 1974. Scientific Creationism. Creation-Life Publishers, San Diego, California.
- <sup>3</sup>Mauro, Philip, 1974. Wonders of Bible chronology. (A summary of Martin Anstey.) Reiner Publications, Swengel, Pennsylvania.

Yours faithfully  
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Received 6 June, 1979

### Venusian Canopy

The subject of a vapor canopy surrounding the antediluvian Earth has been an active area of study at least since Whitcomb and Morris proposed it—or at least brought it to many people's attention.<sup>1</sup> (To the best of my knowledge they first proposed a vapor canopy; I know that other kinds had been suggested earlier.) Recently Dr. J. Dillow suggested a rather detailed model of the antediluvian atmosphere.<sup>2</sup> The thick vapor

canopy proper existed above about six miles.<sup>3</sup> At the bottom of the canopy was a thin zone of mixing; and below that the troposphere. At the bottom of the troposphere—at the surface—mild temperatures and windless conditions were maintained uniformly over the entire surface of the planet. Arguments were presented to show that the canopy would have been stable for the approximately 1,600 years for which it existed.

To propose such a model is a very bold undertaking; for the Earth's atmosphere today is greatly different. For that reason, I noted with great interest the reports of the Venusian atmosphere sent back by the Pioneer Venus probes. Venus, with its thick atmosphere consisting primarily of carbon dioxide with a smattering of particles of sulfuric acid, would be an ideal test case to be compared with the Earth's antediluvian atmosphere.

In fact, the data returned by the Pioneer Venus probes astonished everyone who was following up the matter. The probes began transmitting at an altitude of 41 miles. From that altitude down to 30 miles were thick clouds of carbon dioxide, small amounts of sulfuric acid and water, and traces of some other materials. From 30 to 20 miles there was only a very thin haze of particulate matter in otherwise clear conditions. And from 20 miles all the way down to the surface, absolutely no particles were detected, the atmosphere being perfectly clear.<sup>4</sup>

Thus, there exists now on Venus an atmosphere with a three-layered structure, just as the Earth's atmosphere was formerly divided into three layers. There are, it is true, many differences between the Venusian atmosphere and that of the antediluvian Earth, temperature profile and composition, for instance; but the three-layered structure is similar.

Whitcomb and Morris discussed a canopy nearly two decades before the Pioneer Venus probe, and Dillow's article was received by the *Creation Research Society Quarterly* about nine months before the probes entered the atmosphere of Venus. How remarkable that Dillow's predictions (for his work could be considered a prediction of what another sort of atmosphere might be like) were in the mail to *Creation Research Society Quarterly* subscribers at the same time that the Pioneer Venus probes were sending back their data supporting his predictions!

### References

- <sup>1</sup>Whitcomb, John C., and Henry M. Morris, 1961. The Genesis Flood. Presbyterian and Reformed, Philadelphia, Chapter VI.
- <sup>2</sup>Dillow, Joseph C., 1978. Mechanics and thermodynamics of the pre-Flood vapor canopy. *Creation Research Society Quarterly* 15(3):148-159.
- <sup>3</sup>*Ibid.*, p. 150, Figure 1.
- <sup>4</sup>Knollenberg, Robert G., and D. M. Hunter, 1979. Clouds of Venus: particle size distribution measurements. *Science* 203(4382): 792-795.

Yours in Christ  
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### Creationism and Taxonomy

I wish to express my appreciation of Dr. Howe's article in the June 1979 number of the *CRS Quarterly*,<sup>1</sup> with particular reference to his remarks on taxonomy of kinds of angiosperms. Far too few discussions of creationist taxonomy have appeared in the *Quarterly*. For that reason I would like to add to Howe's article the very fine one by Siegler which appeared recently in the *CRSQ*.<sup>2</sup>

Interestingly both of these biologists lean, or leaned toward the *genus* as the modern representative of the Genesis kind, at least in some groups. On page 41 Howe says, "This type of evidence causes the present author to suggest that creationists take the *genus*, in many instances, as representing the modern counterpart of the created kinds among angiosperms." On page 37 Siegler says, "Siegler considered certain of the broader categories, particularly '*genus*' as more representative of the Genesis '*kind*', and for that reason suggested that the term '*genus*' be applied to '*kind*'."

However, continuing on page 38, Siegler says, "In light of known plant and animal crosses not only between species or genera, but even between families, Marsh proposed a new name which would suggest none of the 'confused and arbitrary categories of present-day nomenclature.' His choice of the term *baramin* (from Hebrew roots, *bara* created, and *min* kind—see Marsh *Evolution, Creation, and Science*) seems particularly appropriate. Ignoring presently accepted nomenclature, all individuals which will cross and/or have similar morphologies are placed in the same *baramin*." In his article Siegler<sup>4</sup> gives an illustration of how "*baramin*" could be used in a formal creationist taxonomic table.

It is possible that two of the articles by Marsh<sup>5,6</sup> which have appeared in the *CRS Quarterly* will be found helpful in a study of creationist taxonomy, also his recent book *Variation and Fixity in Nature*.<sup>7</sup> Certainly Siegler's book<sup>8</sup> *Evolution or Degeneration, Which?* should be studied by every student of creationist nomenclature. Up to now, published creationist discussions of creationist taxonomy are precious few. Let us hope for more such discussion. And I would suggest that it would be well for us to keep these ideas together.

### References

- <sup>1</sup>Howe, George F., 1979. Biogeography from a creationist perspective 1: taxonomy, geography, and plate tectonics in relation to created kinds of angiosperms. *Creation Research Society Quarterly* 16(1): pp. 38-43.
- <sup>2</sup>Siegler, Hilbert R., 1978. A creationist's taxonomy. *Creation Research Society Quarterly* 15(1): pp. 36-38.
- <sup>3</sup>Marsh, Frank L., 1947. Evolution, creation, and science, Review and Herald Publishing Association, Takoma Park, Washington, D.C., pp. 174, 175, 200.
- <sup>4</sup>Siegler, *Ibid.*, p. 38.
- <sup>5</sup>Marsh, Frank L., 1973. The Genesis kinds and hybridization: has man ever crossed with any animal? *Creation Research Society Quarterly* 10(1): pp. 31-37.
- <sup>6</sup>\_\_\_\_\_, 1978. Variation and fixity among living things. A new biological principle. *Creation Research Society Quarterly* 15(2): pp. 115-118.
- <sup>7</sup>\_\_\_\_\_, 1976. Variation and fixity in nature. Pacific Press Publishing Association, Mountain View, Calif., Omaha, Nebr., and Oshawa, Canada.

\*Siegler, Hilbert R. 1972. Evolution or degeneration, which? Northwestern Publishing House, Milwaukee, Wis.

Sincerely,  
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Received 25 July, 1979

### There is Genuinely Christian Rock Music

The article on music by Thomas Schirrmacher was a fine change of pace for the Quarterly<sup>1</sup>. However, his assertion that: "If a rock group sings about love or God, it may mean nothing; but if we, as Christians, sing about it, it means everything"<sup>2</sup> is not followed by a parallel statement such as: "If a Christian rock group sings about love or God it means everything". Schirrmacher's words might seem to suggest that there are no rock bands which sing of the Lord and His Creation.

But the fact that there are contemporary musicians who "proclaim the glory of God's Creation"<sup>3</sup> is evident from the lyrics of today's "Jesus music". In Keith Green's latest album, for instance, is a message of truth:

You who made the whole world with Your hands  
Walked along this land  
Humbled as a man<sup>4</sup>

Another example is in Petra's (Greek for "rock") album *Come and Join Us*:

We are like stones built together in a wall  
Made up of whosoever the Master Builder calls  
We are not worthy but together we are strong  
Built on the Rock of Ages the Wall is almost done<sup>5</sup>

Surely only the cosmic Master Builder can give lasting satisfaction; but the philosophies of the world, such as evolution, bring emptiness. As DeGarmo and Key vocalize in their tune *Chase the Wind*:

They made you your own creator  
And gave you a pot of gold  
You found yourself caught up in mysteries  
On your own life is cold<sup>6</sup>

This is suggestive of the monism of Eastern thought, which makes no clear distinction between the Creator and the Creation but instead promises (as happened in Genesis chapter three) ascension to omniscience.

The foregoing three illustrations from Christian rock follow the pattern set by Martin Luther, Isaac Watts, and William Booth, who also used the popular style of music to proclaim the Good News.<sup>7</sup> A prime illustration of the use of a prevalent medium to present the Gospel is St. Paul's address to the council at Mars' Hill. (Acts 17:18-34.) He quoted two well-known Greek poets, (Verse 28.) to make his message better understood. In a similar way rock music, instead of poetry, may be used today. Interestingly enough, there is an actual contemporary Christian recording label named "Mars' Hill".<sup>8</sup>

In conclusion, then, rock-and-roll *can* be applied to promoting God's truth.

### References

<sup>1</sup>Schirrmacher, Thomas, 1979. Music: evolution or creation? *Creation Research Society Quarterly* 16(1):73-74.

<sup>2</sup>*Ibid.*, p. 74.

<sup>3</sup>*Ibid.*

<sup>4</sup>Green, Keith, and Melody Green, 1978. "You" in Keith Green's *No Compromise*. Sparrow Records, Canoga Park, California.

<sup>5</sup>Hartman, Robert M., 1977. "Come and Join Us" in Petra's *Come and Join Us*. Myrrh Records, Waco, Texas.

<sup>6</sup>DeGarmo, Edward, and Dana Key, 1978. "Chase the Wind" in DeGarmo and Key's *This Time Thru*. Lamb and Lion Records, Los Angeles.

<sup>7</sup>Norman, Larry, January 1975. The story of solid rock. On the album cover of Randy Stonehill's *Welcome to Paradise* (1975). Solid Rock Records, Hollywood, California.

<sup>8</sup>Reviews, 1979. *Cornerstone* vol. 8 (issue 46):19.

Yours in the Word

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Received 7 August, 1979

### "Of Course"

Some of our readers remember Byron Nelson, author of *Before Abraham*, *After Its Kind*, and several other good books founded upon observation and valid reasoning. He no longer is living but I prize his letters. In browsing among my papers I came across a letter from this friend which reveals an abundant attitude among our opponents. Nelson had made available one of my books to a professor of Genetics at the University of Wisconsin. I here quote from his reply:

"Thanks for sending me the copy of 'Heredity: a Study of Science and the Bible' by William J. Tinkle.

"I enjoyed reading the book. The author is quite well informed in genetics. . . . Of course, I disagree with his basic conclusion about evolution, but he makes a good case for his view.

"The book is being returned. Thank you again.

Sincerely,

(a Wisconsin Univ. professor)"

Those two words—of course—so common as an attitude, heard mentioned as an every-day occurrence, are usually glossed over with an appearance of fact. For science is founded upon facts, observed facts. Without them the world never would have heard of science. Evolutionists contend that their conclusions are based on observation while we go on faith. The above letter, however, is an example of theories supplanting observed facts and causing facts to be forgotten. Does my Wisconsin opponent have the right to approve my understanding of genetics and yet excuse himself for not agreeing with my main conclusion? "Of course" is such an easy way to go with a crowd that is only guessing. Why did he not write, "Some of the author's conclusions ignore certain facts; therefore I disagree."? With such an attitude we could sooner reach that very desirable goal, "the Truth". If this professor were the only one with the attitude of believing a preferable lingo this letter would not need to be published.

The present writer was once a student in Wisconsin Univ. I hope I never took this attitude: "Professor So-and-so probably has the truth, but my class does not agree with him; therefore I oppose his conclusions." Among scientists, truth should be a banner to which every knee bows; the goal toward which ever voyager

strives; a true scientist spends his ultimate vitality seeking truth.

But they say, "Forty million Frenchmen can't be wrong." How about the six hundred voting members of the Creation Research Society, all of whom have advanced degrees in some science?

I recall the oft quoted verse:

"I do not like you, Doctor Nell;

The reason why I cannot tell.

But this I know and know full well

I do not like you, Doctor Nell."

Substitute Dr. Tinkle for Dr. Nell and you have the professor's letter. But with all that the Creation Research Society has written and said, perhaps the professor has changed his mind.

Truly yours,  
William J. Tinkle (Ph.D.)  
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Received 2 April, 1979

### Was the Pre-Flood Earth Watered by Sub-Surface Water?

I would like to raise a question in regard to D. Russell Humphreys' article in the December CRSQ, "Is the Earth's Core Water?"<sup>1</sup> While there is much in the article that I find quite suggestive I must suggest a modification in his exegesis of II Peter 3:5, 6. I think we must be quite careful about pressing the language for such scientific comment as "Perhaps this means God formed the nuclei of silicon, iron, and other elements out of water by banding together the various combination of neutrons and protons from the nuclei of hydrogen and oxygen atoms of water." I realize that Dr. Humphreys is only suggesting this as a possibility but it seems to me that this kind of treatment of the text brings all exegesis into disrepute. Certainly, these scientific comments were not sharable between Peter and his readers and are therefore not a possible meaning of the author. Also, I am quite interested in his discussion of the "Springs of Eden." It may well be that geysers could supply the "mists" of Gen. 2:5, 6 which in turn watered the entire surface of the ground. My problem with this is the immense amounts of heat that would be introduced into the atmosphere by such a world-wide system of geysers. Can calculations be performed to quantify this a little more to see if the surface could even be habitable. Also, wouldn't the atmosphere be quite muggy and humid? Hardly a paradise!

### Reference

<sup>1</sup>Humphreys, D. Russell, 1978. Is the Earth's core water? Part one: the Biblical evidence. *Creation Research Society Quarterly* 15(3):141-147.

Your Brother in Christ,  
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Received 1 February 1979

### Heating from Core Waters

Mr. Dillow's question about possible overheating of the earth by waters from a hot core stimulated me to do a few very rough calculations. I found that expansion alone could drop the water temperature by thousands of degrees Celcius. In addition there would be heat transfer during the 3000 kilometer trip to the surface, so it is quite possible for slower-moving waters to arrive at the surface as cool springs.

Faster-moving water could arrive as steam, producing geysers; but the steam would not have to be extremely hot. If it were between 100 °C and 200 °C, each gram of steam would add roughly 640 calories of heat to the atmosphere. (Latent heat included.) Even if all the 80 trillion gallons per day<sup>1</sup> of water arriving at the surface were in the form of geysers, the heat added would only be about  $2.25 \times 10^{15}$  calories per second. For comparison, this is about five percent of the heat energy presently arriving from the sun.<sup>2</sup> Therefore it does not seem to me that such springs and geysers could have a great effect on the surface temperature of the early earth.

I want to encourage creationists to do other calculations like this to test the model. Presently I have my hands full trying to finish the second article of the series. I would appreciate your prayers concerning this.

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- <sup>1</sup>Humphreys, D. R. 1978. Is the earth's core water? Part one: the Biblical evidence. *Creation Research Society Quarterly*, 15(3):141-147. See especially p. 142. See also reference 16 in that article.  
<sup>2</sup>Humphreys, D. R. 1978. Using the second law more effectively. *Creation Research Society Quarterly*, 14(4):211-212. See reference 4 in that article.

Yours in Christ,  
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Received 28 March, 1979

### Appearance Does Not Prove Descent

I would like to put a question to your biology experts: Is there any proof that the hare and the rabbit are descended from a common ancestor?

According to the 9th edition of the Enc. Brit. (1890), all experiments at cross-breeding have failed and are not likely to succeed, because the habits of the two animals are so disparate.

This by no means unique case of animals similar in appearance being quite distinct in other ways, seems to establish a principle directly relevant to the ape-man controversy. Creationists often argue that *only* man is bipedal, *only* man makes tools, etc., etc.—but there is nothing in the Bible that actually says this. Suppose God *did* choose to make a creature walking on two legs, capable of shaping stones or building a wigwam by instinct (really no more marvelous than the beaver's dam or the weaver-bird's nest)? Such a creature would still be infinitely inferior to man if it could not talk or write or calculate or build permanent dwellings, or worship—and yet its skeleton, particularly its skull might *look* not very dissimilar to that of homo sapiens.

(Continued on page 162)

## CREATION RESEARCH SOCIETY

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

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

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

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

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

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

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

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

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

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## Expansion of the Universe

(Continued from page 181)

### References

- <sup>1</sup>Gamow, George, 1974. One two three infinity. Viking Press, New York. Chapter X.
- <sup>2</sup>Shipman, Harry L. 1978. The restless universe. Houghton Mifflin Co., Boston, is a good standard astronomy text in which to read the long chain of indirect measurements supporting the distances associated with the notion of an expanding universe.
- <sup>3</sup>The exact numerical value for  $t$  found by using  $H = 10^{-5}$  miles/sec light year in Equation (3) is 18.6 billion years. However, as Figure 2 shows, the value of the Hubble constant is not accurately known. Therefore, its reciprocal is, of course, not accurately known. Here, the round figure of 18 billion years will be used for the reciprocal of the Hubble constant instead of the figure 18.6 billion, which would be consistent with Equation (2).
- <sup>4</sup>Actually, it is well known that for a flat universe  $t = (2/3)(1/H)$ , about 12 billion years, instead of  $t = 1/H$ , about 18 billion, as in Equation (4). This correction factor of  $2/3$  is not new, and it is evident from Equation (16) later in this article.

<sup>5</sup>The assumption of a homogeneous universe prior to the big bang will result in a homogeneous universe now; but the universe is not homogeneous. The galaxies are known to occur in groups. See, e.g., Smith, Elske, V.P. Jacobs, and Kenneth C. Jacobs, 1973. Introductory astronomy and astrophysics. W.B. Saunders, Philadelphia. Section 19.3. The assumption of homogeneity is made purely for simplicity. It is well to note here that the transition from the big bang to the present inhomogeneous universe has evolutionists stumped. See Slusher, Harold S., 1978. The origin of the universe. Creation-Life Publishers, San Diego, California.

<sup>6</sup>Halliday, David, and Robert Resnick, 1974. Fundamentals of physics. John Wiley and Sons, Inc., New York. Section 14.4.

<sup>7</sup>Hurley, James P., and Claude Garrod, 1978, Principles of physics. Houghton Mifflin, Boston, give the mass of the neutron as  $1.67495 \times 10^{-27}$  kg, on the inside front cover. Evans, Robbley D., 1955. The atomic nucleus. McGraw-Hill, New York. Equation (1.3) gives the radius of the neutron, a thing actually rather hard to define, as  $1.2 \times 10^{-15}$  m.

<sup>8</sup>The last term  $(6\pi G_0 C)^{-1/2}$  is expressed in metric units.

<sup>9</sup>All times have been converted into seconds.

<sup>10</sup>Adler, Ronald J., Maurice Bazin, and Menahem Schiffer, 1975. Introduction to general relativity. Second edition. McGraw-Hill, New York. p. 394.