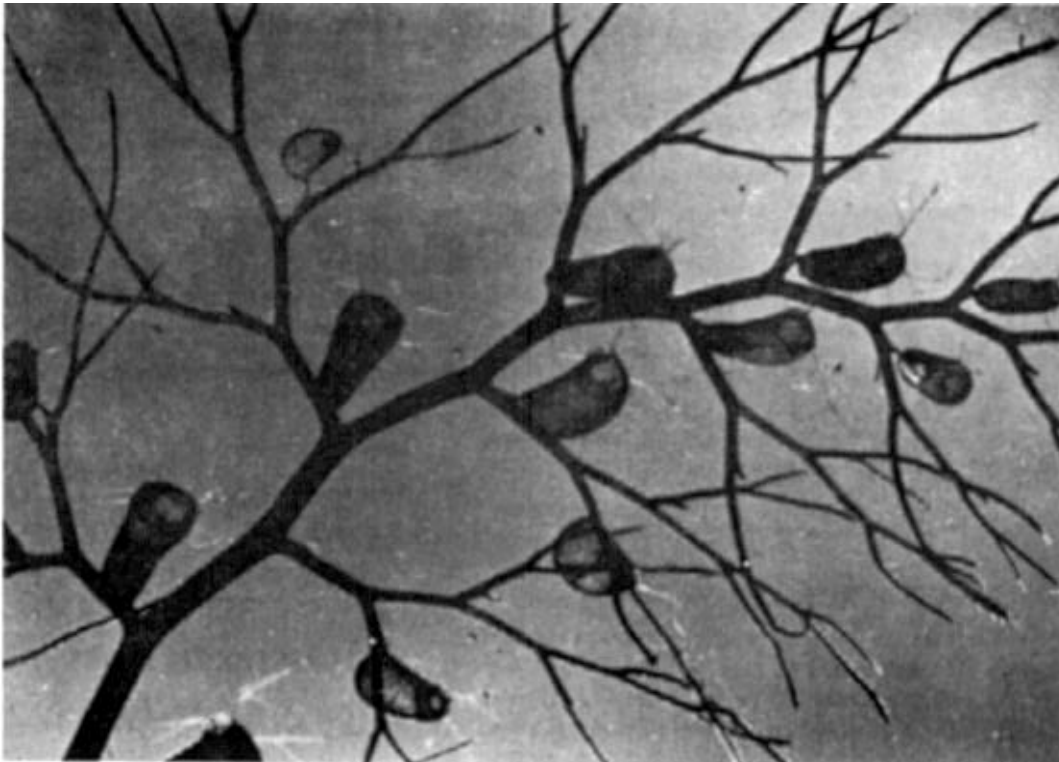


CREATION RESEARCH SOCIETY QUARTERLY



Haec credimus:

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

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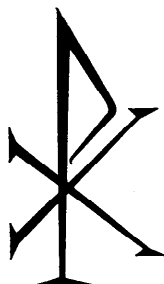
NUMBER 2

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Road, Ann Arbor, Michigan 48104.

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 400 voting members (with graduate degrees in science) and over 1300 non-voting members. The *Creation Research Society Quarterly* has been gradually enlarged and improved and is now recognized as probably the outstanding publication in its 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.

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RESEARCH NOTE

Professor Wilbert Rusch, Sr., 2717 Cranbrook Road, Ann Arbor, Michigan 48104 (Phone: 313-971-5915) is taking some time in January, 1973 to investigate tracks in the area of Texas and the Southwest. He would appreciate any interested persons writing to him about localities where new foot track remains may be studied or other phenomena of this nature that he might investigate. Anyone with information should contact him at the above address.

COVER ILLUSTRATION

The common bladderwort, *Utricularia vulgaris*, affords an excellent example of tropism as discussed by Willis E. Keithley, who supplied the original photograph, in his article, "The Barbaric Bladderwort," on the next page.

THE BARBARIC BLADDERWORT

WILLIS E. KEITHLEY*

If one were asked to tell the difference between a plant and an animal, the obvious response would be that the animal moves, while the plant does not and that the animal captures its food, while the green plant produces its foods from sugar which it manufactures in photosynthesis. Both of those assumptions would be invalid for some plants which exhibit a surprising "agility" in a tropism called *turgor movement*.

One of the most spectacular of these reactions is seen in the common bladderwort, *Utricularia vulgaris*. This plant is completely water-borne and reveals a carnivorous nature by snaring small aquatic insects and crustacea. The traps consist of many small bladders or sacs attached to the stem by a very fragile petiole (See cover illustration). At the mouth is a hinged trapdoor with a very sensitive trigger. To set the trap, the pod or sac is collapsed, just as you would suck the air out of a toy balloon (Figure 1).

When a swimming insect or other small animal touches the trigger hair, the bladder immediately expands *in 1/50 of a second!* This creates a vacuum in the sac and the inrush of water engulfs the hapless insect, which is now ingested while the door is closed and the trap reset.

But the operation is even more spectacular than this description. The petiole by which the trap is attached is quite weak and fragile. Thus, since the sac is not securely anchored, the hydraulic resistance of the inrushing water actually draws the entire trap forward, and in that twinkling of an eye, strikes out like a snake the full



Figure 1. Common Bladderwort

length of its petiole. A jaded biologist may be revived with a strand of *Utricularia*, a binocular microscope, and a common straight pin. As the trigger hair is touched, this astounding gnat-trap will snatch the pin so rapidly that the action cannot be seen, but so violently that the tug can actually be felt.

Of course, the obvious questions are, how is such a tropism accomplished without nerve or muscle tissue; what caused it to develop an appetite for plankton; how did it satisfy that yen before the trap was invented; and how did the plant then develop such an extravagant mechanism? We search in vain for any process of adaptive progression, or any primeval ancestry which had profited from some fortuitous experiment of "Mother Nature."

Would it be too tenuous to suggest a Divine act of creation? No other evidence provides an adequate answer.

*Willis E. Keithley is an experienced naturalist, evangelist, and nature photographer. He resides at Rt. 2, Box 1417, Madras, Oregon.

NEW PUBLICATION

Fossil Man, a Reappraisal of the Evidence With a Note on Tertiary Man by Frank W. Cousins. 1971. Published by Evolution Protest Movement, Hants, England. Revised Edition. 107 pages including an Atlas of Skulls (photographs and descriptions), Glossary, and Index.

Included in the revised edition is an additional 31 page appendix of new material (since 1965) updating the work.

A very important and up to date addition to creationist anthropology. Paperback, \$3.00.

Available from A. G. Tilney, Hon. Sec., Evolution Protest Movement, 110 Havant Road, Stoke, Hayling Island, Hants, England PO11 OLL.

THE GEOLOGIC AGE OF THE MISSISSIPPI RIVER

(With a Presentation of Basic Factors Pertaining to Age-Estimates of River Deltas*)

BENJAMIN FRANKLIN ALLEN†

The Mississippi-Missouri river system is the longest in the world, measuring some 4,221 miles in length. In flood season flat-land inundation below Cape Girardeau has always been a problem. About 1850 congress ordered General Andrew A. Humphreys to make a survey of the whole area, which was completed and published in 1861.

The English geologist, Charles Lyell, promoter of the Principle of Uniformitarianism, had made superficial examination of the river and delta, and gave the river system an age of 60,000 years, on the basis of a total depth of the delta of 528 feet. Humphreys showed these measurements to be erroneous, that the actual depth of the delta was only 40 feet. Below that was the blue clay layer and below that marine fossils, indicating that antedating the river was a marine estuary intruding far up into what is now the lower Mississippi River flood plain.

Therefore, using Lyell's formula for age computation, Humphreys got an age of about 4620 years, or approximately the time of the Flood of Noah. It is logical to believe that most of the present river drainage systems of the world were born at the close of the Flood.

There are less data available for computing the age of other major rivers of the world, but the data available seem to concur with the age of the Mississippi River.

If the river were as old as many uniformitarian geologists believe, the whole Gulf of Mexico would have been filled with sediment in some 10,000,000 years.‡

The rivers of the world owe their existence, location, and character to the differences in elevation of the land as expressed in mountains, plains and valleys. That this unevenness of surface was originally caused by up-and-down movements of the earth's crust, is apparent.

If these movements were of sufficiently sudden and severe occurrence they would have been of a catastrophic nature, the great bodies of water would have been unbalanced and set in violent motion, overflowing the land and creating a fresh surface for the start of entirely new river systems. If it can be shown by accepted facts of geology that the world's present river systems began simultaneously, then it would seem reasonable to conclude that the cause was just such a cataclysm of a world-wide scope occurring immediately prior to their birth.

*Reprinted from the *Bulletin of Deluge Geology and Related Sciences*, 2(2):37-62. September, 1942.

†EDITOR'S NOTE: Clifford L. Burdick of Tucson, Arizona, knew Mr. Allen and had contact with the old Deluge Society in Los Angeles. As a note of historical interest, I include the following comments extracted from a letter of Clifford Burdick's to me, July 23, 1970:

On the whole I think Allen did an outstanding piece of work on this paper. It always did stand out in my memory as one of his best. He was an indefatigable researcher. He was educated as a lawyer, graduate from the University of Arkansas. He had a logical mind, like Price . . . with whom he was associated in the old Deluge Society in Los Angeles, which had its meetings at the medical school at the White Memorial. . . . Allen was for years the head of the society. He had no formal training—like Price—in geology, but got interested in it. . . . Allen lived in a trailer, filled to the top with books. His main means of support was contributions from members of the society, such as Dr. George Rue. . . .

‡Abstract written by Clifford L. Burdick, consulting geologist, Tucson, Arizona.

The delta of a river, built by its conveyed sediments, is the chief source of information concerning the length of time the river has been flowing. The average volume of solid matter carried annually, the yearly increase in the length of the delta, and its total cubic content can all be measured with a surprising degree of accuracy. These facts form the basis for the calculation of the whole period of the river's existence from its origin to the present time. Thus the approximate date when a river began flowing can be established.

If, by this method, fair age-estimates can be obtained of a sufficiently large number of deltas to be considered as fairly representative of the world's rivers, and the life span is found to be substantially the same for all, the significance of such a result would be striking. Automatically the date would seem to be fixed, not only of the beginning of the world's rivers, but of the original catastrophe itself which must immediately have preceded the origin of the rivers.

If the date of this convulsion is found to correspond, within reasonable limits, to the chronology of the aqueous catastrophe as recorded in sacred history, supported as it is by archaeology, such coincidence will be of vital importance, both to science and to religious faith.

The Mississippi Delta, a Special Study. Inasmuch as the Mississippi river with its delta has been the subject of more scientific study than any other in the world, and since the main problems are very much the same for all rivers, it has been selected as an example for special study and will be given examination in detail. Basic principles pertaining to age estimates of all deltas will also be presented.



Figure 1. An Apollo series view of the Mississippi River and gulf coast of Louisiana looking from West to East. The Mississippi River is seen as a thin twisting ribbon in the upper left. Clouds obscure the delta which is visible in Figure 2. The two fine photographs are supplied by the courtesy of National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Texas 77058, Edward O. Zeitler, Chief, Earth Resources Research Data Facility.

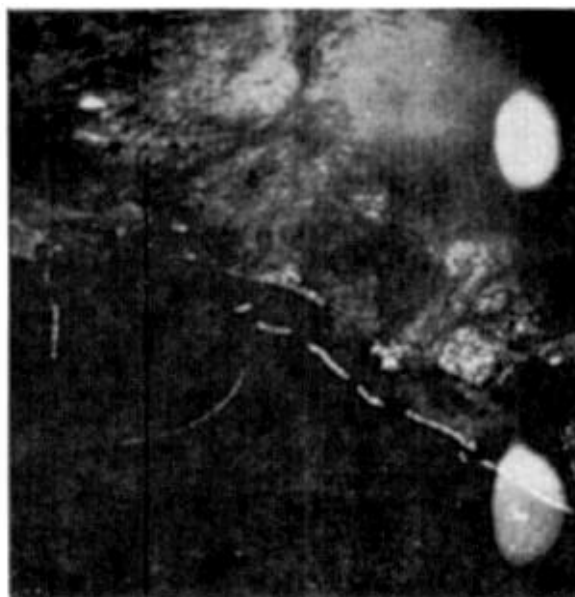


Figure 2. Apollo series view of the Mississippi River Delta. Lake Pontchartrain and Lake Borgne are clearly visible as is also the mouth of the Mississippi River and part of the amazing delta (compare this photograph with a map). This splendid Apollo shot will help illustrate the delta itself which figures so prominently in B. F. Allen's strong argument for the young-earth Flood concept.

Though given at the risk of tiring some readers, this careful attention to detail is indispensable to the main object of establishing a reliable basis for calculating age-estimates of all rivers. While firmly establishing the age of the Mississippi river, the object of this study is also to lay a foundation for age-estimates of other rivers.

It should be borne in mind that the present paper is intended as little more than a suggestive outline of the subject, which it is hoped others may be encouraged to follow in a more comprehensive investigation. In the present paper, only the age of the Mississippi river will be calculated.

The Problem and Its Outline

For more than twenty-five years there was a disagreement between Sir Charles Lyell and General A. A. Humphreys over scientific interpretations with regard to the age of the Mississippi river delta. Sir Charles Lyell, professor in Kings' College, London, and leading English geologist of his day, had estimated its age as 60,910 years.¹ General Humphreys, by different methods, had estimated it as from 4,400 to 5,000 years.

During a large part of that time Humphreys was in charge of the U. S. Army Corps of Engineers working on the river and delta, and, with his staff of experts and the aid of professor E. W.

Hilgard, state geologist of Louisiana, and other contemporary geologists, had accumulated a vast array of facts and a thorough knowledge of the whole delta area.

Hilgard quotes Humphreys as saying in an early report: "The river is flowing through the delta region in a channel belonging to an epoch antecedent to the present."² Lyell had challenged this statement. The contest was on, and has continued to the present day, into the second or third generation of geologists.

There are seven general features of the problem which should be considered. (1) Is the channel bed of the river antecedent to the river? Could the bed of the river have been an estuary? (2) What is the significance of the layers of gravel beneath the river, the Gulf, and the delta, and do they demand cataclysmic waters for their origin? (3) Shall we accept General Humphreys' data, and the reports of his staff, as the approved basis for the age of the delta? (4) Do the subsequent and latest views on the factors vital to the age of the delta, which sharply oppose each other on certain items, still fairly sustain the originally discovered facts? (5) The main problem being the general theory of deltaic subsidence, does the actually observed subsidence in the Mississippi delta, considered in the light of the established principles of geo-physics, sustain that

theory? (6) Is Lyell's estimate of the age of the delta based upon a consistent conception of its depth? (7) Do Humphreys' two methods of calculating the age of the delta rest upon a reasonable interpretation of all available facts, and do they properly check with each other?

The most important question of all is the theory of deltaic subsidence. It assumes that deltas, by their increasing weight, depress the crust of the earth, and thus grow downward many times faster than upward. The data given here mainly refer to the Mississippi delta, though the opposing general theories are discussed. In order to make clear first the less technical features in preparation for this problem, and to give an adequate conception of its significance, this discussion of subsidence will be reserved till the last, just before entering upon the final computations of the age of the Mississippi delta.

The "Antecedent Bed"

Hilgard and the U. S. Army Engineers had discovered what they interpreted to be an ancient "estuary bottom," extending some six hundred miles up the river, as far as to Cairo at the mouth of the Ohio. Into the sediment forming this ancient bed, the river had cut its channel from low water downward through many of its strata.

This same material had been found, so they stated,³ beneath New Orleans in an artesian well, the log of which had been carefully preserved. In this well the upper stratum, approximately 38 to 41 feet in thickness, was of typical delta alluvial deposits. The bottom of this stratum was marked by a thin layer of white quartz sand at the 41-foot level, which was the beginning of a distinctly different formation, carrying layers of a certain "blue clay" interspersed with other clay and layers of various types of sand and shell fragments—this being the first occurrence of the shells. This formation continued on down to the bottom of the well, a depth of 630 feet.

These men pointed out that the depth of the Gulf on each side of the delta corresponded with the 41-foot level of the well. All along its lower course the river deepens from 150 to 200 feet in places, and in its bed they found the same ocean shells. The supposition of these engineers was that the present river is flowing over the site of an ancient "estuary," its bottom now deeply eroded by the river. Hilgard,⁴ in describing it, said:

It is shown that the delta, or alluvial deposits proper, cover the older formations to a comparatively slight depth only, the river running on paludal [marshy] deposits and then on an ancient sea-bottom of corresponding age, from above New Orleans to near its mouth.

Another more recent authority is cited by Trowbridge,^{5, 6} who says:

The whole of the immediate valley of the river in the driftless area of Wisconsin, Illinois, Minnesota and Iowa, appears to have been cut out since the close of the Tertiary, and there is no evidence that the river existed in Tertiary time. The Pliocene Citronelle formation, the outcrop of which is crossed by the river above Baton Rouge, is not a part of the delta, and was eroded by the river so that it forms the erosional walls of the valley there.

Hilgard⁷ long before had pointed out the nature and order of the various deposits in this supposedly old sea-bottom beneath the river. First there was found the very thick strata far beneath the bed of the river consisting of ocean sediments containing marine shells, mingled with land sediments. This, as was later discovered, reached to a depth of 3,000 feet, where a layer of coarse gravel was spread out under the river and delta and well out into the Gulf and under all the north Gulf Coast states.

Much nearer the surface were found other layers of similarly wide extent. These layers constitute the "antecedent bed," the first consisting of coarse sediments, pebbles and gravel mixed with sand and clay, which he called "Orange Sand." Next above came the "Bluff," or "Loess," thought to have been originally a wind-blown deposit brought from the north by the supposed estuarine waters, and spread out over the "Orange Sand." Apparently it fell from the atmosphere *in standing water*, by no means river water. Then followed the fine "Yellow Loam" mixed with clay, which seemed more like the deposit of strait-like waters from the glaciated area, but not by river action.

Each of these layers was laid down evenly and, regardless of topography, at much the same thickness all over the bottom of the supposed "estuary." After these came the formation of the "upper terraces," which was pointed out as of ocean origin, and the "lower terraces," the formation of which was attributed to the river.

The Meaning of the Terraces. Terraces along river valleys are ancient shore lines, or strand lines, originating from two sources: the lower were cut by rivers and occur only in connection with them, sloping with their gradients in every case. The upper, or higher terraces were cut by the ocean and can be traced for the most part around the continents of the world. They follow their own ocean level, independently of the river terraces, around all ocean embayments, and up all river embayments as well, which proves that the ocean was over all so-called "estuarine" river beds.

Hilgard's view regarding the oceanic character of the Mississippi "antecedent" bed receives strong confirmation in the fact that wherever these higher terraces are found in deltas the world over, they lend themselves only to the interpretation of true ocean terraces, but never as river terraces. Had they been formed by gigantic rivers in a past era, *then in connection with them would be found the remnants of gigantic deltas, and these do not exist anywhere in the world.* There are plenty of gigantic sedimentary plains reaching down into the water, but these are not deltas, and cannot be attributed to rivers.

Professor Price⁸ recently reviewed the subject of terraces which in all their aspects bear an important relation to Deluge Geology.

Significance of Pebbles Beneath River, Delta, and Gulf. Hilgard⁹ described his conceptions of the causes of widespread pebbles and sediments, as follows:

The great torrent which spread the northern drift is seen to have swept over the southern coast with sufficient force to transport pebbles of five or six ounces in weight [one-third of a pound] from far distant regions, the nearest being Tennessee and Arkansas.

Note the recent confirmation of a much deeper bed of gravel by a later geologist:

Gravels below New Orleans, thought to be equivalent in age . . . lie at least 3,000 feet below sea-level. . . . Pleistocene glaciation caused streams to carry heavy loads of gravel and other debris, overloading them to such an extent that they anastomosed and spread their coarse deposits widely over the Gulf Coast States.¹⁰

Another recent authority says of the shallow bed:

Littlefield, who made a special study of the bars below the mouth of the Arkansas river and found that between 400 and 700 miles below Cairo there was a gravel bar consisting of pebbles as large as 64 mm. [about two and one-half inches] in diameter just downstream from almost every bend, concluded that most of these gravels were locally derived from a valley fill, probably of Pleistocene age. He said, "Below the mouth of the Red River the quantity and size of the pebbles decrease, except where the river crosses the Citronelle formation, and no gravel was found in the lower 150 miles of the river."^{11, 12}

This interpretation of a "valley fill" conforms approximately to the findings of Hilgard in the local well at New Orleans, that no gravel was found in the delta, but coarse white quartz sand

at a depth of from 38 to 41 feet, and between that and eight inches farther down "chiefly coarse silicious sand, part sharp, mixed with fragments of shells."¹³

Trowbridge, in describing the gravels out in the Gulf off the delta, said:¹⁴

The coarsest sediment shown on the map by the oblique lines which lies on the surface of a submarine dome¹⁵ that stands more than 100 feet above its surroundings, did not come to the Gulf through the river, at least not through the river as it is now.¹⁶

After making every effort to uphold Lyell's view of the depth of the delta, but still expressing doubts, another reputable geologist¹⁷ makes a more recent statement concerning these sediments:

Even more necessary are further offshore investigations, where the pioneer work of Trowbridge has indicated some of the many problems awaiting solution. Glauconite¹⁸ is said to be present "on the outer steep slope of the Gulf bottom," and coarse sediments cap mounds well beyond the pass mouths on the floor of the Gulf.

Gravel Calls for Water Cataclysm

The utter impossibility of transportation by the river of these great strata of gravel-bearing clay and sand should at once be apparent. Not only is the gradient of the whole valley too slight to admit of it, but our greatest rivers in capacity and power afford no comparison to the magnitude of force, volume and expanse required for such a transcendent accomplishment.

Add to this the phenomenon, impossible to a river, of distinct layeration with each layer composed of its own peculiar grade of sand, the differing layers ranging from the finest to the coarsest, with the interspersions between of other layers of the finest clays—clearly, *overspreading waters* laid down *one kind at a time*, impossible for a river.

Then, capping off the whole series of pre-river formations, is the final overspreading layer of "Yellow Loam," apparently not greatly altered or shifted by the waters. But as though these all were still not convincing enough, the climax of evidence is furnished by the deposits of seashells in the sands and clays of some of these underlying layers. In the face of these astounding facts, Lyell's doctrine of uniformity breaks down completely—and just where it is counted on most heavily.

The gravels and sands are much coarser in the upper regions of the deposits, becoming less coarse as the Gulf is approached. It was perhaps this fact that led the geologists to believe they

were dealing with river action, especially since there is a river there now.

Even Hilgard, whose more acceptable theory of a "great torrent that produced the northern drift" of coarse gravels, shells and landward fragments, and "swept over the southern coast," did not seem to realize that it could not have been river action. A gradient such as that of the Mississippi, at least from Cairo on down to the Gulf, would be utterly insufficient for the task, much less an estuary such as Hilgard postulated, with its opposing force of ocean waters and the tides opposing the river waters.

Nowhere in operation today can be found an example of such a tremendous feat of transportation. Catastrophic action is apparently demanded.

General Humphreys on the foundations Beneath the Mississippi Delta. The long and close personal study given to the river and delta by General Humphreys, with his staff of engineers, and Professor Hilgard and other eminent geologists called in for collaboration, lends great weight and authority to his official findings, more than to those of more widely known geologists who visited the area only briefly.

During their practical labors, Humphreys and his associates observed and identified in many localities the same "Blue Clay" as that discovered in the artesian well at New Orleans. In this well the blue clay first appeared at a depth of 41 feet, and frequently from that depth downward.

Following is General Humphreys' summary of the main facts he offered concerning the Blue Clay and the depth of the delta:

The Blue Clay

Inferences Respecting the Blue Clay and Facts Bearing Upon Its Probable Age.

The facts are very important for they prove either that the peculiar Blue Clay in the bed of the river is alluvial deposit, or that the thickness of the alluvial stratum in the delta region has been greatly overestimated, and that the river is flowing through it in a channel belonging to a geological epoch antecedent to the present. The following data have been collected:

1. *Its physical characteristics.* The clay is quite different in appearance, color, etc., from any deposit now made by the river. As long as it remains wet, it seems nearly insoluble, resisting for years the strong current of the river. If it is thoroughly dried, however, and then again placed in water, it rapidly disintegrates into a powder. The clay itself has a somewhat gritty feel between the teeth and a peculiar taste. It effervesces less with acids than the present deposits of the river, judging by the samples

of the latter collected by the survey.

2. *It underlies the Yazoo Bottom* below the greater sand stratum, if we may judge from the fact that it constitutes the bottom of the Yazoo and the Sunflower rivers, as well as that of the Mississippi; and all three are on the same level.

3. *It underlies the Vicksburg Bluff*, which is a Tertiary formation. In this bluff it underlies the stratum which contains marine shell, and which Sir Charles Lyell and Dr. Harper both pronounce Eocene Tertiary; that is, it is the oldest Tertiary stratum. . . . It undoubtedly underlies other of the river bluffs. . . . It is visible only at low water.

4. *It underlies New Orleans* [below 41 feet] in strata alternating with sand and marine shells for at least 630 feet, as shown by the artesian well which was begun in that city in February 1854 and carried to that depth. Dr. N. B. Benedict, recording secretary of the New Orleans Academy of Sciences, in behalf of a committee of that body, of which he was a member, devoted himself to the study of the well, securing samples of every stratum pierced, and otherwise thoroughly investigating the subject. . . . The geological age of the strata pierced is well established, but it is evident that none below the depth of 41 feet from the surface were deposited by the river. The same must be acknowledged in reference to the channel of the river itself, for it is identical in character with the sample of the very last stratum, which was presented for comparison by Dr. Benedict. . . . [Here follows the log of the well as prepared by the Academy.]

5. *It crops out under sandstone on the east coast of Texas.* Mr. A. M. Lee, of Knoxville, Tennessee, an engineer of high scientific attainments, formerly of the army, states that this identical clay with which he is familiar, crops out under calcareous sandstone at a depth of 24 feet below the level of the Gulf at Aransas Bay and Lagune Madre on the coast of Texas.

6. *It possibly underlies the Estacado.* (A well was drilled by Capt. John Pope, Topographical Engineer). . . . The close analogy between the physical characteristics of such a formation and that underlying the Vicksburg Bluff, together with the similarity of the supposed geological ages, suggest that they may be identical. . . .

7. *Found in the Missouri River Valley.* Lieutenant S. K. Warren, Topographical Engineer, states that this peculiar Blue Clay very closely resembles a formation which covers a great area in the immediate valley

of the Missouri east of the Black Hills. His geological assistant, Dr. Hayden, assigns a place for this formation near the middle Cretaceous, and describes it as follows: "Bluish and dark-gray plastic clays, containing *Nautilus De Kayi*, *Ammonites placenta*, *Baculites ovatus*, and *B. compusus*, with numerous other marine molusca . . . remains of *Mosasauros*. Thickness 350 feet." . . .¹⁹

Gulf Depth Compared. Humphreys, in a letter to Colonel Theodore Lyman, well summarized his data, saying:

There can be no misapprehension as to the identity of the clay found below the depth of 41 feet in the artesian well with that in the bluffs at Columbus, Vicksburg, etc., and in the bed and channel-way of the river. There is an unmistakable difference between this clay and that deposited by the river. . . . Further, the original depth of the Gulf of 41 feet at New Orleans is at least as great as that of the Gulf off the coast of Alabama and Mississippi, where the sandy bottom indicates that the original marine bottom has not been covered with the mud of the Mississippi river.²⁰

He then refers to maps published in his Professional Paper 13, herein frequently quoted from. These maps give the contours drawn from extensive soundings by the U. S. Coast Survey, showing that there is no reason for supposing the bottom of the delta to be any deeper than the bottom of the Gulf on each side where no river sediments have been deposited upon it.

Concerning this point, he wrote to Sir Charles Lyell, as follows:

When I came here in the fall of 1850, I was familiar with your views upon the subject, but I could not accept them. There was no instance on the whole Tertiary coast of the United States of a sound, or bayou inlet of a sea, with the great depth which you assigned to the ancient sound into which the Mississippi river originally emptied. Nor was there anything in the form and character of the adjacent coast and country to render such an original depth probable.²¹

The coast country is low and flat.

Portales' Report of the Coast Survey. Portales, a leading authority on shore and ocean geology, dredged samples of the clay formation from the bottom of the lower part of the river and delta from Carrollton to the mouth. These contained, besides the characteristic clay, corals and marine shells in abundance. In the summary of his report to General Humphreys, he said:

The most general conclusion which can be drawn from this examination is the confirma-

tion of your opinion that the bed of the river is not composed of recent alluvium, or in other words, that the river has not contributed to any considerable extent to the formation of its bed in the localities examined, but in flowing over a former sea-bottom.²²

Of the peculiar clay beneath the river and delta, (after over 30 more years of research,) Hilgard says: "This is called the 'Blue Delta Clay' by Humphreys and Abbott; it will here be called Port Hudson Clay, because it is entirely independent of the modern delta formation built up by the river."²³

Again, at this late date, 1912, speaking of the formations below the Blue Clay, he said: "But these formations, as well as the Port Hudson Clay, have nothing to do with the present problems of the delta, beyond serving *as the floor on which it is built forward*. The depth of the sands and silts of the true delta is from 30 to 40 feet, and rarely reaches 60 feet." Elsewhere in the same paper he said:

As is well known, a continual shelf covered by a comparatively shallow depth of water, runs out for 30 miles beyond the present mouth of the river, then breaks off into the deep waters of the Gulf. The original stratum of this shelf is the Port Hudson Clay, (the "Blue Clay" of Humphreys and Abbott); but this is now coming to be gradually covered with the delta deposits and river sediments.

Later Views vs. Undisturbed Original Facts

The old controversy still has not come to an end. But the basic facts supporting these older views are still acknowledged to a surprising degree, though interpretations may vary. A study of the late literature discloses that many of the detailed data and thorough observations which determined and supported the older views are now seldom considered. They are lost or ignored beneath the weight of standard geological doctrines that postulate the very slow but continuous general upheaval and subsidence together with other features of uniformitarianism.

Forty years after the appearance of the Humphreys-Abbott report, even as late as 1912, Hilgard, then at the University of California, and still the leading authority on the Mississippi delta, noted that the well-established facts which he and Humphreys had patiently established were being ignored by later men, regardless of the absence of anything new by way of refutation of the original conclusions. Even today their careful and accurate report seems to be among the most valuable of all geological contributions to the subject.

That some still hold to the old view that the river cut its channel through a Tertiary sea-bed

is shown by the short statement by Mr. Trowbridge²⁴ given previously and here repeated: "The whole of the immediate valley of the Mississippi river in the Driftless Area of Wisconsin, Illinois, Minnesota, and Iowa, appears to have been cut since the close of the Tertiary, *and there is no evidence that the river existed in Tertiary time.*" He continues, stating that this condition extended down approximately to Baton Rouge. Here, he says, the delta begins, and "does not, as many textbooks teach, extend up to the mouth of the Ohio river and include all of the Tertiary formations of the Mississippi embayment."

Another view, almost opposite to this, yet bearing out some of the main fundamentals of the older view, was expressed as late as 1941. As these late geologists view the size of the delta, instead of its being from 12,500 to 12,600 square miles in area as originally estimated by Lyell, Hilgard, Humphreys, and others, the position is taken that it "extends from Louisiana to central Texas," and begins in southeastern Missouri, progressing 600 miles southward. They say: "More than 200,000 square miles have been filled by the river to depths ranging from something over 100 to more than 12,000 feet; and the river has probably been working several million years to make the deposits."²⁵

Yet continuing they make the following statement as to the character of the bed on which the river flows, which, after all, is basically not far from the older views: "The 200,000 square miles of the landward part of the delta was once all sub-oceanic, so that, in drilling wells through the delta sediments, most of the material encountered were deposits below the sea. This is determined by fragments of sea shells found in well cuttings."

As to the depth of the river sediments, they wrote:

In drilling wells for oil or water in the delta, drills cut through a few feet to possibly 100 feet of sand and clay deposited above the ocean level. Below this are found a few feet deposited in shallow water, and below that a few thousand feet of clay and fine sand deposited far from shore.

The "100 feet deep of sand and clay" coincides with the Hilgard-Humphreys report that the delta is 100 feet deep at the outer part. But that it is "deposited above the ocean level" is questioned, especially if applied anywhere on the real delta, because at its highest point up river it is not over 15 or 20 feet above sealevel and less than that in its lower parts, most of it being only five feet or less.

In this report, however, the distinct identity of the bottom of the real delta and the original bottom of the Gulf can be easily seen; though

why these geologists should add to the deeper "few thousand feet of clay and fine sand" the words, "deposited far from shore," is not apparent. *Such materials are certainly not being deposited now in any sea "far from shore,"* a fact to which authorities on shore deposits abundantly testify.

Thus we see that Benson and Tarr, while extending the delta to such extreme widths, still constructively admit that it is as shallow as reported by the Humphreys group. Trowbridge, on the other hand, while still clinging to the excessive depth advocated by Lyell, flatly disagrees with Benson and Tarr as to the wide extent of the delta. He would narrow it down even more than the original workers.

Though holding opposite opinions on these vital points, these men all agree to excessive age-estimate of the delta involving many millions of years, *and use opposing arguments to sustain it.* Yet none of them offer any newly discovered facts of importance; and no facts at all that in any way invalidate the careful work of those earlier geologists, but they ignore many basic facts upsetting to their theory.

It would seem that the late opinions are governed more by the standard doctrines of uniformity than by any new supporting evidence. The original position of the Humphreys group, the only one ever held with any unanimity, is still apparently the only logical position to hold, as all subsequent discoveries, though meager, seem to harmonize with it.

Dana,²⁶ also one of the former generation of geologists, demonstrates that the Mississippi river alone, with its generally agreed sedimentary load of 1/2600 of the bulk of its water, *could fill the whole Gulf of Mexico with silt in only 10,400,000 years.* And this period is not far from the figure vaguely intimated for the delta alone by these later and more doctrinaire geologists than Dana.

Benson and Tarr, as well as Russell and Russell, and also Trowbridge, take the position that the 30 to 100 foot delta of Humphreys, Abbott, and Hilgard is only the "top-set bed" of the real delta, that is, only that part laid down above the ocean water by river overflow. Subsidence, they say, enables a delta to grow downward hundreds of times faster than upward.

But, if the delta "has been working several million years to make the deposits," as they claim, why is not this top layer hundreds of times thicker than the bottom layers? Why does it not constitute almost the whole supposed thousands of feet, since only in the original shallow depth of the Gulf shore there could form the bottom-set and fore-set beds?²⁷ This position thus breaks down under mere logic.

It has become clear that the general theory of deltaic subsidence is the most important ob-

stacle to establishing the age of any delta. If true, especially would this apparently forbid the possibility of any two or more rivers being the same age. Lyell insisted that the necessary variation in the rate or amounts of subsidence of different deltas renders any general coincidence in the age of the rivers of the world utterly impossible.²⁸

The Significance of Deltaic Subsidence

All geologists assume that deltas subside, but they do not agree as to the cause or extent of that subsidence. The main issue is the question of whether the sediments merely settle into more compact form, or the crust of the earth itself actually gives way beneath their weight, or whether both occur.

Obviously, this question is most fundamental, especially in its relation to the depth of deltas. Therefore, because it is so vital in calculating delta age, it has been reserved to the last.

In discussing the general features of the problem, certain questions naturally present themselves. (1) How is the basis of the theory of deltaic subsidence related to uniformitarianism, and how is it applied to the Mississippi delta? (2) What is the relation of the ocean and river terraces to the supposed subsidence of the Mississippi delta, and do they prove the general theory? (3) Does the supposed deep trough or syncline beneath the Mississippi delta agree with field observations, and with the principles of geophysics involved? (4) Does the relative thickness of the beds of deltas, as compared with that of the beds beneath them, indicate that such subsidence has occurred? (5) Are local earthquakes which are accompanied by sinking of land proof of the general subsidence theory? (6) Do the facts from coal deposits sustain the theory that coal was formed in subsiding delta swamps? (7) Can lava flows and extensive erosion cause lands to sink or to rise, or, do the observed conditions defeat the theory of current subsidence and upheaval?

Though to the lay reader these questions may seem extraneous to the main subject and objectives, it will soon become apparent that they go to the most vital parts of the whole problem of the geologic age of the Mississippi delta and other deltas. Nearly all of the data are from the Mississippi delta, and the remainder are pertinent and necessary in establishing the broad general principles of a *long-needed science of delta formation*, on which to base age estimates of the Mississippi river and other rivers of the world.

The Basis and Implications of the Theory. The general theory of crustal deformation is based on the supposition that vaguely-defined forces beneath and upon the surface of the earth are con-

tinuously exerted to cause changes of level, both of subsidence and emergence. Excepting the work of erosion, these forces are credited with producing the continents, the islands, the mountains, the valleys, and also all irregularities of surface under water.

Almost infinitely slow movements, acting through eons of time, are postulated, though certain movements are supposed to be more rapid than others. This is the principal feature of the doctrine of uniformity and one of the main supports of the theory of geological evolution. But it is very vague and vulnerable to attack.

As applied to deltas, it teaches that the crust of the earth is depressed or bent downward by the weight of the increasing delta sediments. The accumulating sediments in all basins are supposed to be depressing the bottoms of these basins so as to make room for more and more of the sediments.

The theory teaches that deltas grow downward hundreds of times faster than upward, and that after a billion or more years an extremely thick bed of deltaic sediments results. This body of sediments is called a "lens," because it is supposed to be very much thicker in the central portion than around the edges.

Typical uniformitarian views are expressed by Russell and Russell²⁹ as follows: "Louisiana and the adjacent areas in Texas and Mississippi have been the theater of deltaic sedimentation for such a long period of time that it is impractical, if not impossible, to assign either date or stratum of rock as marking the beginning of Mississippi river history."

Every sedimentary layer from the surface down to an unknown depth where there is no more mingling of ocean fossils with land fossils, they conceive to be the work of delta-sedimentation. Describing it, they say: "The geo-syncline³⁰ presumably has been increasing in depth, and the base of the Tertiary is thought to lie possibly as deep as 30,000 to 40,000 feet in the vicinity of New Orleans." Clearly, these men out-Lyell Lyell, doubtless who would have been pleased to know of such a vast increase in the estimated depth of the delta, and therefore of its age.

The Evidence of the Terraces. These men report that in the central part of the state of Louisiana, certain of the highest ocean terraces above the alluvial plain of the river slope slightly more than do the lower terraces along the river. They stress this fact in support of their theory, reasoning that in the immense lapse of time between the making of these two sets of terraces, the delta subsided enough to cause this difference, which is only from one to two or three feet per mile.

These isolated terraces are more than 100 miles from the delta and many miles from the river itself, toward the west on the edge of rising land.

It would seem that they are too far distant from the delta to bear any particular relation to it.

Professor Price has shown that these upper terraces were not formed by the river at all, as were the lower terraces, but by the ocean itself before the river existed.³¹ This view was originally brought out in detail by Hilgard, in presenting his evidence of the supposed estuary of pre-river history; and he voiced the opinion of the entire Humphreys group.

Price suggests that all of the ancient ocean beaches may have been only very temporary, the result of a brief halt in the general withdrawal of the oceans from the lands; or that each of these strand lines might have been cut by a single storm. The depth of the ancient beaches cut by the waters is only trivial compared to modern beaches, and this is generally true the world over.

He also offers and approves the generally accepted view that because these ancient strand lines as a whole have the same elevation above the oceans all the world over, they mark retrogressive stages by which the oceans, due to some general or very large subsidence somewhere on the ocean floor, sank to their present level. He suggests that the occasional local and irregular tilting of these old ocean beach lines may indicate that while parts of the ocean floor were then undergoing final adjustments, *so also were parts of the land*. Indeed this would be seemingly inevitable.

From the viewpoint of the student of Deluge Geology, these ocean terraces were apparently cut while the sediments were freshly deposited. The sediments were especially deep towards the Gulf where they would settle the most. Therefore, if not disturbed, they might naturally have tilted somewhat in that direction. No doubt there might be found some of these irregular lines that show a northward slope.

The ocean terraces often are locally tilted in other parts of the world. In any case, no dependence can be placed in them to shed light on the subsequent formation of the delta. They are too far away from the delta. Besides, the greatest degree of tilting claimed is not worth considering by comparison with the extreme tilting that would be indicated if caused by the enormous delta subsidence (30,000 to 40,000 feet) which these men postulate.

Russell and Russell further insist:³² "Evidences of subsidence are so overwhelming in the lower parts of the delta, and agree so closely with the hypothesis that subsidence is the result of sedimentary loading, that escape from the idea that deltaic sedimentation is the most potent factor in the Gulf Coast disastrophism³³ seems impossible."

They describe the subsidence of Indian mounds, buildings, streets, and other landmarks, and sum up as follows: "Survey markers near the mouths of the most active passes³⁴ subside at the rate of nearly eight feet a century. Twenty miles inland the rate is about two feet a century."

The facts here brought out are all granted, but they appear directly against the theory propounded. *They merely indicate that the fresher, softer, and deeper the sediments are, the more and faster they settle.*

The Geophysics of Subsidence. According to this theory of delta subsidence, not only the immediate site of deposition settles, but the weight of the delta supposedly depresses the crust of the earth in the whole surrounding region, carrying down with it the entire delta and vicinity. The crust of the earth is supposed to be rigid enough to cause this.

Geologists point to certain lakes and embayments on the far flanks of deltas, affirming that these were carried downward by the regional subsidence of the deltas. From the principles of geo-physics, the most rapid subsidence should be *beneath the center of gravity of the delta as a whole*. From this point the subsidence should be less in all directions. This is the theory of the formation of the geo-syncline or deepening trough through the continuous deposit of sediments.

But as a matter of fact, the actual subsidence is *most rapid in whatever portion of the delta the deposition happens, for the time being, to be greatest*. Such locations may be many, and the areas of deposition may vary in size, and shift about widely from time to time, each perhaps sinking at a different and changing rate. These facts, seemingly so fatal to the modern interpretation of deltaic subsidence, are ignored by proponents of the theory.

Inasmuch as the theory of deltaic subsidence is thus lacking in the proper geo-physical behavior essential to the theory, the existence of these lakes and bays can be attributed just as well to other causes. Now, as always, they occupy delta areas farthest from the river and have been least affected by sedimentation. River overflows lose most of their sediments within a mile or two after leaving the river. It would seem, therefore, that they merely have not as yet been filled up, or that sedimentation is too slow or has not as yet been sufficient to overcome the local settling of the sediments they have received.

The theory of the deltaic geo-syncline demands a downward dip on all sides toward the delta to indicate the 30,000 to 40,000 feet of thickness claimed for deltaic material by Russell and Russell, the present leading proponents of the theory. If Trowbridge's claim be allowed of a small delta area of about 150 miles long by 50 or 60 miles

wide, this great depth within such a small area would call for the strata to dip at an extremely steep angle, causing a syncline that would be nothing but a deep sinkhole.

But though these same authorities are also leading oil geologists and as such would never think of drilling into a syncline for oil, and though their sole purpose in recent studies of the delta region has been to understand the relation of modern river deltas to the formation of oil, and though oil is now being produced from beneath parts of the delta, yet, not one stratum has been reported from those wells as actually indicating any syncline.

There is also another very significant fact that stands squarely in the way of this theory. The famous "Blue Clay" that underlies the delta and the Mississippi river above for several hundred miles, instead of dipping steeply underneath the delta as called for by the syncline theory, follows the present Gulf bottom gradient without deviation or break all the way underneath the delta and all the surrounding regions.

Shallowness of Deltas Misinterpreted as Subsiding Top-set Beds. Bear in mind how the capping of all of these supposedly deep beds with only the thin top layer from 20 to 100 feet thick is utterly inconsistent with the "deep delta" theory. These men hold that this cap is the top-set bed, the bed formed above the level of the Gulf after the delta had emerged from the ocean, *formed by river overflows on land.*

Their theory is that, as it thus formed, it was gradually lowered by regional subsidence. But they say the many thousands of feet of deltaic sediments below it were laid down *under water*, (some say, "far from land"). Now the thing that seems to defeat this theory is *the thousand-fold thickness of those underlying beds as compared to the supposed top layer.* If this top layer has been growing thicker and pressing down the delta for millions of years, *why is it so remarkably thin as compared to the beds below it?*

Could the bottom beds be also thousands of times thicker, by subsidence, than the depth of the Gulf at the site of the delta? In other words, how could beds 30,000 to 40,000 feet thick be laid down in water only 20 to 60 feet deep?

It would seem, also, that the up-river part of the delta, that nearest the original shore, *the oldest part*, in that case, *should have the deepest top layer*, under the theory, *instead of the shallowest, because it has had the longest period above water.* Therefore, logic alone seems to defeat this theory. How does it happen that this supposed top layer is so thin *in all deltas* as compared to the thickness of the theoretically deep deltaic beds below them?

The marvel of geologists (from their viewpoint) is this extreme shallowness of deltas, or

what some presume to be the top layer only. It is little wonder that some of them have invented the theory that these thin deltas are only the top-set beds of the supposedly very deep deltas which supposedly "have grown hundreds of times faster downward," by subsidence of the crust of the earth by the mere weight of the sediments. On the shallowness of the deltas, in flat denial of this theory, the following statement is by perhaps the leading authority on the origin of sedimentary strata:

The depth of delta deposits on modern sea coasts varies greatly, but is, on the whole, comparatively slight. Thus the mud of the Nile delta is not over 10 to 15 meters thick. It rests on loose sand. The delta deposits of the Rhine have a thickness of 60 meters, those of the Rhone over 100 meters. In the Po the depth average is 122 meters, though near Venice 172.5 meters were penetrated without reaching bottom. The delta deposits of the Ganges and Bramaputra rest on the older sediments and average only 20 meters in thickness. The actual delta deposits of the Mississippi range from 9.5 to 16 meters at New Orleans, increasing to 30 meters at the head of the passes.³⁵

It is suggested by a co-worker that, inasmuch as deltaic sediments are mostly laid down under water, and therefore displace the water, their downward pressure is thereby so greatly reduced that little weight is left to exert pressure on the bottom. Such sediments being of very light material anyway, he says the added weight is so small that the theory of deltaic subsidence is rendered all the more untenable.

The terms of the theory of deltaic subsidence counteract this suggestion largely, however, by the postulation that, through millions of years, sediments many times deeper than the water have gradually subsided, and that, by comparison, the weight of the water is now insignificant. Besides, the claim is made that, after the delta is built up and becomes land, still the subsidence continues by the deposit of alluvium from river overflow. However, suggestions like this are helpful, because, in discussing them, added light is thrown on the subject.

"The Legerdemain of Local Upheavals." Trowbridge, strange to say, he being an advocate of the general subsidence theory, very logically rejects general subsidence as applied to the Mississippi delta. He writes as follows:³⁶

The total amount and rate of settling have not been determined. The settling is probably due to the compacting of the underlying sediments, rather than to disastrous³⁷ subsidence of the delta as a whole, and to superficial drainage and decay of vegetable matter.

So many opposing views existing among these recent delta authorities, reveal a weakness in their theory, and invoke most favorable impressions of the Humphreys group, the only set of workers yet to agree on a mutual interpretation of all the basic facts.

Earthquakes in river valleys which were accompanied by some subsidence, and at least one such occurrence in a delta, have often been strongly urged as examples of subsidence caused by sedimentation. A small area just above the delta of the Indus subsided slightly on the occasion of an earthquake.

Another example was the New Madrid earthquake in the Mississippi valley in 1912, though this was some hundreds of miles above the delta. Geologists who endeavor to use such occurrences in support of the subsidence theory seem to forget that deltas and river valleys are no more subject to such phenomena than most any other part of the earth.

Hilgard, in his report to General Humphreys, criticises this theory thus:

Much has been said of the possible effects of earthquakes which so frequently startle, for a moment, the inhabitants of the Mississippi valley; and it is more than likely that the record of such events as those of New Madrid and Reelfoot lake will be found stamped on many dislocated strata hereafter. But there is a wide difference between such effects and the legerdemain machinery of "local upheavals" which is so readily resorted to by amateurs for the explanation of any unusual phenomenon.³⁸

Though there is little likelihood that this was intended as applying to Lyell, yet Lyell was perhaps the originator of the application of these particular earthquakes to the theory of delta subsidence, if not the original proponent of the theory itself. He strongly contended that delta subsidence rendered impossible the accurate estimation of the age of any delta, and for this reason he especially opposed the idea that the rivers of the world could be of the same age.

Deltaic Subsidence and the Swamp Theory of the Origin of Coal. In support of the general theory of subsidence or changes in level as applied to deltas, the theory is frequently urged that coal was formed in deltaic swamps or where marine remains are present in estuary swamps.

Not only is coal presumed to have been formed in deltas, as a consequence of their gradual subsidence, but coal formation is also pointed to as proof of the general subsidence theory of deltas. It is used both as proof and as the thing to be proven. Therefore a brief examination of the facts about coal formation and deltas is necessary, and doubly profitable. Coal theories are so

closely connected with the whole subject of delta formation that *no adequate conception of the problems and principles of deltas is possible without putting those theories to the test and proving that they are false.*

The veins or seams of coal are said to be buried and carbonized remains of vegetable swamp-mud, principally of timber or other vegetation that has grown in swamps which later have become sunken, and been buried where it grew by deposition of silt; after which other growth has appeared and in its turn been sunken and buried, and so on, endlessly, the process repeating through millions of years on end. Accumulation of vegetation sufficient to produce a single vein of ordinary thickness is supposed to have required a long geologic period.

The kinds of vegetation, so far as identified, that have been converted into coal, in supposed estuarian swamps, are the same, generally speaking, as those found in coal fields of supposed deltaic swamps. This means, if this coal-origin theory be true, that the plants which grew in brackish, or saline environment, *are the same kind as plants which grew in fresh water swamps.* Yet today with few exceptions, plants grow only in either one or the other of these two opposing environments, *but not in both. The same is true of fish life.*

Of course, in an ocean delta all degrees of salinity may be found, depending on whether river or ocean water locally predominates. These conditions might change from time to time. But in a coal-mining area, such fluctuations seldom, if ever, occur. At times, fossil deposits known to have come from the deepest parts of the ocean are found interlayered with coal. Frequently coal is interlayered with coarse gravel, and often with coarser conglomerate. Even large rocks, called "erratics," sometimes appear.

Yet no delta in the world today contains any sediment coarser than sand. It should be apparent that all of these conditions not only point away from the deltaic and swamp theory of the origin of coal, but especially oppose the estuarian origin of coal formation.

Sometimes, protruding up through many layers of sediment (representing, so they say, as many geological ages) tall trees, petrified or carbonized, have been found, some in upright position, but most of them oddly slanting.³⁹ Such trees may appear with tops that have not suffered from weather, wear, or decay, any more than their root ends, before being transformed into their present state. Because of this phenomenon, geologists hesitate about assigning to the layers of these particular formations the millions of years they habitually assign to layers elsewhere exactly the same except for the position of the fossil trees.

In a supposed coal-bearing swamp thus silted up many feet deep, always deeply enough to bury standing trees, why should not large numbers of trees be found in a standing position? Why are they practically all prone as though having drifted to the location? (And bear in mind that this discussion omits consideration of the coal beds themselves.) These questions are still unanswered.

A single coal deposit consisting of many seams, one above another, contains almost exactly the same kinds of plants throughout, *even to the outer edges*. But in the natural swamp forest today, the kinds of plants vary from time to time, not only as to kind, but as to location in the swamp, and may change almost completely within a man's lifetime. Moreover, as to location, they may differ in kind from place to place in the area, especially from the center toward the outer edges.

This leads to the next question: How could a swamp subside at the exact rate necessary for the growth of almost identically the same kinds of plants throughout the entire area of the swamp, and do this while it was passing through changes constantly for millions of years? And how could a single standing tree be found extending up through them all?

Of the few instances where coal and peat have been found beneath deltas, Lyell and others have made the most in an effort to bolster up their theory.⁴⁰ But they ignore the fact that coal and peat are found also, and much more abundantly, under the rivers themselves farther upstream, and under other rivers and even in far distant hills and mountains, having no relation either to rivers or deltas.

Furthermore, the apparent insincerity of the claim that coal is a deltaic swamp product, or the product of any other kind of swamp, is revealed by the fact that there appears to be no record of any modern delta or swamp having produced coal, *or ever having even been prospected for coal*. Why should not *at least a few such swamps* be still in process, with many rich beds of coal beneath as the finished product?

In concluding this discussion on coal and deltas, a sample statement is in order from those who aver the delta-swamp theory, to illustrate the attitude which they take (but also to show their agreement with the writer on the recent age of two great deltas):

The Ganges annually carries across its delta to the sea sufficient sediment to cover one square mile 221 feet deep; the Mississippi annually discharges into the Gulf of Mexico sufficient to cover one square mile 268 feet deep. Apply these figures to the hypothetical case, and assuming that one half of the discharge goes to make forest

beds by which the delta is built outward, it is seen that the Ganges would completely reclaim this area in 4,524 years and the Mississippi in 3,730 years. These, however, are two of the greatest rivers. But even if the Carboniferous rivers [the supposed Carboniferous geologic age], discharging across the region of the Appalachian coal fields, delivered but one tenth part of the detritus borne to the sea by the Ganges and the Mississippi, it is seen that the transgressive effect of the supposed subsidence would be completely nullified in periods of 45,240 and 37,300 years.⁴¹

In other words, Dr. Barrell is so sure that subsidence exactly keeps pace with deposit that he depends upon subsidence to be in exact proportion to the deposit. This is the essence of the doctrine as applied to coal formation. Hence, he infers that, if the supposed carboniferous-age rivers maintaining the great Appalachian coal-making swamps were only one tenth of the size of the two large rivers which he names, those ancient deltas would require just ten times as long to subside an equal amount, thus exactly keeping pace with deposit. But the whole theory has been shown to be untenable by abundant data.

For these and many other reasons, the idea that coal is a delta product and therefore affords proof for the subsidence theory is rejected. European geologists, as a rule, do not hold the swamp theory of coal-formation.

Lava Flows as a Factor in Surface Depression. There are many hundreds of square miles of lava flows in the world, some of them many thousands of feet thick. The lava habitually sought out and flowed down valleys, often over sedimentary deposits of great thickness. But although lava is a great deal heavier than sediments of any kind, especially deltaic material, in no case did it cause subsidence, at least not enough to be reported by geologists.

Why do we not have huge geosynclines of lava layers? The fact is that geologists, in view of their firmly held crustal depression theory, have long marvelled that lava has not depressed the crust of the earth.

As an explanation of this paradox, leading authorities offer the argument that since the lava flow is the result of expansion from beneath, there is no actual addition of load to the earth's crust. This may be granted, but it would seem that the very expansion of the underlying material would render it all the more susceptible to the compression demanded by this theory of depression.

The question still persists. Why may ordinary sediments depress the earth's surface, and yet lava, which is many times heavier, even though

it buries these sediments by many thousands of feet, fail to add weight sufficient to cause such depressions?

Again, lava has been known in many instances to flow with great thickness farther than the length of any river delta in the world. In these cases, the transported lava did not represent any expansion of the underlying material, but was an actual addition to the weight upon the crust where it accumulated. Yet no subsidence from this cause has ever been reported.

Thus the contention that crustal subsidence is the result of transfer of sediments from one part of the earth to another, in which river flow is distinguished from lava flow, is without foundation. This subject is given a typical geological discussion by Dr. Charles M. Nevin,⁴² who takes the usual viewpoint, but who admits there must be something wrong somewhere.

If overloading is the cause of subsidence, then it stands to reason that a condition the reverse of overloading would give a result the reverse of depression, namely, elevation. All geologists admit that the large valleys were formed by erosion. The amount of material eroded out must have been many times greater in weight than that composing deltas. Yet, admittedly, in no case has appreciable elevation resulted from loss of load, another enigma to uniformitarians. Nevins admits this also.

These same geologists who contend so strongly for depression of the crust of the earth by deltaic overloading, admit that many individual mountains standing apart exist as separate units "by reason of rigidity of the earth's crust" to use Nevin's words. Would it not seem rather queer, then, that a few feet of vegetable swamp mud, *nature's lightest sediment*, should be so potent?

Summary of Delta Subsidence. Seven lines of evidence have been introduced which apparently disprove the theory that delta sediments depress the crust of the earth:

1. The argument drawn from the slight slope towards the Gulf of some of the upper terraces in central Louisiana is nullified by the fact that these are not river terraces, but ocean terraces having no relation to the delta as such, but maintaining in general a constant level all over the world. Other reasonable causes are assigned for occasional irregular local tilting. Even if they were river terraces they are too distant to be depended upon as guides in delta subsidence. Such isolated cases would require multiplying a hundredfold to provide evidence for the 30,000 to 40,000 feet as claimed.

2. The true principles of geo-physics would require greater subsidence at the center of gravity in the delta as a whole than at other points, whereas actually deltas are found to settle most

rapidly at any point where fresh sediments at the time are being deposited.

3. Though recent geological opinion affirms that the Mississippi delta lies in a deep trough, or geo-syncline, yet the Blue Clay that has been shown to underlie the whole delta, in no instance dips to accommodate such a geo-syncline. Moreover, the drilling of many oil wells throughout the whole region reveals no strata that indicate such a structure.

4. Earthquakes, as a cause of subsidence, are ruled out, being no more frequent in river deltas and alluvial lands than elsewhere; one case only having been reported, that of the Indus.

5. Every attempt to prove that coal formation demands conditions afforded by the theoretically subsiding modern delta or estuary is apparently frustrated by numerous facts regarding coal that disprove the swamp-coal theory, and the subsidence theory as well.

6. Lava flows apparently block the general theory of local flexibility of the earth's crust. Though much heavier than delta sediments, lava flows do not depress even the sediments, much less the crust of the earth.

7. Conversely, no erosion has been enormous enough to relieve the internal pressure sufficiently for the crust to rise; and large outlying mountains are admittedly dependent for their existence on the rigidity of the earth's crust.

In view of the foregoing facts, the theory of general subsidence will be disregarded in the present paper in calculating the age of the delta of the Mississippi river or the age of the delta of any other river.

The Age of the Mississippi Delta

Having thus made clear the main issues in the controversy, the way is now open to deal directly with the mathematics of the age of the Mississippi delta.

Sir Charles Lyell's Estimate. Sir Charles Lyell's own account of his calculations on the delta's depth and age follows in part:⁴³

When I visited New Orleans in February, 1846, I found that Dr. Riddell had made numerous experiments to ascertain the proportion of the sediment contained in the waters of the Mississippi; and he concluded that the mean annual amount of solid matter was to the water as 1/1245 in weight, or about 1/3000 in volume. From the observations of the same gentleman, and those of Dr. Carpenter and those of Mr. Forshey, our eminent engineer, the average width, depth, and velocity of the Mississippi, and thence the mean annual discharge of water, were deduced. I assumed 528 feet, or a tenth of a mile, as the probable thickness of the de-

posit of mud and sand in the delta; founding my conjecture chiefly on the depth of the Gulf between the southern point of Florida and Belize (a city on the lower delta), which equals an average of 100 fathoms, and partly on some borings 600 feet deep in the delta at New Orleans, in which the bottom of the alluvial matter had not been reached. The area of the delta being 13,600 square miles, and the quantity of solid matter annually brought down by the river being 3,702,758,400 cubic feet, it must have taken 67,000 years for the formation of the whole, and if the alluvial matter of the flood-plain above the delta be 264 feet deep, or half that of the delta, it might have required 33,500 years more for its accumulation, even if its area be estimated as only half that of the delta, whereas it is in fact, larger.⁴⁴

Lyell later accepted a slightly higher annual water discharge from Mr. Forshey, the engineer, which, as Lyell said, "would diminish by one eleventh the number of years required to accomplish the task alluded to." This reduces his estimate of the age of the delta to 60,910 years.

The writer questions Lyell's assumption of 528 feet as the depth of the delta, because, **first:** In the log of the well at New Orleans, at this depth there occurred no change in fossils or other materials from those immediately preceding, and there was nothing at 528 feet to mark the termination of a stratum. On the other hand, the sediment at that depth was decidedly different from that above the 41-foot level, *which did very definitely mark a geologic horizon* both in the fossils and in the character of inorganic materials.

Second: the method followed by Lyell involves a great inconsistency. In selecting an average depth, he takes the average depth from the delta to the tip of Florida, which takes in the deepest part of the Gulf, running to 946 feet,* and takes no account of the shallow waters that lie along the shore on the site of the delta. Why should he do that? Besides, the bottom of the formation not having been reached at the bottom of the well at New Orleans, the choice of even the bottom would have been illogical.

Much more accurate and reasonable appears to have been the method of Humphreys in plotting on his map (published in his Professional Paper 13, already referred to) the contours of the whole Gulf, and then choosing the depth along the coast on each side of the delta corresponding in distance with the delta from the general shore line. This Humphreys found to be

approximately 40 feet for the middle part, but 100 feet for the outer edge.

Third: Lyell's position that the delta could not start till the river had filled up its flood-plains is seemingly not tenable, as the river is still filling up its flood-plains though it has built its delta; and this is true of all rivers with flood-plains and deltas. Therefore his call for a separate period for that purpose, though seemingly plausible, cannot be granted.

Hilgard on the Depth of the Delta. Lyell had not only challenged in Humphrey's former report the statement that "the river is flowing through the delta region in a channel belonging to a geological epoch antecedent to the present," but also had suggested that the log of the New Orleans well be examined by a competent geological observer, not having made such examination himself, apparently having seen only the written account of the log drawn up by non-geologists of the local Academy of Science. General Humphreys, therefore, appointed Professor Hilgard, state geologist of Louisiana, to make the investigation.

But the Civil war interfered and Hilgard's report was not published till 1868. From that report is taken the following statement: "The annual, or in a sense the rather mensual floods of the river ought to cause a much more frequent alteration and change in the character of the deposits than is actually found, especially in the lower portion of the profile."⁴⁵ He further reports that an occasional fragment of decomposed or partly lignitized wood is found in the deposits below 41 feet, but that the true river sediments above that depth besides having the larger fragments, are permeated with fine crumbs or grindings of wood, by the wear of the river.

Thus Hilgard points out that the *extreme thickness of the layers below the 41-foot level is incompatible with river action*, and that this view is further supported by the difference in wood fragments, none ground fine by river action appearing below the 41-foot level. In this connection he says:

Sir Charles Lyell still inclines in a measure to the opinion that the strata penetrated in the New Orleans well may be delta deposits. This supposition, however, appears to be incompatible, not only with what we already know of the general geology and geological history of the lower Mississippi valley (as shown in former papers), but with the character of the strata themselves. *They are altogether too prevalently of a marine character, so far as examined.*⁴⁶

The same opinion is given by Trowbridge.⁴⁷ He and others admit that the layers beneath the 41-foot level are to a large extent contemporaneous with the shellfish living today in the Gulf.

*Note by Clifford L. Burdick: Allen says the deepest part of the gulf is 916 feet (measuring, I assume, on a straight line from the delta of the river to the southern tip of Mexico). Actually, it is nearer to 7,000 feet.

Many authorities place these shells back in the Pliocene; but Hilgard, in his table, comparing the shells found below 41 feet at New Orleans with those thought to be of the Pliocene and post-Pliocene on the coast of South Carolina, and comparing these both with those now living in the Gulf, says that for the most part these shells are apparently of one series.

He makes the astonishing statement:⁴⁸ "Moreover, not only the leading shells of the New Orleans strata, but the *entire list*, excepting the new species, might be picked up in an hour's time on the beach of any of the islands of the Mississippi Sound." One would conclude that the situation shown by this testimony does not lend consistency to the theory of the geologic ages.

In Hilgard's log, in this same report, no shells are listed till a depth of 41 feet and 8 inches is reached, and then he mentions "a few shell fragments." At 41 to 42 feet, he says he found,

coarse rounded sand, with numerous shells, mostly broken, quite hard *Macra lateralis*, *M. Sayi*, *Arca transversa*, *Cardium magnum*, *Tellina flexuosa*, *T. tenta*, *Lucina costata*, *Venus crebraria*, *Astarte lunulata*, *Pandora trilineata*, *Oliva literata*, *Natica pusilla*, *N. campeahensis*, *Acus dislocation*, *Marginella limatula*, *Bullina cassaliculata*.

Continuing in his report, he described the findings at 543½ to 546 feet, as follows:

Coarse white beach sand, with numerous shells, *Macra lateralis*, *Arca transversa*, *A. ponderosa*, *Lucina costata*, *L. multilineata*, *Pholas costata*, *Artemis concentrica*, *Cardium N. sp.* [same as at 43 to 56, and at 235 feet]. *Bullina canaliculata*, *Olive mutica*, *Pleurotoma carinum*, *Buccinum acutum*, *Natica pusilla*, *Dentalium sp.*

Notice the similarities between shells found at a depth of from 543 to 546 feet with those at from 41 to 42 feet. One naturally is led to wonder why Lyell, who chose 528 feet as the average depth of the delta, could not just as well have chosen 41 feet, *and better, because it marked the only distinct transition in the whole log.*

Hilgard's report especially shows the changes in the minerals composing the sands and clays below 41 feet to be far too extreme and abrupt to have been laid down from a river channel, where the grains would be mixed and remixed continuously as they were carried along by the river, producing a more homogeneous deposit.

These abrupt extremes tend to show that the sediments have been brought in large quantities at a time and from different directions, as by oversweeping continental waters. There is abruptness also in the changes in nature of the

sands, much of which is too coarse and too sharp for river sedimentation in that delta. There is nothing like it in the present Mississippi delta.

Humphreys on the Age of the Delta. Only the small lower end of the delta has a depth of 100 feet, and this lessens gradually all the way up to the other end. At New Orleans, about half way up to the head, the depth is 41 feet. Therefore, Humphreys chose 40 feet as the average depth of the delta.

Humphreys, with his background of thorough knowledge and vast data, offered several corrections to Lyell's estimate of the amount of sediment carried annually in the waters of the river. He found that more sediment is carried than Lyell has allowed, and especially that large amounts of solid matter are being constantly rolled along on the bottom of the river-bed, of which Lyell had taken no account.

Humphreys also brought more accurately into calculation the bayous, the outlets, and the subsidiary rivers, as well as the delta itself. He made different estimates from different conditions, using alternative sets of figures, in one set taking into account rivers and territory not included in the other, thus providing a scientific countercheck on each estimate. He had all territories and rivers involved carefully platted on maps and charts by the engineers in his department. In a letter to Lyell, he said:

Now, using the red curves of No. 1, and adopting 40 feet as the mean depth of the alluvium inside of the 10-fathom curve, we have 4,900 years as the age of the delta. [The Tansus river bottom is included in this computation, and in the one following.]

Using the red curves of No. 2 and the mean thickness of 40 feet for the alluvium inside the 10-fathom curve, we have 5,400 years for the age of the delta.

The first agrees better than the second with the age computed (4,400 years) from measurements upon the progress of the river into the Gulf, which afforded a means of determining the age of the delta independently of any knowledge of the quantity of earthy matter held in suspension by the river water or that moved along the bottom of the river.⁴⁹

This next method referred to (the result being 4,400 years) is very much simpler than the other, and supplies a countercheck. Humphreys *averaged the yearly rate of advance of all of the mouths of the river into the Gulf*, and then *divided that rate per year into the total number of miles up to the head of the delta to get the age of the delta.* He said:

It is assumed that the rate of progress has been uniform to the present day . . . and

there are some considerations connected with the manner in which the river pushes the bar into the Gulf each year, which tend to establish the correctness of that position . . . the number of years which have elapsed since the river began to advance into the Gulf can be computed. The present rate of progress of the mouth of the river may be obtained *by a careful comparison with the progress of all of the mouths of the river*, as shown on the maps of Captain Talcott, U. S. Engineers, 1838 and the U. S. Coast Survey in 1851—the only maps that admit of such a comparison. They give 262 feet for the mean yearly advance of all the passes (mouths).⁵⁰

Therefore, the 262 feet, divided into the total distance to the head of the delta, (1,152,800 feet) gives 4,400 years as the age of the delta.

The writer might be inclined to add two or three feet to the 40, because possibly New Orleans might not be quite far enough down the river to represent the cite of average depth. Two more feet would make it 4620 years.

Still another estimate based on Lyell's figures of annual discharge of sediment and area of delta, by which he produced 60,900 years, is offered by the writer, discarding Lyell's depth figure of 528 feet, and using Humphreys' more reasonable figure of 40 feet for the depth of the delta. This 40 feet is about 7½% of 528 feet, and the result would be 7½% of Lyell's age estimate of 60,900 years, or 4,567 years. This is not too far from Humphreys' 4,400 years, and almost equal to his other estimates, and the two additional feet in depth would make it remarkably close.

Is This the Total Age of the River? Humphreys said:

The age of the delta has been estimated at 4,400 years, upon the assumption that the river was of equal magnitude during the whole of the period of its delta-forming condition. This assumption implies that the river was suddenly brought into existence with its present condition, or was suddenly converted into that condition. The rapid, simultaneous upheaval of the whole basin of the river would have brought that river suddenly into existence with very much the same characteristics that it now possesses; but geologists do not admit the possibility of such a rapid upheaval.⁵¹

Humphreys then defeats the geologists' theory of supposed very slow uplift. He had previously cited the constant presence of the pre-river "Blue Clay" at the river's low water mark; now he says that no such alluvium is found higher than the high water mark in the present river. Therefore, he asserts, no delta was uplifted, as in such case

its remains would have been cut into, with remnants left. This sound conclusion gives expert confirmation to other evidence submitted against the theory of general upheaval and subsidence.

He then postulates the condition of the possible river before it was delta-forming, saying that it must have been a clear river with no floods and therefore no sediments. He proposed the possibility that the 300-foot gorge between St. Louis and Cairo could for a time have impounded the river behind it while it was being cut down, thus depleting the water of its sediments. He reasoned that the 300-foot fall to the Gulf from the bottom of this cut would not be sufficient to cause a muddy stream.

As to the length of time involved, that would depend upon the hardness of the material in the cut and the depth of the water that was doing the work. From modern and recent detailed observation, geologists are in possession of very surprising data as to the rapid cutting power of water.⁵² It is likely that this particular formation is only soft sandstone and shales, with possibly parts consisting of unhardened materials. Postulating the Genesis flood, and that this cut was made during the run-off of the waters before much hardening of materials in those strata had taken place, a comparatively short time only was necessary to make this cut.

A Survey of the Evidence

After about a century of diligent geological study of the Mississippi river and its delta, much of it devoted to various features bearing on the age of the river, reasonable conclusions based on acceptable facts now seem to be justified. Sir Charles Lyell had estimated its age at 60,900 years.

But General Humphreys, who, with his staff of engineers and geologists, had charge of the delta for twenty-five years, and Hilgard, studying it until thirty-five years later, accumulated vast data which have apparently never been superseded by subsequent discoveries. Their basic evidence appears to prove that the river has been in existence only 4,400 to 5,000 years. Facts developed since then seem only to strengthen this conclusion.

The main features may be stated briefly as follows:

1. *The Pre-River Formation.* Recent oil geologists find the deepest layers to consist of fine land sediments apparently deposited far from land but somewhat interlayered with ocean sediments, a phenomenon totally unknown to present geological processes, though fitting remarkably well with Deluge mud settling in deep waters during that postulated catastrophe.

Tending to show the erratic and at times extremely violent nature of those waters thus in

commotion, there is that great layer of gravel some 3,000 feet beneath the whole region of the north Gulf coast, underlying the delta and well out into the Gulf. Another witness to that overspreading torrent is the bed of gravel and clay nearer the surface, also spread out as widely, far wider than any river could spread it, into which the river has cut its channel for hundreds of miles.

The source of this gravel is thought to be the glacial region of the north, the size of the gravel decreasing as the Gulf is approached. All of this, including the ice and water as the source of the gravel and the clay, is well in line with Deluge Geology.

Upon this bed of gravel and clay was deposited a great mantle of wind-blown material, a feature of almost world-wide occurrence. And this, too, coming as it did late in the Deluge period, and possible only in a world barren of vegetation and subject to extremes of temperature which could produce the wind, is acceptable to the catastrophic theory.

The original investigation of the pre-river foundation of the Mississippi apparently demonstrated that this wind-blown material fell into the supposed pre-river estuary and settled without being extensively transported. Still above this came the "Yellow Loam," a fine loamy clay brought in by supposed *estuarine* waters, and still prior to the birth of the river. All of these layers were called the "antecedent bed" of the river which subsequently appeared and cut down through them all and into the layer of gravel and clay.

2. *The Deposits Impossible by River, Estuary, or Normal Ocean.* No river of the gradient of the Mississippi could have transported or deposited such underlying strata as the gravel. The lack of speed and power to transport and spread out such material, much less distribute it so evenly over such a wide area, appears to rule out river action. But very much less could such deposition have been accomplished by an estuary, not only because of a lack of sufficient gradient, but because of the constant buffeting of tides with river flow.

The ocean in normal behavior is also out of the question. The finer materials, especially the loess, apparently fell from the atmosphere into standing water periodically in commotion and at rest but not of a river.

3. *Only Oversweeping Ocean Capable of Forming the Deposits.* Waters not now acting anywhere in the world are demanded, waters covering the whole region, at varying depths and at various speeds. The extremes between coarse gravel layers and the finest clay, sand, etc., all equally spread out, seem to demand these variations and this agency.

The beds of gravel mingled with clay do not so much represent gravel alone carried along by the torrential waters as they do the whole being forced along *as a single viscous mass* by deep waters oversweeping these wide areas in great force. This type of deposit is common throughout the world and diligent study should be given it. The heavy material pushed bodily along the bottom of all deep and rapid streams is a feeble example, the best that nature now affords in operation at present.

For nearly a century certain geologists have freely granted that, should the earth be suddenly disturbed in its rotation, the crust would convulse and the waters would produce just such a debacle as Deluge Geology postulates.

4. *The Size of the Delta.* There was no marked difference between Lyell and Humphreys as to the size of the delta, the main point at issue being the depth. But later geologists, ignoring the findings of these early workers, have gone to extremes in both. Some, while still retaining Humphreys' shallow depth averaging about 40 feet, would spread it out all over the southern Mississippi valley and north Gulf coastal plain. They claim an area of 200,000 square miles instead of the 12,600 to 13,500 of Lyell and Humphreys.

Others would retain the small area, or even narrow it down still more, but make a vertiable "bottomless pit" syncline of it, 30,000 to 40,000 feet deep. But for such sink-hole no proof whatever is offered, and in fact, oil-well logs bear out Humphreys' figures as to the depth and as to the utter lack of any such syncline.

5. *The Theory of Changes in Level.* The most potent obstacle to any dependable basis for the depth and therefore the age of the delta has been the theory of subsidence and upheaval, especially the theory of general subsidence by the weights of deltaic sediments. But the identical "Blue Clay" found at the water's edge up-river was found 40 feet deep at New Orleans and on the Gulf bottom on each side of the delta, and this fact seems to defeat that theory.

Again, if the theory were true, the delta *as a whole* would subside, *and the subsidence would be greatest at the center of gravity of the delta as a whole.* Instead, the most rapid subsidence is wherever the most rapid deposit of fresh sediments happens to be going on.

The theory of the swampy origin of coal is urged by those who hold the general subsidence theory, *and they point to this theory of the origin of coal as proof of the general subsidence of the deltas.* But this theory of coal is very vulnerable and easily disproven and is not held by European geologists generally.

Lava flows, though often thousands of feet thicker and much heavier than delta sediments, do not depress the crust of the earth, and do not

even depress sedimentary layers. Conversely, the most deeply eroded areas on earth have never been known to rise on account of that erosion.

For all of these reasons the general theory of subsidence is rejected in estimating the age of deltas.

6. *The Depth of the Delta.* Having disposed of the theory of general subsidence as applied to deltas, the many simple facts of the delta of the Mississippi adjust themselves easily as to its depth. At New Orleans it is 40 feet deep, and 100 feet at its outer edge, and this is well in agreement with official topographical surveys of the Gulf bottom on each side of the delta, and with the "Blue Clay" in the river at corresponding depths. Considering these facts it is difficult not to accept the 40 foot *average* depth chosen by the Humphreys group. (The author would perhaps deepen this estimate two or three feet, inasmuch as New Orleans is apparently not quite far enough south to represent the place of average depth. But this would not greatly lengthen the age of the delta.)

7. *Age Estimates.* Except in the matter of his chosen depth of 528 feet, Lyell's final estimate of 60,910 years was otherwise based on fairly acceptable data. With the 40-foot depth instead of his 528-foot depth, the age of the delta by his calculations is well within range of that of the Humphreys group. The two methods used by Humphreys form a balancing check on each other that lends confidence to the results.

Conclusions

That the age of the Mississippi river is within the general range of 4,500 to 5,000 years, in view of all of the facts and principles thus far brought out, now seems beyond much doubt. How it could be substantially increased or decreased is difficult to see. Suppose it were doubled, or quadrupled, such a period would still not be a start toward the immense ages required by the uniformitarians.

Even Lyell's estimate, though satisfying the requirements of the geologic age theories of his day, would have to be multiplied several fold for the standard doctrines of today, which demand millions of years instead of thousands. Therefore, any changes in the estimates which would lend any comfort to the evolutionary theorists are almost unthinkable.

The question at once presents itself as to how a great river system like the Mississippi *could thus suddenly come into being except by a geological revolution practically continent-wide.* Since there is no sign of any other river system having previously occupied that vast area, or any part of it, such a cataclysm seems to be demanded, a complete and profound reworking of the crust of the earth to great depths. Furthermore,

it is a river system eroded on a surface which was itself the obvious result mostly of water action but *vastly different from river action or any other geological work by water action known today.*

A mere glance at the size, depth and character of the other deltas of the world should impress anyone that they may well be virtually the same age as the Mississippi delta. All of the facts and principles developed in this present study will be of vital application to the other deltas and rivers, and these remarkable results for the Mississippi delta form the basis for age estimates of other rivers of the world.

Labors on several other natural chronometers involving geological processes, besides the growth of river deltas, are apparently developing, each with considerable capacity for accuracy, and they will be of utmost value in correlating and counterchecking. Altogether, there appears to be some promise of satisfying all reasonable doubts *not only that the Flood of Noah was universal, but that it occurred well within the range of dates set by sacred writings and archaeological evidences.*

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BOUNDARIES OF THE MIN: AN ANALYSIS OF THE MOSAIC LISTS OF CLEAN AND UNCLEAN ANIMALS*

ARTHUR J. JONES**

The Mosaic food lists are analyzed in detail and exhaustive lists of the genera covered by each Hebrew name are presented. The author shows that the min generally lie at the family level (superfamily, family, subfamily) in current classification systems. An annotated bibliography is provided.

Introduction

It was concluded in the first article ["A General Analysis of the Biblical Kind (Min)," *CRS Quarterly*, 9(1):53-57 (June, 1972)] that the Mosaic lists of clean and unclean animals do permit an analysis of the boundaries of the *min* ("kind").

The present article contains continued analysis of the lists in detail in order to determine where, in the modern hierarchy of biological categories (phylum, class, order, family, genus, species), the *min* would generally lie. I have endeavored to list under each Hebrew name all the species which would have been denoted.

I encountered considerable difficulty in this task because I initially did not know where to obtain certain information. In order to enable

others to investigate this subject more readily I have appended a bibliography of all the literature which provided relevant information.

Annotated Animal Lists

The size of the animal is indicated in parentheses. In the case of the clean *behemah* this is shoulder height/horn length. In all other cases the total (head to tail) length is given. If a second figure is given this is the *standard length* (which excludes the tail). All measurements are given in centimeters.

OUTLINE OF ANIMALS OF THE MOSAIC FOOD LISTS

1. *Behemah*

1.1. *Clean behemah*

1.1.1. *Domestic behemah* (Dt. 14:4).

- a. *shor*—domestic cattle: ox, *Bos taurus* (100-140/variable); zebu, *Bos indicus*; buffalo, *Bubalus Bubalis* (170/150).

*Second in a series of articles dedicated to the memory of Dr. Jacobus Johannes Duyvené de Wit (1909-1965), late Professor of Zoology at the University of the Orange Free State, Bloemfontein, South Africa.

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- b. *kesebh*—domestic sheep: *Ovis aries* (c. 80/variable, often absent).
 - c. *'ez*—domestic goats: *Capra hircus* (c. 80/variable).
- 1.1.2. *Wild behemah of forest and field* (Dt. 14:5).
- a. *'ayyal*—deer: red deer, *Cervus elaphus* (130/120); fallow deer, *Dama dama* (95/60); giant fallow deer, *Dama mesopotamica* (100/60); roe deer, *Capreolus capreolus* (65/25). All behemah with antlers (i.e. branched horns).
 - b. *tsebi*—gazelles: dorcas gazelle, *Gazella dorcas* (60/30); mountain gazelle, *Gazella gazella* (60/25); goitred gazelle, *Gazella subgutturosa* (65/35). Behemah of moderate size; very swift, leaping as they run; horns of moderate length, ringed and lyrate.
- 1.1.3. *Wild behemah of desert regions* (Dt. 14:5).
- a. *yachmur*—hartebeests: bubal hartebeest, *Alcelaphus buselaphus* (135/35). Large behemah with upright, lyrate horns from a single large pedicel; horns with heavy rings.
On the basis of the Arabic, *yachmur* is often identified as the roe deer, but this is almost certainly incorrect.
 - b. *aqqo*—mountain goats: ibex, *Capra ibex* (80/90). Behemah of moderate size with long, slender, curved horns, the front surfaces bearing prominent transverse knobs.
 - c. *dishon*—antelopes: addax, *Addax nasomaculatus* (90/85). Also possibly the blackbuck, *Antilope cervicapra* (80/65). Behemah of moderate size; long horns in a straight line, but spirally twisted (corkscrewed).
 - d. *te'o*—oryx: *Oryx leucoryx* (90/70). Behemah of moderate size with long straight horns.
 - e. *zemer*—mountain sheep: mouflon or red sheep, *Ovis ammon* (includes *O. musimon* and *O. orientalis*) (70). Also possibly the barbary sheep, *Ammotragus lervia* (100/70). Behemah of moderate size with large spiralling horns.
- 1.2. *Unclean behemah*
- 1.2.1. *Behemah which chew the cud, but do not divide the hoof* (Lv. 11:4-6; Dt. 14:7).
- a. *gamal*—camels: Arabian camel (dromedary), *Camelus dromedarius* (350).
 - b. *'arnebeth*—hares: cape hare, *Lepus capensis*; European hare, *Lepus europaeus* (65); Arabian hare, *Lepus arabi-cus*.
 - c. *shapan*—hyraxes: rock hyrax, *Procavia capensis* (55).
- 1.2.2. *Behemah which divide the hoof, but do not chew the cud* (Lv. 11:7; Dt. 14:8).
- chazir*—pigs (domestic and wild: *Sus scrofa* (140)).
2. *Unclean birds*
- 2.1. *Predatory and scavenging land birds* (Lv. 11:13-17; Dt. 14:12-16).
- a. *neshar*—griffon vultures: griffon, *Gyps fulvus* (100); Rüppell's griffon, *Gyps rüppellii* (90). Not the eagle which neither congregates round carrion (Jb. 39:30, Mt. 24:28) nor has the head and neck covered with creamy down instead of feathers (Mi. 1:16).
 - b. *peres*—vultures: bearded or golden vulture or lammergeier, *Gypaetus barbatus* (105); cinereus or black vulture, *Aegypius monachus* (100); lappet-faced vulture, *Torgos tracheliotus* (95).
 - c. *'ozniyyah*—eagles: short-toed eagle, *Circus gallicus* (65); golden eagle, *Aquila chrysaetos* (85); imperial eagle, *Aquila heliaca* (80); Verreaux's eagle, *Aquila verreauxii* (80); steppe eagle, *Aquila nipalensis* (65); greater spotted eagle, *Aquila clanga* (70); lesser spotted eagle, *Aquila pomarina* (65); tawny eagle, *Aquila rapax* (70); white-tailed eagle, *Haliaeetus albicilla* (80). Generic for all large eagles.
 - d. *'ayyah*—buzzards: long-legged buzzard, *Buteo rufinus* (65); common buzzard, *Buteo buteo* (55); honey buzzard, *Pernis apivorus* (55); eagles: Bonelli's eagle, *Hieraetus fasciatus* (65); booted eagle, *Hieraetus pennatus* (50); osprey: *Pandion haliaetus* (55); harriers: hen harrier, *Circus cyaneus* (50); pallid harrier, *Circus macrourus* (45); Montagu's harrier, *Circus pygargus* (45); marsh harrier, *Circus aeruginosus* (50); goshawk: *Accipiter gentilis* (55); falcons: saker falcon, *Falco cherrug* (45); lanner falcon, *Falco biarmicus* (45); peregrine falcon, *Falco peregrinus* (45); shaheen or Barbary falcon, *Falco pelegrinoides* (40). Generic for medium-sized birds of prey: buzzards, smaller eagles and large falcons.
 - e. *da'ah* (*dayyah*)—red kite, *Milvus milvus* (60); black kite, *Milvus migrans* (55).

Easily distinguished from the other birds of prey by the long angular wings, forked tails and buoyant, gliding flight.

- f. 'orebh—crows: raven, *Corvus corax* (55); fan-tailed raven, *Corvus rhipidurus* (50); hooded or carrion crow, *Corvus corone* (45); jackdaw, *Corvus monedula* (35); rook, *Corvus frugilegus* (45); jay, *Garulus glandarius* (35); starlings: common starling, *Sturnus vulgaris* (21); spotless or Sardinian starling, *Sturnus unicolor* (21); Anatolian starling, *Sturnus purpurascens* (21); rose-coloured starling, *Sturnus (Pastor) roseus* (21); Tristram's grackle, *Onychognathus tristrami* (25). As a group name 'orebh covers the large, black scavenging Passeres and their allies. The inclusion of the starlings is noted by Wood.¹
- g. bath ya'anah—eagle owl, *Bubo bubo* (55). This is the largest of the world's owls although the Palestine race is rather smaller than the largest (70). A solitary owl of wilderness and desert. NOT the ostrich (R.V., R.S.V.) which does not fit the habitats described, is too large to occur at this point in the list and is not, in any case, a flier. Two words are correctly translated *ostrich—ye'enim* (Lam. 4:3) and *renanim* (Jb. 39:13).
- h. tachmas—barn or screech owl, *tyto alba* (40). A moderate-sized, noisy owl which is usually associated with farms and buildings.
- i. shachaph—gulls and terns: glaucous gull, *Larus hyperboreus* (65); great black-headed gull, *Larus ichthyaetus* (60); herring gull, *Larus argentatus* (55); lesser black-backed gull, *Larus fuscus* (50); Audouin's gull, *Larus audouinii* (50); slender-billed gull, *Larus genei* (45); common gull, *Larus canus* (40); white-eyed gull, *Larus leucophthalmus* (40); Mediterranean or great black-headed gull, *Larus melanocephalus* (40); black-headed gull, *Larus ridibundus* (40); little gull, *Larus minutus* (30); Caspian tern, *Hydroprogne tschegrava* (50); swift tern, *Sterna bergii* (50); Sandwich tern, *Sterna sandvicensis* (40); lesser crested tern, *Sterna bengalensis* (40); lesser sooty or bridled tern, *Sterna anaethetus* (35); common tern, *Sterna hirundo* (35); little tern, *Sterna albifrons* (25); gull-billed tern, *Gelochelidon nilotica* (40); whispered tern, *Chlidonias hybrida* (25); black tern, *Chlidonias niger* (25); white-winged black tern, *Chlidonias leucop-*

terus (25).

G. R. Driver² rejects the interpretation, "gull," since this is not the water bird section of the list. This action is, however, unwarranted. Many gulls are raptorial (e.g. the great black-headed; also the Caspian and black terns) and several species are usually found inland—even in desert regions where they feed on snails (e.g. the black-headed and lesser black-backed gulls). See Tristram³ and Meinertzhagen⁴ *in loc.*

- j. nets—hawks: Levant sparrowhawk, *Accipiter brevipes* (35); sparrowhawk, *Accipiter nisus* (30); shikra, *Accipiter badius* (25); black-shouldered kite, *Elanus caeruleus* (30)—quite unlike a kite in behavior; falcons: Eleonora's falcon, *Falco eleonora* (40); hobby, *Falco subbuteo* (35); kestrel, *Falco tinnunculus* (35); sooty falcon, *Falco concolor* (35); lesser kestrel, *Falco naumanni* (30); red-footed falcon, *Falco vespertinus* (30); merlin, *Falco columbarius* (30). Generic for all the smaller hawks and falcons.
- k. kos—little owl, *Athens noctua* (20). An owl of deserts and ruins, often seen during the day, noisy.
- l. yanshuph—Scops owl, *Otus scops* (includes pallid or striated Scops, *Otus brucei*) (19). Found near human habitation. Distinctive but monotonous song.
- 2.2. Long-toed marsh birds (Lv. 11:18; Dt. 14:16); tinshemeth—rails and coots; purple gallinule, *Porphyrio porphyrio* (50); coot, *Fulica atra* (40); moorhen, *Gallinula chloropus* (35); water rail, *Rallus aquaticus* (27); corncrake or landrail, *Crex crex* (26).
- 2.3. Short-legged water birds (Lv. 11:17, 18; Dt. 14:17).
 - a. qa'ath—pelicans: white pelican, *Pelecanus onocrotalus* (165); Dalmatian pelican, *Pelecanus crispus* (175). Very long hooked bill with a large distensible throat pouch (crop). Flies with head carried well back on the shoulders. Highly gregarious. Not a diver. The Hebrew name, "the Vomiter" (from *qo'*, "to vomit") relates to their habit of regurgitating from the throat pouch partly digested food for their young.
 - b. racham—Egyptian vulture, *Neophron percnopterus* (65).
 - c. shalakh—cormorants: pygmy cormorant, *Phalacrocorax pygmaeus* (50); cormorant, *Phalacrocorax carbo* (90). Long slender hooked bill. Short wings, flying

with the long neck extended. Gregarious. A diver.

2.4. *Long-legged water birds* (Lv. 11:19; Dt. 14:18).

a. *chasidah*—storks: white stork, *Ciconia ciconia* (100); black stork, *Ciconia nigra* (95); Marabou stork, *Leptoptilus crumeniferus* (105). Long pointed bill. Long broad wings, flying with the long neck extended. Gregarious. A very conspicuous migrant (Je. 8:7). Mixed feeders. The Marabou stork is quite vulturine in its habits.

b. *'anaphah*—herons and bitterns: goliath heron, *Ardea goliath* (140); grey heron, *Ardea cinerea* (90); purple heron, *Ardea purpurea* (80); squacco heron, *Ardeola ralloides* (45); buff-backed heron or cattle egret, *Bubulcus ibis* (50); great white egret or heron, *Egretta alba* (90); little egret, *Egretta garzetta* (55); bittern, *Botaurus stellaris* (75); little bittern, *Ixobrychus minutus* (35); night heron, *Nycticorax nycticorax* (60). As a group name *'anaphah* covers all the long-legged, wading water birds and their allies. The Hebrew name (cf. *'aph* "nose") probably refers to the prominent, variously shaped bills. There are so many of these birds on the Palestine list that in some cases only the genera are listed:

Spoonbills and Ibises (Threskiornithidae): spoonbill, *Platylea leucorodia* (85); sacred ibis, *Threskiornis aethiopicus* (65); glossy ibis, *Plegadis falcinellus* (55); Flamingos (Phoenicopteridae): greater flamingo, *Phoenicopterus ruber* (125); Cranes (Gruidae): grey crane, *Grus grus* (115); demoiselle crane, *Anthropoides virgo* (100); Stilts (Recurvirostridae): black-winged stilt, *Himantopus himantopus* (40); Sandpipers, Godwits, Curlews, Snipe (Scolopacidae): curlew, *Numenius arquata* (55); sandpipers, *Tringa* spp. (28-30), *Calidris* spp. (13-20); woodcock, *Scolopax rusticola* (35); snipe, *Gallinago* spp. (26-27); ruff, *Philomachus pugnax* (26); Jack snipe, *Lymnocyrtus minima* (19); godwits, *Limosa* spp. (40); Thick-knees (Burhinidae): stone curlew, *Burhinus oedicephalus* (40); Plovers (Charadriidae): lapwing, *Vanellus vanellus* (30); spur-winged plover, *Vanellus spinosus* (26); plovers, *Charadrius* spp. (15-20), *Pluvialis* spp. (27-28); dotterel, *Eudromias morinellus* (20); Coursers (Glareolidae): cream-coloured courser, *Cursor*

ius cursor (23); Phalaropes (Phalaropidae): grey phalarope, *Phalaropus fulicarius* (20). Doubtless other genera should be added to this list.

2.5. *Hoopoes* (Lv. 11:19; Dt. 14:18); *dukhipath*—hoopoe, *Upupa epops* (28).

2.6. *Bats* (Lv. 11:19; Dt. 14:18); *'atalleph*—bats: (Megachiroptera, Pteropidae) Egyptian fruit bat or Rousette, *Rousettus aegyptiacus* (18)²; (Microchiroptera, Emballonuroidea, Rhinopomatidae) greater mouse-tailed bat, *Rhinopoma microphyllum* (15); lesser mouse-tailed bat, *Rhinopoma hardwicki* (14); (Emballonuridae) naked-bellied tomb bat, *Taphozous nudiventris* (13); tomb bat, *Taphozous perforatus* (10); (Rhinolophidae, Nycteridae) Egyptian slit-faced bat, *Nycteris thebaica* (11); (Rhinolophidae) greater horseshoe bat, *Rhinolophus ferrumequinum* (10); lesser horseshoe bat, *Rhinolophus hipposideros* (7); Mediterranean horseshoe bat, *Rhinolophus euryale* (8); *Rhinolophus clivosus* (9); *Rhinolophus blasii* (8); (Hipposideridae) trident leaf-nosed bat, *Asellia tridens* (9); (Vespertilionoidea, Vespertilionidae) barbastelle, *Barbastella barbastellus* (9); Arabian barbastelle, *Barbastella leucomelas*; serotine, *Eptesicus serotinus* (13); Bott's serotine, *Eptesicus bottae* (11); long-winged bat, *Miniopterus schreibersi* (12); notch-eared bat, *Myotis emarginatus* (9); whiskered bat, *Myotis mystacinus* (9); Daubenton's or water bat, *Myotis daubentonii* (8); Natterer's bat, *Myotis nattereri* (9); greater mouse-eared bat, *Myotis myotis* (14); lesser mouse-eared bat, *Myotis blythi* (13); long-fingered bat, *Myotis capaccinii* (9); Hemprich's long-eared bat, *Otonycteris hemprichi* (18); Kuhl's pipistrelle, *Pipistrellus kuhli* (9); Nathusius' pipistrelle, *Pipistrellus nathusii* (9); Rüppell's pipistrelle, *Pipistrellus ruppelli*; common pipistrelle, *Pipistrellus pipistrellus* (8); Bodenheimer's pipistrelle, *Pipistrellus bodenheimeri* (8); noctule, *Nyctalus noctula* (13); grey long-eared bat, *Plecotus austriacus* (9); particolored bat, *Vespertilio murinus* (10); Schlieffer's bat, *Nycticeius schliefferi* (8); (Molossidae) European free-tailed bat, *Tadarida teniotis* (14); Egyptian free-tailed bat, *Tadarida aegyptiaca* (12).

3. *Clean insects* (Lc. 11:22).

a. *'arbeh*—desert locust, *Schistocerca gregaria* (6-7); migratory locust, *Locusta migratoria* (3-6); Egyptian grasshopper, *Anacridium aegyptium* (3-6); Generic for all the large, short-horned, swarming

- grasshoppers which are a threat to crops.⁶ *'arbeh* strictly denotes "crowd," "swarm."⁷
- b. *So'am*—The rendering "bald locust" (AV, RV, RSV) is based on Talmudic and Rabbinical statements that the head is long and smooth (bald).⁸ This clearly refers to such short-horned forms as *Acrida* and *Acridella* and thus to the Acridinae-Truxalinae group of Acrididae. These subfamilies include the majority of Palestine Acrididae, so as a group name *so'am* probably denotes all the short-horned grasshoppers which are more or less solitary (doubtless including the solitary phases of the locusts).
 - c. *chargol*—This term seems to be derived from a root meaning, "to run swiftly"⁹ or "to leap in going."¹⁰ This suggests another group of solitary forms, probably those long-horned grasshoppers and crickets which fulfill the above conditions. These are distinguished from the preceding not only by the long antennae, but also by the presence in the female of a long ovipositor ("tail")—the acridids have short, stubby ovipositors (no "tail"). Aharoni¹¹ suggests *Tettigonia viridissima* (7) as the main form.
 - d. *chaghabh*—Moroccan locust, *Dociostaurus maroccanus* (2-3); Palestinian locust, *Caliptamus palestinensis* (1.5-3.5). Generic for all the small, short-horned, swarming grasshoppers which are a threat to crops.¹² *Chaghabh* is possibly derived from a root meaning, "to hide," i.e. swarms covering the ground or sky.¹³
- In the absence of specific information I have been unable to give a full list of genera under each name. All I can do is list the Palestine *Saltatoria* here and leave it to others to give us a fuller analysis:
- Tettigonioidae: Tettigoniidae (long horned grasshoppers) *Tettigoniinae*: *Tettigonia*, *Metrioptera*; *Decticinae*: *Pholidoptera*, *Medecticus*, *Festella*, *Paradrymadusa*; *Saginae*: *Saga*; *Phaneropterinae*: *Isophya*, *Tylopsis*, *Acrometopa*; *Conocephalinae*: *Conocephalus*.
- Gryllacridoidea: *Lezinidae* (cave crickets) *Lezina*.
- Grylloidea: *Gryllotalpidae* (mole-crickets) *Gryllotalpa*.
- Grylloidea: *Gryllidae* (crickets) *Gryllinae*: *Gryllus*, *Acheta*, *Tartarogryllus*, *Modicogryllus*, *Gryllopsis*, *Paragryllopsis*, *Gryllomorpha*; *Nemobiinae*: *Pteronemobius*; *Eremogryllodinae*: *Eremogryllodes*.
- Grylloidea: *Myrmecophilidae* (ant crickets) *Myrmecophila*.
- Grylloidea: *Mogoplistidae*: *Arachnocephalus*.
- Grylloidea: *Oecanthidae*: *Oecanthus*.
- Grylloidea: *Trigonidiidae*: *Trigonidium*, *Anaxipha*.
- Tetrigoidea: *Tetrigidae* (pygmy or grouse locusts) *Acrydium*, *Paratettix*.
- Tetrigoidea: *Tridactylidae* (pygmy mole-crickets) *Tridactylus*.
- Acridoidea: *Pyrgomorphidae*: *Pyrgomorpha*, *Pyrgomorphella*, *Poecilocerus*.
- Acridoidea: *Pamphagidae*, *Akicerinae* & *Pamphaginae*: *Tmethis*, *Orchamus*, *Prionosthenus*.
- Acridoidea: *Acrididae* (short-horned grasshoppers) *Dericorythinae*: *Dericorys*; *Tropidopodinae*: *Tropidopola*; *Calliptaminae*: *Calliptamus*, *Kripa* *Sphodromerus*; *Eyprepocnemidinae*: *Eyprepocnemis*, *Paraeprepocnemis*, *Thisoicetrus*; *Cantantopinae*: *Pezotettix*, *Podisma*; *Cyrtacanthacridinae*: *Anacridium*, *Schistocerca*; *Acridinae* (includes *Oedipodinae* and *Truxalinae*): *Acrida*, *Acridella*, *Durionella*, *Platypterna*, *Aiolopus*, *Morphacris* *Oedipoda*, *Locusta*, *Acrotylus*, *Spingonotus*, *Leptopternis*, *Hyalorrhapis*, *Pyrodera*, *Helioscirtus*, *Mioscirtus*, *Scintharista*, *Bodenheimerella*, *Chorthippus*, *Dociostaurus*, *Eremippus*, *Ramburiella*.
- #### 4. Unclean land swarmers
- 4.1. *Small carnivores* (Lv. 11:29); *choledh*—weasel, *Mustela nivalis* (36/29); marbled polecat, *Vormela peregusna* (50/30); Egyptian mongoose or ichneumon, *Herpestes ichneumon* (50/25); also possibly the beech or stone marten, *Martes foina* (65/44); European genet, *Genetta genetta* (80/40) and the small desert fox, *Fennecus zerda* (60/40): Generic for small carnivores. Not the mole rat (*chaphar-parah* Is. 2:20).
 - 4.2. *Small rodents* (Lv. 11:29); *'akhbar*—(Sciuridae, Sciurinae) sousliks: *Citellus*; (Cricetidae, Cricetinae) common hamsters, *Crice-tus*; Eurasian hamsters, *Cricetulus*; golden hamsters, *Mesocricetus*; (Cricetidae, Microtinae) common field voles, *Microtus*; (Cricetidae, Gerbillinae) smaller gerbils, *Gerbillus*; jirds, *Meriones* (including the bushy-tailed jirds, *Sekeetamys*); fat sand rats, *Psammomys*; (Spalacidae) mole rats, *Spalax*; (Muridae, Murinae) field mice, *Apodemus*; Nile rats, *Arvicanthus*; rats, *Rattus*; house mice, *Mus*; spiny mice, *Acomys*; short-tailed bandicoots or mole rats, *Nesokia*; (Gliridae, Glirinae) fat dormice, *Glis*; garden dormice, *Eliomys*, forest dormice, *Dryomys*; (Dipodidae, Dipodinae) jerboas, *Jaculus*, five-toed jerboas, *Allactaga*. Generic for all small rodents.

4.3. *Lizards* (Lv. 11:29-30)

- a. *tsab*—desert monitor, *Varanus griseus* (130/55); Nile monitor, *Varanus niloticus* (160/65); mastigure or spiny-tailed lizard, *Uromastix aegyptius* (100/55); *Uromastix ornatus*. Generic for the very large desert lizards. The monitors are carnivores. The mastigures seem to be strictly herbivorous, but this would hardly be guessed from their fierceness.¹⁴ The Arabic *dhabb* denotes the mastigures.

Not the tortoise (AV., modern Hebrew). The tortoise is so very similar to the turtle (a water swimmer without scales and fins—hence unclear) that it would not need to be mentioned.

- b. *'anaqah*—rock geckos, *Ptyodactylus* (c. 15/8); house geckos, *Hemidactylus* (c. 10/5.5); *Alsophylax* (c. 10/5.5); wall geckos, *Tarentola* (c. 20/10); naked-toed geckos, *Gymnodactylus* (c. 10/4.5); bent-toed geckos, *Cyrtodactylus* (c. 10/4.5); *Stenodactylus* (c. 10/6); *Ceramodactylus* (c. 10/6.5); *Tropicolotes* (c. 10/4.5). Generic for geckos.
- c. *koach*—rainbow lizard or hardoun, *Agama stellio* (30/11). At least half a dozen other species of agamid (all *Agama*, c. 15-30/6-11) are known from the region, but the hardoun is by far the commonest.¹⁵ Generic term for the agamids: broad, flat lizards with short extremities which run with the body erect in a very characteristic fashion.
- d. *leta'ah*—common lizard, *Lacerta laevis* (20/8); green lizard, *Lacerta viridis* (50/14); wall lizard, *Lacerta muralis* (20/7); European fence lizard, *Lacerta agilis* (20/8); a few other *Lacerta* (c. 20); fringe-toed lacertids, *Acanthodactylus* (c. 20/8); desert lacertids, *Eremias* (c. 15/5); snake-eyed lacertids, *Ophisops* (c. 15/5). General term for all medium sized and small lizards of typical lizard shape.
- e. *chomet*—skinks, *Scincus* (c. 20/12); mabuyas, *Mabuya* (c. 20/8); *Eumeces* (c. 40/17); cylindrical skinks, *Chalcides* (c. 25/15); lidless skinks, *Ablepharus* (c. 10/5); Asian sand skinks, *Ophiomorus* (c. 15/10). General term for all the snake-like lizards with short legs (sometimes absent) and tapered heads, which move through dry sand with a characteristic swimming motion.
- f. *tinshemeth*—chameleon, *Chamaeleo chamaeleon* (30/15). Tail long and prehensile,

curled downwards like a catherine wheel. A quite unmistakable lizard! The Hebrew *tinshemeth* is used of two animals in these lists—c.f. English, “turtle” (turtle, turtle dove) and “ichneumon” (insect, small carnivore).

Comments Concerning the Outline

1. **Camels.** The camel is the only true ruminant which is not cloven-hoofed. The toes end in broad nails and the weight is carried on broad cushions behind.

2. **The Hare.** Since the hare does not possess hooves at all it is, on the face of it, surprising that it should be classed as a *behemah*. It looks more like a rodent and for a long time the lagomorphs (rabbits, hares, pikas) were indeed regarded as *Rodentia*. However, the sharp differences from the rodents and the similarities to the hoofed animals which they *do* possess demanded recognition and in 1912 they were formally separated from the *Rodentia*. All in all they are a conundrum to the evolutionist.¹⁶

Although lagomorphs are not true cud-chewers they do show a form of pseudo-rumination (reigestion).¹⁷

3. **The Hyrax.** In general appearance and habits, the hyrax resembles the rodents and was originally classified with them. But, after being placed near the rhinoceroses for a long time, it has now been positioned in an isolated order. There are similarities to the lagomorphs and to the ungulates (some extinct forms were as large as pigs)—another major conundrum for the evolutionist.¹⁸ Each digit ends in a tiny hoof-like nail. Like the hare, the hyrax is not a true cud-chewer, indicating that the Hebrew “chew the cud” means simply “chew again” rather than our scientific analysis in terms of the specialized four-chambered ruminant stomach.

Although this is not a scientific listing it is certainly remarkable that in the Mosaic classification the hare and the hyrax were placed with the hoofed animals and not with the rodents.

4. **The Vultures.** It is unfortunate that we have such a low view of the vulture for in all its movements it is a majestic bird far surpassing the eagle in size and power.

Although quite dissimilar in flight silhouette, the three species, bearded vulture, black vulture, and lappet-faced vulture, share several features which unite them as a separate group from the griffons. They are all solitary birds of the remote mountains and plains (of the desert edge), whereas the griffons are more sociable and range over all types of country. They do not compete with the griffons, but wait until the griffons have finished with a carcass, and then take over the bones. They carry the bones aloft and drop

them on rocks in order to break them open and expose the marrow (Hebrew *peres* from *paras* "to break," i.e. "the breaker"). Whole animals (esp. tortoises) are treated in similar fashion.

Some scholars separate the vultures from the eagles and hawks as a distinct family—Aegypiidae—with two subfamilies, Gypaetinae (for the lammergeier) and Aegypiinae (for the rest). The vultures do seem to be a distinct kind: a thorough investigation is needed.

5. Falcons. The falcons (genus *Falco*) divide fairly readily into two groups: the large falcons of desert or semi-desert which kill their prey by swooping on it at enormous speed and the smaller falcons of open forest and town which pursue smaller prey. The latter group belongs under *nets*.

6. Egyptian Vulture—rachamun. G. R. Driver¹⁹ rejects this identification (despite the Arabic *rachamun*, "white carrion vulture") since vultures were already dealt with earlier in the outline and this is the water bird section of the list. But it must be emphasized again that this list is serving a practical purpose, not a scientific one.

Even though *Neophron* is a vulture it slots in well at this point. On the one hand its small size and thin bill set it apart from the other vultures making it difficult to include it earlier in the list.

Also, it has many characteristics which might allow placing it with the water birds: its black and white coloration (pelicans, storks); its hooked bill (pelicans, cormorants); its massive wings (pelicans, storks); its method of feeding its young by regurgitation (pelican); its flight pattern (very similar to the stork's); it is seen in great flocks²⁰; it is omnivorous (storks and herons are mixed feeders), the diet including live crustacea taken from the water; it is often seen with the flocks of water birds (especially pelicans) and like the stork it is noted for its devotion to its mate and young. All in all I can see no valid reason to doubt the interpretation that *rachamun* refers to the Egyptian Eagle.

7. Bats. Despite the large number of species the bats are a very homogeneous group both in appearance and in anatomy. Linnaeus²¹ classified the seven bats known to him into a single genus (*Vespertilio*) of his order Primates—bats that are now placed in two suborders, four superfamilies and five families!

The modern families (17 in all) are certainly of far smaller scope than in most mammalian orders and there are almost certainly less "kinds" than families (possibly no more than five). Note that this reference demonstrates that the Hebrew *tsippor* covers all vertebrate winged fliers and not just birds.

8. Clean Insects. Lack of information makes this the most difficult section of the list.

In the literature available to me only Bodenheimer,²² Rivnay,²³ and Chopard²⁴ discuss the *Orthoptera* of Bible lands but they give no details for other than a few important crop pests. I am primarily a vertebrate zoologist and not at all familiar with either the insects or the literature. Consequently the analysis presented here must be regarded as preliminary.

To be counted as clean an insect must fulfill certain conditions:

(1) It must be a winged flier, i.e. apterous or near-apterous forms (e.g. *Festella*, *Prionosthenus*) are excluded.

(2) It must have a hind pair of jumping legs, i.e. forms which do not have these legs (non-orthopterans) or do not employ them for leaping (e.g. *Saga*) are excluded.

(3) It must be primarily herbivorous, i.e. forms which are primarily predacious or omnivorous (e.g. many long-horned grasshoppers) are excluded.

Thus it is mainly the short-horned grasshoppers (Acridoidea)—the dominant group of Orthoptera in Bible lands—that are clean.

9. Conclusions. The analysis of the outline is summarized in Table One. It is immediately clear that in vertebrates the *min* of the Mosaic food lists generally lie at the family level in current classification systems. In the case of the *Orthoptera*, however, the sub-family would often seem to be the *min* grouping. However, there has been a marked tendency over the past decades to elevate Orthopteran subfamilies to the rank of families. So the difference may only reflect the inadequacy of present classifications. (Perhaps an entomologist could comment?)

The use of the word *min* in these Mosaic food lists certainly precludes the possibility of reading theistic evolution into the Biblical account. Many *min* are mentioned—not just one or a few as evolutionists would demand. Thus creation "after their kinds" must have involved the rapid appearance of numerous discrete and unrelated groups of animals.

It may be argued that the word *min* is more inclusive or perhaps exclusive as it is used here than it is in the context of Genesis chapter I. In a previous article²⁵ I have shown that *min* is a precise technical term. It is therefore unlikely that there is any difference.

Genesis I states that God created many *min* (the word is collective) of beasts, of cattle, of creeping things, etc. If Moses had been asked to give instances of *min*, I feel certain that his answer would have been in line with what we have learnt from the food lists.

In the "kind creation concept" however, there is still room for some modification within the boundaries of one *min*. The late Dr. J. J. Duy-

Table I: The Animals of the Mosaic Food Lists

Hebrew	Family	Subfamily	Genus	Species	Vernacular
1. <i>shor</i>	Bovidae	Bovinae	Bos, Bubalus	3 spp	cattle
2. <i>kesebh</i>	Bovidae	Caprinae	Ovis	aries	sheep
3. <i>'ez</i>	Bovidae	Caprinae	Capra	hircus	goat
4. <i>'ayyal</i>	Cervidae	Cervinae	Cervus, Dama	3 spp	deer
		Odocoileinae	Capreolus	capreolus	roe deer
5. <i>tsebi</i>	Bovidae	Antilopinae	Gazella	3 spp	gazelle
6. <i>yachmur</i>	Bovidae	Hippotraginae	Alcelaphus	buselaphus	hartebeest
7. <i>aqqo</i>	Bovidae	Caprinae	Capra	ibex	wild goat
8. <i>dishon</i>	Bovidae	Hippotraginae	Addax	nasomaculatus	Addax
9. <i>te'o</i>	Bovidae	Hippotraginae	Oryx	leucoryx	Oryx
10. <i>zemer</i>	Bovidae	Caprinae	Ovis	ammon	wild sheep
11. <i>gamal</i>	Camelidae		Camelus	dromedarius	camel
12. <i>'arnebeth</i>	Leporidae	Leporinae	Lepus	3 spp	hare
12. <i>shaphan</i>	Procaviidae		Procavia	capensis	hyrax
14. <i>chazir</i>	Suidae		Sus	scrofa	pig
15. <i>neshar</i>	Accipitridae	Aegyptiinae	Gyps	2 spp	vulture
16. <i>peres</i>	Accipitridae	Aegyptiinae	3 genera	3 spp	vulture
17. <i>'ozniyyah</i>	Accipitridae	Buteoninae	2 genera	8 spp	eagle
		Circetinae	Circaetus	gallicus	eagle
18. <i>'ayyah*</i>	Pandionidae		Pandion	haliaetus	osprey
	Accipitridae	Perninae	Pernis	apivorus	buzzard
		Accipitrinae	Accipiter	gentilis	goshawk
		Buteoninae	2 genera	4 spp	buzzard
		Circinae	Circus	4 spp	harrier
	Falconidae	Falconinae	Falco	4 spp	falcon
19. <i>da'ah (dayyah)</i>	Accipitridae	Milvinae	Milvus	2 spp	kite
20. <i>'orebh*</i>	Corvidae		2 genera	6 spp	crow
	Sturnidae		2 genera	5 spp	starling
21. <i>bath ya'anah</i>	Strigidae	Buboninae	Bubo	bubo	eagle owl
22. <i>tachmas</i>	Tytonidae	Tytoninae	Tyto	alba	barn owl
23. <i>shachaph</i>	Laridae		5 genera	22 spp	gull
24. <i>nets*</i>	Accipitridae	Elaninae	Elanus	caeruleus	'kite'
		Accipitrinae	Accipiter	3 spp	hawk
	Falconidae	Falconinae	Falco	7 spp	kestrel
25. <i>kos</i>	Strigidae	Buboninae	Athene	noctua	little owl
26. <i>yanshuph</i>	Strigidae	Buboninae	Otus	scops	Scops owl
27. <i>tinshemeth</i>	Rallidae		5 genera	5 spp	rail
28. <i>qa'ath</i>	Pelecanidae		Pelecanus	2 spp	pelican
29. <i>racham</i>	Accipitridae	Aegyptiinae	Neophron	percnopterus	vulture
30. <i>shalakh</i>	Phalacrocoracidae		Phalacrocorax	2 spp	cormorant
31. <i>chasidah</i>	Ciconiidae		2 genera	3 spp	stork
32. <i>'anaphah*</i>	Ardeidae		7 genera	10 spp	heron
	9 other families		22 genera		waders
33. <i>dukhiphath</i>	Upupidae		Upupa	epops	hoopoe
34. <i>'atalleph</i>	8 families		17 genera	36 spp	bat
35. <i>'arbeh*</i>	Acrididae	Cyrtacanthacridinae	Schistocerca	gregaria	locust
		Acridinae	Anacridium	aegyptium	grasshopper
		Locusta		migratoria	locust
36. <i>sol'am*</i>	Acrididae	several sub-families			grasshopper
37. <i>chargol*</i>	Tettigoniidae				grasshopper
	Gryllidae?				cricket
38. <i>chaghabh*</i>	Acrididae	Calliptaminae	Calliptamus	palestinensis	locust
		Truxalinae	Dociostaurus	maroccanus	locust
39. <i>choledh</i>	Mustelidae	Mustelinae	2 genera	2 spp	weasel
	Viverridae	Herpestinae	Herpestes	ichneumon	ichneumon
40. <i>'akhbar</i>	6 families	8 subfamilies	20 genera		rodent

Table I: The Animals of the Mosaic Food Lists (*Continued*)

Hebrew	Family	Subfamily	Genus	Species	Vernacular
41. <i>tsab</i> *	Varanidae		Varanus	2 spp	monitor
	Agamidae		Uromastix	2 spp	mastigure
42. <i>'anaqah</i>	Gekkonidae		9 genera		gecko
43. <i>koach</i>	Agamidae		Agama		lizard
44. <i>leta'ah</i>	Lacertidae		4 genera		lizard
45. <i>chomet</i>	Scincidae		6 genera		skink
46. <i>tinshemeth</i>	Chameleontidae		Chamaeleo	chamaeleon	chameleon

vené de Wit suggested that the Lord endowed each kind with a rich genetic potential. Before the Fall (and its outworking in the Flood) this potential would have permitted a wealth of variety in plants and animals.

After the Fall it also provided the biological basis for variation and selection to meet the vicissitudes of a changing and often hostile environment. Yet such selection can only produce variations on the original themes—no new kind can be formed nor can the boundaries of any kind be transgressed.

Does this mean that all the animals of one *min* are related by descent? The Bible does not require this and in fact the accounts would seem to imply a different situation.

The only creature of which interrelationship by descent is definitely true—man—is not regarded as a *min* at all (note the contrast in Genesis I between the animals and plants which were created *according to their min* and man who was created *in the image of God*).

Further the parallel term to *min* in relation to man is *mishpachah* ("family") which denotes political, extrinsic relationship *not* genetic, intrinsic relationship.²⁶ I would thus suggest that each *min* contains several created stocks (although these may have subsequently intermingled), and that therefore the unity of the *min* is not one of descent.

There is thus a wide open field for creationist research: What is the basis of the unity of a *min*? What criteria can be used to distinguish *min*? Can all the members of the same *min* interbreed? If not how has reproductive isolation developed? What processes of variation can occur? Speciation (in the present day sense) does occur, but what processes are involved and how do these relate to the integrity of the *min*?

Dr. de Wit initiated a project to study these questions and carried out some fundamental research. I have been working in the same field and I hope to survey the progress in a later article. But the work remains unfinished.

It is hoped that this present analysis of the word *min* in the Mosaic lists will stimulate the genetic research needed to answer these questions. The current evolutionary frameworks have

had a stultifying effect on biological science and they greatly hinder research.

Yet, we do not have an accepted creationist alternative! I believe that we are now in a position to develop such an alternative that we may work further towards the reformation of biology.

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BRASSY SERPENTS ASSIGNED ROLE OF GUINEA WORMS

WILLARD L. HENNING*

Many facts are presented to establish the position that the brazen serpents which bit the children of Israel in the wilderness of the Arabian desert were literal venomous snakes, and not guinea worm attacks as stated in parasitology textbooks. The miracle of instantaneous healing from a look at a brass snake on a pole is readily understood in light of John 3:14, 15.

And the people spake against God, and against Moses, Wherefore have ye brought us up out of Egypt to die in the wilderness:

for there is not bread, neither is there any water; and our soul loatheth this light bread.

And the Lord sent fiery serpents among the people, and they bit the people; and much people of Israel died. Therefore the people came to Moses, and said, We have sinned, Lord, and against thee; pray unto the Lord,

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that he take away the serpents from us. And Moses prayed for the people.

And the Lord said unto Moses, Make thee a fiery serpent, and set it upon a pole: and it shall come to pass, that every one that is bitten, when he looketh upon it, shall live.

And Moses made a serpent of brass, and put it upon a pole, and it came to pass, that if a serpent had bitten any man, when he beheld the serpent of brass, he lived. And the children of Israel set forward, and pitched in Oboth. (Numbers 21:5-10)

This account may be summarized by saying that the children of Israel complained to God and to Moses because of their wilderness journey, only manna to eat, and no continual supply of water. Their complaint against God and His provision together with complete lack of faith brought swift and severe judgment at the hand of God in the form of many poisonous snakes suddenly appearing, biting and killing a number of people.

The Israelites soon realized their mistake, confessed their sin and asked Moses to intercede for them. God told Moses to provide a brass serpent fastened to a tall pole whereby all who obediently looked upon the serpent would be immediately healed of the venomous bites of the snakes.

The true meaning of this story is clear and is readily understood by Bible-believing Christians. However, in two rather widely used parasitology textbooks on the college level (Arthur W. Jones: *Introduction to Parasitology*¹ and Asa C. Chandler: *Introduction to Parasitology*²), the "fiery serpents" are claimed to be guinea worms (*Dracunculus medinensis*) which caused "burning pain," and were removed by carefully winding them each (a few turns each day) on a stick as they were drawn from the festered sore. However, after a careful scrutiny of facts regarding the guinea worm (the female of which is about three feet long and lives just under the human skin, causing a long continuous welt on the surface), along with facts relating to the actual situation, the textbook hypothesis seems quite erroneous.

In the first place it is probable that poisonous snakes were very common in the desert of Arabia. In Deuteronomy 8:15 we read: "who led thee through that great and terrible wilderness, wherein were fiery serpents, and scorpions, and drought, where there was no water; who brought thee forth water out of the rock of flint." This

suggests that poisonous snakes already in the desert suddenly became very aggressive in attacking many people.

The expression "fiery serpent" probably does not refer entirely to the painful bites of snakes or guinea worm attacks, but might as readily refer to bronzy color of the snakes. In verse eight of Numbers 21, Moses was asked to make a "fiery serpent" and place it on a pole. Later it is referred to as a brazen serpent, the brass also being the type of altar whereby sins were atoned for in the tabernacle in the wilderness.

The time element greatly favors literal poisonous snakes causing fatal or near fatal bites since it is recorded that "much of the people died." Moses probably was able to melt some brass in a few hours and form the brass serpent and place it on a pole the same day. Thus those many who had not died had the opportunity to look at the brass serpent on the pole and be instantaneously healed. The spiritual significance of this is given in John 3:14, 15.

As to another point, the length of the life cycle of the guinea worm, from ingestion of larvae to the maturing of the worm under the skin would require over a year.³ In addition, it would have taken from ten to fifteen days for Moses to extract a single worm. Since each worm is only one or two millimeters in diameter and lacks an exoskeleton, it would have dried and shrunk some if somehow fastened to the upper part of a pole in the desert.

And it is estimated that there was a total of about one and one-half million people in the entire camp, so they surely could more readily behold a brazen serpent than a soft worm the diameter of a string.

The brazen serpent which Moses made was retained by the children of Israel for over 700 years (according to Ussher's chronology), and was used as an object of worship and sacrifices. It was finally broken in pieces by King Hezekiah of Judah (II Kings 18:14).

On the basis of the Biblical account of the incident in Numbers 21:5-10, scientific facts, and obvious implications, it seems most logical to conclude that poisonous snakes rather than parasitic guinea worms were the real "fiery serpents."

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ON ASSUMPTIONS AND THEIR RELATION TO SCIENCE

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The fact that everyone has a set of "accepted assumptions" is emphasized and its relevance to science dealing with origins is explored. It is suggested that the failure to recognize incompatible sets of "accepted assumptions" results in much futile discussion of purported "evidence" for a particular view. Ample evidence is cited showing that confirmed evolutionists are so on philosophical grounds. No conceivable theoretical difficulties in biology will convince them otherwise! An implicit plea is made that everyone repudiate the thought that his personal view is the only possible rational one! To paraphrase Sydney Smith, the primary object of this paper is not to tell men things they don't know, but to remind them of what they are constantly forgetting!

Introduction

Over the years, men have come to recognize several sources of knowledge. These include sense perception, reason, testimony (including revelation) and intuition. These sources are by no means mutually exclusive. This paper deals primarily with the bearing of certain "accepted assumptions" (hereafter designated AA) on scientific inquiry relating to past events.¹ These AA strongly influence one's view of the nature and meaning of reality.

Examples of AA are the validity of reasoning,² causality, time and space invariance, absolute time and space, and an "orderly" universe. AA might also underlie such ideas as: "the whole is equal to the sum of its parts"; the only useful method of scientific inquiry involves quantitative modeling³; and "the present is the key to the past."

Some AA are so universally accepted that their intuitive basis is not apparent. Most AA have, to some extent, other sources of knowledge to corroborate their acceptance. Some can be easily mistaken for facts. Again, each man will have his own personal collection. David Bohm emphasizes this point by saying:

It seems clear that everybody has got some kind of metaphysics, even if he thinks he hasn't got any. Indeed, the practical "hard-headed" individual who "only goes by what he sees" generally has a very dangerous kind of metaphysics, i.e. the kind of which he is unaware (e.g. "You can never change human nature"; "There must always be wars," etc.) Such metaphysics is dangerous because, in it, assumptions and inferences are being mistaken for directly observed facts, with the result that they are effectively riveted in an almost unchangeable way into the structure of thought. What is called for is therefore that each one of us be aware of his metaphysical assumptions, to the extent that this is possible.⁴

If in the course of argument, a proponent of a particular idea is clever enough to conceal his

conclusion until the last, it is often possible to proceed unchallenged. Moreover, in many cases, overt agreement may be gained on points made.

However, if a conclusion does not agree with a listener's AA, strong exception will be taken often, not on the basis of errors in the argument, but because the conclusion is unacceptable for philosophic reasons. It is not uncommon for such objections to be manifestly illogical as presented. The objector may be unable to pinpoint the implicit assumptions which result in this position of conflict, but generally prefers to appear unreasonable rather than surrender his AA.

The "theory of theories" is based to some extent on AA. The qualifications of a "good" theory are generally thought to include such things as beauty, elegance, and simplicity. It is understandably difficult to agree on criteria for testing the extent to which theories exhibit these characteristics.

Theories "should" also contain elements of a more concrete nature such as internal consistency, generality, and falsifiability. For example, a theory that is so constructed that no experiments can be conceived that could refute it has little predictive value; at best it may be useful as a classification scheme. (The Ptolemaic theory of the solar system which allowed for an arbitrary number of epicycles was of this type, and partly for this reason was accepted for a rather long time.)

If a theory is refutable, it is not immediately discarded when a "refutation" is produced, but a careful analysis is made to develop possible ways of explaining the contradictory data. The contradiction may turn out to be only apparent. Reinterpretation of the data and/or modifications of the theory may remove the problem. Even if none of these avenues prove profitable, there is a possibility that future work will clear up the difficulties.⁵

A judgment must be made as to whether the usefulness of the theory outweighs its inadequacies. In many cases, it is retained because it is thought to be better than any alternatives. In actuality, a strong adherence to such a theory may render it worse than no theory! It may so bias current investigation that the achievement

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of a fundamental understanding of the subject is greatly hampered or postponed.⁶

The search for knowledge contains inferences, abstractions, plausibility arguments, interpolations, extrapolations, oversimplifications, generalizations, and analogies. These are also clearly dependent on AA. The so-called "scientific method" involves observation and interpretation. Obviously, interpretation is a function of AA.

Furthermore, observation is theory-laden.⁷ The idea that science is mainly done by "simple" observation—"Just look, and see what happened!"—is an oversimplification. We are *not* born seeing. We are born with the capacity to see. What we see is a function of what we are looking for, which in turn depends on our previous experiences.

Pure, objective science is itself an abstraction, an idealization, a fiction! Let us not overlook the obvious. Science is done by scientists—people with biases, beliefs, emotions, and a priority list headed by A.A. I agree that

... all of us will think more clearly when we frankly and openly admit that a lot of "hard-headed common sense" and "factual science" is actually a kind of poetry, which is indispensable to our general mental functioning.⁸

Two Theories of Origins

With these general remarks, let us consider the two basic theories of origins—the evolutionary theory and creationism. Evolutionists believe "that the general progress of evolution has involved the development of new organ systems and increasing complexity."⁹ Creationists hold that the basic "kinds" of plant and animal life were created (suddenly and miraculously), and do not have a common ancestry, but are the work of the same Designer. It is outside the scope of this paper to evaluate the relative merits of these beliefs.

Current evolutionary theory is definitely being examined more critically in recent years as seen by such symposia as the Wistar Institute Symposium in Philadelphia (1967) and the double sessions in 1966 and 1967 held under the auspices of the International Union of Biological Sciences. These symposia were attended by scientists from several disciplines such as physics, mathematics and philosophy as well as biology. Attention was given to the tendency to overstate one's case. For instance, H. H. Pattee, a physicist from Stanford stated

It is now commonly asserted, not only that the secret of heredity is understood in terms of physics, but that "no paradoxes had been encountered, no 'other laws of physics' had turned up," and that "... up to the present time conventional, normal laws of physics and chemistry have been sufficient. . . ."¹⁰

He also mentioned that

... to admit uncertainty about the basic nature of heredity, enzymes, or evolution is often regarded only as evidence that you have lost contact with modern biological knowledge. . . . [However] I am not even aware of any "loose" treatments of the physics of heredity by molecular biologists. Therefore I do not see any evidence that the physical basis of heredity has been worked out.¹¹

This admission does not imply a tendency to reject the hypothesis of evolution. An indication of the strength of the underlying AA is clearly seen in the pollyanna attitude that *somehow* "Nature" has done it (The argument seems to go—"After all, we're here!"). Pattee has said:

Even though we do not understand the mechanism, the only conclusion I have been able to justify is that living matter has distinguished ITSELF from nonliving matter by ITS ability to achieve greater reliability in its molecular hereditary storage and transmission processes than is obtainable in any thermodynamic or classical system.¹² (capitalization added)

One of the disappointing aspects of the symposia attempting to formulate a theoretical biology was the failure to examine carefully the most prevalent assumption in biology today, viz. that evolution has taken place. Most of the time was devoted to scrutinizing current theories of evolutionary mechanisms, with the basic underlying assumption receiving little more than a perfunctory glance.

Hidden AA Unrecognized

This failure to recognize (or admit) hidden AA is illustrated by a comment made by Ernst Mayr. Speaking of the evolutionary theory, he also displays an unwarranted faith in the scientific method when he asserts, "If a scientific theory is not correct, evidence will be found sooner or later that will permit us to 'falsify' (refute) such a theory."¹³

Such a statement is misleading for two reasons. The author fails to distinguish between science in the restricted sense, which depends on reproducibility of results and verification; and those areas of science which treat problems of origins—unique historical occurrences which are not subject to experimental techniques.

Furthermore, he includes a false assumption—that the results of experiments designed to test suggested mechanisms for evolution (i.e., natural selection or microevolution) have relevance in the testing of the more deep-seated assumption, viz. that evolution has taken place. This basic assumption is an AA, and is irrefutable.

... There is a characteristic difficulty in finding evidence that could really refute a general

and basic set of metaphysical assumptions. It is generally admitted that each theory has its "failures." But only very rarely does one regard these failures as evidence tending to refute the metaphysics. Rather, one places the fault in particular failures to solve certain "problems" that arise within the framework of the theory. But if one is not fully aware of the metaphysical assumptions, he may not see that these problems could actually be inherently and basically insoluble, because his metaphysics makes assumptions whose meanings are confused when extended out of certain limited areas, where they may work fairly well.¹⁴

In spite of the fact that the hypothesis of *evolution* is not subject to direct experimental falsification or verification scientific "testability" is sometimes used as a criterion for rejecting the *creation* hypothesis.

Suppose, for example, that the difference between living and nonliving matter depended upon different initial conditions. From the point of view of the physicist we would have to call this a "special creation" which may be allowable as a highly unlikely event or miracle; but this would nevertheless be scientifically barren since it can be neither derived from any physical theory nor tested by any real experiment.¹⁵

It is unfortunate that the need for "real experiments" seems to take precedence over the more basic issue—what sequence of events did (*in fact*) transpire in the past? This point deserves further consideration.

The past is composed of a series of unique events (unique in the sense that things which did actually happen make up these events and things which did not happen were absent from the sequence of events). Thus, any argument after the events, concerning what might have happened, in no way changes what did transpire. It is readily seen that this state of affairs creates a serious problem for any study of origins.

Assume for the sake of argument that evolution is a possible means by which life can be explained. If the creation hypothesis is correct, all experiments which are used as support for the possibility of life arising by evolution are largely irrelevant (and an emphasis of these experimental results is misleading). In the long run, it appears that a theory consistent with what *did* happen would be the most fruitful. Therefore, evolutionists bias their search for origins by rejecting one theory on the basis of its irrefutability, failing to realize (or choosing to ignore) the fact that the evolutionary hypothesis is equally irrefutable.

Although many creationists feel that evolutionary theory is incompatible with certain scientific

principles (e.g. the second law of thermodynamics) they would concede that the underlying reasons for not accepting the doctrine of evolution are philosophical—based on a particular view of the Bible as revelation.¹⁶ Evolutionists would do well to admit that believing in evolution involves no less an act of faith—an adherence to a different set of AA. The beginning point of the evolutionist as well as that of the creationist rests on a strong **personal conviction!**

Two Approaches Involve Same Data

Neither creationists nor evolutionists reject the raw data uncovered by scientists, although it must be pointed out that the data which are used may reflect the theoretical biases. Of course, each school of thought can point to data which are difficult to fit into the other theory.

Scientists are well aware that the same data can often be fitted comfortably into different theories. J. Maynard Smith, a geneticist from Brighton, England, illustrates this point nicely when he says, "... the main task of any theory of evolution is to explain adaptive complexity, i.e. to explain the same set of facts which Paley used as evidence of a Creator."¹⁷ Notwithstanding this awareness, at times it is conveniently forgotten as is seen in the following statement:

Even though the basic principles of the evolutionary theory have been confirmed by literally tens of thousands of scientific investigations, this does not mean that the evolutionary process is known in all of its details.¹⁸

Evolutionists have been confronted with some difficult questions, but clever men can generally, by plausibility arguments, escape any "corner." This is obvious from reading their writings.¹⁹ For instance:

It does seem odd, therefore, that just when physics is thus moving away from mechanism, biology and psychology are moving closer to it. If this trend continues, it may well be that scientists will be regarding living and intelligent beings as mechanical, while they suppose that inanimate matter is too complex and subtle to fit into the limited categories of mechanism. But of course, in the long run, such a point of view cannot stand up to critical analysis. For since DNA and other molecules studied by the biologist are constituted of electrons, protons, neutrons, etc., it follows that they too are capable of behaving in a far more complex and subtle way than can be described in terms of the mechanical concepts.²⁰

... If there is a crucial distinction between living and lifeless hereditary machinery, and if it cannot be explained classically, then the physicist will not only have a very strong point but also a profound problem. The point

is that the secret of life is neither simple nor understandable by classical models; the problem is to express hereditary rules in the language of quantum mechanics, that is, to describe how an exceptionally reliable non-holonomic constraint can arise in a single molecule. This is not primarily a problem arising from the complexity of enzymes or our inability to calculate solutions to certain equations. It is of the same nature as the problem of interpreting the measurement process in quantum mechanics where we must use both reversible (deterministic) and irreversible (statistical) descriptions for a single physical situation. But in case of molecular hereditary processes it is even less clear where to apply each type of description.²¹

I am willing to call the general evolutionary theory plausible in that some very intelligent men subscribe to it. In fact, if one makes certain assumptions, evolution is reasonable.

Dogmatism has traditionally been identified with religion (particularly by those not religiously inclined). That it is not confined to "religion" but is also present in "science" can best be illustrated by quoting a reply to a creationist's attack upon the evolutionary theory.

Frankly, I do not know of a single well-informed person who questions the factuality of evolution. . . . Nor is there any longer any question as to the mechanisms of evolution. . . .²²

It is too bad that people learn so little from history. The above statement is strangely reminiscent of words spoken by A. A. Michelson, a prominent physicist, at a laboratory dedication in 1894:

The more important fundamental laws and facts of physical science have all been discovered, and these are now so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote. . . . Future discoveries must be looked for in the sixth place of decimals.²³

Dr. Michelson was a much better experimentalist than prophet! Less than thirty years later, the physicist's picture of the principles and laws governing nature were fundamentally different, incorporating the revolutionary concepts of quantum theory and relativity theory. Both theories involved drastic changes in previous AA. Ideas implicitly assumed true for centuries have been attacked.

Conclusion

It would be reassuring to be able to prove that one's personal AA are the "right" ones. Since some AA carry very much weight indeed, one

"prove" one's position. It is a natural tendency to "proselyte" for one's own view. However, many arguments between opposing viewpoints take place at a level which precludes agreement because of conflicting AA, and prevent an appreciation of valid points.

cannot necessarily appeal to "known" laws to

Perhaps the classic example of the strength of AA is that of Einstein. His debates with Bohr lasting over a period of years, and his rejection of the prevailing interpretation of quantum physics can be traced to his philosophic position—"God does not play dice with the Universe."

Let us admit that science involves interpretation; it cannot exist without it. It emphasizes experiments—controlled experiences! "What we learn from experience depends on the kind of philosophy we bring to experience,"²⁴ as C. S. Lewis has said.

Let creation scientists make their "accepted assumptions" clearly known and use them as a basis for the research and study of origins. At the same time, let us press the evolutionists to admit that they too have "accepted assumptions" and are basing their views largely on philosophical-religious presuppositions.

When these points are clearly recognized and understood, perhaps the debate between evolutionists and creationists can generate less heat and a little more light.

References

- ¹The term "accepted assumptions" refers to premises which are taken as true (in many cases, on intuitional grounds). They may *in fact* be false. They may be unprovable (and hence unfalsifiable); they may be subject to proof but not yet proved; there may exist an alleged proof. In this connection, it is worth noting that what one person accepts as proof beyond a reasonable doubt will fail to convince another, so proof is a relative term.
- ²Lewis, C. S. 1970. *Miracles*. The MacMillan Co., New York, pp. 20-24. Here Lewis argues convincingly for the necessity of this assumption and gives some interesting observations on its implications for scientists whose philosophy excludes the supernatural.
- ³Blackburn, T. R. 1971. Sensuous intellectual complementarity in science. *Science*, 172 (3987): 1003. This reference recommends a broadening of the footnoted view.
- ⁴Bohm, David. 1969. *Towards a theoretical biology*, II. Edited by C. H. Waddington. Aldine Publishing Co., Chicago, p. 41.
- ⁵For example, the irregular orbital motion of Uranus about the sun seemed to be inconsistent with Newton's gravitational law. The conflict was resolved with the discovery of Neptune. In this case, Newton's law was used to help locate the planet causing the perturbation!
- ⁶Newton's corpuscular theory of light was generally accepted for more than one hundred years (mostly due to his prestige) until the "evidence" was rather overwhelming in favor of the wave theory.
- ⁷Cf. Margenau, H. 1950. *The nature of physical reality*. McGraw-Hill, New York.
- ⁸Bohm. *Op. cit.*, p. 42.
- ⁹Dodson, Edward. 1960. *Evolution: process and product*. Reinhold Publishing Corp., New York, p. 153.

- ¹⁰Pattee, H. H. 1969. Towards a theoretical biology, II. Edited by C. H. Waddington. Aldine Publishing Co., Chicago, p. 268.
- ¹¹Pattee. *Ibid.*
- ¹²Pattee, H. H. 1968. Towards a theoretical biology, I. Edited by C. H. Waddington. Aldine Publishing Co., Chicago, p. 78.
- ¹³Mayr, Ernst. 1971. Letters to the editor, *The American Biology Teacher*, 33 (1): 50.
- ¹⁴Bohm. *Op. cit.*, p. 103.
- ¹⁵Pattee. *Op. cit.*, p. 72.
- ¹⁶Creationists feel that revelation is the only reliable means of determining past events. Testimony by "Someone" who was there should outweigh speculation.
- ¹⁷Smith, J. Maynard. 1969. Towards a theoretical biology, II. Edited by C. H. Waddington. Aldine Publishing Co., Chicago, p. 82.
- ¹⁸Mayr. *Op. cit.*, p. 50.
- ¹⁹Blum, Harold F. 1962. Time's arrow and evolution. Harper & Brothers, New York and Morowitz, Harold J. 1968. Energy flow in biological systems. Academic Press, New York.
- ²⁰Bohm. *Op. cit.*, p. 34.
- ²¹Pattee. See reference 10. p. 279.
- ²²Mayr. *Op. cit.*, p. 49.
- ²³Quoted from Bartlett's familiar quotations.
- ²⁴Lewis. *Op. cit.*, p. 7.

THE SMYRNA FIG REQUIRES GOD FOR ITS PRODUCTION

OSCAR L. BRAUER*

Small wasps, male and female, are hatched in a caprifig in closed cells. The male wasp gnaws out of his cell. He then gnaws a hole in the cell of the female and fertilizes her whom he has never seen. The female emerges from her cell and in leaving the fig to accomplish her mission in life she becomes covered with pollen. She enters the fruit fig attempting to lay her eggs, but the fruit fig is built so she cannot lay her eggs, but in exploring the fig she pollinates the fruit-producing fig.

A young wasp lies dormant in a caprifig all winter, but hatches at the exact time to lay her eggs in the summer crop of caprifigs which is necessary to pollinate the fruit. This all requires exact timing which means God controls it.

Introduction

The peoples of the world are in more confusion of mind than at any other time in recorded history. This condition has been mostly caused by the disbelief in the reality of God. Fundamentally, the evolution theory is the principal cause for this lack of belief in God.

One probably cannot restore confidence in God by arguments against evolution alone. However, these arguments are necessary. Possibly the most effective arguments are those that point out in reality those things that cannot be explained by any other presupposition than God.

Naturalistic explanations of the origins of living things take most of the processes for granted. For example, if there had been a satisfactorily complete evolutionary history of other figs, this history would have broken down in the case of the Smyrna Fig. This is illustrated by the difficulties of getting Smyrna figs to bear fruit in California under the new name of Calimyrna Fig.

The Smyrna fig either fresh or dried has about the most delicious flavor of all the figs. For over a century, California had been blessed with the Black Mission Fig and the Adriatic Fig. In the San Joaquin Valley these two kinds of figs were in commercial production and very profitable.

Early History of Smyrna Figs in California

George C. Roeding, the large nurseryman of Fresno, was very anxious to get the Smyrna fig in production in the San Joaquin Valley. He found, however, that many others had brought cuttings of the Smyrna fig into California on numerous occasions. Although the cuttings grew very well the resulting trees would not bear fruit. The young figs when about the size of a walnut dried up and fell off.

In 1880-1882 G. P. Rixford, a publisher in San Francisco, imported 14,000 cuttings of Smyrna figs and gave them away to subscribers as gifts. These cuttings grew rapidly but the mature trees bore no fruit. Numerous other individuals imported cuttings with similar results.

All kinds of theories were advanced to explain why the Smyrna figs would not bear fruit in California. Some thought it was the soil, and others the climate. Roeding did not believe the answer was as simple as that. He learned that in Smyrna when the fruiting fig was beginning to develop fruit, the growers went out into the hills, cut limbs off the wildfig and brought them in to hang in the bearing fruit trees.

This suggested strongly that there must be some insect that is needed to pollinate the fruit fig. About 1890 Roeding had some of the fruit of the wild trees, which now had been named

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caprifig, sent to him. He opened a caprifig and with a toothpick took out some pollen and put it into a fruiting fig still on the tree. With a blowtube, pollen was blown into other living figs. All these pollinated fruits bore good fruit. This convinced Roeding and others that a pollinating insect was needed. Nevertheless, since the Black Mission and Adriatic figs did not need pollination most of the growers did not believe pollination was necessary.

Further Studies of the Smyrna Fig in California

The caprification of the Smyrna fig was completely studied and explained by Mr. W. T. Swingle and Dr. Gustav Eisen. On October 3, 1889, Dr. Eisen reported: "When I first announced at a horticultural meeting in Fresno in 1887 my final conclusion about caprification and the necessity of importing the *Blastophaga psenes* wasp, I was hooted down."

However, Roeding believed in caprification and kept on importing caprifigs until he got the wasp introduced in 1900, and the industry begun. He offered a prize for naming the now successful fig and received the name *Calimyrna*.

The Secret of Caprification

When the fruit figs begin to develop, small female wasps about 2.5 millimeters long hatch in the galls or enlarged ovaries of the caprifig fruit. At the same time male wasps hatch in nearby galls. The male wasp finds an enclosed gall containing a female wasp. He gnaws a hole in the gall containing the female and fertilizes the latter. This male wasp has never seen a female wasp and she has never seen him. After performing his only purpose in life he dies and is absorbed by the caprifig.

Who taught the male wasp what to do and how to do it? The only reasonable answer is that God taught him. If evolution was at all involved in the life of this tiny insect, it is highly improbable that his life would have been so short. God had a purpose for its life. When it had played its part, there was no further need for it.

God's purpose was to produce food for man, the birds, and some animals. Every part of the lives of the *Blastophaga psenes* both male and female was planned with exact timing for each step of the many processes so that each occurred exactly at the right time. If any time sequence should fail, the fruit crop for that year would fail and possibly all crops thereafter.

The young female crawls out of the hole the male insect has made and proceeds to leave the caprifig. The pollen flowers are bunched around the outlet of the caprifig. As the wasp escapes she is covered with pollen grains. If perchance she gets into a fresh caprifig when she emerges she lays her eggs in the suitable places as she

finds them, which continues her species.

The fruit grower wants her to do something else than perpetuating the species so he keeps the caprifig trees away from the fruiting trees.

God has planned that the female wasp pollinate the fruit fig. Since there are no other figs to enter the wasp enters the fruit fig. Now the "style" in the fruit is so long that the little wasp cannot lay its egg at the bottom of it as she would had it been a caprifig. But in feeling out the style it is pollinated. This makes the fruit develop and ripen.

The female not realizing that she is accomplishing her life's purpose goes on and on through the first fruit, and on through many others. At the end of the "search" it dies exhausted and frustrated. However, now the fruit figs develop normally and produce seeds which add to its flavor. Up in the hills of Smyrna, and away from the bearing orchards in the San Joaquin Valley, the wasps enter the caprifigs and perpetuate the race of *Blastophaga psenes*.

In the active caprifig the ratio of eggs that produce females, to those that hatch into males, is 10 to 1. Or simply, there are ten times as many eggs that produce females as there are eggs hatching into males. This fact increases the efficiency, as the unfertilized females can gnaw their way out and be just as effective in pollinizing the fruit as their fertilized sisters. Who planned this increase in efficiency? It is improbable according to evolutionary chance. This shows the wisdom of God in producing efficiency.

There are two kinds of fruit produced by the caprifig. The "profici" crop of caprifigs must emerge at the time the fruit figs are coming on. Then the "mammas" figs must carry the dormant embryo wasps all winter and ripen just at the right time to activate the new profici crop, which must pollinate the on-coming fruit crop. Only the figs inhabited by the gall wasps remain on the trees of the caprifig during the winter.

Notice how exact timing must occur. Nothing is left to chance. The mammas caprifig must bring the hibernating wasps ready to emerge in April exactly when the wasps are needed to lay their eggs in the profici crop so in June these eggs will hatch when the edible fruit needs pollination. Then the mammas wasp eggs must be laid in the mammas figs to hibernate over the winter.

If the timing failed in any one of these steps the whole system would break down. God has to hold everything in balance so each part will come on at the right time. Not one of the steps can fail. If the female wasp should happen not to be dusted with pollen, no fruit would develop.

So again we know whose wisdom bunched the pollen flowers in the caprifig around the exit so whatever female wasp emerges she will carry

pollen which she unconsciously needs to pollinate the fruit figs.

To think that all of this exact pattern resulted from evolutionary chance is preposterous. Without God nothing like the Smyrna fig could exist. Now common sense would indicate that such an involved arrangement as the Calimyrna Fig could not have originated by the chance reactions of unguided and purposeless forces in nature. Only God could have planned such a complicated set-up, and made it work.

This study emphasizes what evolutionists for-

get, the *purposes* of creation. Evolutionists pretend that things arise by chance without a definite purpose or a completely thought out plan. But God always has a purpose for his creations and definite detailed plans that he can make work.

Suggested Readings

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COMMENTS ON SCIENTIFIC NEWS AND VIEWS

HAROLD ARMSTRONG*

Microtubules and Creation

Recently I read somewhere in some Creationist literature that, at the time when a certain evolutionary theory was proposed, people supposed that the cell was about as complicated as a ping-pong ball. Whereas, of course, scientists are still learning about its complexity.

One fairly recent discovery is that of microtubules in the cell. These seem to be found in many or most cells, and to have a certain resemblance to the circulatory systems in larger creatures. Indeed, one might have guessed that something of the sort would be found; for there is a tendency for features found on a large scale to be repeated, in an analogical way at least, on a smaller scale. One is reminded of the old philosophers, with their interest in comparing the macrocosm and the microcosm; indeed, they went farther on less evidence than modern men have done.

One difference seems to be that the microtubules in the cell. These seem to be found in features like the circulatory organs. The discovery of the microtubules, it might be mentioned, depended on the electron microscope; for their diameter is typically 2×10^{-6} centimeters, about one thirtieth the wavelength of visible light.

It appears that the microtubules are direction markers, keeping the cell in shape and guiding the internal transport of materials.¹ It is pointed out that: "... microtubules ... do not assemble themselves at random ... [but] very precise mechanisms exist for determining when and where microtubules are made."

The point of all of this, of course, is plain: how could living cells, in all of their complexity,

conceivably have arisen by some accidental con-course of dead material? Merely to state the matter, putting in for "cell" a description of the cell in all of its complexity, would be to expose the absurdity of supposing that such a thing could happen.

Yet the evolutionary theory absolutely needs it to have happened. For if not, there must have been a supernatural intervention into the course of things at least once, for life to be started at all. But if once, why not oftener?

Why not wield Ockham's razor, to cut out the transformations between kinds (the alleged ones, that is), for which there have never been really convincing explanations anyway? If we admit one Creation, we may as well admit the separate creation of the various kinds. Indeed, there have been those who have held just that, not on Scriptural grounds but because the evidence points that way. And certainly a Creator who could create one kind of creature could as easily create many kinds.

May I add one remark, having to do now with my own study: physics? Is it possible that, just as the study of living things erred by underestimating their complexity, so are physicists doing about the thing with which they are concerned? Is it possible, for instance, that our notions of atomic structure (a matter which can scarcely yet be said to be free from difficulties) are enormously over-simplified? If we hold that God made atoms as well as cells, when the cell turns out to be enormously complex, we should not be surprised to find some complexity in the atom.

Earthworm Sexuality Defies Evolutionists

Recently I have been reading a book by E. Gibbons, an authority on wild foods. He had occasion to comment in one place on earthworms (not that he was advocating them as wild food).

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He wrote:

... the common night crawler, *Lumbricus terrestris* ... [has] the body ... made up of 100 to 180 ringlike segments, called somites, separated by tiny grooves. ... this earthworm has something almost like feet ... four pairs of them to each somite, except for the first three ... and the last. ... These almost-feet, called setae, are small bristle-like chitinous rods ... each seta is connected to muscles in the worm's body and can be moved in any direction, extended or withdrawn at will. ... Each night crawler is both a complete male and a complete female ... [but] the worm cannot fertilize its own eggs. Mating occurs at night in warm, moist weather. ... There is ... reciprocal cross-fertilization. ...²

Thus the earthworm is another example to the many which creationists already have of the complexity of even the humblest creatures. As usual, the difficulty of believing that such complexity could have evolved needs no comment.

There is, however, another point here. The sexual behavior of these creatures is worth some thought. It is hard enough to imagine how the more usual kind of sexual reproduction could have come about by evolution, or little by little.

How much more difficult to explain that in which each creature is both male and female, but they have to mate. What possible advantage could that have for survival. Is this system supposed to have evolved from ordinary sexual reproduction, or vice versa? In either case, the difficulties need no comment.

It is hard to see how they could have transferred from one system to the other, or what advantage there would be in so doing. But there is no difficulty at all in believing that they were created that way, as viable organisms.

Prairie Dogs "Utilize" Bernoulli's Principle

Bernoulli's principle, the principle that in a moving fluid the pressure is less where the velocity is greater, is the key to many surprising phenomena and applications in aero- and hydrodynamics. There is now some reason to believe that various animals apply the same concept to satisfy their needs.

Prairie dogs, for instance, seem to apply the principle to help in ventilating their burrows.³ The burrows have two openings, the one at ground level, the other raised by a mound. The presence of the mound does not seem to be just by chance, for they "... go to some trouble to shape and repair the mounds around the exhaust holes. ..."

Because of friction, the wind is slower at the surface than at even a foot or two above ground level. Thus by Bernoulli's principle, the pressure

is a little less at the raised hole, which then is indeed an exhaust hole. Without this relationship, it is suggested, they might have trouble in getting enough fresh air into the burrows.

The application to the position of the creationist is plain enough. How could such a manner of building burrows have evolved?

Incidentally, there might be a project here for some of the Christian schools, or someone else who might be interested. It might be possible to find a burrow, and actually measure the difference in pressure with a sensitive manometer. Also, maybe imitations of the burrows could be constructed, and their effect measured.

Vestiges or Useful Organs?

It used to be common, among those looking for some reason for believing in evolution, to point to organs which were considered to be vestiges—organs which seemed to have no function, but which might correspond to organs which did have some use in other creatures. Indeed, that line of alleged evidence is not heard so much nowadays, for upon closer examination fewer organs are seen to be without function.

It has been pointed out, moreover, that, even were many such organs to be found, they would not really help the cause of evolutionists. For what needs to be explained is not how disused organs might linger in some cases, but rather how organs which would be needed in the future could be prepared beforehand.

In any event, it appears that another organ has been removed from the list of useless ones. The pineal gland has long appeared to have no particular function. Now it appears that it is "... not the vestigial structure once thought. ..."⁴ It produces the secretion, melatonin; and, it is suggested, seems to have some influence on behavior.

The ability to make good predictions is often considered to be a test of good science. Might it be proposed, as a prediction of creationistic science, that eventually all organs will be found to have some function?

In so doing, of course, we should be following the old philosophers, who said that nature neither lacks necessities nor abounds in superfluities. Lest this seem pantheistic, let it be remembered that the philosophers, at least those of them who were Christians, did not think of nature as something independent, but as God's work of Creation.

Algae of Surtsey

Surtsey, the volcanic island formed off Iceland a few years ago, continues to provide object lessons, and especially to show how quickly landforms can develop. A recent, rather unusual study, investigated organic materials in the sediment in a lagoon.⁵ It is concluded that:

... green algae were the primary contributors of organic matter ... the fact that this lagoon was observed to be inhabited primarily by green algae ... is of interest, as well as the fact that the record ... has been chemically preserved in the lagoon sediment. ...

The algae, or traces of them, seem often to be found in rocks that are considered to be extremely old. However, it would seem that when and if the sediment found at Surtsey should harden, it might well preserve traces of the algae.

Is it possible that what the algae really record is a state of affairs something like that which prevailed at Surtsey? If so, is the time when the fountains of the great deep were broken up a likely one in which all this might have happened?

Likely there was much volcanic activity; later, when the water had partly subsided, there would have been many lagoons, in which the algae might thrive. So in some cases some of the rocks in question might actually be younger than those which have fossils of larger creatures.

Plants Give Insect Indigestion

The many and varied means by which the human body defends itself against attacks have been commented on in our publications. It is certainly hard to see how these things could have evolved; for, like so many other features, they need to be nearly perfect before they are of any use at all.

Now a most unexpected example of such a thing has been found. It appears that certain plants, tomatoes and potatoes among others, have means of defending themselves against insects.⁶ If the leaf is damaged, for instance, as insects start to eat it, the plant produces a considerable concentration of a material which inhibits the insect's digestion. It does this by inhibiting the action of proteinases in the insect's stomach.

This is surely as remarkable a defense as one could imagine. And how could it have evolved? Did the plants produce compounds at random, until they hit upon one that affected digestion? I shall leave it up to the reader to imagine how many trials that might take!

Nor was it "survival of the fittest." For apparently many plants which have no such provision survive—nay, flourish. Again, the defense is not a sure one. Anyone who has had a garden knows that insects can ruin tomatoes and potatoes.

No, here is another example of a clever design. And again, as so many times before, we can argue that a design implies a Designer.

Not from the Apes

A recent book: *Not from the Apes*, might be of interest to some creationists.⁷ While author Kurten does not take up a creationist position, the book contains useful information.

The author maintains, among other things, that it should not be said that man descended from apes; that it would be more correct to say that the apes and monkeys descended from (early ancestors of) man. He says also that men and apes have been separate lines for more than thirty-five million years.

These, and the other theses which the author proposes to maintain (he calls them "propositions"), are set forth at the beginning of the book. Such a practice might well be adopted more widely.

The grounds on which the author advances his theses about descent are partly at least that the apes and monkeys are more specialized than man. This is a point that some creationists might investigate. Maybe it is not true that greater specialization indicates further descent; it would seem that it is just as possible for beings to become more versatile as for them to become more specialized.

Creationists can, of course, always use books such as this for argument: that if the experts disagree they can not all be right, but they could all be wrong. Besides that, there will be points to which a creationist interpretation can just as well be given. For instance, if the lines of men and of apes appear to have been separate for so long, maybe the reason is that they have been separate as long as they have existed.

Man's Missing Ancestors

While it is pointed out often enough, in publications such as this, that there are great difficulties in finding any way in which man could have come from apes—or from something like them—it is not so usual to find such an admission in a journal in which the evolutionary theory is usually upheld.

It is interesting, then, to find an article in which an author admits something of the sort.⁸ In fact this quote is found: "Amid the bewildering array of fossil hominoids, is there one whose morphology marks it as man's ... ancestor? ... the answer appears to be no."

The article in particular applies some notions of population genetics to the matter. It seems unnecessary to quote it at length here, since the *Scientific American* is so generally available. Of course, the author does not draw the conclusion that man is a special creation, but hopes that more evidence will set the matter straight.

But from the creationist viewpoint, since there is admitted to be no evidence for man's descent,

it is just as reasonable to hold that he was created specially. And by special creation, a person can by-pass a thousand difficulties which face any theory of descent.

Even from a purely human viewpoint, when there is the same amount of evidence for each of rival theories (actually, we might say that there is more evidence for special creation, but let that pass), is it not reasonable to adopt the one that offers the fewest difficulties?

Learning Is More Than Mazes

It is reported that learning is a much more complicated thing than many had supposed.⁹ Lest it be said that anyone who has ever taught or attended school knows that, let it be added that it is learning by animals that is being discussed.

It appears that animals learn different things in different ways. Learning to avoid poisons, for instance, is quite different from learning what kinds of food are good. And such standbys as avoiding shocks, and going through mazes, are yet another matter.

We may draw several conclusions from this. First of all, even if there were only one kind of learning it would be hard enough to see how it could have evolved. Then surely the fact that there are several kinds (probably many), makes it that much more difficult to believe in evolution, just as it is hard to believe that the several kinds of flight practiced by different kinds of creatures could have evolved separately—or, for that matter, evolved at all. But when God created these creatures, it was no problem for Him to give them such various abilities at learning as He saw to be good.

In the second place, it would appear that the usual experiments in which rats go through mazes and avoid shocks tell us something about how rats learn to go through mazes and avoid shocks—and maybe little else.

In the third place, since most of the things which human beings have to do are different from those which animals have to do, it would appear to be very risky, to say the least, to try to draw any conclusions about human beings from experiments carried out on animals.

Varves Possibly Not Annual

A recent, rather technical paper, may have an important idea for us. It has to do with the fact that stresses may affect the solubility (or otherwise), of materials. Thus, in rocks, for instance, complicated patterns of stresses might cause materials to dissolve in some places, and re-precipitate in others.¹⁰

This may be of interest, for it might have to do with the patterns called varves, or by other similar names. Such patterns of many layers

have been ascribed to annual depositions; and on this ground great ages have been claimed for various deposits.

It would seem worthwhile to investigate whether, in some cases at least, it may not rather be that complicated patterns of stress caused materials to dissolve out of certain layers, and to re-precipitate in others. Such a process, of course, could have been going on in all of the layers simultaneously; so even great numbers of such layers need not be evidence of great ages.

Volcanic Ash in Antarctic Ice

It has been suggested that the ice age (and it would seem that there was something of that sort, although the usual accounts may exaggerate both its extent and its importance), may have come at the end of the Flood, and may have been caused by dust in the atmosphere. The dust could have come from volcanic eruptions, which likely occurred in connection with the breaking up of the fountains of the great deep.

We know that such a thing is possible, for in quite recent times there have been appreciable reductions in temperatures, following great eruptions. There is also some evidence of such an event a long time ago.

Drilling through the ice in the Antarctic regions has revealed, at certain depths, considerable volcanic ash and dust embedded in the ice.¹¹ The deposit of especial interest was estimated to be about 18,000 years old; but we know that the tendency is to exaggerate such ages.

What is of interest is that it was estimated that the time at which the ash and dust were deposited was a time of unusually low temperatures. The temperature was estimated by a method depending on the amounts of different isotopes of oxygen. In view of what we know about the application of isotopes to dating, we may accept these conclusions with some reservation.

It is not necessary, of course, to suppose that this deposit dates from right after the Flood. It could have been a purely local thing. But we do have here more evidence to show that a catastrophic explanation of the ice age is the most reasonable one.

Vestiges of a Canopy?

Some recent reports of investigations carried out by rockets fired to great altitudes contain evidence of water-cluster ions, as large as $H^+(H_2O)_6$ at about 85 kilometres. Apparently they are found in a rather sharply defined layer.¹²

This discovery may be of some interest to creationists in giving a clue about the canopy, which many believe surrounded the Earth before the Flood. There are questions about the state of the water in the canopy, and how it was supported.

A suggestion had been made in these pages that if it consisted, in part at least, of charged ions, it could have been self-supporting by the mutual repulsion. Moreover, there would have been no electrical effect at all below the canopy; it is a well-known theorem in electrostatics that a uniform hollow sphere of charge causes no electric field at all on the inside.

It would seem possible, then, that the water in the canopy might have been at least partly in the form of ions of the sort mentioned here. Thus it may not be wrong to suggest that the ions just discovered may be, so to speak, remnants of the canopy.

A Catastrophic Ice "Age"

A problem which creationists have to consider is that of finding out just where the "ice ages" (to such an extent as there really were such times), fit into history. Presumably they (or maybe better "it"; for there is some reason to believe that there was only one), came after the Flood; else the traces would likely have been wiped out. Then the time becomes very crucial. Also, creationists need to find out something about the causes of the glaciers.

I have been reminded^{13, 14} that volcanic eruptions can cause a cooling of the Earth, because the dust scattered in the atmosphere and stratosphere obscures the sun's rays to some extent. There are well-known examples, such as in 1783; and again in 1883—the eruption of Krakatoa.

Such eruptions spread dust over the whole earth, and caused appreciable cooling for as long as maybe fifteen years. Moreover, the dust tends to be swept toward the polar regions, so the greatest effects would be caused there.

Perhaps things happened something like this. The "breaking up of the fountains of the great deep" at the beginning of the Flood may well have involved great volcanic eruptions. (Incidentally, just as there is some reason to believe that there was no rain before the Flood, it is at least possible that there was no volcanic activity.)

The eruptions may well have been beyond anything that we can imagine, spreading enormous amounts of dust. In a short time the dust would have caused much cooling, especially well away from the equator; and maybe even before the Flood was over, snow was falling in those parts.

Just as the rain during the Flood must have surpassed anything that we have seen or can imagine, so the blizzards at this time must have been beyond our experience. Imagine a snow-fall of hundreds of feet!

Possibly, at the higher latitudes, the snow came fairly early in the Flood. That might account for the frozen mammoths and other animals in Siberia and elsewhere. There might be a paral-

lel here. Hard winters have occurred on the ranges, in which cattle were frozen in the snow during blizzards. Has anyone ever examined any of these, when the snow melted later? Is there any evidence as to how their condition compares with that of the mammoths?

It might even be that the cooling was so great that the whole Earth would have frozen, had it not been for the enormous amounts of lava which, being quenched in the water, warmed it considerably. This, of course, would cause still more evaporation, and thus still more snow.

The land, where the glacial action was going on, might not at that time have been raised above the sea level (as it was then). Thus the ice may not all have moved as glaciers; it may have been like icebergs, partly floating and partly scraping along. Thus there would be a very great amount of scratching, etc.

As the land did rise above the water (if the Flood was ended thus), there would have been much motion of the layer of ice, again with much scraping.

In view of the greater magnitude of the eruptions at the time of the Flood, one might extrapolate from the fifteen or so years mentioned above to say one hundred or so, for most of the effects of the cooling to disappear. Of course, it seems possible to hold that there is still some effect; that we are not yet quite over the "ice age."

It should be remarked that, of the various causes of the ice ages which have been proposed from time to time, the one of dust is the only one for which it can be said that there is evidence, in that something of the sort, admittedly on a smaller scale, has happened in recent times. But the dust theory is good only for a short ice age; the conditions might last for a hundred years or so, but it is hard to see how they could have lasted for tens of thousands of years.

The dust will work only for a catastrophic ice age. But there is evidence that catastrophic is just what it was, e.g. the frozen mammoths. So it would seem that the ice age, happening something as suggested here, could fit in with all of the evidence.

Catastrophic Storms and Cave Formation

Even among those for whom uniformitarianism is the official doctrine, so to speak, it is becoming more and more necessary to admit catastrophes. A recent letter actually uses words such as "catastrophic" in discussing such an event.¹⁵

In August 1969, hurricane Camille passed through parts of Virginia. At places, there was as much as 30 inches of rain. The resulting enormous flows of water affected many natural features, and in particular Cave Springs Cave, near Lexington.

The letter writers, speaking of the "... cataclysmic storm . . .," go on to say that . . . processes are greatly accelerated during times of major floods. Evidence indicates that in ancient times floods of similar magnitude have occurred . . . one cataclysmic storm . . . may accomplish more . . . than many centuries of . . . erosion.

Many of the effects of the storm had to do with the alteration of the cave. It is suggested that the water was saturated or supersaturated with carbonates, and that mass transfer by solution and precipitation played a very important part.

It could be added, if 30 inches of rain caused this, what might more than a mile of rain do? By comparison with what has been found here, it may be decided that the Flood would have had more effect than millions of years of uniform processes. Hence the millions of years are not needed. And that is just what creationists have been saying.

Flaws in Fossil Logic

The alleged descent of the horse, which has been "exhibit A" (or "B" at least), for evolutionists for many years, has been seen of late, under more careful scrutiny, to be not so convincing after all.¹⁶ It may be worthwhile, starting from some things which have been said about that matter, to go on and draw a general conclusion.

The criticism has been, partly at least, that some of the alleged members of the series very likely had nothing to do with horses; that the "Eohippus" was likely an animal like the modern hyrax, for instance.

Now to look at the general case. Consider any fossil. It is either like or unlike some creature living today. If like, where is the evidence for evolution, or indeed that anything at all has changed? If unlike, where is the evidence that one has descended from the other? Surely, in this matter, the evolutionist finds himself on the horns of a dilemma.

The evolutionist's difficulty is compounded by the fact that he has only skeletons of the ancient creatures, often incomplete skeletons, and maybe not many of those. Of *Archaeopteryx*, for instance, there seem to be about three fossils. It would seem possible that so few samples might be freaks, or the young of a much larger creature. Who would guess, had he not seen the living creatures, that fossils of a tadpole and of a frog, if such should be found, represented different stages of the same kind of creature?

Since the fossils would be the only real evidence for evolution (the other alleged evidence is of use only to some one already persuaded), and since it has been shown that evolution does

not follow from the fossils, is the theory not left without any logical support at all?

What Is a Dominant Group?

Almost any evolutionary book on geology will contain the statement that at one time the trilobites were "dominant," at another time the dinosaurs, etc.

This notion has now been criticized, on the grounds that nobody says what is meant by a dominant group.¹⁷ Any criteria that have been proposed are so broad as to be meaningless, in that they are not adequate to exclude any group of organisms from the classification. It is concluded that:

. . . the argument that the sequence of successive dominant groups . . . provide evidence for evolutionary progress is a common argument . . . few . . . attempt a clear definition of the key term "dominant group" . . . two major supporters . . . do attempt such a definition and both fail . . . [so] the argument fails to establish its conclusion due to the fact that one of its premises is meaningless.

The whole article should be read. It might be noticed here that dominant groups of fossils (if there be such a thing), do not necessarily indicate dominant groups of living creatures (whatever that may mean); it could be that the really dominant group of creatures did not make good fossils, while a relatively minor group did. Again, it could have been said, two hundred years ago, that the passenger pigeons were fairly dominant. Yet we know that they have left no descendants at all.

Stellar Abundance Data Doubtful

In the many attempts that have been made to show that the universe evolved, and how it did, "stellar abundances," the proportions of the various elements, have been used as evidence. Now the very notion that we have accurate data about these abundances has been challenged.¹⁸

Attempts to determine what there is in the atmosphere of a star (for it is mostly the atmosphere that can be investigated in detail), depend, of course, on spectroscopy. However, the interpretation is far from simple: as the author of the article points out it "... rests on several assumptions, particularly the existence of microturbulence, for which there is no experimental or theoretical justification."

It is impossible to set up comparable conditions in the laboratory; so experimental controls are not available. The only comparison possible is with conditions in the Sun; and even there the agreement with theory is not all that good.

The fact is, that a vast structure of speculation has been built on a very weak foundation of fact. So we may consider that if attempts to learn the

present composition of the stars are of very doubtful validity, how much more can this be said of attempts to guess at their past history.

The Silence of Mars

Apparently Russian attempts to get really "close-up" information about Mars by unmanned rockets have not been as successful as were the flights to Venus.

It has been reported, however, that information obtained makes it seem even less likely that there is anything living on Mars.¹⁹ The planet is certainly very dry; although some formerly expected to find moisture in the polar "ice-caps," it now appears that they are largely frozen carbon dioxide. As for moisture in the atmosphere, it is reported that the atmosphere contains not more than five microns of precipitated water.

Is it not remarkable that, years ago, when it appeared (on uniformitarian grounds, at least), that there might be living beings on other planets, nobody said much about the matter? Now, when all the evidence is to show that there is none, we have books and symposia on "Intelligent Life in the Universe" (i.e., other than on the Earth). Whereas the only intelligent life (and corporeal, as is understood in these discussions), of which we know is here on Earth; and from some of these discussions one might have his doubts about that.

Little Water on Mars

Yet another piece of evidence has appeared to show that Mars must be a barren planet. It is reported that infra-red spectroscopy has shown that that planet's polar caps are composed of carbon dioxide frost, i.e., "dry ice."²⁰ The investigators found no clear evidence for ordinary (i.e., from water), frost at all; in any event the amount of water must be less than one per cent that of carbon dioxide.

So here is another reason for believing that, in the Solar System at least (and really we have not enough information about conditions elsewhere), the Earth is the only place suitable for living beings.

Indeed, it would not hurt creationism were we to find living things on Mars. For we believe that God was quite able to put such creatures wherever it seemed good to Him. Still, Scripture suggests fairly strongly that only the Earth was "made to be inhabited." It would be fair to claim it as a prediction of creationism that no living beings will be found outside the Earth (as has been suggested already). Then, if successful prediction is to be counted as support for a theory, there would be one more score by creationists.

Mars Likely Lifeless

Now that several unmanned rockets have visited Mars, we may view the results. Some data from Mariner 9 would seem to be typical.²¹ The reports that we get are continually about a barren planet. As for the changes of color which were once supposed to show that something was growing, it is now reported that:

... wind-blown dust now seems to be the most likely explanation for ... changes in the appearance of Mars. Strong winds ... periodically shift loose dust and uncover surface materials whose reflective properties are different. ...

The atmosphere seems to be mostly carbon dioxide, its characteristic thickness being only about ten kilometers. The south polar cap, which has been observed, is definitely frozen carbon dioxide, and apparently quite thin.

Is it not remarkable how things can change? A book, on rockets and space flight, published in the fifties, suggested that in the Solar System, as well as on Earth there was almost certainly life on Mars, very likely on Venus, and possibly even on the Moon. Now all the evidence is that in the Solar System there is no life except that here on Earth. (I mean corporeal life, which is what was in mind in the discussions referred to.)

Yet more remarkable is another thing. The time was when speculations about living beings outside the Earth was the business of science fiction. Now, when there is more evidence against the existence of living beings other than on the Earth, I have seen numerical speculations published, about the number of civilizations outside the Earth which would have reached such-and-such a stage. Think of it!

There is no evidence whatsoever that there are living beings, intelligent or otherwise, outside the Earth. There is not a single firm fact on which to go in thinking about such matters. Yet here are mountains of speculation arising from not even a real molehill of fact.

Creationist writers, when they had occasion to mention the matter at all, have for some time doubted that any living beings would be found elsewhere. In fact, that could fairly be counted as one of the predictions of creationism; and everyone would grant that fulfilled predictions are evidences for the truth of a scientific view. (I will not say "theory"; for creationism is not a theory; it is the receiving and believing of God's Word.)

Mars, Predictions and Valid Theories

In an anthology of articles from the *Quarterly*, Dr. W. E. Lammerts, writing on 24 February 1971, predicted that no living things will be found on Mars, just as none had been found on the Moon.²² We know now (I am writing this

in March, 1972) that that prediction has gone a long way toward being confirmed.

It is generally admitted that the changes of color (whether real or apparent), which follow the seasons on Mars, have nothing to do with vegetation, but rather come from some such cause as the shifting of dust according to the prevailing winds. Needless to mention, there is no trace of the "canals." And every new piece of evidence that comes in makes the atmosphere, and the supply of water, seem less adequate.

So it is being demonstrated again that it is possible to make predictions on the basis of creationism.

It is perhaps worthwhile, the matter having been brought up, to consider why modern men think that successful prediction is a mark of good science. It might be pointed out, for instance, that a Ptolemaic astronomer was able to predict eclipses fairly successfully.

Again, it is often considered that the prediction of the position of Neptune was a high point of Newtonian astronomy. But suppose that Neptune had been known before Newton's work. Would the work have been thereby any less valid? Surely nobody would say so. So does the prediction prove anything at all?

Yet many feel that it does prove something, if a theory can be used to formulate valid predictions.

Is not the reasoning something like this? Scientists know that, given the facts, a little ingenuity will suffice to arrange them into some sort of pattern. If, then, another fact, which was not known at the beginning, is gained, and it fits in with the pattern, scientists feel that other new facts are likely to do likewise, and that the pattern must have something to do with some underlying reality. In one sense, then, this means that the value of valid predictions as a test of a theory comes not so much from the nature of things as from human nature.

Yet, as was mentioned, many feel that more than human nature is involved. Scientists cannot help feeling that there is some underlying nature to which their theories should conform, and that valid prediction is a test of this conformity.

Incidentally, one often encounters an inconsistent position on this point. There are those who make much of the valid predictions of theories, but refuse to admit any underlying reality. Such an attitude, of course, necessarily goes along with atheism.

Now if there were no underlying reality, valid prediction, of course, could not prove apprehension of that reality. If that were so, the theory could never be more than an arrangement of facts. And if so, it would matter little which was known first, the fact or the theory.

On the other hand, if a man had seen part, but not all, of a complicated machine, everybody would admit that the better he was able to predict what other parts of the machine were like, the better he understood the design. Thus, in the study of nature, if valid prediction proves anything, it can be only that one understands (to a certain extent), the design.

But if there is a design, there must be a Designer. So anyone who believes that the validity of a theory in natural science in prediction is an indication that the theory is good, must logically believe in the Designer of nature, Whom believers call God.

Criticism Essential in Journals

No doubt many readers of this publication have had trouble at times, in having works published, not because they were shown to be wrong, but because they maintained unpopular theses. H. Dingle, the noted philosopher of science, has made, in commenting on a discussion about such matters, some remarks that deserve to be noticed.²³

He points out that a referee, who examines a work, is, or should be, a witness, not a judge. His duty is just to look for errors of fact, or of development. He continues,

It is unfortunate that referees are often invested with an authority to which they are not entitled . . . the author, other things being equal, is more likely to be right than the referee, since he has given the point more thought than the referee has had time for . . . unless publication is assured when substantial error . . . is not unmistakably evident, it becomes impossible for the most dangerous of all misconceptions—those universally shared—to be exposed.

Dingle might be expected to write on the basis of some experience, for in the last few years he has been maintaining an unpopular thesis: that in certain respects the theory of relativity, as it is usually set forth in the books, is fallacious.

Dingle's opponents seemed either just to reiterate the usual view, or else to discuss mathematics when he was discussing physics. In fact, his experience was something like that of O'Rahilly, who, having been involved in a similar controversy some years ago, remarked that the heretic is treated worse in physics than in theology.

Creationists are probably not much concerned about an argument about physics. But they are concerned about the state of mind which tries (all too often successfully), to prevent any criticism of the "party line." The notions which men happen to have about things at any time are not necessarily final; it is only by free discussion that those which are true can be established and those which are false rejected.

It is, in fact, much to be wished that scientific journals would deliberately reserve a certain amount of space, say at least five per cent, for criticism of the notions usually accepted; provided, of course, that the criticism be presented in a reasonable case.

That would hardly apply to journals such as this one, which are already critical of the "party line"; criticism of criticism seems to become a little complicated.

But for "standard" (so to speak) journals, such a policy would be much to be desired. And surely this is especially so in cases in which it turns out that the publication is supported wholly or partly by public funds.

Faith and Evolution

Ingram is certainly right, in his point that evolution is really not a belief but a refusal to believe.²⁴ The evolutionist is really the skeptic of these times. For he has to maintain, ultimately, that everything has come about by chance.

But, from one viewpoint at least, chance is nothing. If one says that a coin is heads-up by chance, he means that there is no reason (at least, none that is known and controlled) why it is that way.

At the same time, it is not hard to see why some have called belief in evolution a faith. In the first place, it is often held as tenaciously as any real faith. Of course, it is inconsistent to do so; the dogmatic skeptic is the epitome of inconsistency, or, as someone once put it, he is contradiction incarnate.

In the second place, the evolutionary theory, if thought out thoroughly, is harder to believe than any system of faith ever expressed in any Creed. If one believes in a God of infinite power, there are then no real difficulties; evolution, on the other hand, requires a new "deus ex machina" for every new matter which is considered. Addison, it may be remarked, expressed this point very well (in terms, of course, of issues that were current in his time), in his essays "On Zeal," and "On Infidelity," which are among those published in *The Spectator*.

It might be noticed that something similar might be said of humanism. For if we look into it, we find that humanists do not really want to

admit that man is man; they want to make him an animal—nay, a machine. So here again is a gross inconsistency.

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- ²¹Hammond, A. L. 1972. Mars as an active planet: the view from Mariner 9, *Science*, 175(4019):286-287.
- ²²Lammerts, W. E. (Editor) 1971. Scientific studies in special creation. Presbyterian and Reformed Publ. Co., p. vii.
- ²³Dingle, H. 1971. What are references for?, *The Observatory*, 91(983):163-164.
- ²⁴Ingram, T. R. 1971. Letter to the editor, *Creation Research Society Quarterly*, 8(2):116.

REPORT OF 1972 BOARD OF DIRECTORS MEETING

The annual meeting of the Board of Directors this year was remarkably harmonious and efficient. The meeting was called to order by the vice-president, Larry Butler, at 7:00 P.M., April 21 at Concordia Junior College, on behalf of President Henry Morris, who came later. Other

Board members present were Harold Armstrong, Thomas Barnes, Clifford Burdick, Wayne Frair, Duane Gish, George Howe, Richard Korthals, John Klotz, Walter Lammerts, Karl Linsenmann, Wilbert Rusch, Sr., John Moore, Harold Slusher, William Tinkle, and Emmett Williams, Jr. John

Grebe, who has retired and is living in Arizona, was absent. Members engaged in silent prayer. Minutes of the 1971 meeting were read by William Tinkle and adopted without change.

Duane Gish explained that the Creation-Science Research Center dissociated from Christian Heritage College at San Diego, California. He and Henry Morris remained with the college and started a new organization: Institute for Creation Research.

Membership Secretary Wilbert Rusch reported a membership of 1768 persons, which is a gain over last year. Also 145 institutions such as libraries, schools, and churches subscribe to the *Creation Research Society Quarterly*.

Members discussed the need for a new brochure describing the Society to send to inquirers. John Moore will prepare new brochures.

George Howe, Editor of the *Quarterly*, described the editorial policy, which then was approved. John Moore, Managing Editor, explained that reprints of articles often are requested, incurring much work and expense. He requested that persons do not ask for reprints but make copies through photocopying means.

Larry Butler reported on research projects which become more numerous each year. Emmett Williams demonstrated how George Mulfinger bubbles carbon dioxide through water which then passes over limestone and drips upon a stalactite in a laboratory. This stalactite gained one pound in three years, which indicates that cave structures may be younger than certain estimates which have been made.

Two human skeletons were uncovered by mining activity in Utah and were inspected by three Board members: Clifford Burdick, Duane Gish, and Wilbert Rusch. If the skeletons were of the same age as the stratum in which they were found, as Clifford Burdick suggested, they might throw new light upon the age of the human race; but Prof. Rusch, who reported in detail, is not sure. He will make a further report.

Saturday, April 22, 9 A.M., Board members convened again. President Morris in charge, and engaged in silent prayer.

A report showed that the influence of the Creation Research Society is increasing, attested by the fact that 21,000 copies of the 1970 textbook, *Biology: A Search for Order in Complexity*, are in circulation. Many Christian schools use the book and Boards of Education of several states are considering adoption as a supplementary text. President Morris appointed a committee consisting of John Moore, Duane Gish, and John Klotz to supervise the new edition of *Biology* and preparation of a laboratory manual and teachers' manual.

A few months ago Duane Gish and Walter Lammerts were invited to speak at the University of California at Davis to a large, cheering

audience of students. At the Seminar which is being promoted by the Bible-Science Association, Milwaukee, October 10 to 12, 1972, several Board members will speak. These opportunities to give the message of true science and its relation to God's Word are appreciated.

The report of the treasurer, Richard Korthals, showed a balance as in former years but the increased size of the *Quarterly*, and the increased amount of research, have resulted in the need for more cash contributions. Board members voted not to increase membership dues or price of the *Quarterly* at present, even though printing costs have risen sharply.

The following paragraph was submitted by Editor Howe as Article IV, Section 2 of the By-laws:

While publications of the Society are not intended to support any particular chronology such as Ussher's, they shall be in keeping with Creation in a Creation Week as expressed in the Statement of Belief. Since by its Statement of Belief the Society is understood to be opposed to the concept of vast geological ages, its publications shall be consistent with the concept of the Creation Week in relatively recent time.

This statement was passed by a vote of 15 to one.

Walter Lammerts moved that the plans of Larry Butler for research in natural selection be approved. It was passed and referred to the Research Committee: Butler, Slusher and Williams.

John Moore moved that an hourly rate of remuneration be paid to those who work on revision of *Biology* or write for teachers' or laboratory manuals. This motion passed unanimously. John Klotz moved that we transfer \$2,500 from the research fund to the textbook fund and the motion was passed.

Emmett Williams presented a policy of writing a topical index of articles by the Society, which was adopted, and he offered to start the work. Harold Armstrong, Duane Gish, and Emmett Williams were added to the Editorial Board at the request of Editor Howe.

Secretary William Tinkle reported on results of the election of Board Members, conducted by mail, as follows: Three Year Terms—Clifford Burdick, Wayne Frair, John Grebe, George Howe, Karl Linsenmann, and John Moore; Two Year Terms—John Klotz, Richard Korthals, Walter Lammerts, Henry Morris, Wilbert Rusch, Sr., and Harold Slusher; One Year Terms—Harold Armstrong, Thomas Barnes, Larry Butler, Duane Gish, William Tinkle, and Emmett Williams, Jr. Then the six men elected for one year were nominated to be placed by mail before the voting

(Continued on page 145)

BOOK REVIEW

The Human Quest: A New Look at Science and Christian Faith by Richard H. Bube. 1972. Word Books, Waco, Texas. 262 pages, \$6.95. Reviewed by Bolton Davidheiser.*

In this book Dr. Bube is said to reexamine the traditional conflict between science and Christian faith "with fresh and penetrating insight. . . . False dichotomies are removed, and valid and meaningful descriptions of increasing significance are [made] simultaneously possible." Dr. Bube cites as examples of false dichotomies those between creation and evolution, between mind and matter, and between body and soul (page 29).

The reader is told that dogs and cats have souls, which brings to mind the lecture by Thomas Henry Huxley on the nature of a frog's soul. The soul of any creature is said to be commensurate with the total development of that creature, and hence the soul of a dog or cat falls short of the capabilities and potentialities of the souls of men.

Likewise Bube holds that the soul of a two-week-old human embryo is less human than the soul of a two-month-old human embryo. This raises questions about the soul of a person who has become a human vegetable through brain damage or senility, as well as the state of the soul at the time of death. Dr. Bube concludes that if a soul is to exist after the death of the body, it must be a soul newly created by God for a new mode of existence.

As to the false dichotomy between mind and matter, Dr. Bube holds that in created beings mind is an attribute of a patterned interaction of matter, but the Creator is an exception. Since God is a Spirit, the mind of God does not depend upon the interaction of matter. In this discussion Dr. Bube says that "the Christian position has always been that God created man out of nothing." We understand the Christian position has been that God created the first man from the dust of the earth and the first woman from a portion of his side. But this, of course, would be an example of a "false dichotomy" between creation and evolution.

The creation versus evolution controversy no doubt is the one most pertinent to our times. A part of the problem lies in definitions. It is pointed out that theologians as well as scientists accept "micro-evolution." As generally defined, "micro-evolution" deals with observable changes. Thus the question is not whether or not "micro-evolution" is a fact but whether or not it is evolution.

The classic illustration of "micro-evolution" is the case of the light and dark moths in England, color phases of the same species. In the daytime the moths sit on trees. In the unindustrialized areas where the trees are light in color the light moths are camouflaged while the dark moths stand out from the background in contrast. Hence birds tend to eat the dark moths first because they can see them more easily.

In the industrialized areas, where the trees are darkened, the reverse situation obtains and the birds tend to consume the light moths first. As a result, the light moths are more abundant in the unindustrialized areas and the dark moths more abundant in the industrialized areas. This is hailed by some as an outstanding example of evolution!

Dr. Kettlewell, who investigated the case of the moths, said that if Charles Darwin had lived to see this he would have witnessed the culmination of his life's work. His life's work was to make it seem plausible that all forms of life on earth evolved by natural means from some simple type of ancestor. As a result of this investigation of moths, the public is being told that evolution now has been proved to be a fact and no one any longer can doubt it—because the birds eat more dark moths from the light trees and more light moths from the dark trees! This would be an example of "micro-evolution," but it is presented to the public as a proof of "macro-evolution" or real evolution.

Actually it is not an example of evolution at all. The moths are just the same as they were before the industrial revolution and are not in a process of becoming anything else. Thus it may be charged that referring to such phenomena as any kind of evolution (as micro-evolution) amounts to a brainwashing technique to make real evolution seem less objectionable to those who have scruples against the concept of evolution.

Dr. Bube believes "philosophical evolutionism" can be anti-Christian—if it denies moral guilt in the religious sense—or it may be cast in a Christian perspective—when God is seen as the motivating power behind evolution (theistic evolution), when man's historical failure is seen to involve him in moral guilt (in the garden of Eden?), and deliverance is recognized as through the atonement of Christ. Dr. Bube says, "When a man commits himself to Christ, he returns to the path of evolutionary advancement and plays a role in his own time in the advancement of God's kingdom."

The author uses the term "Christian evolutionist" several times. He prefers to call creationists "antievolutionists," which he does twenty-

*Bolton, Davidheiser, Ph.D., lecturer and informed critic of evolution, Box 22, La Mirada, California 90638.

six times in his chapter on "The Evolution Controversy." He uses the term "creationist" only once, and that is in reference to its use in a quotation.

He takes Teilhard de Chardin seriously and believes that "valuable insights can be gained by an understanding of Teilhard's perspective," but he acknowledges that Teilhard's evolutionary theology "cannot really find room for the reality of moral guilt and divine forgiveness" and that it does not have "an appropriate response to sin and Christ's work of atonement."

Dr. Bube resolves the alleged "false dichotomy" between creation and evolution in the same manner that has been employed by some other members of the American Scientific Affiliation. He says,

And as far as man is concerned in his human attempt to understand the meaning of existence and the character of matter in terms of ultimate meaning and theological significance, it does not matter at all whether God created the earth five billion years ago or fifteen minutes ago. The only significant thing for him to know is that God *did* create the earth (page 192).

As far as a man is concerned in his human attempt to understand the meaning of existence and the significance of human personality in terms of ultimate meaning and theological significance, it does not matter at all whether God created man in a process of evolutionary development or whether God created man in an act of divine fiat. The only significant thing for him to know is that God *did* create him (page 199).

It is the belief of this reviewer that because of the definitions of "evolution" and "creation" which this kind of writing is obliged to employ, the problems are not resolved but are thrown into greater confusion.

A Reply from Dr. Bube

Dear Dr. Davidheiser:

Thank you for the opportunity to see and comment on your review of *The Human Quest*.

I am disappointed that you have chosen to review only a portion of the book rather than to

assess the major position of the entire book. It is amazing that a reviewer would make no mention of the applicability of Theses I and II, when it is clear that they are the foundation for the entire book. It would certainly be helpful to the reader if you could point out to him the limited scope of your review.

Specific comments on your review follow:

(a) The use of the term "human" in paragraph three without the context of my definition of the term is certain to be misleading.

(b) Since the Christian position has always been that God created all things out of nothing, the "dust of the earth" was also created out of nothing, and hence in any ultimate sense, man also was created out of nothing. There are no grounds for your misapplication of this phrase in paragraph four.

(c) Your paragraphs five thru nine (about one third of the review) do not contain a review of the book, but material about which the book has nothing to say. Its inclusion implies that it is part of the book's explicit argument and hence is misleading.

(d) The quotation in paragraph 10 is not what "Dr. Bube says" about his own convictions necessarily, but is what certain Christian evolutionists maintain. Your use of the quote implies that this is a viewpoint I am endorsing. My treatment of the viewpoint as a speculative model, especially in view of *Journal of the American Scientific Affiliation*, 23:140 (1971), should be clear.

(e) Why I avoid the use of the word "creationist" should also be clear in paragraph eleven. Christian evolutionists *are* "creationists." As long as you insist on a false dichotomy here, you contribute to confusion and division among Christians.*

Sincerely yours,
R. H. BUBE

*EDITOR'S NOTE: The reader can see that semantic confusion in a discussion of origins comes not from Dr. Davidheiser but from Dr. Bube. Evolutionism is the concept of wholesale descent with modification in which all or nearly all "kinds" of modern life derive from a common ancestor. Such a view is not creationistic because it does not fit the miracle framework of *Bible* Creationism "after its kind." Furthermore, unsurmountable *scientific* problems confront any evolution view—be it a so-called "Christian" view or an agnostic theory.

LETTERS TO THE EDITOR

Psychology and Jay Adams' Book

Dear sir,

Since I sell Christian literature and have been a student myself, I have been very interested to find a truly Christian approach to psychology. About a year ago a book, *Competent to Counsel*, was brought to my notice.

The author, Jay E. Adams, had been engaged in the same quest (with a more pressing need to find an answer—he is a minister, and was appointed to the chair of Practical Theology at Westminster Theological Seminary—teaching pastoral counselling), and had written his book to explain what the Bible has to say about Psychiatric Counselling.

It is, to my mind, the equivalent to Psychiatric Counselling of *The Genesis Flood* to modern Geology. Mr. Adams would be most interested, I am sure, to work with anyone who would like to widen the scope of his book and produce a Christian textbook of Psychology.

Certainly, if there are members of the Society who would like to take up Harold Armstrong's challenge (*Creation Research Society Quarterly*, 8(3):200, "Psychology and Christian Faith") they should start by reading this book (published by the Presbyterian and Reformed Publishing Company, 1971. \$4.50) and by contacting the author at Westminster Theological Seminary, Philadelphia, Penn.

Yours faithfully,
H. P. PHILLIPS
Evangelia Discount Shop
P.O. Box 33310, Takapuna
Auckland, New Zealand

Trained Flatworms Not Nonsense

Dear Sir,

I am quite concerned about one of the comments of John W. Robbins made in reviewing *The Second Genesis: The Coming Control of Life* by Albert Rosenfeld (*C.R.S. Quarterly*, 8(3), 1971).

Robbins regards as "scientific nonsense" the results of experiments in which it has been shown that feeding trained planarians to untrained planarians increases the rapidity of learning in the untrained planarians. What evidence is there that the results of such experiments are nonsense?

I would remind John R. Robbins that similar results have been found in the case of rats and hamsters.¹ Surely these results merely show that *often* memory is stored chemically.

It is my opinion that statements such as those made by John R. Robbins only bring discredit upon this Society. It reminds me of an experi-

ence I had about a year ago with a non-scientific Christian. This brother did not believe that there were such things as chromosomes and believed that heredity was "all in the blood." No amount of scientific evidence would convince him—I even showed him photographs of chromosomes!

We should not throw overboard the results of experimental science, but carefully analyze it and see how it fits in with creation doctrine. If it is at variance with creation views then we should carefully examine the experiment and see where the fault lies—it is not good enough to say "Scientific Nonsense" if we do not *like* the results!

Yours faithfully,
DR. A. J. WHITE
Edward Davies Chem. Laboratories
Amberystwyth, 5423 INE
Cards, U. K.

¹G. Rattery Taylor: *The Biological Time Bomb*, Panther Science (1968), p. 147.

Free Creation Leaflets Available

Dear Editor:

I have been a sustaining member of C. R. S. for several years and have much enjoyed many of the articles which have appeared in your quarterlies and annuals. It is my conviction that if the scientific evidence against the theory of evolution can be presented in a concise, brief, convincing manner, that many who now use it as a "crutch" for continued denial of the Lord Jesus Christ could be won over, and that the faith of many wavering Christians would be greatly strengthened.

With that end in mind, I recently had 10,000 copies of a tract printed, in the hopes that I might be able to get it into circulation not only in my own area but across our continent. The tract is entitled, "Five Laws of Science Violated by the Theory of Evolution."

I feel that the *Creation Research Society Quarterly* could be very instrumental in helping to accomplish this, since the matter of evolution versus creation is of great concern to nearly all its readers. I hope, therefore, that you might see fit to at least mention the availability of such a tract in a future issue of your publication.

These tracts are available from the author at no cost, as long as they last. Thank you for your consideration.

Yours in Christ,
REV. JAMES C. BRADY
3411 W. Gadsden St.
Pensacola, Fla. 32505

More on Old Testament Dates

Dear Sir:

In his letter to the editor "On Old Testament Dates" published in the *Creation Research Society Quarterly* of December 1971, William Harvey Beard makes the point that, based on Hebrew chronology, creation probably occurred about 6147 years ago, i.e. 4175 B.C., or at most 7972 years ago, i.e. 6000 B.C.

It may be of interest to note that, according to ancient Ukrainian chronology (of the Ukrainian Trypillian culture on the north shore of the Black Sea), September 14, 1972, will mark the year 7481. This means that according to the Ukrainian calendar, year 1 was in 5509 B.C.

This date is 1334 years older than that calculated by Mr. Beard, however, he himself concedes that his calculations could be extended to 6000 B.C. Perhaps this difference is due to the "omitted generations" in the Hebrew genealogues.

Yours sincerely,
ROMAN SENKIW
Vice President
Ukrainian Student Organization
of Michnowsky (TUSM)
Central Executive
P.O. Box 141
Riverton, New Jersey 08077

Proposed Strategem for Children

Dear Dr. Lammerts:*

At a recent discussion with the minister of our church regarding creation and evolution he exclaimed, "But what is one to do when the children come home from school or college, primed by their teachers on the 'facts' of evolution? How can we combat this by reference to faith alone, especially when the teachers hold the whip hand of grades?"

As a teacher of over 40 years experience (now retired from the position of Professor of Chemistry at Queens College of the City University of New York but still adjunct professor of chemistry at New York Institute of Technology), I can appreciate the position of both teacher and student. The teacher does not wish to place himself in what is, unfortunately, the position of an outsider or "queer" but he must teach the syllabus. The students are in the dilemma of being under pressure to learn the "theory" of evolution and wanting to believe the Bible as taught in Sunday School and the church.

*EDITOR'S NOTE: Readers interested in working on the project of developing specific questions for school students to use are encouraged to correspond directly with Dr. Schneider. Potential questions for this list should be mailed to him and then at a later date C.R.S. *Quarterly* may feature a summary list.

I would suggest, as a task for the Creation Research Society, that a list of questions be compiled which can be asked by the students of the teachers. These questions, without appearing as "fresh" or "smart-alecky" would be perfectly legitimate as indicating the interest but also the intelligence of the student and would, simultaneously, challenge the knowledge and confidence of the teacher on the validity of the evolution theory.

Certainly the enthusiasm and perhaps the confidence of the teacher in this theory would be lessened. A teacher of evolution who has his or her own doubts is a vulnerable one.

The questions must be simple, so that a student can comprehend them, and be of the type that, if he was really thinking about the subject, would occur to him as he reads the daily newspapers. The questions would be fundamental. They should not be intended to trap the teacher or expose his ignorance, but would bring home the great gaps and fallacies in the theory he is teaching. For example:

Is man the final end product of evolution or is further development expected?

How can, as reported in the newspapers and the technical journals, the outside of the moon be older than the inside?

If a virus is parasitic and multiplies only by action on higher organisms, how could it have been a link in the evolutionary chain?

If life began by the formation of an amino acid by the electrical discharge through an atmosphere of ammonia, carbon dioxide, and water, where is this atmosphere now?

Why do the different radioactive dating methods give different ages for the same rocks?

Is the extrapolation of radioactive decay studies over the past 75 years (the time we have known radioactivity) to 3 to 6 billion years statistically valid?

If the elements studied in radioactive dating are assumed to have been completely in the form of the parent element, would this not have formed a supercritical mass?

In the famous experiment which showed that (under highly unnatural conditions) amino acids could be formed in an atmosphere of methane, ammonia and water, Miller never did explain how that reducing atmosphere, postulated for the sake of "proving" the origin of life, changed over to the present atmosphere of oxygen and nitrogen. What happened, for example, to the carbon of the methane? It certainly requires more than a faith which moves mountains to accept this distorted theory. There is nothing like making the facts fit the theory.

Children who have been taught to accept the word of their teachers, do so without question

and it is about time that intelligent and Christian parents see to it that some searching but legitimate questions be directed at these teachers.

I believe that if such lists of questions were drawn up by the specialists of the Creation Research Society and sent to ministers and church personnel who are faced with and concerned about this problem, progress could be made in demonstrating that at least as much pure faith is required for acceptance of evolution as for the Biblical account. Let us give people anxious to testify to their faith some weapons to use.

Sincerely yours,
FRANK L. SCHNEIDER, PH.D.
Round Hill Lane
Port Washington, N. Y. 11050

More on Ecology

Dear Editor:

I write concerning Mr. Robbin's article, "Ecology: The Abolition of Man," C.R.S. *Quarterly*, 8(4):280-284, March, 1972.

Your readers clearly understand the difference between science and scientism. Why shouldn't the same distinction be understood between ecology and ecology-ism? If evolutionists are not abashed to subvert science to their "faith," why would they grant immunity to any *branch* of science be it embryology, or ecology as here?

Ecology is simply a field of science, the study of the inter-relation of all living things with each other and with their environment. Just because some "johnny-come-lately" can make political capital out of the current interest in it, ecology does not cease from being a science.

The science ecology is not controversial. C.R.S. *Quarterly* editors obviously accept it: for example, in the last issue, "The Yucca and Its Yucca Moth," is fine ecology. The many examples of God's design, of symbiosis, of commensalism, of life not being a struggle for existence, are all pure ecology.

The Bible also teaches ecology: Psalms 50:10, "every beast of the forest is mine, and the cattle upon a thousand hills" is beautiful ecology. Lev. 19:9, 10, "thou shalt not wholly reap the corners

of thy field . . . neither shalt thou gather every grape" is good ecology. Lev. 25:4, "the seventh year shall be a sabbath of rest unto the lands" has to do with ecology. And Luke 12:24, 27, "consider the ravens . . . consider the lilies. . . ." Our Lord Himself was an ecologist!

Applied ecology does just the opposite of destroying the human race: it is intended to conserve the natural riches God has endowed us: clean air, forests, wildlife, natural areas, pure water. Of course, battles develop as to whether a power plant should be atomic or coal; but politics should not denigrate ecology.

Basically we are in agreement. Robbins does not want man abolished and neither do the ecologists. But books like Rachel Carson's, *Silent Spring*, show DDT is a man-killer. Somebody better do more homework!

Sincerely yours,
GEORGE BEDIGIAN
1 Phillipse Rd.
Yonkers, N. Y. 10701

1972 BOARD OF DIRECTORS

(Continued from page 140)

members for a possible election for three more years.

President Morris named the following committee to investigate feasibility of accepting advertisements in the *Quarterly*, to report by mail in six months: Karl Linsenmann, Emmett Williams, Harold Slusher.

The following officers for the Board were elected for one year: President, Henry M. Morris; Vice-President, Larry Butler; Secretary, William Tinkle; Treasurer, Richard Korthals; and Membership Secretary, Wilbert Rusch, Sr.

After considerable discussion the following plans were adopted for next year: time of meeting, April 27-28, 1973; place of meeting, Concordia Junior College, Ann Arbor, Michigan. Board members should assemble at 5 P.M. at Arbor Lodge Motel, 3245 Washtenaw, Ann Arbor, Mich. 48104.

WILLIAM J. TINKLE,
Secretary

