

Creation Research Society Quarterly

Haec credimus:

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

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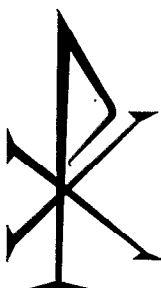
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COVER ILLUSTRATION

The front cover illustration of a field of wheat was supplied by the Canadian Department of Agriculture, Ottawa, Ontario, Canada.

There is food for thought, as well as for the body, in such an everyday thing as wheat, as is pointed out in Dr. Walter Lammerts' comments on wheat and other food plants, in the Panorama of Science section in this issue of the *Quarterly*. It is not at all clear how the variety of wheat now commonly grown originated, and much the same might be said about many other domestic crop plants. One is inclined to say that either a crop plant came much as it now is from the Garden of Eden, or else there were some extremely skillful plant breeders in the early days.

Incidentally, does not the picture provide a striking illustration of Ecclesiastes 11:4?

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PREDICTIONS IN CREATION SCIENCE

The theme for the Annual issue of the *Quarterly* in June 1978 will be scientific predictions arising from considerations of the fact of Creation. Possible authors are encouraged to begin thinking about that topic.

One such prediction seems to have been fulfilled already. Creationists have predicted that no living beings would be found in the Solar System elsewhere than on the Earth. As is well known, recent exploration seems to have shown that that is true.

Items for the next Annual issue should reach the Editor by the middle of February 1978.

WAS NOAH'S ARK STABLE?

DAVID H. COLLINS*

Received 12 April 1977

The article deals with the question, "Would Noah's Ark survive the cataclysmic forces of a world-wide flood?" The procedure followed is that which is followed by naval architects in modern ship design. Initially the weight and contents of the ark are evaluated. Then, by way of calculations, the ability of the ark to remain upright in high winds (up to three times hurricane force) is investigated. The results of these calculations are evaluated on the basis of modern practice, including the U.S. Coast Guard Regulations. The conclusion drawn from the investigation is that the ark was extremely stable, well able to withstand the forces hurled against it in the flood.

In consideration of the Biblical story of Noah's Ark and the Flood, the question is often raised concerning the ability of such a box to withstand the cataclysmic forces which would occur in a world-wide flood. The ark had not only to withstand 40 days and nights of rain, but also the wind and wave action, if the Biblical account is accurate. It is proposed to examine the ark by means of naval architectural investigation of its stability, to determine if it indeed had the ability to survive these forces.

In an article in *Creation Research Society Quarterly*, Henry M. Morris¹ went some way in dealing with this issue. He made a good attempt based on his assumptions. However, he only considered what would be called the static stability of the ark, that is the stability of a vessel in still water, with the exciting forces removed. This is only half of the necessary investigation to determine the stability of a vessel at sea.

One needs to consider also the magnitude of upsetting forces, the wind and waves, that could be survived, in order to demonstrate that it would be stable under adverse weather conditions. There are four features of stability that warrant consideration:²

1. The angle of steady heel** under the influence of the force acting to overturn the ship.
2. The range of positive stability.
3. The residual dynamic stability.
4. The relative magnitudes of the maximum moment*** to right the ship and the moment to overturn it.

These four areas will be investigated later in this paper.

Construction of the Ark

This is the description of the ark in Genesis 6:14-16:

Make for yourself an ark of gopher wood; you shall make the ark with rooms, and you shall cover it inside and out with pitch. And this is how you shall make it: the length of the ark three hundred cubits, its breadth fifty cubits, and its height thirty cubits. You shall make a window for the ark and finish it to a cubit from the top; and set the door of the ark in the side of it; you shall make it with lower, second and third decks.

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**Heel is the action of tipping over sideways, away from an upright condition.

***Moment is the tendency or measure of tendency to produce rotation especially about a point or axis. Opening a door creates a moment on the hinge.

The ark was evidently a box-type structure rather than the curved ship-shapes of classical or modern times. "The word ark signifies a box (Hebrew, *tebah*; Greek, *kibotos*)". This rectangular construction would have been the simplest; they wouldn't have to bend timbers and planks to suit the curvature. The curvature in a ship's hull is primarily so that under propulsion it may gain additional speed. The ark was unpowered! It had no need for speed or efficient use of its propulsive force. Another advantage of the box-shape is a gain of about 30% in the amount of inside space.

What is a cubit? "The actual length of the cubit varies from 18 inches to 25 inches. There were long cubits and short cubits and royal cubits and Egyptian cubits and Talmudic cubits"⁴ For present purposes I will assume the cubit equal to 18 inches. The final stability calculations would be basically independent of the choice because the stability will be determined by the proportions. The resulting dimensions in feet are shown in Figure 1.

The relationships of these figures compare favorably with those of modern shipping, as Giannone has shown.⁵

How deep did the ark float? In order to determine the stability it is necessary to establish the draft of the ark. The draft is the height that the water comes to along the side of the ship, measured from the bottom of the ship. Morris assumes that the draft was 15 cubits, the same as the depth of the water over the land.⁶ But if one works by estimating weights, which is the normal procedure, a much different answer is obtained. It is standard procedure in ship design, whenever estimates or assumptions are involved, to choose that which would result in the least stable condition. The less the draft, the more difficult to maintain a stable condition.

For example, oil tankers have a very deep draft and are the most stable ships built today; on the other hand, container ships have very small drafts and are often in borderline stability. A lesser draft not only decreases the ability of the ship to right itself, it also increases the surface area available to the wind force, yielding a larger capsizing moment. Therefore one should follow the estimate of the smaller draft to be on the safe side. Now the weight of the ship and its cargo will be determined.

Weight and Load of the Ark

Filby used a reasonable method for estimating the weight of the ark. Since no one today knows what gopher wood is, he took the weight of cypress as a

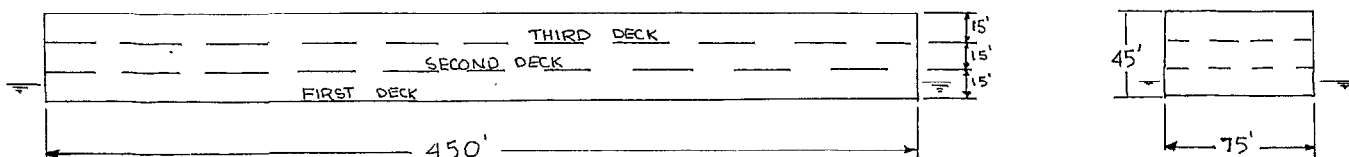


Figure 1. This shows the ark, in side and end views. The dimensions assumed in the text are indicated.

reasonable approximation, obtaining a rough approximation of the structure.

Taking the ark as being made of cypress wood, with planks one foot thick, allowing two extra decks or floors and reasonable longitudinal and cross walls we can calculate that it would require something like 280,000 cubic feet of timber, which at about 530 oz. per cubic foot gives a deadweight of about 4140 tons.⁷

Having verified the figure of 4140 long tons (1 long ton = 2240 pounds) by independent calculation, the weight of the animals and provisions must be estimated.

Filby estimated 100 long tons of living cargo, which includes two of each kind, the extra clean animals and the humans.⁸ Now taking a list of mammalian types from *Larousse Encyclopedia of Animal Life*,⁹ in which basically all types of mammals are represented, and adding the maximum weight of each type, one gets 26.4 long tons; and when this is multiplied by two of each, yields 52.8 long tons. The eight humans would add about another long ton to make it 53.8 long tons. This leaves the birds, reptiles and additional clean animals.

All of the large animals are previously included; and the weight of additional animals would not bring the total over 100 long tons; especially since the use of the maximum weights for each species would give a high estimate because the ark would likely have to be carrying younger animals with their full reproductive life ahead of them so as to repopulate the earth. Therefore this estimate of 100 long tons leaves a reasonable margin to take into account any animals that might have been forgotten. The figure of 100 long tons, then is reasonably accurate for the present purpose.

Filby estimated that on the average each animal would consume 20 times its weight in food and 20 times its weight in water.¹⁰ This seems low if it is considered that they would probably have to rely on the ark for provisions for a while after being released, to allow sufficient time for reproduction of other food sources. Therefore I will assume 30 times their weight for food and 30 times their weight for water. This results, initially, in 6000 long tons of provisions. Therefore the total initial weight was 4140 + 100 + 6000 long tons, or 10,240 long tons. This gives an initial draft of 10.6 feet.

Remembering that the lighter draft will have less stability, then one should estimate the lightest draft before grounding. One might consider that about half of the provisions would be consumed, and the wastes cast overboard, before the ship grounded. This gives a weight of 7240 long tons and a draft of 7.5 feet, much less than Morris's 22.5 feet (15 cubits). Assuming that most of the provisions are on the first (lower) deck, and that most of the animals are on the second and third decks, as the lower deck would probably have poor ventilation, the center of weight above the bottom of the ark is approximately 18.5 feet.

Investigation of Stability

Thus the ark had in the least stable condition, a weight (W) of 7240 long tons, a draft of 7.5 feet, and a center of weight of 18.5 feet above bottom. The length (L) 450 feet, beam (b) 75 feet, and height 45 feet.

How far can the ark be allowed to tip and still be considered stable? Morris wrote, "Thus for any angle up to 90° the ark would right itself." This is true, but there are other facets which need to be considered in investigating the stability of the ark. If the ark rolled that far, the animals be tossed all over the place (just try to imagine standing on a 90° slope, let alone tipping first 90° to one side then 90° to the other—they'd be piled in a heap and so seasick they couldn't eat!) There is also the more serious problem that if the ark tipped as much as 60° it would be flooded because the window (1 cubit from the top) would be under water. If air could go through it for ventilation, water certainly could!

There was also a door in the side, probably on the third deck. It is not known whether it was sealed water tight or not, so an angle of heel to keep the water below the bottom of the door will be used as the worst condition. This would mean that the angle of heel to be sure that the ark did not flood must have been less than 38° (the angle to the bottom of the door). (See Figure 2 with a comment.) This is called the angle of downflooding. In the United States Coast Guard "Rules for Passenger Vessels" there is a requirement for stability in heavy weather conditions. Before the construction of a ship is

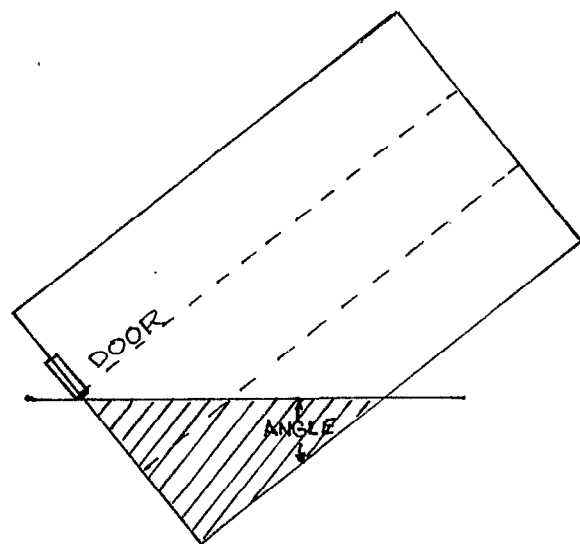


Figure 2. This shows the maximum extent to which the ark could have tipped without danger of water entering. The bottom of the door, up to which the water may come, is taken to be 30 feet above the bottom of the ark. The part under water, the triangle shown shaded, is equal in area to the part under water when the ark is level, i.e. a rectangle 75 by 7.5 feet. Thus the angle can be calculated.

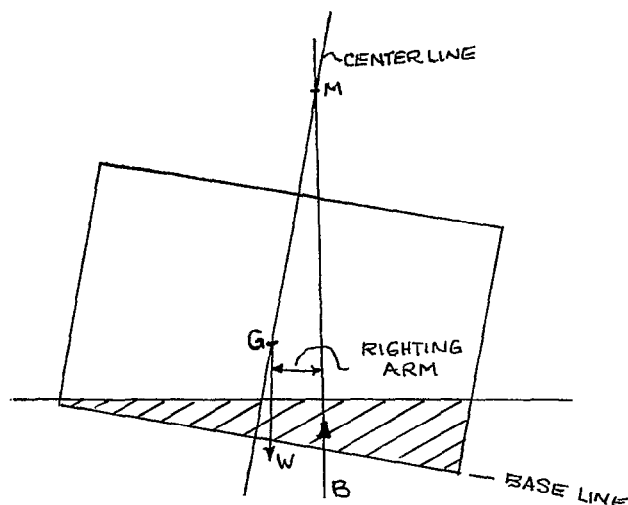


Figure 3. This shows the couple, or moment, tending to right the ark if it was tipped. The line GM is parallel to the sides of the ark, and passes through its center of gravity. The line BM is vertical, and passes through the center of gravity of the displaced water, i.e. through the center of gravity, or centroid, of the area under water, which is shown shaded.

approved, it must be demonstrated that in a 60 knot wind the ship has adequate stability to limit the angle of heel to one half of the angle of downflooding or to 14° , whichever is less.¹² In this case I will use 14° , as it is less than 19° , which is half of 38° .

Righting Moment Curve Established

The next step is to establish the righting moment curve. This shows the amount of a moment, in foot-tons, there is to right the ship at a given angle. (See Figure 3) This is determined by heeling the ship to five or six different angles, calculating the righting arm at each angle, multiplying the righting arm by the weight (W), and plotting the results.

The righting arm is the perpendicular distance between the line of action of the weight of the ship (W) and the line of action of the buoyant force (B) as shown in Figure 3. The line of action of the weight is vertical through the center of weight, 18.5 feet above the baseline on the centerline of the ship. The line of action of the buoyant force is vertical through the center of the cross-section of submerged area, which is the center of gravity or the displaced water (shaded).

If the intersection of the line of action of the buoyancy and the centerline of the ship, point M, is above the center of weight, point G, then the righting arm is positive, resulting in a moment to right the ship. If point M is below point G then the righting arm is negative and will act to overturn the vessel.

The distance along the centerline from point G to Point M is called the metacentric height and is used as a measure of static stability. This is basically what Morris presented in his paper. However: "Stability is often, erroneously, evaluated on the basis of metacentric height alone, without the benefit of a complete righting arm curve."¹³ But the notion of the metacentric height as a measure of stability is useful and is discussed later in this paper. The value of the righting arm is multiplied

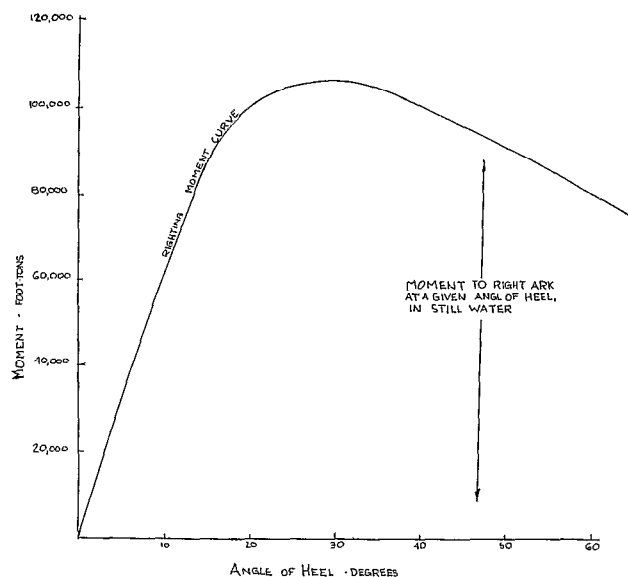


Figure 4. This shows the righting moment, a measure of the tendency to return to an upright position, vs. the angle of heel, through which the ark was tipped.

by the weight (W), yielding the righting moment. These values are then plotted on a graph, angle of heel versus moment. (See Figure 4)

Overturn Forces Considered

What about the forces that might overturn the ark? Well, because the ark has a very high freeboard (distance from the waterline to the bottom of the door) and a relatively low center of gravity, the primary capsizing force will be the wind. After the rain, "But God remembered Noah and all the beasts and all the cattle that were with him in the ark; and God caused a wind to pass over the earth and the waters subsided." (Genesis 8-1) This wind must have been more than just a mild breeze if it caused the waters to recede. The wave force will be small in comparison.

"When a ship is exposed to a beam wind (a wind coming perpendicular to the length), the wind pressure acts on the portion of the ship above the waterline and the resistance of the water on the ship's lateral motion exerts a force on the opposite side below the waterline."¹⁴ (See Figure 5)

The moment to overturn is equal to the force of the wind pressure times the arm (half the distance from the center of area exposed to the wind to the center of the underwater area) plus the force of the water pressure times the same arm. The water pressure is the result of the wind trying to push the ship sideways and is approximately equal to the wind pressure. Therefore the moment to overturn is reduced to the force of the wind pressure times the distance between the centers of areas.

The moment to overturn at 0° heel is therefore equal to the wind pressure at a given velocity times the area exposed to the wind times the vertical distance between the centers of the wind and water areas. The wind pressure is about 10 lbs/ft² at about 110 knots wind velocity.¹⁵ The wind pressure varies with the square of the velocity, therefore for a 210 knot wind (three times

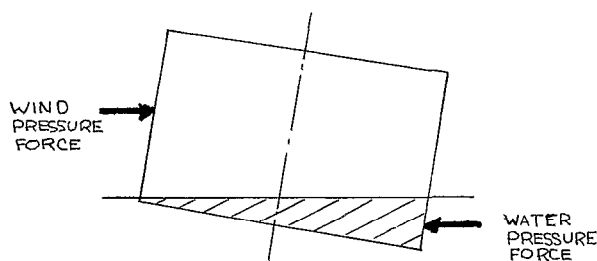


Figure 5. The wind pressure force and the water pressure force are equal and opposite. But, since they act at different levels, they form a couple, which tends to turn the ark clockwise in this instance. The magnitude of this couple is called the moment to (i.e. tending to) overturn the ark.

hurricane force) the pressure would be 110 lbs/ft².

At 60 knots the resulting moment is 1700 foot-tons.

At 110 knots the resulting moment is 5090 foot-tons.

At 210 knots the resulting moment is 18650 foot-tons.

The curve of the moment to overturn is determined by multiplying the moment at 0° by the cosine² at each of the angles and plotting the results on top of the Righting Moment Curve. This results in Figure 6.

Four Features of Stability

These curves show that the ark was extremely stable, even in 210 knot winds, three times hurricane force. In examining the four features of stability mentioned earlier I will use the curve for 210 knot winds and the righting moment curve in Figure 6.

1. The first stability consideration is the *angle of steady heel under the influence of the force acting to overturn the ship*. This is determined by the intersection of the righting moment and the overturning moment curves, Point A. Its value for the ark is about 3°. This is very good, better than most modern ships, which average about 5°. This means that when the ark is tipped by a gust the righting moment will act to return the ark to within 3° of vertical. Due to the steepness of the righting moment curve at this point, the ark would rarely tip much beyond this point. This means the occupants had a reasonably comfortable ride.

2. The second stability consideration is the *range of positive stability*. This demonstrates how far the ark could roll without capsizing. It is to the point where the righting arm curve would re-cross the overturning moment curve. It can be seen from Figure 6 that it would be well past 60°. Again this is much better than modern shipping, where it is not at all uncommon for the range to be less than 30°.

3. The third stability consideration is the *residual dynamic stability*. This represents the work required in addition to the effects of the overturning moment under consideration to capsize the ship. To demonstrate sufficient dynamic stability for the ark, one needs to determine the area between the righting moment and overturning moment curves from point A to the angle of limitation, 14° (the shaded area in Figure 6). This must be larger than 22,370 degree-foot-tons, based on Table 4 in *Principles of Naval Architecture*.¹⁶ The area in Figure 6 is equal to 365,000 degree-foot-tons, more than 16 times that required.

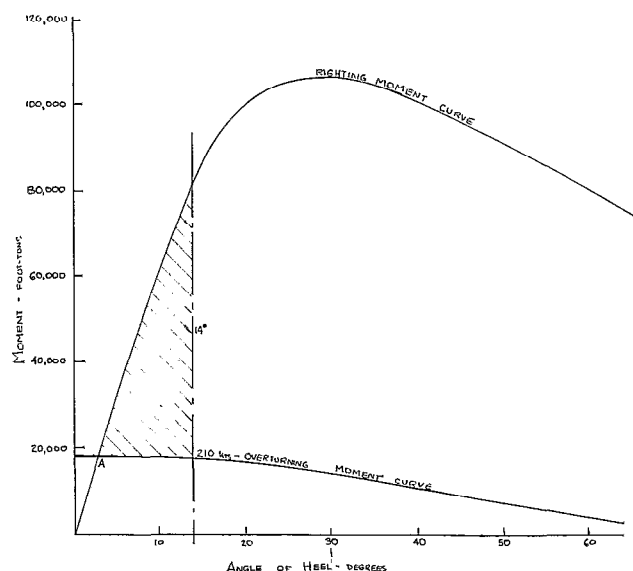


Figure 6. The ark would heel at the angle at which the overturning and righting moment curves intersect, here about 3° under the conditions assumed. The shaded area is a measure of extra stability, so to speak, and, as is shown, is most generous.

4. The fourth stability consideration is the *relative magnitude of the maximum moment to right the ship and the moment to overturn it*. "The excess of maximum righting arm over the heeling arm, in addition to providing a margin for the upsetting forces of wind and wave, is essential as an allowance for inaccuracies in calculating the heeling and righting arms."¹⁷

This takes into account any minor variations in the assumptions, such as weight, draft or center of weight. It is basically a factor of safety. The maximum righting moment is 106,000 foot-tons. The maximum overturning moment is 18,650 foot-tons. The margin is more than four and one half times the maximum overturning moment!

As seen by the above considerations, Noah's Ark was extremely stable, more stable, in fact, than modern shipping. This is primarily because in modern shipping the extra margin of stability is sacrificed for attaining higher speed and more maneuverability.

As a secondary check on the stability the metacentric height can be evaluated and compared to the United States Coast Guard "Rules for Passenger Vessels". The metacentric height is the distance from point G to point M in Figure 3, as earlier explained. The available metacentric height (GM) is determined by taking the moment of inertia of the waterplane ($L \times b^3/12$) divided by, the length times the beam times the draft, adding the center of buoyancy (one half of the draft, 3.75 feet) and subtracting the center of weight (18.5 feet). For the ark this yields GM equal to 47.75 feet. The Coast Guard¹⁸ requires:

$$GM = \frac{PAh}{\Delta \tan 14^\circ}$$

$$P = .005 + (\text{length}/14,200)^2$$

$$A = \text{area acted on by wind}$$

$$h = \text{the distance from the center of wind area to the center of water area}$$

$$\Delta = \text{the weight, } W \text{ (7240 long tons)}$$

This results in a required GM of 1.27 feet. In ship design it is normal to require an additional 1.0 foot margin, yielding 2.27 feet required. The available GM, 47.75 feet is much greater than 2.27 feet. This verifies the earlier calculations. The ark is *extremely* stable.

Conclusion

Noah's Ark was extremely stable. When God told Noah how to build it, he did a very good job. He made the ark so stable that it would be fully safe whatever cataclysmic forces of the flood were hurled against it!

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⁶Morris, *Op. cit.*, p. 143.
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¹³Reference 2, p. 98.
¹⁴*Ibid.*, p. 57
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¹⁶Reference 2, p. 149.
¹⁷*Ibid.*, p. 98.
¹⁸Reference 11, p. 72.

DELTA FORMATION, HISTORY AND ARITHMETIC

THOMAS F. HEINZE*

Received 23 March 1977

In reading *The Genesis Record* by Henry M. Morris I was struck by the statement that Ur of the Chaldees was originally a seaport before delta deposits filled the sea and left Ur high and dry in the desert.¹ I recalled an article in a *Creation Research Society Quarterly*² containing the point that the earth under deltas does not subside by the tremendous amounts which would be necessary to accomodate present rates of formation to allow them to fit in with the geological ages postulated since their beginning.

Accepting the age of Ur in the Encyclopedia Britannica as 3500 BC, (a Creationist might make it younger) and the present position of almost 200 miles from the Persian Gulf, one finds a delta formation rate of about 35 miles for every 1000 years. This is true whether or not there has been a subsidence of the sea bottom as the delta advanced for the simple reason that 5500 years ago the Persian Gulf was at Ur, and now it is almost 200 miles away.

It is probable that formerly the Tigris and Euphrates rivers deposited delta materials more rapidly than at present, as the materials would have been deposited in the shallower waters near the normal shore, the rivers would have had more available top soil to wash away, etc. This means that the dates obtained by simple arithmetic in projecting this action back into time would probably be too long rather than too short. Even so extending the gulf on back in its present direction, 80,000 years ago one finds that it extended inland about to Paris! If this seems a bit absurd, one may go a step far-

ther. Assuming the same rate of formation for the delta of the Mississippi would suggest that 120,000 years ago the Gulf of Mexico extended clear up to the North Pole.

If these calculations are not true, because in prehistoric times the sea bottom really did subside enough to slow delta formation significantly, why is there no evidence of such a slow rate in historical times? It must certainly have been a marvelous breach of uniformitarian principles. Ur gives investigators a check which cannot be passed off as being irrelevant because of dealing with only a few score years, as modern delta studies might be. Whether or not sea bottoms are subsiding under deltas so that their formation is much slower than would otherwise be the case, Ur is now almost 200 miles from the Gulf!

In addition if one assumes that at one time the Persian Gulf actually extended all the way back up the Euphrates Valley so that the mountains of Syria were the extreme limit, or even that it cut all the way through to the Mediterranean Sea, (which certainly is stretching everything to the maximum possible), the delta building process would still have had to start less than 40,000 years ago. In (alleged) geological time, 40,000 years is nothing. Thus evidence of this kind from deltas is evidence for a recent creation.

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FOSSIL ZONES

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For the first third of this century most creationists held to the concept that there was no general sequence to the fossils, but that they were arranged into the "geological column" simply to support the theory of vast ages of time. More recent studies suggest that there is a general sequence, although not in such detail as the evolutionists hold. In order to explain this orderly arrangement, the ecological zonation theory has been proposed, and has been accepted by many creationists. According to this theory the fossil "zones" are the remnants of the original life zones of the antediluvian earth.

Some questions and problems are discussed, and answers suggested.

Historical Outline

Modern uniformitarian geology was introduced by James Hutton to the Royal Society of Edinburgh¹ in 1785. After describing the globe, its core, water, land, and air, and the various geological processes, he declared that their formation must have taken "an indefinite succession of ages." He imagined one cycle after another, and considered that "the result, therefore, of our present inquiry is, that we find no vestige of a beginning,—no prospect of an end."

When Charles Lyell published his *Principles of Geology* in 1830, he built it on Hutton's uniformitarian hypothesis. This, the first textbook on geology, went through 12 editions and was used in colleges in England and America for 50 years. By the end of the century following Hutton's promulgation of uniformitarianism this viewpoint had become almost universal.

Lyell's geological philosophy was clearly evolutionary, for though his book was published nearly 30 years before Darwin's *Origin of Species*, he wrote: "The disposition of the seas, continents, and islands, and the climate, have varied; the species likewise have changed."²

Practically all of the scientific world had accepted the idea of evolutionary geology by the end of the 19th century, and many church people had adopted some kind of progressive creationism or theistic evolution. Ardent advocates of evolution boastfully claimed that the Genesis "myth" of the Flood had been completely obliterated.

When George McCready Price in particular, initiated the 20th century revolt against evolution, he charged that the churches had apostasized and were following after pagan philosophies.³ In 1906 he published a small book challenging the current geological concepts of long ages of time. Uniformitarianism, he stated, was both unproved and unprovable.⁴ He argued that the "geological column", with different periods in consecutive order, was arbitrary. Rocks, he declared, had been classified by their contained fossils without respect to their actual position. In his *New Geology*, published in 1923, he stated what he called the Law of Conformable Stratigraphic Sequence: "Any kind of fossiliferous rock, 'young' or 'old', may be found conformably on any other kind of fossiliferous rock, 'older' or 'younger'."⁵

He stated further that "in olden times as now there were zoological provinces and district."⁶ But these provinces, as he called them, had no orderly arrangement. They were scattered hit-and-miss, and the arrangement of them into a sequential order was regarded by him as merely a subterfuge to support the evolutionary theory.

The views of Price were accepted by many church-related colleges, and by several fundamentalist church leaders. Several evangelists ardently proclaimed the doctrine of creationism, basing their arguments on ideas presented in various volumes published by Price. It was not until a third of the 20th century had passed that any serious challenge was given by creationists to this interpretation of the rocks, or proposals made to modify it.

Reconsideration

During the school year 1920-21 I took the course in geology that Price taught at Pacific Union College, in Angwin, California. Then, after graduating in 1922, Price having moved to another college, I took up the course and taught it for 25 years. At first I used his *New Geology*; and, not having read widely nor done any independent field work, I continued to promote the views regarding the fossils that were given in the text.

In the spring of 1936, while discussing the distribution of the fossils, one of my students questioned the interpretation given in the text. He was the son of an oil-well promoter in Oklahoma, and had grown up in the oil business. "But," he said, "there is an order to the rocks. The oil drillers depend on that, and can tell in just what stratum they are by the fossils."

Upon his invitation I spent a month with him visiting oil drillings, consulting with oil geologists in their laboratories, and traveling over Oklahoma and northern Texas studying the arrangement of the rocks. When the month was over, it was quite apparent that further study had to be given to the problem. For the next nine years I spent much time reading geological reports and books on stratigraphical geology, and making field trips through California and other western states studying the rocks.

By 1945 I was thoroughly convinced that there was a natural order to the arrangement of the fossils. The question now was, How can one interpret that fact without accepting the geological ages theory? Some other explanation was needed in order to be able to hold to the Biblical account of creation and the Flood.

In 1933 I had graduated from the University of California with a major in the field of ecology, and as

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the studies proceeded on the rocks it became evident that there was a close similarity between the arrangement of the life zones in the field at present and the arrangement of the fossils.

Ecological Zones and Fossil Zones

Wherever studies have been made, the present world of life has been arranged in life zones (or associations or communities—whichever one may choose to call them). Each zone has a characteristic assemblage of species fitted to the environment. In different parts of the country are zones of similar ecological position, but with different species. For example, in the Sierra Nevada mountains of California is a zone dominated by the Western Yellow Pine. In the Rockies, in the same ecological zone, is the same pine, with an assemblage of different species. The Yellow Pine is taken as an indicator of the Transition Zone, having exactly the same relation to the zone as do “index fossils” to the fossil zones.

Not only do the lands show ecological zonation, but the oceans do as well. Wherever mapping has been done, the waters are definitely zoned, as may be seen in the reports of many marine stations.

Interpretation of Fossils in Terms of Zonation

The tables of “correlation” which are found in the geological reports are attempts of outlining the relative chronological positions of the strata. They might, however, be just as readily considered to represent relative ecological position. Authors of geological literature, refer to the “age” of a formation. This might as well mean that that formation had an assemblage of fossils that relate it to other formations ecologically. But there is order; for if there were not, it would be impossible to make any system.

If one were to postulate a direct creation by an omniscient Creator, then certain assumptions would be unavoidable, among them the following:

(1) The surface of the earth would be diversified by mountains, plains, lakes, rivers, and seas of different sizes and at different levels.

(2) These diverse features would be the home of many different kinds of plants and animals.

(3) The plants and animals would be grouped in communities according to their individual adaptations to the varying environmental conditions, and these communities would, in their broader aspects, constitute the major life zones.

(4) The arrangement of the life types in that original creation would not necessarily be the same as at present. Indeed, it would be much more orderly than at present, for the present world is biologically impoverished, and has been terrifically distorted and confused by the vicissitudes through which it has passed.

The theory of ecological zonation was first published⁷ in 1946. Since then it has been quite generally recognized by many conservative creationists who have studied it. However, a few have expressed questions that puzzle them; and attention should be given to some of these questions.

Of course anyone who holds to progressive creationism or theistic evolution, or any other aspect of the

“gap theory” that allows life upon the earth before the third day of creation week a few thousand years ago, will not accept this theory of ecological zonation; in fact he would have no need of it, as it would not fit into any scheme that allows for long ages for life upon the earth.

A Number of Questions Considered

(a) How could the Flood, some ask, arrange the fossils in any order? Would it not mix them all up so that there would be no order or sequence of any kind?

This question, in my opinion, arises from a misunderstanding of the nature of the Flood. According to Genesis 8:3 as I interpret it, the waters reached maximum height at the end of 150 days or five months. Therefore the rise of the waters must have been comparatively gradual. Without doubt there would be disturbances in the waters of the earth that would produce the lower sediments, and there would be a wash-off of soil to produce mud that would form the shales.

In the Cambrian rocks black shales are often found. I have seen hundreds of feet of black shale in New York and Ontario. The color has been attributed to the presence of organic matter. The suggestion has been made that these shales might have been formed from ancient soils, although modern geologists admit of no land in “Cambrian times”. But to the creationists the black shales may be significant.

As the waters rose higher and higher, and the turmoil caused waves to break against the land, zone after zone would be washed away and spread out in the surging waters. Eventually there would result in sequence of deposits with plants and animals in the same order in which they had been on the land. Of course one cannot expect perfect coordination between the fossil zones and the original land zones, as there would be some mixing. But the fact that there is any zoning at all indicates that there must have been zoning on the land, unless one ascribes it to geological ages.

(b) Sometimes the question arises: Why would not land plants appear in the Cambrian even, if the sediments were produced by Flood waters? But the picture here suggested for the rising Flood waters, comparatively little vegetation would be carried into the seas until the disturbances reached a certain volume. Any plant remains that were carried into the seas would float on the top, and would not be found in the bottom sediments—not until the violence of the storm had increased to tear away masses of the land and bury plants and animals beneath them.

(c) What about the repetition of certain fossil layers? In some cases there is an alternation over and over again. In the Paris and London basins are six cycles, marine sediments having come from the north and terrestrial from the south. In Burma are alternating beds varying in thickness from 1,000 to 12,000 feet, but all appear to have been deposited in water not over 600 feet deep. Coal beds show many alternations with shales, sometimes as many as a hundred such alternations being seen.

A most notable example of cyclic sedimentation is found on the Gulf coast of Texas. Sellards reported this graphic picture:

The outstanding feature in the history of Cenozoic sedimentation in Texas is a continuous and relentless struggle between the encroaching waters of the Gulf and the heavily loaded, large streams....

A correct interpretation of the geology depends upon a knowledge of the remarkable intergrading and interbedding of the two types of sediments, the continental and the marine....

At least nine maximum transgressions of the sea occurred, and . . . each transgression was followed by a maximum regression. . . .

Abundant river water heavily laden with sand and silt meandered across the flat coastal plain. . . . Trunks of trees, logs, and large branches were carried downward by the currents. . . . The heterogeneous mixture of sands, clays, and lignites, the remarkable exhibits of current bedding, the stream ripple marks, . . . can be explained only by a constant shifting of river beds over a flat, swampy coastal plain.⁸

As one considers what is described and evidence in other parts of the earth, it becomes evident that terrific back-and-forth washing or wave action was involved. This would account for the alternation of strata which might, superficially, give one the impression of a succession of habitats or communities.

(d) Some species range through several zones. How does this fit the picture?

For the last five years I have been photographing the plant communities of California. It is noticeable that while some species are limited in their range, others run through many communities. Certain species may be found all the way from the Great Valley to the top of the Sierra. But this does not present any difficulty in defining the communities, or life zones. The recognition of a certain community or zone depends on the assemblage and not on any one species. In many communities from two to ten species are considered as indicators, because they are typical. Others may be present also, but may range widely.

The situation is the same for fossil zones. The fact that some species range more widely than others is no problem.

(e) But, it is asked, would not violent Flood waters carry some species completely outside their original habitats? That is true; but it would be true also that they would be most abundant in the original habitats. Here is an illustration: In the Cambrian the following are found:

Sponges are common, and they run up to the Pliocene

Brachiopods have the same range, but are markedly members of Cambrian.

Jellyfishes are few, but range up to Pliocene

Tetra Corals occur up to the Permian.

Gastropods occur in some numbers, then a few up to Pliocene.

Trilobites are very abundant, and a few occur as far as Permian.

Starfishes occur, and a few are found up to Pliocene.

But now take a look at the outstanding features of the major systems. Each has its characteristic assemblage of life forms. The systems from Cambrian to Mississippian

are almost entirely marine, although a few simple plants are found in Devonian and Mississippian.

In the Pennsylvanian a marked change may be seen. A vast array of plants are to be found, which appear to have thrived on marshy land or along the borders of waterways. Also many amphibians are included.

The Pennsylvanian is famous for coal beds. Notable, also, in this system are gigantic delta beds, indicating great volumes of water.

In the Mesozoic rocks amphibians, reptiles, and different types of plant life are most common.

The Tertiary rocks are usually more broken and scattered and laid down on the tilted and broken layers beneath them. They contain higher plants and animals, particularly mammals.

It should be noted that the Cambrian is marked by the abundance of trilobites, the Devonian by fishes, the Pennsylvanian by peculiar trees, the Mesozoic by great reptiles, and the Tertiary by mammals. Of course evolutionists believe that this indicates a succession of life in time; it is just as strong an indication of an arrangement of life in space—ecological zonation.

Some creationists are puzzled by the presence of marine fossils in the Mesozoic and Cenozoic rocks. (Notice I say *marine*; there is no way to know whether ancient waters were fresh or salty.) But this need be no problem, if one considers that there is no reason for believing that all the waterways of the antediluvian earth were at the same level.

All bodies of water are not at the same level today. Lake Superior is at an elevation of 600 feet; Lake Tahoe is at 6200 feet elevation; and Lake Titicaca is over 12,000 feet above the sea. This situation in the ancient world would account for "marine" life mingled with the fossils in the upper zones.

In Table 1 note how the occurrence of dominant types assumes the appearance of a natural sequence of ecological zones from the lower left to the upper right, as the check marks form a diagonal line. Only the dominant types are listed.

(f) What about species found in reverse order? Does this not upset the zonal theory? Not at all; for many things happening locally might cause order of deposition to be disturbed and perhaps reversed.

Conclusion

There are only three possible explanations for the arrangement of the fossils in the rocks: (1) there was no order to the arrangement of the ancient biotic communities; and the so-called "geological column" is purely arbitrary, (2) there was temporal order in the ancient world; because of long ages of life succession, or evolutionary progress, or (3) the "geological column" represents the spatial arrangement of the ecological zones of the world before destruction of the arrangement by the Flood.

The ecological order cannot be worked in minute detail, because on the Flood theory allowance must be made for irregularity on account of wave action and distortion of the strata during the Flood and afterwards. But, allowing for certain irregularities such as have been noted, the ecological zonation theory does afford an alternative to the geological ages theory.

Table 1. This shows the distribution of the dominant types according to the conventional geological column, and also in terms of flood geology. The distribution (in the conventional terms, of course) can be checked against a standard book, e.g. *Historical Geology* by Carl O. Dunbar.

	Trilobites	Brachiopods	Craptolites	Crinoids	Cephalopods	Corals	Dipnoi	Crossopterygii	Sharks & Bony Fishes	Echinoderms	Ferns	Scale Trees	Scouring Rushes	Insects	Amphibia	Reptilia	Dinosaurs	Birds	Cycads	Conifers	Deciduous Trees	Sea Reptiles	Mammals	Man
Modern																							X	X
Pleistocene																							X	
Tertiary																		X					X	
Cretaceous																	X							
Jurassic														X		X	X		X	X	X			
Triassic											X	X				X	X		X					
Permian											X			X		X				X				
Pennsylvanian		X									X	X	X	X	X									
Mississippian		X			X					X														
Devonian		X		X	X	X	X	X		X														
Silurian	X	X		X	X	X																		
Ordovician	X	X	X	X	X																			
Cambrian	X	X																						

The conservative creationist cannot accept the ages theory, and recent knowledge of stratigraphic geology makes it imperative that some kind of order be recognized in the arrangement of the fossils. The ecological zonation theory is a logical alternative.

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Editor's Note: Creationists differ among themselves as to the amount of importance which they attach to zonation. In this article it is considered to be very important. Other authors, while they admit that it has occurred in some places, consider it of only minor all-over importance. For instance, see Burdick, Clifford L., 1976. What about the zonation theory?, *Creation Research Society Quarterly* 13(1):37-38. Since the question, then, is one of degree, it would seem that answers will come only by exploration and field work.

ENZYMES AND RECEPTORS COULD NOT HAVE EVOLVED TOGETHER

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Endocrinologists have just begun to deal with the homology of hormone and receptor structure. Of particular interest is the relationship of arginine vasopressin to its receptor site in the kidney of the rat and other mammalian vertebrates including man.

Vasopressin acts as an anti-diuretic hormone when its release by the posterior pituitary is followed by its uptake at a specific receptor site of the kidney. This release and absorption causes water to be retained by that organ. These two factors (hormone and receptor) must bear a precision key and lock relationship to one another in order to function properly.

A puzzle for the evolutionist lies in the fact that the pressor substance of non-mammalian vertebrates is arginine vasotocin. Supposedly not only the hormone itself evolved from vasotocin to vasopressin, but the lock or receptor site evolved to receive it with the same precision in both instances.

In his *Textbook of Endocrinology*¹ Robert Williams, M.D., asked how these structural changes came about in two widely separated organs. How were they coordinated in evolution? He draws the conclusion that no answer is yet completely acceptable.

Apparently this system produces an evolutionary contradiction, for a successful trait in two organs of the non-mammalian (amphibia, birds, bony fish, reptiles) endocrine system would have to be completely changed in the evolutionary stream for no reason. It is highly questionable that random chance could lead to the simultaneous mutations necessary for two mutually dependent regions to change exactly to meet each other's needs. If this were so, where are all the unsuccessful "experiments" that didn't make the grade? It is up to the evolutionist to substantiate these claims with fossil evidence.

Mutually dependent organs are useless without each other. Their simultaneous precision changeover is a lot to ask of natural selection! Special creation would appear to be a preferable explanation for the known data.

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THE CRISIS IN RADIOCARBON CALIBRATION

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A comparison of radiocarbon dates obtained from Egyptian archaeological samples and from contemporary tree growth-rings shows significant discrepancies over an extended period of time. On geophysical grounds, however, a single calibration curve for the whole of the Northern Hemisphere of the Earth is predicted. Further, there is no justification for suspecting the tree growth-rings used for calibration to be contaminated in any way. The author concludes that the discrepancies are due to chronological errors in assigning ages to the Egyptian samples and the dendrochronological samples, and shows that calibration before about 500 B.C. may be justifiably questioned. Additional C-14 calibration anomalies resulting from measurements of a number of dendrochronological samples are also discussed to indicate that, if they are correct, the fundamental principles of the dating method require revision.

1. Introduction

Any archaeological dating technique must yield satisfactory results with samples of known age. Libby's initial presentation of the radiocarbon dating method demonstrated validity with a number of dendrochronological and archaeological samples.

Following this, when experimental techniques substantially improved and provided greater accuracy and reproducibility of radiocarbon age determinations, it became apparent that measurements using both tree growth-rings and archaeological samples showed significant deviations from the expected values. As a result, the initial assumption of a constant atmospheric radiocarbon activity was challenged, and it became

necessary to calibrate the radiocarbon timescale using samples of known age.

Tree growth-rings, especially from the Bristlecone Pine, have been used widely for calibration purposes because samples are readily available over a long period of time. Archaeological samples suitable for calibration purposes, however, are relatively few. Nevertheless, Egyptian tombs and temples provide a unique supply of uncontaminated materials which date from a period when important variations of atmospheric radiocarbon activity appear to have occurred. If radiocarbon calibration is to be carried out with confidence, there must be agreement between the results obtained from dendrochronological and archaeological samples of the same age.

It has certainly been possible to say that there is general agreement between the two sets of data, but

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because of uncertainties in the ages of many archaeological samples, and because of inherent errors in the measurement of radiocarbon age, the comparison is subject to certain limitations. Greater rigor is practicable in the period represented by the well-defined Egyptian samples, and it is the purpose of this paper to compare the radiocarbon measurements obtained from Egyptian materials and from contemporary tree-growth-rings, and to consider the implications of the result.

2. Comparison of Radiocarbon Dates obtained from Samples of Known Ages

Limitations of the results obtained from historically dated samples from Pharaonic Egypt were recognized by participants of the Twelfth Nobel Symposium in 1969, and this was formally expressed in a resolution, printed at the end of the Proceedings.¹ Using specially selected short-lived samples, a number of new radiocarbon measurements were made at the British Museum and the University of California, Los Angeles, Radiocarbon Laboratories, and the results, together with some of the earlier measurements, were published by Edwards² and Berger.³

The data have been reviewed by McKerrell⁴ in consultation with colleagues at the British Museum, and this has led to a few minor revisions and the exclusion of seven doubtful samples. Consequently, from well-defined archaeological samples, there are 63 radiocarbon age determinations which provide a basis for comparison with the dendrochronological data.

Bristlecone Pine and Giant Sequoia trees have supplied the growth-rings assigned to the period under discussion. Renfrew and Clark⁵ have reviewed most of the different approaches that have been made to prepare a radiocarbon calibration curve based on the tree-ring results, and have pointed out a number of unsatisfactory aspects. Clark⁶ claims to have derived a calibration curve which is statistically sound, and is free from the deficiencies noted in the earlier work. In my judgment, Clark has largely succeeded, and his curve is the best available analysis of the tree-ring data.

Before proceeding with the comparison, it is necessary to point out that McKerrell and Clark have considered the data with the intention of identifying possible systematic errors in the measurements of any particular laboratory. Such errors would be apparent if the radiocarbon dates published by one laboratory were consistently higher or lower than those of other laboratories testing the same samples. No such errors have been found, and so all the data may be used with confidence.

Egyptian data, as tabulated by McKerrell, and Clark's calibration curve, which is based upon the tree-ring data, are plotted in Figure 1. The error limits applicable to the Egyptian data have been omitted for the sake of clarity. For the two sets of results to be compatible, the Egyptian results should be evenly distributed about the tree-ring calibration curve. It is clear from Figure 1 that this even distribution does not always occur. Whilst agreement is fair after 600 B.C., the Egyptian dates clustered at 600 B.C., 1200 B.C. and 1900 B.C. are obviously displaced from the tree-ring curve.

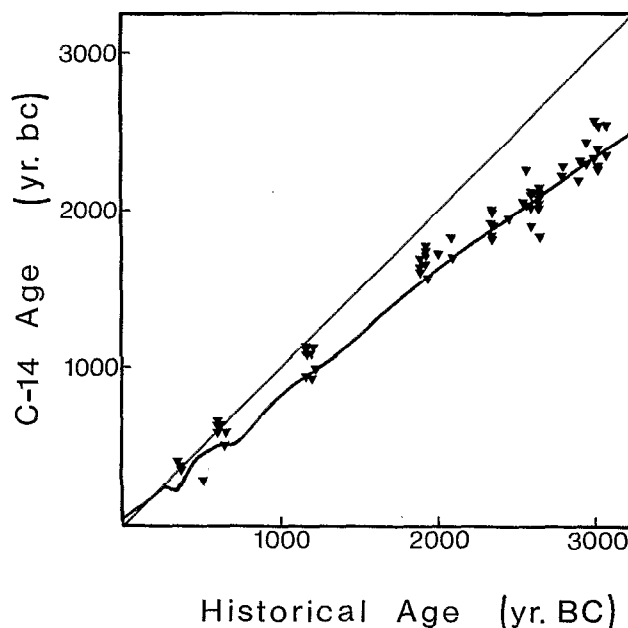


Figure 1. A comparison of Egyptian radiocarbon dates and Clark's tree-ring calibration curve. (C-14 half-life = 5570 years.)

The period 2300-2700 B.C. shows very good agreement, and before 2700 B.C. the agreement is good, but with a slight tendency for the Egyptian radiocarbon dates to be older than the equivalent tree-ring dates.

A *t*-test to compare all the Egyptian dates in the range 600-1900 B.C. has been carried out using Clark's calibration curve as a baseline. The *t*-test compares the deviations of the tree-ring radiocarbon dates from the curve with the deviations of the Egyptian radiocarbon dates. There are 171 tree-ring dates (n_1) within this period, and 17 Egyptian dates (n_2). The mean value of the tree-ring deviations ($\bar{x}_1$) from Clark's curve is, by definition, zero, and the standard deviation is 80 years. The mean deviation of the Egyptian dates ($\bar{x}_2$) is 93 years, and the standard deviation is 70 years. The value of *t* has been calculated using the equation:

$$t = \frac{|\bar{x}_1 - \bar{x}_2|}{\left\{ \frac{\sum (\bar{x}_1 - x_1)^2}{n_1 + n_2 - 2} + \frac{\sum (\bar{x}_2 - x_2)^2}{n_1 n_2} \right\}^{1/2}} = 4.65$$

The value of *t* for 0.001 probability and 186 degrees of freedom is 3.32 and the calculated value is greater than this. Therefore, it is more than 99.9% probable that there is a real difference between the mean values of the two sets of data.

A further test has been made by taking the earliest possible historical ages for the Egyptian samples, instead of the most probable values. The relevant data has been tabulated by McKerrell.⁴ In this case, the value of *t* is 3.80, and is still greater than 3.32 which represents the 0.001 probability level. Therefore, even if the most favourable conditions for reconciling the two sets of data are granted, the probability that there is a real difference is still greater than 99.9%.

Thus, the general analysis of McKerrell is fully justified: that the Egyptian data in the period 600-1900

B.C. are virtually incompatible with the tree-ring data. McKerrell has made a number of statistical tests on groups of data within comparatively short time intervals to show that the discrepancy is marked throughout the period.

The tendency of the tree-ring calibration curve to overcorrect radiocarbon dates by comparison with Egyptian chronology has also been noted by Berger,³ and Harkness and Burleigh.⁷ Derricourt's study⁸ briefly discusses the calibration of Middle and New Kingdom radiocarbon dates and comments that in this period the tight historical chronology and the radiocarbon dates are hard to unite.

Whilst there is a continued need to clarify the situation by obtaining the radiocarbon dates of additional well-defined Egyptian samples, it is the argument of this paper that the discrepancy must now be regarded as proven beyond reasonable doubt. Archaeological controversies about the radiocarbon/historical chronologies of the Aegean, Wessex and North European cultures^{4, 9-11} are the inevitable consequences of the existence of two radiocarbon calibration curves, the tree-ring and the Egyptian, during the Mycenaean period.

A detailed study of the C-14 dates of samples coming from the Late Bronze Age in the Aegean has been made by Betancourt and Weinstein,¹² and they provide partial confirmation of the discordance. They find significant discrepancies between the calibrated radiocarbon dates and the archaeological ages in the early and middle periods of the Late Bronze Age.

There are several papers published which compare Egyptian and tree-ring radiocarbon data and conclude that agreement is satisfactory. Probably the most widely cited is that of Clark and Renfrew.¹³ However, they confine their attention to the period 1800-3000 B.C., and it is admitted by all that there is a common calibration curve over most of this range. Since the critical period is 600-1900 B.C., it is necessary to reconsider their conclusion: "the present harmony gives some grounds for optimism concerning the validity of the bristlecone pine calibration as applied to prehistoric studies in general." In the subsequent sections of this paper, the anomalous radiocarbon results are accepted as proven, and far-reaching implications are shown.

3. Radiocarbon in the Atmosphere

Studies of atmospheric mixing rates, made possible by large amounts of radiocarbon injected into the atmosphere during nuclear weapons testing, have shown that a uniform global distribution of radiocarbon is to be expected. Fairhall and Young¹⁴ have reviewed the relevant information. Longitudinal mixing of the troposphere is rapid, with a timescale of the order of a few weeks. Meridional mixing is slower, and in this case the timescale is several years long.

The work of Libby, Anderson and Arnold¹⁵ showed that throughout the world, the radioactivity of living things was uniform. Lerman, Mook and Vogel¹⁶ have updated this work using the growth-rings of trees collected from different continents. They conclude that there is no longitudinal effect at all in the distribution of C-14. However, a latitude effect was found: samples from the Southern Hemisphere were slightly depleted in

radiocarbon and appeared to be about 40 years older than contemporaneous samples from the Northern Hemisphere.

These latitude differences were thought to be caused by a combination of two effects: (1) the surface area of the ocean in the Southern Hemisphere is about 40% greater than that in the Northern Hemisphere, resulting in a greater rate of C-14 transfer from the atmosphere to the ocean waters in the Southern Hemisphere; (2) the C-14 absorption rate is increased in latitudes 40°S-50°S because of the higher average sea-level wind speeds, and needs to be about three times the normal value in order to account for the reduced C-14 activity levels. (Experimental confirmation of this greater absorption rate has not yet been reported.)

The radiocarbon activities of European tree growth-rings, covering the period from the 11th century to the 19th century A.D., have been measured by Suess.¹⁷ Further measurement of the samples has resulted in some minor revisions, and the data has been tabulated by Houtermans.¹⁸ Comparison of the results obtained from European and from American wood¹⁹⁻²¹ gives good agreement, with no apparent geographical effects.

The radiocarbon dates of some known-age European parchments have been obtained by Berger et al.,²² and they are fully consistent with the trends which are present in both the European and American tree-ring results. Cain and Suess²³ report that the European Oak chronology has been extended to about 350 B.C., and the radiocarbon activities of samples from the period 190-338 B.C. have been measured. There is close agreement between these results and those obtained from Bristlecone Pine and Giant Sequoia samples of the same period.

One conclusion that may be drawn from this evidence is that a single calibration curve should apply to all samples in the Northern Hemisphere. Thus, a tree-ring calibration curve derived from measurements on American samples should apply in Europe and the Near East. It follows from this that the discrepancy between the tree-ring results and some of the Egyptian results should not be attributed to the geographical separation of the sample localities, and other explanations for the difference should be sought.

4. Possible Contamination of Tree-Ring Samples

Tree-ring samples are of particular relevance to radiocarbon calibration for at least four reasons: the atmospheric C-14 activity at the time of growth may be calculated following measurements on the wood; many samples are available; the tree-ring chronologies are claimed to be accurate; and the chronology of Bristlecone Pine is very lengthy.

It is necessary to consider whether there is any possibility of the wood being contaminated so that the calculated C-14 activity of the wood at the time of its growth is different from the genuine value. Since calibration based on tree-ring measurements is of major importance to the radiocarbon dating method, there have been many investigations into a number of possible sources of contamination.

The cellulose and lignin constituents of wood are remarkably strong and stable polymers and are very

resistant to chemical changes after they have been formed. Consequently, preliminary treatments are employed either to isolate the cellulose and lignin, or, at least, to remove obvious contaminants.

For example, some trees are very resinous, and the resin may diffuse across the growth-rings. This has been clearly demonstrated by Jansen²⁴ from some measurements on a New Zealand rimu tree. In the discussion following Jansen's paper, Damon stated that the Bristlecone Pine has a resin which permeates the wood, but that all the resin is removed by treatments given prior to measuring the radiocarbon content of each sample.

Damon also indicated that even when the resin is not removed, there is no noticeable difference in the test results. Another source of contamination, applicable to both the tree-ring and the Egyptian samples, is the possible degradation of wood by bacterial or chemical attack.

Here again, the standard pretreatments are able to remove any contaminants. Some trees have the capacity to store food on the periphery of the heartwood. This is true of a Western Red-Cedar, reported by Fairhall and Young.¹⁴ In trees that have this ability, there exists a possible mechanism for the transmission of C-14 across the sapwood.

Cain and Suess²³ consider that the retention of sap material by heartwood formation is the most significant mechanism by which carbon can be incorporated in a ring many years after the time of its growth. However, even if such growth characteristics are representative of Bristlecone Pine and Sequoia trees, the effect on C-14 dating would be negligibly small. Cain and Suess comment that the increase in C-14 due to such effects cannot be more than 0.2-0.3%, which is below the ordinary limits of carbon-14 measurement precision.

Berger^{3, 25} has made direct checks on the diffusion of C-14 across tree-rings, and his observations confirm the isotopic stability of the wood macromolecules. One of the checks compared the C-14 activities of growth-rings of Bristlecone Pine and Oak trees with contemporary atmospheric concentrations of C-14, which have varied greatly in recent years because of nuclear weapons testing. There is close correspondence between the two sets of results, and no evidence of any transmission of radiocarbon from recent to older wood.

It is highly significant that the Bristlecone Pine wood was not pretreated to extract for resin prior to measurement. The implication is that if food storage, heartwood formation and resin migration effects are present, their influence on C-14 levels in the wood is so small as to be outside the limits of detection.

The possibility of in situ production of carbon-14 in wood has received some attention. Libby and Lukens²⁶ have suggested that lightning bolts may generate neutrons which are capable of entering wood, interacting with nitrogen atoms and forming radiocarbon. This reasoning is equally applicable to neutrons generated by cosmic ray particles which penetrate to low altitudes.

Fleisher²⁷ has shown that neutron production by lightning is negligible when compared with that resulting from the cosmic ray flux at ground level.

Harkness and Burleigh⁷ have irradiated Bristlecone Pine wood with a dose of neutrons equivalent to a natural environment exposure of 6000 years, and have reported no enrichment of carbon-14. Even if some nitrogen was transmuted, the release of energy was thought to be sufficient to rupture the chemical bonding of the cellulose or lignin molecules, enabling the products to be removed by pretreatment procedures.

The evidence, therefore, is that tree-rings are ideal samples to use for radiocarbon calibration. After the pretreatments, there is no reason to doubt that the wood is unchanged, except for radioactive decay, since its time of growth.

Whilst it is of importance to study all possible sources of error, it should be noted that, even if there was a reason to doubt the integrity of the wood samples, the discrepancies between the Egyptian dates and the tree-ring dates would be unresolved. A correction which might remove the disagreement within the period 600-1900 B.C. would also have the effect of producing disagreement in the preceding millennium.

5. Chronological Errors

It has been shown that the results obtained from tree-rings and from the Egyptian samples should be in agreement. Atmospheric mixing is very good, and it should be possible to establish a radiocarbon calibration curve which is applicable to the whole of the Northern Hemisphere. Dendrochronological samples appear to be ideal for use in the preparation of this calibration curve. However, discrepancies are observed between the two sets of results.

On the basis of this evidence, there is only one conclusion that can be drawn: chronological errors must be present. It is recognized that such a conclusion has far-reaching implications, because high accuracy is claimed for both the Egyptian chronology and the tree-ring chronology. The problem of finding the errors is therefore a problem of no small magnitude.

Egyptian chronology has been briefly discussed by Edwards.² The chronological data from documents and inscriptions are extensive but of varying quality. A few anchor points for the chronology of the Middle and New Kingdoms are believed to have been provided by the Sothic dating method; and it is this that gives Egyptian chronology its authority and claim for accuracy.

The time lapse between the beginning of the Old Kingdom and the beginning of the Middle Kingdom is taken primarily from information provided by the Turin Royal Canon. The Saite Period and the following dynasties are dated by cross-reference to the well-defined chronologies of Assyria, Babylonia, Persia, Greece and Rome.

Consider first the possibility of errors in Egyptian chronology. If the tree-ring calibration curve is used as a basis for this revision, the radiocarbon dates obtained from Egyptian samples should be corrected in the customary way. For example, the Twelfth Dynasty C-14 dates associated with the death of Sesostri II are 1633, 1600 and 1691 b.c. When these are corrected by Clark's calibration curve, they result in a mean figure of 2025 B.C., with a standard deviation of 65 years. This should be compared with the currently accepted

historical date of 1880 B.C., with limits of ± 25 years. The basic difference between the two dates is 145 years.

Since Sesostri II reigned only a few years before the most important of the Sothic dating anchor-points, there is little doubt that the revision of 145 years effectively destroys the validity of the Sothic dating method in the Middle Kingdom. If the accepted chronological relationship between the Old Kingdom and the Middle Kingdom is valid, a correction of about 145 years should be made to the whole of the Old Kingdom period. However, the radiocarbon dates for the Old Kingdom are generally in agreement with the tree-ring calibration curve.

From this evidence, therefore, no changes should be made to the currently accepted historical dates for the Old Kingdom. Thus, another consequence of the revision is that the transition period between the Old and Middle Kingdoms is, at present, incorrectly understood. It follows that the observed agreement between the calibration curve and the Old Kingdom dates is coincidental. A similar calibration of the New Kingdom radiocarbon dates shows that the Sothic dating method has to be abandoned for this period also.

It should be noted that Egyptian chronology provides the basis for dating other cultures and civilizations in the Old, Middle and New Kingdom periods because it alone is supposed to be independently derived; and it is precisely for this reason that it is of such importance to archaeologists. A revision of Egyptian chronology must necessarily have far-reaching implications in revising the chronology of many ancient Near East civilizations.

However, the situation is quite different when the radiocarbon dates representing the Saite period are corrected. During this period a number of excellent synchronisms between Egyptian, Assyrian and Babylonian history are on record; and the Assyrian and Babylonian chronologies are independently derived, and an analysis of a number of solar eclipse observations greatly enhance their authority.²⁸ The historical dates assigned to the Saite period can therefore be regarded as firmly established. The conclusion that follows from the available evidence is that the tree-ring calibration curve fails to give accurate results during the Saite period.

The tree-ring radiocarbon results for the period under consideration are obtained primarily from Bristlecone Pine samples. The principles governing the construction of the Methuselah chronology have been outlined by Ferguson.^{29, 30} The growth-ring sequence has been built up by extensive cross-matching of large numbers of living and dead trees, and published results include statistical statements of sample growth characteristics, and of the correlations between them. There are two possible sources of error: the cross-matching of growth-ring sequences, and the claim that the ring indices in the chronology represent annual growths of the constituent trees.

Criticisms of Ferguson's statistical justification of the reliability of his chronology have been made by Sorensen.^{31, 32} Whilst admitting the force of Sorensen's arguments, I consider it most unlikely that confusion in the cross-matching of tree-ring sequences has occurred in the time interval under consideration in this study. This is because the Methuselah chronology has proved

to be reproducible, for it has been checked in two ways. Bristlecone Pine samples from 1900 A.D. to before 1100 B.C. have been obtained, dated and processed by the University of Pennsylvania Laboratory²¹ and this indicates that the Methuselah chronology can be used to positively identify the growth periods of wood samples.

Of greater significance is the formation of the Campito chronology by LaMarche and Harlan.³³ Bristlecone Pine trees from Campito Mountain have been used to prepare a chronology extending back to 3435 B.C. Comparison of the Methuselah and Campito chronologies has shown excellent agreement, and LaMarche and Harlan conclude that the error in the Methuselah chronology at 3435 B.C. is probably zero. Consequently, it is accepted here that Ferguson has successfully identified a sequence of tree growth characteristics.

The other possible source of error is that intraannual rings have been mistaken for true annual rings. Tree growth-rings are essentially a response to climate: whilst it is normal for trees to have clearly defined rings in temperate zones of the Earth, tropical trees usually have no distinct annual growth-rings.³⁴ An intraannual ring may form when the growth activity of a tree is modified by unfavorable climatic conditions.

Glock and Agerter³⁵ have studied trees in which many intraannual rings have formed in a growing season, and they report that these rings are as distinctly formed as true annual rings. However, intraannual rings are generally identifiable because, although the normal growth behavior is affected, the characteristic latewood/earlywood boundary is imperfectly formed.

The growth behavior of Bristlecone Pine has been studied by Fritts,³⁶ and from this work it is clear that these trees are resistant to the formation of intraannual rings. This is confirmed by the fact that no intraannual rings were formed in a sample of 70 trees growing on Campito Mountain in the period from 1953, the final year of an earlier series of ring width measurements, to 1971.³³

Ferguson²⁹ reports that multiple growth-rings are extremely rare in Bristlecone Pine, and especially infrequent in the sites studied for chronology building. In the growth-ring analyses of about 1000 trees in the White Mountains, only three or four specimens were found with incipient multiple growth layers. LaMarche and Harlan³³ describe the intraannual growth bands of Bristlecone Pine as having diffuse boundaries, and contrast them with the sharp boundaries observed in true annual rings.

Consequently, the Bristlecone Pine chronologies are thought to be free from errors due to intraannual rings. However, it is the argument of this paper that strong evidence for the inaccuracy of the tree-ring chronology is found in the radiocarbon results of wood dated at about 600 B.C., and the most likely source of error is the presence of intraannual rings in the chronology. These could only have been produced if the climatic conditions at the time of growth were substantially different to what they are today.

Giant Sequoia samples have contributed to the calibration curve up to about 1350 B.C., and there is good agreement between the Sequoia and the Bristlecone Pine results. If intraannual rings are included in

the Bristlecone Pine chronology, it would appear that the same climatic conditions that produced these growth-rings have produced similar effects in the Giant Sequoia trees.

The claim for accurate dating of the tree-ring samples is very strong. If it were not so, it is doubtful whether the preparation of a tree-ring chronology would be feasible at all. In the period under discussion, a possible source of error is the presence of intraannual rings in the chronology, produced by climatic conditions radically different from those that are observed today. Nevertheless, such a source of error alone cannot account for the deviations from the Egyptian data plotted in Figure 1. It is not realistic to suggest the addition of 150 rings at about 500 B.C. and the omission of 150 rings at about 2000 B.C. If there are errors in the tree-ring chronologies, then there are almost certainly errors in Egyptian chronology as well.

The argument of this section may be summarized as follows. The anomalous radiocarbon results presented in section 2 are capable of a number of possible explanations. However, most of these possibilities have been carefully investigated, and as a result they may be excluded from further consideration. By default, chronological error is left as the prime suspect. The discussion has shown that the chronologies can be questioned, although to do so is to challenge the main assumptions on which the chronologies rest.

In the case of Egyptian chronology, the Sothic dating method has to be discarded, and in the case of dendrochronology, the unstated assumption of past climatic conditions being similar to those of today is probably incorrect. It is not the purpose of this paper to develop these points, but merely to identify them as topics requiring further discussion.

6. Anomalous Results from Dendrochronological Samples

Whilst extensive tree-ring radiocarbon measurements have been made using Californian Bristlecone Pine and Giant Sequoia samples, some test results are available from other trees that have grown in different parts of the world. The agreement between American and European dendrochronological sample results has been noted in section 3.

Kigoshi and Hasegawa³⁷ have measured the radiocarbon content of the growth-rings of a Japanese tree, *Cryptomeria Japonica*. The most significant feature of these results is that over almost the entire period of 1800 years, the radiocarbon dates are of the order of 100 years older than those obtained from equivalent American samples.

These differences were noted by Kigoshi and Hasegawa, who suggested that the cause might be due to differences in the nature of the air masses over the two areas. However, studies of atmospheric mixing rates, which were discussed in section 3, have shown that this explanation is inadequate as it stands. In the Northern Hemisphere, geographical variations of the atmospheric radiocarbon activity level ought not to be found, and these Japanese results must be classed as anomalous.

Jansen²⁴ has obtained results using the growth-rings of Australian and New Zealand trees, and although the

data covers only the last 1000 years, it is sufficient to identify a trend. Again, throughout the period, the radiocarbon dates are older than those applicable to American and European trees of the same age.

Whilst some doubt exists about the age of one of the trees studied, the deviations that are observed are at least as great as those of the Japanese tree-ring results. As was noted in section 3, there is some justification for saying that the Southern Hemisphere results may be 40 years older than the Northern Hemisphere results, but Jansen's data indicates deviations considerably larger than this. Therefore, these results must also be classified as anomalous.

No serious attempts to account for these anomalies have been published. Experimental or dendrochronological errors may be suggested, but at present there is no evidence to suspect this to be the case. If there have been substantial latitude and longitude differences in atmospheric radiocarbon concentrations persisting for at least 1800 years, it is necessary to revise some of the basic geophysical principles underlying the radiocarbon dating method.

These results are incompatible with current thinking about climatic conditions in the past, atmospheric mixing, radiocarbon production rates, etc. It is regrettable that no further work has been published to either confirm or deny these anomalous results. If they are valid, they provide clear evidence of the need to revise the basic principles of the radiocarbon dating method.

Harkness and Burleigh⁷ have suggested that these measurements might have a bearing on the problem of the discrepancies between some of the Egyptian results and the tree-ring calibration curve. Whilst this may be the case, sufficient has been said in this paper to show that, far from assisting to solve one anomaly, the Japanese, Australian and New Zealand tree-ring results must stand as anomalies in their own right.

7. Summary

Whilst there is general agreement between the Bristlecone Pine/Giant Sequoia radiocarbon calibration curve and the results from known-age archaeological samples from Europe and the Near East, significant differences are observed in the period 600-1900 B.C. Geophysically, there is no basis for thinking that at any particular time the atmospheric radiocarbon activity in the Near East has been any different from that in America. Neither is there any basis for questioning the integrity of the tree-ring samples used for constructing the radiocarbon calibration curve. Consequently, the evidence is very strong that there are chronological errors in the ages assigned to the samples.

The presence of errors in Egyptian chronology during this period has been shown to have serious implications for the dating of the Old Kingdom. One of the concluding sentences of Clark and Renfrew's study of this earlier period is as follows:

The conjunction of the bristlecone-pine-calibrated Egyptian radiocarbon dates and the historical dates for Ancient Egypt from 3100-1800 B.C. carries with it the implication that, within the error limits discussed, both chronological systems are correct.¹³

However, this study has shown that discordant results for the Middle and New Kingdom and Suite periods are of greater importance than concordant results for the Old Kingdom, and that the opposite conclusion is warranted:

The discrepancy between the bristlecone-pine-calibrated Egyptian radiocarbon dates and the historical dates for Ancient Egypt from 1900-600 B.C. carries with it the implication that, within the error limits discussed, both chronological systems are incorrect.

There is, consequently, a need to rethink the whole question of radiocarbon calibration before about 500 B.C.

Tree-rings from Japan, Australia and New Zealand are found to have anomalous levels of radiocarbon activity. At very least, this means that the principle of worldwide radiocarbon calibration should be regarded as tentative until the cause of these geographical variations is known. However, since the principle of worldwide calibration is so well-founded, it is possible that these anomalous results indicate the need for a fundamental revision of current thinking about the whole radiocarbon dating method.

8. Concluding Remarks

The Bristlecone Pine and Giant Sequoia wood samples and the Egyptian archaeological samples have been tested with meticulous care in highly reputable laboratories, so that the radiocarbon results can be justifiably claimed to be among the most accurate that have ever been obtained. This point is accepted by all students of radiocarbon calibration.

The argument of this paper is that the best results reveal anomalies which imply that, before 500 B.C., the real ages assigned to the samples must be questioned. This study, therefore, challenges the widespread confidence in the validity of current thinking about radiocarbon calibration, with all its implications for the uniformitarian interpretation of the past and for the evolutionary development of man. In addition, it provides a foundation for further discussion of radiocarbon calibration, and a paper is in preparation in which the author, seeking to be guided by the Biblical framework of history, will explain the principles underlying a revised calibration curve.

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ON THE RECOMBINATION OF RARE RECESSIVE MUTATIONS

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In *Biological Science - An Inquiry into Life*¹ an attempt is made to show how a mutation for larger wing (possibly harmful because too big for a bird's wing muscles) and one for stronger muscles (of no use and possibly harmful since they might break the wings) could be combined to give an advantageous combination of a bird with stronger muscles with larger wings.

Assuming this combination would be advantageous, what are the chances for it to be established in a population?

According to the textbook authors, a mutation to the recessive condition such as large wings, symbolized according to Mendelian terminology by lower case letters *lw*, in distinction from the normal type or normal wings symbolized by the capital letters *LW*, might occur in 1% of the population. This is a reasonable assumption. Similarly the gene or mutation for stronger muscles (*sm*) might well occur in 1% of a population.

Though conceivably both mutations could occur in the same population at about the same time, this is rather unlikely; but it has no real bearing on the problem involved in the question of their recombination in one bird.

Specific Calculations Cited

According to the Hardy-Weinberg principle^{2,3} the mutation for large wing (*lw*) would remain in the ratios shown in Table 1.

Combining the 0.0099 heterozygote classes one finds about 2% of the population heterozygous for the gene for large wing (*lw*).

Similarly considering the gene for strong muscles (*sm*) one may postulate its occurrence in 1% of the population; and it would similarly stabilize as shown in Table 2.

Again combining the 0.0099 heterozygote classes one finds about 2% of the population with the gene for strong muscles in heterozygous condition. So far the textbook authors referred to above have postulated quite reasonable assumptions. But they then go on to state:

There will be many individuals in the population that will carry the mutant gene over many generations, giving time for environmental change or new combinations to occur.

Table 1. The ratios of the mutation for large wing (*lw*), according to the assumptions made in the text. The letters across the top represent the genes from one parent, those at the left the genes from the other parent. Since only 1% of the population carries the recessive factor only 1% of the genes are recessive (*lwSM*). On the other hand, 99% of the genes are dominant (*LWSM*). The union of the gametes results in the four classes of bird represented in the table. Note that only one bird in ten thousand is homozygous recessive and thus actually has the large wings.

	0.01 <i>lwSM</i> male	0.99 <i>LWSM</i>
0.01 <i>lwSM</i>	0.0001 <i>lwSM</i> <i>lwSM</i>	0.0099 <i>LWSM</i> <i>lwSM</i>
0.99 <i>LWSM</i> female	0.0099 <i>lwSM</i> <i>LWSM</i>	0.9801 <i>LWSM</i> <i>LWSM</i>

Table 2. This shows the ratios of the mutation for strong muscles (*sm*). It is similar in construction to Table 1; and similar remarks could be made about it.

	0.01 <i>LWsm</i> male	0.99 <i>LWSM</i>
0.01 <i>LWsm</i>	0.0001 <i>LWsm</i> <i>LWsm</i>	0.0099 <i>LWSM</i> <i>LWsm</i>
0.99 <i>LWSM</i> female	0.0099 <i>LWsm</i> <i>LWSM</i>	0.9801 <i>LWSM</i> <i>LWSM</i>

Thus we can see that any species will carry a load of mutations for natural selection to work upon. (p. 615)

But what in reality are the chances of the genes for large wing and strong muscle being brought together in the double recessive condition, and so presumably conferring an advantage for the bird?

To get at this one must consider *all* members of each population as having an equal chance of mating with each other. I am indebted to Dr. John Klotz of Concordia Lutheran Seminary for giving me the formula for working out this interbreeding problem.

First it must be remembered that both dominant or normal factors occur in 99% of each population. There

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are four dominant factors involved, two for normal wing, and two for normal muscles.

Likewise at the other extreme in 1 % of the population there are four factors involved, two for large wing, and two for strong muscles. These are the recessive factors or mutated ones. Let the dominants be represented by a and the recessives by b , and here $a = 0.99$ and $b = 0.01$. The distribution of characteristics is then represented by:

$$a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4 = (a + b)^4$$

The fractions having all dominant factors, three dominant and one recessive, etc., are then as indicated in Table 3. Note that only $b^4 = 0.01 \times 0.01 \times 0.01 \times 0.01 = 0.00000001$ of the population will have four recessives; i.e., be doubly recessive and thus the assumed improved phenotypic expression. This fraction amounts to one individual in one hundred million.

Therefore, actually the chances of two mutations each occurring 1 % of the population, and presumably resulting in an advantageous combination if present together in one bird in homozygous condition, are so small as to be negligible. It is odd indeed that textbooks written by authorities such as the authors of *Biological Science-An Inquiry into Life* do not point this out.

Actual Bird Habits Considered

When one considers the actual habits of many birds such as quail the chances of such mutations ever being recombined seem even more remote. Thus the California quail, *Lophortyx californicus*, is very gregarious and goes about in coveys or flocks of from about 25 to 35 pair of birds. It is most interesting that coveys do not intermingle with others but practice quite a sharp segregation.

This can most easily be observed when some one member of the flock is injured. In this instance though the injured or limping quail may be quite a ways behind the flock, it never waits to join another covey. Rather it follows along behind the rest of the flock, catching up when the birds next stop to eat grain seeds, grass, or simply dust themselves. Also, a male always acts to sort of "round up" the flock and keep them together, sounding the alarm if there is any danger.

A mutation then in any one flock would no doubt maintain itself according to the Hardy-Weinberg principle. But a quail with another mutation in an even nearby covey would not, under normal circumstances, ever mate with an individual of another covey. Since the flocks do not, as far as I have seen in the 10 years I have observed them, ever reach a total of 100 in-

Table 3. This shows the respective fractions of the birds which will have the various possible combinations of dominant and recessive factors. Note that only one individual in one hundred million would have four recessive factors, and thus actually have the allegedly advantageous combination of large wings and strong muscles.

Factors	Fractions	Dominant Factors	Recessive Factors
LWSM LWSM	$a^4 = 0.9605$	4	0
LWSM LWsm or LWSM lwSM	$4a^3b = 0.0388$	3	1
LWsm lwSM or lwSM lwSM or LWsm LWsm	$6a^2b^2 = 0.00058$	2	2
LWsm lwsm or lwSM lwsm	$4ab^3 = 0.00000386$	1	3
lwsm lwsm	$b^4 = 0.00000001$	0	4

dividuals, it is most unlikely that mutations occurring in 1 % of a population would ever occur in the *same* covey at approximately the same time (within a span of a few years).

Actually an interesting field of research might well be carried on with quail, or indeed any other birds which keep together in flocks, in order to see just how much intermingling with other flocks occurs. This could easily be done by tagging and would help a great deal concerning questions such as those considered here.

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RADIOHALOS IN COALIFIED WOOD: NEW EVIDENCE FOR YOUNG EARTH

STEVEN J. CONNOR*

Received 7 March 1977

Since the turn of the century, radiohalos have intrigued geochemists and mineralogists. Lately, however, the halos have attracted the attention of nuclear researchers, geochronologists, and cosmologists throughout the world because of their important bearing on nuclear science and on the age of the earth. More specifically, the recent discovery of radiohalos in coalified wood has raised questions regarding the very foundations of geological science. Creationists should understand the radiohalo phenomenon and the implications pertinent to their unique scientific philosophy. Although a complete review of radiohalos will be reserved for a later article, some general background will be given here.

Radiohalos, occurring in over 40 types of minerals, are microscopic spheres of discoloration centered around a tiny radioactive inclusion. Viewed in thin section, they usually appear to be perfectly circular discs or concentric rings with a speck of rock in the center. The discoloration of the host rock is caused by alpha radioactivity emitted by the inclusion. The radii of the rings are related to the energies of the alpha radioactivity and are thus identifiers of the emitting radionuclides (see Figure and Table).

Radiohalos occur in many varieties, but the best known are those due to the uranium and thorium series. U^{235} , being in such low abundance, does not produce a corresponding actinide series halo. Several other unusual but important varieties have been discovered and are discussed quite thoroughly by Gentry.¹⁻⁴ Of special significance is the polonium halo which has been established as a distinct halo type apart from the uranium halo.⁵⁻⁶ The polonium halo in rocks is considered by some to provide evidence for divine, fiat, creation.⁷

In coalified wood from the Colorado Plateau, both uranium and polonium halos are abundant. The halos are thought to have formed after uprooted trees, subsequently infiltrated by a uranium-rich solution, preferentially absorbed alpha radioactive nuclides into minute sites that were later to become the radiohalo inclusions (radiocenters).⁸⁻¹⁰ This type of origin for radiohalos is, so far, unique to coalified wood, and in fact, has been ruled out for other types of minerals.¹¹

Three Specific Facts Explained

There are three facts about radiohalos in coalified wood that are readily apparent upon optical examination. First, the uranium halos are generally embryonic;¹⁰ that is, they are missing rings from the final stages of their development. Most of the U halos are missing the 7.69 meV Po^{214} ring. Second, the Po halos are all of the Po^{210} type (possible 2 or 3 questionable exceptions).¹⁰ Third, the Po^{210} halos occur in three sub-varieties: a. the normal circular disc, b. an unusual

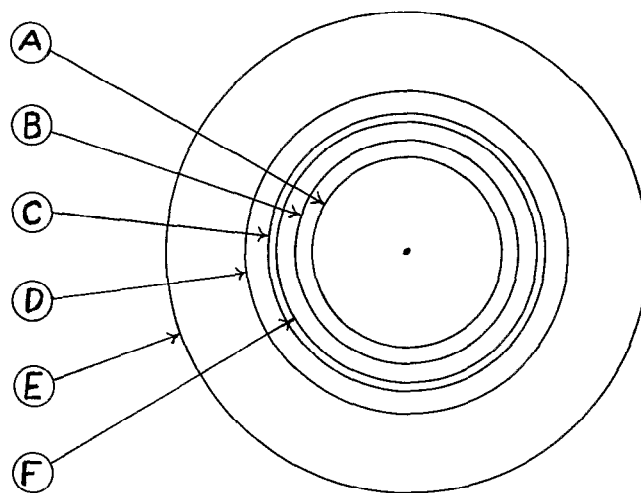


Figure 1. This is a schematic drawing of the halo of the uranium series. The letters refer to the alpha decays of various energies, as listed in Table 1. In coalified wood the uranium halos are generally embryonic; and thus they do not have the 5.3 meV Po^{210} ring, and sometimes not the 7.69 meV Po^{214} ring. Resolution of the 5.30 meV Po^{210} ring and the 5.49 meV Rn^{222} ring is often not possible in several minerals.

Table 1. This lists the nuclides indicating the various stages of decay in the uranium series. The energies of the beta decays are not shown, since they have nothing to do with the present discussion. The letters under "Ring" refer to those indicating the various rings in Figure 1. Each ring is caused by the alpha particles emitted in the corresponding stage of decay.

"meV" means "million electron volts". It is a unit of energy, the kinetic energy which an electron would gain in being accelerated through a difference of potential of one million volts.

Nuclide	Type of Decay	Energy (meV)	Ring
U^{238}	alpha	4.19	A
Th^{234}	beta	—	—
Pa^{234}	beta	—	—
U^{234}	alpha	4.77	B
Th^{230}	alpha	4.68	B
Ra^{226}	alpha	4.78	B
Rn^{222}	alpha	5.49	C
Po^{218}	alpha	6.00	D
Pb^{214}	beta	—	—
Bi^{214}	beta	—	—
Po^{214}	alpha	7.69	E
Pb^{210}	beta	—	—
Bi^{210}	beta	—	—
Po^{210}	alpha	5.30	F
Pb^{206}	stable	—	—

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elliptical disc, c. a very unusual combination of the elliptical disc superimposed on a circular disc.⁸⁻¹⁰

The first fact can be understood by either of two possible explanations. Either the radiocenters contained little uranium to start with, and/or there has been insufficient time for the full uranium halo to develop. Electron microprobe X-ray fluorescence (EMXRF) analyses of the inclusions showed high concentrations of uranium with little or no lead,¹⁰ the final daughter product of uranium decay. Ion microprobe mass spectrometer (IMMA) analyses showed U^{238}/Pb^{206} ratios to be variable but extremely high.¹⁰ Since the U^{238}/Pb^{206} ratio is used as an age indicator, then quantitatively as well as qualitatively, it appears that there has been only a short time since introduction of uranium into the wood.

The second fact can be considered supportive evidence for the preferential accumulation hypothesis for the halo origin. Both Po^{210} ($t_{1/2} = 138$ days) and its beta decaying precursor, Pb^{210} ($t_{1/2} = 22$ years), are chemically suitable to be preferentially accumulated in the inclusions (composed mostly of Pb and Se), and their half lives are sufficiently long to be able to accumulate appreciable concentrations. However Po^{214} ($t_{1/2} = 164$ microseconds) and Po^{218} ($t_{1/2} = 3$ minutes) have half lives too short to accumulate in an inclusion before decaying. The same is true of Po^{214} 's beta precursor. Po^{218} has no beta precursor.

It can be concluded from the third fact that this U and Po infiltration occurred before complete coalification of the wood. The elliptical halos can be understood by assuming plastic deformation of the wood sometime after initial radioactive infiltration but before complete coalification. According to this model of origin,¹⁰ development of a spherical halo could be predicted in 0.5 to 1 year from the accumulated Po^{210} atoms and a second concentric spherical halo in 22 to 50 years as the Pb^{210} atoms slowly beta decay to Po^{210} and then alpha decay to Pb^{206} . Obviously a properly timed tectonic event could deform the wood, producing the dual spherical-elliptical halos.

Radiohalos: Challenge to Geologists

The discovery of radiohalos in coalified wood has challenged the foundations of geological science. How is this so? First, it is interesting to note that the coalified wood was taken from Jurassic and Triassic formations in the Colorado Plateau. However the embryonic structure of the U halos combined with the EMXRF and IMMA analyses suggests that the halos may be only a few thousand years old.

If the infiltration of uranium occurred before complete coalification, then the coalified wood could not be any older. Also the time required for the coalification process must be considerably shorter than what is generally believed today.

Also, from the elliptical halos it follows that infiltration occurred before complete coalification. Thus here is a geologically "old" formation (by uniformitarian viewpoint) that apparently is only a few thousand years old. This is not just a local anomaly. Embryonic U halos have also been found in Devonian Chattanooga shale with U^{238}/Pb^{206} ratios too high for the accepted age of the formation.¹⁰

In conclusion, while exact ages are not here assigned to the formations in which the coalified wood¹⁰ occurs, evidence has been presented which would chronologically place these formations at the time of the Flood several thousand years ago. The use of estimates of age from radioactivity can be justified in this particular case, since there seems to be no Scriptural evidence suggesting that the Creator has intervened on a global scale to produce perturbations in normal physical processes since the Flood.

In my opinion, a knowledge of radiohalos is very meaningful in the light of God's great call to worship in Rev. 14:6 & 7: . . . worship Him that made heaven, and earth, and the sea, and the fountains of waters . . .".

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- ³In this report reference will be restricted mainly to quite recent work.
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MYSTERY OF THE RADIOHALOS†

STEPHEN L. TALBOTT*

Prepared originally about 1975

• Current physical laws may not have governed the past.

• Earth's primordial crustal rocks, rather than cooling and solidifying over millions or billions of years, crystallized almost instantaneously.

• Some geological formations thought to be one hundred million years old are in reality only several thousand years old.

Grant these propositions and—any researcher will tell you—the entire structure of the historical natural sciences would dissolve into formlessness. Few certainties would remain. Yet these very possibilities (and others equally disintegrative) have been suggested in a remarkable series of papers published over the past several years in the world's foremost scientific journals—*Nature*, *Science*, and *Annual Review of Nuclear Science*, among others.

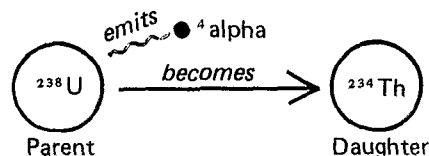
Nor has this assault upon orthodoxy elicited a vigorous counterattack: the research results published to date have been so cautiously and capably elaborated, and evidence so thoroughly piled upon evidence, as to forestall any outcry by those whose scientific sensibility may have been outraged. While some investigators appear finally to be arming themselves for combat, the issue has not yet been joined.

It was over a decade ago that Robert V. Gentry, puzzling over questions about the Earth's age, directed his attention to an obscure and neglected class of minute discolorations in certain minerals. He has since examined more than 100,000 of these "radiohalos," and without doubt stands as the world's leading authority on the subject.

As an assistant professor of physics at Columbia Union College (Takoma Park, Maryland), he has brought to bear upon the halos an array of sophisticated instrumentation such as few researchers ever have the privilege to wield. As a result, he has converted the entire field of radiohalo research into an exact science, transmuting the microscopic spheres of mystery into rich mines of exciting and challenging information.

Radioactive Halo (or Radiohalo): In some thin samples of certain minerals, notably mica, there can be observed tiny aureoles of discoloration which, on microscopic examination, prove to be concentric dark and light circles with diameters between about 10 and 40 μm [one micrometer is

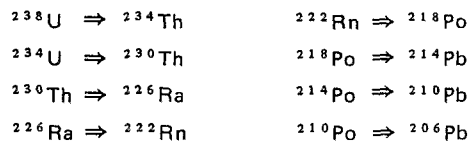
Glossary of Technical Terms



A **parent** radioactive atom decays into a **daughter** atom in various ways, one of which is by the emission of an **alpha** particle from the parent atom's nucleus. Numerous types of radioactive atoms occur in nature, but only three are the initiators of a **decay series**: uranium-238 (^{238}U); uranium-235 (^{235}U); and thorium-232 (^{232}Th).

(The numerical superscript signifies how **heavy** the element is. **Isotopes** of the same element have different weights but nearly identical chemical behavior—as for example (^{238}U) and (^{235}U). An alpha particle has a weight of 4.)

Each of the three decay-series initiators decays, by a chain of steps, into lead. For example, the alpha-decay steps in the ^{238}U series are the following (steps not involving alpha-decay are not shown here):



Similarly, ^{235}U decays by a different series of steps to ^{207}Pb , and ^{232}Th decays to ^{208}Pb . Note that while all the series end up with lead, each one results in a different isotope of lead.

The **half-life** of a given type of radioactive atom is the time during which half the atoms in any collection will decay. The half-life of ^{238}U is $4\frac{1}{2}$ billion years. Half-life, **decay rate**, and **decay constant** are closely related quantities. If we assume that the decay rate has not changed over geologic time,** and if we measure 1) how much of a parent in a rock has decayed into its daughter; and 2) the current rate of this decay, then we can it is generally believed, assess the date when the parent was incorporated into the rock—that is, the date when the rock was formed. In the case of Earth's oldest rocks, this date (some $3\frac{1}{2}$ billion years ago) is thought to be the time when the molten Earth first cooled down sufficiently for rocks to solidify from the primordial magma.

**Numerous other assumptions and technicalities also come into play.

one-millionth of a meter] and centered on a tiny inclusion. The origin of these halos (first reported between 1880 and 1890) was a mystery until the discovery of radioactivity and its powers of coloration; in 1907 Joly and Mugge independently suggested that the central inclusion was radioactive and that the alpha-emissions from it produced the concentric shells of coloration. . . . halos command attention because they are an integral record of radioactive decay in minerals that constitute the most ancient rocks.¹

Gentry's studies have led him to the following conclusions:

1) Some halos ("polonium" halos) imply a nearly instantaneous crystallization of Earth's primordial rocks; and this crystallization must have occurred simultaneously with the synthesis/creation of certain elements.

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†The author prepared this article, about work done by Dr. Robert V. Gentry of the Columbia Union College, in consultation with Dr. Gentry. It appeared in the *Research Communications Network Newsletter*, No. 2, 10 February 1977, and is reprinted here by permission. The content is exactly the same as that of the original; there have been a few changes in layout, according to the style form of the *Quarterly*.

2) Some halos correspond to types of radioactivity which are unknown today.

3) Whereas radiohalos have been thought to afford the strongest evidence for unchanging radioactive decay rates throughout geological time (and these rates enable scientists to determine rock ages), in actuality the overall evidence from halos requires us to question the entire radioactive dating procedure: something appears to have disrupted the radioactive clocks in the past.

4) Halos in coal-bearing formations that are conventionally thought to be 100 to 200 million years old suggest these strata to be only several thousand years old. Further, the time required for coal formation is much less than previously thought.

5) Taken together, these conclusions point to one or more great "singularities" in Earth's past—events or processes that are discontinuous with the rest of history, unique occurrences that critically affect the data we now have. If we attempt to interpret these data solely in terms of current processes, we go astray.

In this report we will discuss only those researches leading to conclusion (1), reserving the rest for a subsequent report.

The Conservatism of Science

Many have noted a conservatism in science essential to its orderly advance: skepticism toward radically new ideas enables scientific journals to retain focus, prevents anarchic descent into theoretical chaos, and makes it possible to extend currently reigning theories yet more embracive. A successfully modified, "tested" theory is preferable to a new "untried" theory. And so scientific knowledge advances in an orderly fashion, with as few wrong turns as possible.*

Gentry has so far avoided clashing with this conservatism, chiefly by concentrating his efforts on publication of data rather than discussion of their implications—and also by the good fortune that his work has been slow to draw widespread attention. That is beginning to change, however. But perhaps the reaction of a number of prominent physicists to Gentry's work on polonium halos (see the comments reproduced at the end) is the most significant gauge of what will be forthcoming.

This reaction is noteworthy both for the confidence expressed in Gentry's work and for the almost uniformly conservative—albeit open—stance toward any extrapolations from the raw data that challenge accepted theory. Of those whose opinions we sampled, only one seemed to suggest (without wishing to be quoted) that we not publicize Gentry's work. He felt that the subject should be "left to the experts," while cautioning that it is too early to reject the conventional view of Earth's history.

In the end, it is, presumably the evidence which will decide this issue. Let us look more closely at the radiohalos themselves.

The Nature of Halos

If a small grain (inclusion) containing radioactive atoms is embedded in certain rock minerals, the alpha

particles emitted from the radioactive atoms travel outward from the inclusion and damage the crystalline structure of the mineral, in time producing the visible discoloration typifying halos. Since each type of radioactive atom emits alpha particles with a characteristic energy, and since this energy determines how far the particle will travel in the host mineral, the diameter of a halo's rings guides researchers in determining which radioactive element is responsible for the halo.

If the radioactive element in an inclusion is the initiator of a decay series then a group of concentric halo rings results, each ring corresponding to a step in the decay series, that is, to alpha particles of a particular energy. In the case of the ^{238}U series, with eight alpha-decay steps, there are five distinct halo rings (some of the alpha particles are so close together in energy that their rings are not distinguishable).

The conventional argument drawn from observed radiohalo sizes is summarized by Struve:

There is excellent evidence that the rates of radioactive processes measured in the laboratory at the present time are valid also for the remote past. If a radioactive element and its decay products are embedded in a crystal, each alpha particle emitted during disintegration travels a certain distance that depends only on the rate of that particular decay step. The more rapid this rate, the greater the energy of the alpha particles, and the farther they go before being stopped and producing a color change in the crystal.

Suppose a speck of ^{238}U has remained undisturbed since the formation of a mineral containing it. Then, because the rate of disintegration at each successive emission is different, eight concentric rings of mineral discoloration will be found surrounding the particle of uranium. These rings . . . have been found in many rocks of different geological ages, and the diameters of the respective rings are always the same.

Thus it can be concluded that the rates of disintegration of uranium and thorium are constant . . .²

As we will learn in a subsequent review, the evidence from halos has led Gentry in a direction quite opposite from Struve's. But more than that, Gentry's halo research appears to strike at the roots of virtually all contemporary cosmologies, posing a fundamental problem which has so far resisted every effort to solve it in conventional terms. This is the problem of the polonium halos.

Polonium Halos

The last three alpha decay steps in the uranium-238 decay series (see glossary above) involve the successive decay of polonium-218 (^{218}Po), polonium-214 (^{214}Po), and polonium-210 (^{210}Po). In contrast to the decay of the parent uranium, these steps occur very quickly; the half-lives of the three forms of polonium are 3.05 minutes, 164 microseconds, and 140 days, respectively. Polonium, therefore, is not thought to be observed in nature except as a daughter product of uranium and thorium decay.

*This conservatism—and its deceptive advantages—will receive continuing discussion in these newsletters.



Figure 1. A uranium-238 halo (left) and a polonium-210 halo in biotite. Scale is 1 cm equivalent to 26.5 μ m.

That is where the enigma begins. For Gentry has analyzed numerous polonium halos possessing, in some cases, the rings for all three polonium isotopes; in other cases the rings for ^{214}Po and ^{210}Po ; and in other cases, the ring for ^{210}Po alone—but none of these halos exhibits rings for the earlier uranium-238 daughters. These halos are evidence for parentless polonium, not derived from uranium.**

But the question then arises, How did the polonium inclusions ever become embedded in the host rocks (more specifically, in Earth's oldest—Precambrian—rocks)? On the conventional view, these rocks slowly cooled and crystallized out of the primordial magma (molten rock) over millions of years.

Under such circumstances, any polonium (with its extremely short half life) that was incorporated into the solidifying rocks would have completely decayed long before the crystalline rock structure was established. No halos could have formed, for they consist precisely of radiation damage to this crystalline structure.

Polonium rings should exist only in conjunction with the other uranium series rings. But since the actual halos were caused by parentless polonium, they require nearly instantaneous crystallization of the rocks, simultaneously with the synthesis or creation of the polonium atoms.

Gentry, well aware that this conclusion is unthinkable to most, has buttressed it with impressive experimentation: fission track and neutron flux techniques³ reveal no uranium in the inclusions that could have given rise to the polonium—a conclusion more recently confirmed by electron microscope x-ray fluorescence spectra;⁴ fossil alpha recoil analysis³ demonstrates that, neither polonium nor other daughter products migrated from neighboring uranium sources in the rock, which agrees with calculations based on diffusion rates;⁵ ion microprobe mass spectrometry yields extraordinarily high $^{206}\text{Pb}/^{207}\text{Pb}$ isotope ratios that are wholly inconsistent with normal decay modes⁶ but which are exactly what one would expect as a result of polonium decay in the absence of uranium.

To date there has been only one effort⁷ to dispute Gentry's identification of polonium halos. As it turned out⁴ that effort might better never have been written, the authors having been impelled more by the worry that polonium halos "would cause apparently insuperable geological problems," than by a thorough grasp of the evidences.

**Gentry has also found halos with rings from polonium-218, -214, or -210, combined with a ring from polonium-212 which is in the thorium decay series. This last form of polonium is also parentless—that is, there are no halo rings for thorium itself or its other daughters.

Challenges to Gentry's interpretation of the polonium halos have been more noteworthy, English physicist J. H. Fremlin wrote in *Nature* (November 20, 1975) that "The nuclear geophysical enigma of the ^{210}Po halos is quite fascinating, but the explanation put forward . . . is not easy either to understand or to believe." Fremlin proposed two possible explanations:

Geologic transfer. If there are uranium inclusions reasonably close to polonium halos, then it is possible that one or more of the uranium daughter products migrated from the uranium site to a new location, where subsequent decay gave rise to the polonium halo.

Since the daughter products have much shorter half-lives than uranium, we would not expect to find any quantity of them remaining at the site of the halo. The polonium would therefore appear to be "parentless." The difficulty with this view is that transfer of uranium daughters in minerals occurs so slowly that the daughters would decay long before they could migrate any significant distance.^{3,5}

If the sophisticated experimentation cited above proved telling against the transfer hypothesis, Gentry and several co-workers delivered a yet more conclusive blow in a very recent paper: polonium halos derived by geologic transfer from uranium sources have now actually been found in coalified wood deposits.⁸ Their presence here was to be expected: prior to coalification the wood was in a gel-like condition permeated by a uranium-bearing solution. Such a material "would exhibit a much higher transport rate as well as unusual geochemical conditions which might favor the accumulation of ^{210}Po "—quite different from the situation in mineral rocks.

Further, of these uranium-derived polonium halos, none were found due to ^{218}Po , and only three could conceivably (but doubtfully) be attributed to ^{214}Po , in contrast to numerous ^{210}Po halos. The half-life to ^{210}Po , we will recall, is 140 days, whereas the half-life of those forms of polonium which failed to generate halos in the coalified wood is a few minutes or less.

So even under the ideal conditions in this wood, the short-half-lived ^{218}Po and ^{214}Po were not able to migrate rapidly enough from the parent uranium to form "parentless" halos. Clearly, then, such migration could not account for the ^{218}Po and ^{214}Po halos Gentry has found in Precambrian minerals, where the diffusion rate is very much lower even than in wood.⁵

Isomer precursors. Two atoms with identical nuclear composition but different radioactive behavior are termed "isomers." For example, ^{212}Po (in the thorium decay series) decays to ^{208}Pb by emission of an alpha particle with an energy of 8.78 MeV. However, about one out of every 5500 ^{212}Po atoms emits an alpha particle with a much higher energy of 10.55 MeV. These rarely occurring, higher-energy ^{212}Po atoms are isomers, and they are apparently explained by some variation in nuclear structure.

The suggestion has been made, therefore, that polonium halos may result from the presence of heretofore unknown isomers which are long-lived and which

decay* into polonium. These isomers ("precursors" of polonium) would circumvent the cosmological problem caused by the short-half-life polonium.

However, not only are such isomers unknown, but a careful search has revealed the presence of no elements which might qualify as the required isomers.^{4,5} "Experimental results have ruled out the isomer hypothesis."⁵

"Singularities"

And so we have Gentry's conclusion in his reply to Fremlin:

But if isomers and uranium-daughter diffusion do not produce polonium halos in rocks, we are left with the idea that polonium halos originate with primordial Po atoms just as U and Th halos originate with primordial ²³⁸U and ²³²Th atoms. . . . Carried to its ultimate conclusion, this means that polonium halos, of which there are estimated to be 10¹⁵ [one million billion] in the Earth's basement granitic rocks, represent evidence of extinct natural radioactivity, and thus imply only a brief period between 'nucleosynthesis' [creation of elements] and crystallization of the host rocks.⁵

In plainer terms, these rocks must have formed almost instantaneously upon the synthesis of the elements comprising them.

Gentry believes the evidence points to one or more great "singularities" that have affected Earth in the past, representing physical processes which we do not now observe. If this is so, then attempts to define these processes in conventional terms will prove fruitless, and the span represented by geologic time is a wide open question.

Further (as we will explore in a subsequent review), Gentry concludes that the most recent "singularity" may have occurred only several thousand years ago. And he finds compelling reasons to question the entire radioactive dating scheme which undergirds our concept of geological time.

Gentry realizes that he still must reckon with the conservatism of science. While his experimental work has been impressive, few would yet concede that it is impregnable, or that his explanations are the only possible ones. As Wheeler remarked:

If the evidence [for the polonium halo] is impressive, the explanation for it is far from clear. I would look in normal geologic process of transfer of materials by heating and cooling; in isomeric nuclear transitions; and in every other standard physical phenomenon before I would even venture to consider cosmological explanations, let alone radical cosmological explanations. (See comments below)

While the evidence does not seem to favor the specific mechanisms Wheeler suggested in early 1975, Gentry can be sure that, in pressing his own decidedly radical explanations, the sound and fury lie yet before him.

Comments by Leading Scientists

Before the demise of the journal, Pensée, the editor—in preparation for a planned article on Gentry's work—approached a number of leading scientists for their assessment of polonium halos. The following responses were received during the first month or so of 1975.

Professor Truman P. Kohman, Department of Chemistry, Carnegie-Mellon University, Pittsburgh. "I do not believe that 'Gentry's contentions' can be regarded as of 'rather startling nature.' However, some of his experimental findings (like those of his predecessors) are quite difficult to understand, and the ultimate explanations could be interesting and even surprising. Many persons probably do not take them seriously, believing either that there is something wrong with the reported findings or that the explanations are to be found in simple phenomena which have been overlooked or discarded. . . . I believe it can be said that Gentry is honest and sincere, and that his scientific work is good and correctly reported. It would be very hard to believe that all, or any, of it could have been fabricated. . . ."

Professor Edward Anders, Enrico Fermi Institute, University of Chicago. "His [Gentry's] conclusions are startling and shake the very foundations of radiochemistry and geochemistry, yet he has been so meticulous in his experimental work, and so restrained in his interpretations, that most people take his work seriously. . . . I think most people believe, as I do, that some unspectacular explanation will eventually be found for the anomalous halos and that orthodoxy will turn out to be right after all. Meanwhile, Gentry should be encouraged to keep rattling this skeleton in our closet for all it is worth."

Dr. Emilio Sergre, Istituto Di Fisica "Guglielmo Marconi," Università Degli Studi, Rome. "The photos [of radiohalos] are remarkable, but their interpretation is still uncertain."

Professor Freeman Dyson, Institute for Advanced Study, Princeton. "Supposing that the results of Gentry are confirmed, what will it mean for theory? I do not think it will mean any radical changes in geology or cosmology. It is much more likely that the explanation will be some tricky point in nuclear physics or nuclear chemistry that the experts have overlooked. That is of course only my personal opinion and I am accustomed to being proved wrong by events. (I just lost a \$10 bet that Nixon would be in office till the end of 1974. I will be glad to lose this one too.)"

Academician G. N. Flerov, Joint Institute for Nuclear Research, Moscow. "We made sure that [Gentry] carried out his investigations very thoroughly. . . . Therefore his data deserve serious attention. . . . It is not excluded that [polonium halos] have been formed as a result of the extremely rare combination of geochemical, geological and other conditions, and their existence does not contradict the logically grounded system of concepts involved in the history of Earth formation."

Dr. Paul Ramdohr, Emeritus Professor of Mineralogy, Heidelberg University, Heidelberg. "The very careful and painstaking examinations of Dr. Gentry are indeed very interesting and extremely difficult to explain. But I think there is no need to doubt 'currently accepted cosmological models of Earth formation' Anyhow, there is a very interesting and essential question and you could discuss it, perhaps with cautious restrictions against so weighty statements like the one above in quotes. It would be interesting and good if more scientists would have more knowledge of the problems."

Professor Eugene P. Wigner, Department of Physics, Rockefeller University, New York. "Even though I know Dr. Gentry personally, I am not sufficiently familiar with his scientific results to be able to judge them. Personally, however, I have a very high regard for him."

Dr. E. H. Taylor, Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. "I can attest to the thoroughness, care and effort which Gentry puts into his work. . . . In a general way these puzzling pieces of information might result from unsuspected species or phenomena in nuclear physics, from unusual geological or geochemical processes, or even from cosmological phenomena. Or they (or one of them) might arise from some unsuspected, trivial and uninteresting cause. All that one can say is that they do present a puzzle (or several puzzles) and that there is some reasonable probability that the answer will be scientifically interesting."

*By beta-emission.

January 29, 1975

You ask for my opinion of Dr. Robert Gentry's work on pleochroic polonium halos. I spent a number of hours reviewing this fascinating work with him some weeks ago. I was impressed with the clarity of the evidence for "anomalous halos"—that is, cases where there are rings indicating the presence of some members of the normal radioactive decay chain without the other members of the family tree that normally are present, that normally do show up in rings of their own, and that have to be there on present views of the radioactive decay chains involved. If the evidence is impressive, the explanation for it is far from clear. I would look in normal geologic process of transfer of materials by heating and cooling; in isomeric nuclear transitions; and in every other standard physical phenomenon before I would even venture to consider cosmological explanations, let alone radiol cosmological explanations. To explore all the avenues that need exploring would take months, not the few hours I was privileged to spend in Dr. Gentry's company. A few days ago I reviewed his work, all too briefly, with Dr. G. Wasserburg of Cal Tech, who is an expert in the radioactive dating of rocks, whose opinion would be much more to the point than mine, especially if he will give it to you in writing.**

John A. Wheeler
(Professor of Physics,
Princeton University)

**Professor Wheeler requested that this letter be printed in full. Dr. Wasserburg's views have not been obtained.

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WHAT WILL THEY SAY IN 10,000 A.D.?

DAVID J. RODABAUGH*

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It is shown herein that evolutionists increase their estimates of the earth's age exponentially. Conclusions are given on the assumption that this trend will continue.

Evolutionists have contended that estimates of the earth's age by creationists are much too small. However, estimates of the age by the evolutionists have varied greatly over the years, as is shown by data, gleaned from the literature, given in Table 1. There is indeed quite a variation. It would be interesting, then, to speculate on what evolutionists will be saying in the future if the present trend continues.

Accordingly, the data from Table 1 were analyzed by least squares, both linearly¹⁰ and exponentially.¹¹ In what follows, y is the estimated age, and t the time, in years A.D., when the estimate was made.

Linear regression yields the equation

$$y(t) = 33553406.95t - 6.228783058 \times 10^{10} \quad (1)$$

The correlation coefficient is

$$r = 0.898994372 \quad (2)$$

To fit with an exponential $y = ae^{bt}$, the curve $\ln(y) = bt + \ln(a)$ is fitted to the data $\{t_i, \ln(y_i)\}$. It will be recalled that $\ln$ represents the natural logarithm. The resulting equation is

$$\ln[y(t)] = 3.651117028 \times 10^{-2} t - 49.70256740 \quad (3)$$

The correlation coefficient is

$$r = 0.969637219 \quad (4)$$

Obviously, the next question is: Which of Equation 1 and Equation 3 better fits the data. Since the correla-

Table 1.

Year in which the estimate was made.	Estimated age of the earth in years.
1850	100 million ¹
1850	25 million ²
1932	1.6 billion ³
1947	3.35 billion ⁴
1949	2.5 billion ⁵
1960	2 billion ⁶
1974	5 billion ⁷
1975	4.5 billion ⁸
1976	4.6 billion ⁹

tion coefficient for Equation 3 is closer to 1.0, it can be concluded that Equation 3 is the better fit.

In fact, if the true correlation is ρ , then

$$z = (n - 3)^{1/2} \times \frac{\ln[(1 + r)(1 - \rho)/(1 - r)(1 + \rho)]}{\ln[(1 + r)(1 - \rho)/(1 - r)(1 + \rho)]} \quad (5)$$

(n being the sample size) has an approximately normal distribution.¹²

Therefore, with 95% confidence, the conclusion is that in the linear Equation 1 the true correlation is between 0.583 and 0.979. For the exponential Equation 3 it is between 0.858 and 0.994.

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Thus the data strongly favor an exponential rather than a linear fit. To predict, then, what evolutionists will be saying in the future one may use Equation 3 and extrapolate. Extrapolation can lead to large errors; but an evolutionist should be the last person to complain, since he extrapolates from the present to over four billion years ago.

The inevitable conclusion is that in 4,000 A.D. evolutionists will assert that the earth is $6.932 \cdot 10^{41}$ years old, and in 10,000 A.D. that it is $9.560 \cdot 10^{136}$ years old.

Or is the conclusion that evolutionists expounding on the age of the earth, like fishermen describing the one that got away, tell a bigger story each time?

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Editor's Note: Dr. Rodabaugh and I have noticed with interest that, according to Equation 3, the age of the earth would have been estimated at about 5,600 years about 1600 A.D. Thus "the beginning" would have been set about 4000 B.C., as a straightforward reading of Genesis would seem to indicate. Now in fact, about that time most learned men, at least in Christendom, would have subscribed to some such estimate of the age; it was around that time that Ussher issued his chronology. But not long afterwards, the age of the earth began to be inflated.

It may be noticed that Equation 3 indicates an exponential increase; and another way of stating such an increase is to say that the thing concerned (here the age claimed for the earth) doubles in a certain time. The time to double can be calculated from Equation 3; and it comes to be about 20 years. It interested me very much that Dr. Gerardus D. Bouw, Ph.D. of Rochester, New York, remarked quite independently, in correspondence, that the age claimed for the earth is doubling about every 20 years.

GALAXY CLUSTERS AND THE MASS ANOMALY

GERARDUS D. BOUW*

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Various proposals which have been proposed to resolve the so-called "missing mass" or "mass anomaly" in galaxy clusters are reviewed here. Basically, these hypotheses can be broken down into two types of proposals: the missing mass hypotheses and the missing physics ideas. The presence of the mass anomaly has been used, in the past, in support of a young cosmos. The validity of such an approach is reviewed.

Introduction

It seems that no matter how hard secular man attempts to describe and affect his environment without reference to the Creator, there is always a vague, uneasy "something's missing" aspect to that endeavour.

This "missing" factor has manifestations in every humanistic search for truth and can be seen in many forms; from the three existential questions of philosophy—Who am I? What do I? and How be I?—to the missing links of evolutionary biology; from the missing volatiles of Mars¹ to that missing factor in each human life which many scientists deem necessary to complete that life. The Christian reader will recognize this vacuous state as the quest for Christ who is the Way, the Truth and the Life.

In this study one particular "missing" property is singled out for a more detailed look. This property is variously called the "missing mass"—by those who hold that the mass is actually present in some undetected form—or the "mass anomaly"—by those who are not sure whether there really is an undetected

source of mass or whether modern physics is really applicable in its present form on such a grand scale.

The mass anomaly is made evident by estimating the total mass of a galaxy or galaxy cluster by two different methods. The first of these involves a straightforward count of the members coupled with a mass estimate for each member. The second method is based on the dynamics of the system. In practice the two mass estimates differ by factors of two or more for galaxies, but 10 to 400 for galaxy clusters.

The Problem on the Galactic Scale

The smallest systems for which this phenomenon is currently recognized is for galaxies; in particular, the Milky Way. This is not because of anything special about galaxies or their sizes so much as that the next smallest system for which comparable dynamic data exist is the solar system. For the Galaxy the two methods of estimating the mass are as follows:

(1) The number of stars per unit volume in the neighborhood of the sun is counted. These are grouped into brightness classes via the mass-luminosity function.² Hence, given the luminosity (intrinsic brightness),

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the star's mass can be estimated and summing over all the types of stars per unit volume gives a stellar mass-density estimate. Add to this the gas density from radio and optical interstellar lines and a local density of about $6.0 \times 10^{-24} \text{ gm cm}^{-3}$ is arrived at.

(2) The second mass-estimating method involves using the space motions of the local stars relative to the galactic center as based on the analysis of 21-cm radio line profiles in the Galaxy and estimates of the distance from the sun to the Galactic center. This yields a force law or rotation-curve from which the amount of matter necessary dynamically to bind the system can be calculated. Doing so yields a local density of $10.0 \times 10^{-24} \text{ gm cm}^{-3}$ which, considering the range of individual density determinations, is about a factor of two greater than the count-mass.³

The Problem on the Galaxy Cluster Scale

The mass anomaly does not end there. Two orders of magnitude greater than the scale-length of a galaxy and 10^{10} times that of the solar system lies the scale-length of the galaxy cluster. Here, too, the mass anomaly is evident but to a far greater degree. There are now three methods for determining the mass of a cluster of galaxies.

(1) The first of these is analagous to the luminosity-determined mass-density for the solar neighborhood mentioned above. It involves a straight-forward count of the number of galaxies of each type in the cluster.

For each of these types one can derive an estimate of the mass-to-light ratio based on observing the rotation-curves of individual galaxies also by statistical velocity considerations of multiple galaxy systems. Given an estimate of the distance to the galaxy a mass-to-light ratio can be calculated. These, in turn, also appear to be on the high side.

It has been noted that the mass-to-light ratio for the Galaxy is about 2. More detailed analysis⁴ indicates a value of 3. The Galaxy is of morphological type Sb to Sc and the mass-to-light ratio usually assumed for an Sb galaxy is 20 while that for an Sc is 10. From the count of the galaxies in the cluster a total mass for the cluster can be derived. Intracluster mass is assumed negligible.

(2) The second method of determining the cluster mass is to invoke the virial theorem. The theorem was originally derived for application to the kinetic theory of gases but has found wide application in kinetics and dynamics. Basically, it amounts to balancing the gravitational attraction force by the centripetal force; but instead of using the orbital velocity directly, it is inferred from the radial velocity distribution and dispersion about the mean of the members of the cluster. Given the standard deviation about the mean velocity of the radial velocity distribution, σ , the mass, M_v , is given by:^{5,6}

$$M_v = 3 R \sigma^2 / KG \quad (1)$$

where R is usually taken to be the cluster radius, G is the gravitational constant, and K is a near-constant which is a weak function of galaxy size and estimates of which range from 0.29 to 3. Depending only in part upon the value of K assumed, the virial theorem mass-estimates can be from 10 to 400 times that of the "number-mass" estimates.^{7,8}

(3) The third method, presented for the first time in the preceding issue⁹ of the *Quarterly* and hereafter referred to as paper 1, involves observation of rotation of the cluster and computation of the amount of matter required to hold the system together. It yields mass estimates which are comparable to those obtained via the virial theorem and, for the Virgo cluster, it yields an empirical value for K of 0.96 ± 0.26 in Equation 1.

Missing Mass Proposals

A sizeable number of proposals have been expounded in an attempt at resolving the aforementioned discrepancy. The main concern here involves clusters of galaxies; so the problem will not be reviewed for individual galaxies. The latter case can, however, be considered as a subset of the former.¹⁰

(1) **Neutral hydrogen (HI) gas** If the missing mass were present in the form of neutral (unionized atomic) hydrogen then it should be directly observable by its 21-cm radio emission line. This has been searched for with negative results.¹¹

(2) **Molecular hydrogen (H₂) gas** The presence of a sizeable amount of molecular hydrogen would be difficult to detect directly from earth-based stations. It has been argued, however, that most of the hydrogen should be photodissociated into atomic hydrogen on account of the intense ultraviolet radiation from galaxies. Case 1 would then apply.¹²

(3) **Ionized gas** If the atomic hydrogen were totally ionized then there would be no 21-cm emission expected. X-ray observations have indicated the presence of ionized gas at temperatures of millions of degrees¹³ but the amount of gas indicated is far too little to account for the missing mass.^{14,15} Another problem with the ionized gas postulate in an evolutionary frame-work is that the gas does not get hot enough until the cluster has reached a point of maximum collapse. This takes about 25 billion years, more than the age of the universe according to commonly accepted estimates.¹⁶

(4) **Fine dust** If fine dust were a major constituent of the intra-cluster material then light passing through it should be reddened and dimmed; much more so than has been observed.¹⁷

(5) **Coarse dust** The presence of coarse dust would not directly effect the reddening of light. Indirectly, however, collisions of particles more than 10^{-2} cm in diameter would vaporize or pulverize the particles so that it is difficult to explain a sizeable amount of coarse dust without the presence of gas or fine dust, at least in a billions-of-years-old framework.¹⁸

(6) **Dwarf galaxies** In the vicinity of bright, nearby galaxies, dwarf systems exist. These tend to cluster in a broad cone about the polar axes of the bright galaxies.¹⁹ The problem of how such cones could originate or be maintained in an evolutionary frame-work aside, this indicates that such dwarf galaxies could possibly contribute sizeably to the cluster mass. A photometric study²⁰ of the Coma cluster indicates, however, that neither faint dwarfs nor intracluster stars could contribute significantly to the total mass of the cluster.

(7) **Black dwarfs** It has been suggested²¹ that the mass anomaly could be resolved by extending the theoretical lower limit to the mass of a star to the point that stars of

sufficiently small mass, from 0.1 to 0.01 solar mass, could form in sizeable numbers. These objects, intermediate between true stars and planets, would not be expected to start nuclear burning and would thus only radiate a negligible amount, cooling to invisibility after some 2×10^7 years.

These black dwarfs are postulated as being formed in globular clusters and then evaporating from their parent protogalaxies as a result of tidal shocks during collapse of the protogalaxy. The theory continues with the assertion that the parent protogalaxies are only able to become elliptical galaxies because observational anomalies would arise if black dwarfs were to form in the same way about spirals. This presupposes that a globular cluster which is in formation has some way of knowing whether or not its protogalaxy is going to become an elliptical or not.

It has also been noted that the presence of black dwarfs could account for the mass anomaly within the Galaxy itself, but if this were so then they must be strongly concentrated toward the galactic plane,²² an observation which runs contrary to the proposed production mechanism.

(8) **Neutrino rest mass** It has been proposed²³ that neutrinos may not really be massless particles but that they may have a rest mass of the order of 10^{-33} to 10^{-32} gm. A rough estimate of the neutrino flux of about 10^6 neutrinos $\text{cm}^{-2} \text{sec}^{-1}$, can be arrived at on the assumption that for every neutron in the cosmos there exists a neutrino which was released upon formation of that neutron.²⁴ The resulting 1 MeV* per neutrino in the flux might close the universe as well as account for the missing mass.

A recently published report²⁵ which indicates that the neutrino is massless cannot be invoked here as contrary evidence since the upper limit on the neutrino rest mass which resulted from that experiment is several orders of magnitude greater than that proposed.

The theory that a rest mass is proposed for a neutrino at all is the result of an interesting inconsistency in relativity theory. According to said theory massless particles such as a photon should not exhibit a gravitational field.

Hence, it is understood that in order for a neutrino to be able to contribute to the gravitational field of a galaxy cluster it must have a rest mass. The inconsistency arises when one notes that his contradicts Einstein's hypothesis that mass and energy are interchangeable; the test of which is the deflection of a ray of light in a gravitational field.²⁶ This, then, is still an open question, albeit it doesn't work for the galaxy case.

(9) **Black holes** Two mass ranges of black holes have been considered. On the basis of tidal distortions in member galaxies it has been demonstrated²⁷ that the number of objects, other than galaxies, with masses in the range of 10^8 to 10^{13} solar masses in the Virgo cluster is negligible. This would include massive black holes.

The case of less massive black holes has also been considered²⁸ but is far less conclusive and is based on a uniformitarian approach. The expression for the mass loss

as a fraction of the total mass, $\delta M/M$, is:

$$\delta M/M \cong Gm^2/MRv^2 \quad (2)$$

where m is the mass of the black hole, M is the mass of the galaxy, R is the radius of the galaxy, and v is the collision velocity. This equation, then, describes the evaporation of stars and black holes from a galaxy. Dr. Peebles concludes that the results are reasonable in an evolutionary framework and hence that the missing mass could exist in the form of small black holes.

This indicates that from 90 to 99.8 percent of all the mass in the cluster (and the universe) is trapped in black holes. This seems extremely high. One could also expect that the black holes might tend to cluster into separate systems but these systems would be subject to the limitations delineated above for the case of massive black holes. A major fraction of the mass in the form of black holes should produce a tremendous flux of x- and γ -rays, but no such flux has been identified (see point 3).

(10) **Mass loss by gravitational radiation** The possible detection of gravitational waves from the galactic center has led to another proposed source of missing mass. If the source of the observed radiation radiates isotropically, then the resulting energy loss would be equivalent to an annual mass loss of 100 solar masses. Assuming that the mass loss rate obeys an exponential decay law, the remaining mass, M , as a function of time, t , is given by:²⁹

$$M = M_0 e^{-t/\tau} \quad (3)$$

where τ is a time constant and M_0 is the initial mass of the galaxy.

At a loss rate of 100 suns per year per galaxy τ is 10^{10} yr and half the mass of the cluster would be lost after 8×10^9 years. Furthermore, by 6.2×10^9 years the cluster would become unbound; but no great change in cluster radius would be expected by 8×10^9 years by which time the mass anomaly would be a factor of 7.

For the mass loss rate of 100 suns per year per galaxy, the mass remaining after 8×10^9 years would only be $0.0003 M_0$. For a single galaxy, then, M_0 would have a value of 10^{14} suns, about a tenth the mass of the larger galaxy clusters today.

The cluster would become unbound after only 0.68×10^9 years and would be virtually unrecognizable as a cluster after 8×10^9 years, when the anomalous mass ratio would only have a value of 70. This latter value is closer to observation, than the former; but one can also recognize galaxy clusters quite distinctly, so that if mass loss by gravitational radiation is confirmed and found to be a general property of galaxies then here, too, a young age is indicated for galaxy clusters. Needless to say, if not all galaxies lose mass at the prescribed rate, then gravitational radiation cannot explain the mass anomaly.

It should be noted that if the galaxy were radiating mass at a rate of 100 suns per year and if it had been doing so for a long time, then the galaxy should be expanding. This effect has been looked for³⁰ and the result is negative; if anything it is contracting. It could not have been expanding for more than 10^7 years. It would seem that gravitational radiation cannot account for the mass anomaly.

*MeV means million electron volts. An electron volt is the energy given to an electron by accelerating it through a potential difference of one volt.

(11) **Errors in the cosmic distance scale** This proposal is probably the most abhorrent to most astronomers. If the distance estimates to the clusters were about a tenth that of current estimates then the mass anomaly would disappear. There are several objections to this proposal.

First, it would indicate that the Galaxy is one of the largest in the cosmos. Second, if the universe were 10 times smaller and still expanding at the present held rate, then the currently held cosmic time scale would also be reduced to a tenth of its present value.

The expansion rate, as well as the distance scale, are all based on a 7-step progression beyond the distance scale of the solar system. These are: parallax and proper motions; zero age main sequence (ZAMS) fitting; cepheid variables in our own and nearby galaxies; brightest stars; H II regions; bright Sc galaxies; and brightest elliptical galaxy in a cluster.

The error introduced at each step varies somewhat but averages about 10 per cent. Normally one might expect that this range would be too high in one step and too low in another so that in toto the errors would cancel. Estimates hover about 30 per cent to the most distant galaxies.³¹

It should be noted, however, that after the de-centralization of the earth with the Copernican revolution, there has been a steady view that neither sun nor Galaxy should occupy any special or central location. Also, to preserve the billions-of-years-old-cosmos hypothesis, a large cosmos is required.

As it is, the expansion age of the universe is less than that estimated by other methods.³² All this contributes to the errors being on the high side; acting in the same direction. This would indicate that the actual cosmic distance scale could be as small as $0.9^7 = 0.48$ that presently assumed. In this light a factor of 10 or so in not as improbable as might be suspected at first sight.

Missing Physics Proposals

(12) **Matter-antimatter repulsion** The proposal³³ assumes that a significant fraction of the cosmos is made up of antimatter and that matter (koinimatter) and antimatter repel each other gravitationally. This has yet to be shown. If there were a sizeable antimatter component in the universe, however, cosmic rays should contain some antimatter which is not observed.³⁴

The proposal would require matter and antimatter to coexist in the same cluster. Interactions between galaxies in the same cluster are believed to be common on a uniformitarian time scale, but none which have been proposed as interacting systems exhibit any energy flux which would require matter-antimatter galaxies to explain. Interaction between matter and antimatter would place many of the same constraints as were covered in topic 10 on the clusters.

(13) **A non-zero cosmological constant** This suggestion is a particular one of a set which can be classed as proposed modifications of the Einstein field equations.³⁵ It is the only one currently under consideration. Originally the cosmological constant was introduced into the field equations by Einstein to account for both Olber's paradox, and to answer the question as to why the cosmos had not collapsed inward over the billions of

years of existence. It postulates that at large distances matter repels rather than attracts.

When it was decided that the universe was expanding the constant was no longer needed and it dropped from vogue; but with the advent of the mass anomaly it was reinstated, but with a sign change, making it an attractive force. Simply put, the force term, including the cosmological constant, λ , is:

$$F' = \lambda mr/3 \quad (\lambda < 0) \quad (4)$$

where F' is the force per unit mass, m is the particle mass (galaxy mass in this case) and r is the position vector. The force law predicts that at large values of r , the velocity, v , should be directly proportional to r . This is not confirmed in paper 1 which yields:

$$v(r) \propto r^3/\exp[(3/2n)r^n] \quad (5)$$

where n is a constant of the observed rotation-curve. Hence it appears that a cosmological constant cannot account for the mass anomaly.

(14) **Changes in the Newtonian force law** These are of two types. One involves changing the exponent of the radial term in the denominator of the force expression and the other involves the variable G proposal. Although no continuous (as a function of size or diameter) modification of the gravitational law has been proposed, a specific modification for the case of a cluster of galaxies has appeared in print.³⁶ The proposed formulation is that the force, F , is given by:

$$F = G'Mm/R^z \quad (z < 2) \quad (6)$$

where M is the mass of the cluster interior to a radial distance, R , from its center; m is the mass of a galaxy, and z is a constant. G' is a different value of the gravitational constant from that which would apply for the solar system. In particular, a value of $z = 1.7$ appears to fit through a plot of the anomalous mass ratio versus cluster radius. But it has been noted³⁷ that the above relationship predicts that the mass-ratio be independent of the velocity dispersion; a conclusion which runs contrary to observation.

The variable G hypothesis has been indicated recently as quite a viable explanation from a uniformitarian framework.³⁸ Based on lunar occultation studies, Thomas van Flandern of the U. S. Naval Observatory announced evidence of variation in the gravitational constant at the 1974 meeting of the American Astronomical Society in Rochester, New York, indicating a rate per unit G of $\dot{G}/G = -(7.5 \pm 2.7) \times 10^{-11} \text{ yr}^{-1}$. This can translate into an effective expansion to a system of $73 \text{ km sec}^{-1} \text{ megaparsec}^{-1}$, a number comparable to estimates of the expansion rate of the universe (the Hubble constant).

If van Flandern's variability of G is confirmed in later work then the Big Bang hypothesis will effectively be disproven and evolutionists will have to consider a new type of cosmogonical model. Outside of Special Creation the Hoyle-Narlikar model appears to be indicated. This proposal can apparently deal with the phenomenon of the mass anomaly on the galaxy cluster scale. It cannot deal with chains of galaxies with discordant redshifts. Neither can it deal with the mass anomaly in galaxies.

Implications for a Young Earth

In the past, the mass anomaly has been used in support of a young-cosmos hypothesis. It was argued that given the conditions inside a cluster of galaxies revealed by the application of the virial theorem, the mass anomaly indicated that the clusters are not bound and that in a billions-of-years-old universe they would have dissipated long ago. With the discovery reported in paper 1 that clusters of galaxies exhibit a rotation-curve, this approach has suffered a set-back. In paper 1 it was noted, though, that two other problems arose for evolutionists.

At present the mass anomaly appears to mean that astronomers do not understand the cosmos well enough to draw any definite conclusions. The fact that gravity is so poorly understood that it cannot be related to other fields (forces) underscores this point. The cause of a variable G , if confirmed, is totally unknown. To Creationists it would not seem possible that variable G could account for the mass anomaly, since the implication would be that galaxies have been around long enough that such a slow rate of change could occur.

The problem could simply be one of perspective. As Shakespeare put it: "The fault, dear Brutus, is not in our stars, but in ourselves . . .".³⁹ Man tends to view time as a unidirectional flow of events. If, however, it is part of a four-dimensional continuum, there might be longer and shorter time-paths between the same events. It would be somewhat as in a baseball diamond; from home to third the right way around is 270 feet, but only 90 the reverse way.

In any case, no satisfactory suggestion has been made which can account for the mass anomaly. Some seem most attractive, such as the distance-scale and variable G proposals, but the last word is still far from in. It is an extremely fundamental consideration, and there is some evidence that the mass anomaly may even occur in star clusters^{40, 41} although the ratio there only appears to be about 1.7 ± 0.2 . After all who today is really any closer to understanding what mass and inertia are than Newton was?

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Note added in proof. Recent X-ray observations [1977, *Science News* 112(3):36] have produced evidence that a hot medium may be present in galaxy clusters, having possibly 5 to 20 times the mass observed at other wavelengths. While this is held to be enough to account for the missing mass, a factor of 10 is the minimum discrepancy observed. The average exceeds a factor of 100; so the X-ray observations would account for only about 10% of that. Since the temperature is estimated to exceed 60 million degrees, the age constraint mentioned in proposal (3) applies.

THE DIFFERENCE BETWEEN ACQUIRED CHARACTERISTICS AND MUTATIONS

WILLIAM J. TINKLE*

Received 25 May 1977

Studies on mutant plants have been reported previously in the *Quarterly*.^{1,2} It was found that mutants were less vigorous, less fruitful, and generally less viable than normal plants.

However, not all changes are mutations. Characteristics may be acquired, maybe by some accident. These are not transmitted to offspring. The present studies illustrate that not all differences are due to mutations. They also suggest that a study of the next generation is a good way to see whether a change is in fact a mutation.

When the previous studies were reported the reports dealt with tomato, *Esulentum*, and campion, *Lychnis alba*, which came up with three cotyledons instead of the normal two. Observation in following generations established that this character is a mutation, recessive and mildey harmful to the plant in that less fruit and seed are produced; also that the mutant plant has less vigor in that it is harmed more than the normal plant by transplanting, lack of light, and cold temperature.

New Observations

In 1976 and 1977 I have made observations on a plant of the Solanaceae family popularly known as sweet pepper or mango. A plant came up with but one cotyledon, and half sized, instead of the normal two. While it is evident that extra cotyledons must be due to a mutation in the gene, this change was not so easily classified; it might be due to an accident in growth.

Geneticists are agreed that changes caused by the environment, or use or disuse, acquired characters, are not inherited by the offspring.³ Such changes do occur and sometimes are large; but they do not appear in

future generations in the absence of the environment which called them forth.

To learn more about this sweet pepper plant with but one-half cotyledon I planted it beside a plant with two normal cotyledons, having no other striking difference in morphology. At the end of the season I counted the seeds produced: two cotyledon plant: 139; one-half cotyledon plant: 208.

Such a difference might be significant if one were comparing large groups of plants which differ in only one character; but in small numbers of individuals it may be due to hereditary dissimilarities other than cotyledons. Again, in a pure line, where the plants all have like genes, due to self pollination and selection, such a difference should not be ignored.

Another Planting Results

I planted a number of seeds from both plants. All the resulting plants (17 from the one-half cotyledon plant, 6 from the other) had two cotyledons. I interpret these results to show that the loss of 1½ cotyledons was due to an accident; that this is an example of an acquired character and not a mutation. Of course such a conclusion could not be drawn from the appearance of an *extra* part which appears in future generations.

There should be more studies of variation. In scientific literature there are many reports of mutations; but often they stop short of telling whether these are harmful or beneficial.

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SEVENTEEN PROBLEMS FOR EVOLUTIONISTS

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This article is mainly a survey and review of portions of the literature of particular interest to creationists. As a teacher the author found that textbook authors present evolution as an assured fact, and rarely mention any problems or objections which might be raised. But there are many problems, which, in the author's opinion, are fatal to the dogma of evolution. Some of those problems are presented and discussed.

Statement of the Question

There are two commonly held definitions of "evolution". One indicates *variation or genetic change observable in a kind*. The other, more popular conception of evolution, is that of *general evolution with great*

changes over vast epochs of time to account for all living things from a common ancestry which arose by biochemical evolution.

Natural selection operating on gene mutations and gene combinations is the proposed mechanism for evolution. Authors of the *B.S.C.S. Text - Yellow Version* for instance, takes this position (see Figure 1):

Selection, whether artificial or natural, sorts out particular gene combinations, and so can bring about genetic differences between different lines

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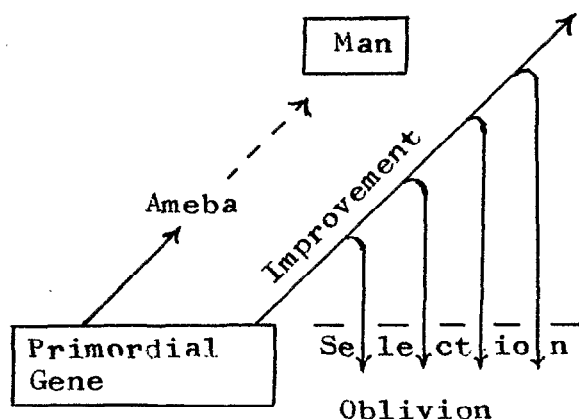


Figure 1. Evolutionists claim that, beginning with some primordial gene, the numbers, kinds, and combinations of genes increased, to the stage of ameba, and eventually of man. Meanwhile natural selection acted as a sieve, to sift out bad genes. But who ever heard of a sieve creating anything new?

derived from the same population. Each selected line has less variability than the unselected population from which it was derived. If selection does not occur too rapidly, mutations, can gradually replenish the store of genetic variability and make still further selection possible.¹

Experiments on the artificial selection for oil content in corn are used as an illustration of a sorting out of particular gene combinations.

In corn, selection had a strong effect and was still producing some changes in the population even after 45 to 50 generations of continuous selection.²

The authors also state that it is not very likely that mutations caused the changes in the oil content. Instead, "all or nearly all have existed in the population before selection began".³

These lab experiments demonstrate that selection can operate on gene combinations and thus produce variations in population. Also, the effect of selection within a kind seems to be limited. Lammerts⁴ states that most have modifying effects and selection can only produce limited results. He gives bud length in roses as an example. The ultimate length in buds is achieved in five or six generations. Also, yield in corn is limited at the point at which all major factors for yield have accumulated through sexual reproduction.

It would seem that genetic recombination through sexual reproduction only produces variations within a kind; and that selection of different gene combinations is only effective up to a point.

The only other possible source of genetic variability, on which natural selection can operate, are mutations. There are three basic kinds of mutations known to occur: (a) structural chromosome changes, (b) gene mutations, (c) changes in chromosome number. But there are problems.

Problem One: Structural Changes in Chromosomes are Most Often Deleterious and at Best Only Produce Variation Within a Kind

Structural changes in chromosomes involve chromosomal rearrangements such as inversions, translocations, deletions, duplications or combinations of these.

Deletions occur when a portion of a chromosome breaks off and is lost. An inversion occurs when a portion of a chromosome broken off, reversed and then attached on the same chromosome. A broken piece of chromosome could also become attached to the homologous chromosome (duplication) or to a non-homologous chromosome (translocation).

John N. Moore states that all reports on structural changes in chromosomes show that these changes are only effective in producing variation within a species or genus. "Never do we find reports of research on structural or numerical changes of chromosomes that may be used to document any true genetic relationship between major groups of animals or major groups of plants".⁵

The argument that structural changes in chromosomes can provide sufficient genetic material for general evolution is not based on any present empirical data.

Problem Two: Observed Mutations Have Resulted in Changes Only in Existing Traits

Gene mutations involve a permanent inheritable change in a gene. Many evolutionists state that gene mutations are the main source of genetic variability. Moore⁶ quotes Dobzhansky:

Replication of genes has long been recognized as an important evolutionary (phylogenetic) process. On the *assumption* that primordial life was represented by a single gene, the thousands of different genes now found in the same gamete in most organisms must be the diverged descendants of the primordial gene.⁷ (Emphasis added)

Moore⁸ states moreover that all known gene mutations result in no new traits but only changes in existing traits. He cites reports such as Potter⁹ and Taylor¹⁰ in this respect.

Dowdeswell¹¹ states that gene mutations are confined to a "comparatively small and limited range of possible changes". Also, successive mutations show no directional trend and mutations are *restricted* to specific loci. This point is very important, but often overlooked.

Klotz¹² quotes Carson, "One of the great dilemmas that modern evolutionary theory has had to face is the fact that most of the mutations found repeatedly, for instance, within populations of different *Drosophila* species, do NOT constitute the kind of differences which distinguish species".¹³

Problem Three: Mutations Are Harmful or Useless

Dowdeswell states:

Some mechanism for the perpetuation of mutant genes is essential as a basis for genetic variation. Indeed without it our whole concept of particulate inheritance would be meaningless. Realization of this has prompted *widespread experimental studies during recent years*; the results obtained have certain fundamental features in common. Of the many mutants detected in the laboratory, all are either recessive or "semi-dominant", and the majority cause harmful physiological effects, hardly any have ever been observed which could possibly be

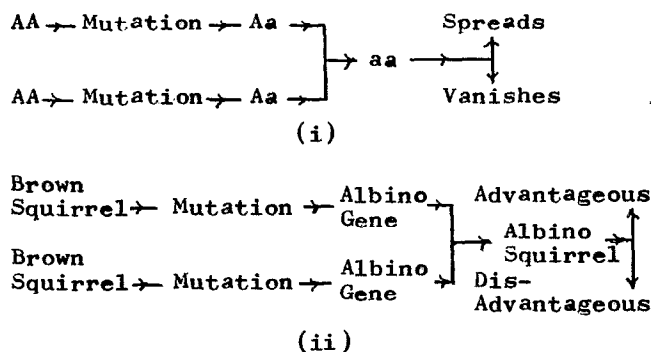


Figure 2. A mutation might change a gene A to a neutral recessive gene a. If two a's should come together in sexual reproduction, a mutated organism would arise, as shown in (i), and if the environment should become favorable it would spread; otherwise it would vanish. Part (ii) shows how it is suggested such a thing might happen with squirrels, if some change should give them a light coloured background.

beneficial to an organism under wild conditons.¹⁴ (Emphasis added)

Dowdeswell then goes on to state that caution should be used in interpreting data. he argues that (a) most present day mutations have taken place before, (b) any beneficial mutation is incorporated very quickly in the population, and (c) such beneficial mutations become progressively less apparent for study since they have been already preserved and incorporated.

One thing is very clear, evolutionists have made predictions in genetics, and conducted widespread experiments; but their dogma has failed the empirical tests. So, to preserve the "theory", they find it necessary to pile one hypothesis upon another. How could one know that beneficial mutations have taken place before, and that they have been incorporated very quickly and are now less apparent for study? Clear-cut beneficial mutations are exceedingly difficult to demonstrate. Most often evolutionists write about "neutral mutations" which exist supposedly in the popultion till an environmental change occurs at which time they *may prove* adaptive.

Lammerts states that the "enthusiasm for demonstrating evolution by a study of induced mutations has died out, since clear-cut cases of obviously advantageous mutations simply do not occur".¹⁵ His work with roses shows that although induced mutations may have horticultural value, they are always less viable or fertile than the original. Many similar studies could be cited.

Recent studies on bacterial resistance to penicillin by way of induced mutations have been cited as examples of beneficial mutations. (Also described thus on page 578 of *B.S.C.S. Yellow Version*). But more recent studies¹⁶ indicate that this is not due to exposure to penicillin; but rather that the mutations occur at a constant rate.

Also, resistant strains have decreased viability under normal conditions; and thus the population soon reverts back to normal type soon after treatment is relaxed or stopped. The B.S.C.S. authors also discuss resistance to DDT exposure. "Here a miniature evolution unfolds before our eyes."¹⁷ Klotz¹⁸ discusses studies which indicate that resistance to DDT declines with time. Some researchers suggest that DDT itself initiates the production of certain DDT-resistant factors in the cytoplasm.

Thus DDT resistance as "miniature evolution" could be questioned.

Gish¹⁹ cites Thompson as stating that "all mutations are either useless, harmful, or lethal".²⁰ Some evolutionists state that over 99% of all mutations are harmful. Thus to say the least beneficial mutations are indeed rare.

B.S.C.S. Text - Yellow Version does not present the student with one single clear cut case of a beneficial mutation. Instead the authors *suppose* a situation of pre-adpion where a mutation would be neutral and recessive thus enabling it to exist in the population till an environmental change would occur. Simultaneously with this *favorable environmental change* would be the coming together of these two *now beneficial recessive mutant genes* through sexual reproduction (see Figure 2). No example of this ever happening is given and for very obvious reasons.

Problem Four: The Mutation Rate is Very Low

Gish²¹ cites Tinkle's work on *Drosophila* which shows "that the mean life of a gene (that is, the average time elapsing without change in any particular gene and its descendants) approximates 100,000 years".²²

The frequency of mutations is estimated as 1 in 100,000 gametes per generation. When one considers mutation rate and frequency of mutations together with the observation that well over 99% of all mutations are harmful, it is of "little wonder" that evolutionists like Goldschmidt realize that evolution by way of micro-mutation and natural selection is just too slow, even if one provides for vast epochs of time. However, if one *assumes* enough gametes, in enough generations, over a long enough period of time, some change may seem possible.

Problem Five: Homozygous Mutants Would Tend to Eliminate A Species

Even allowing for 1 in 1000 mutations to be of an advantage, it would seem that in only a few hundred generations, homozygous genotypes having a harmful effect would result and outweigh the advantageous ones, and thus tend to eliminate the species. That this has not yet happened may indicate a relatively short time of a species (Figures 3, 4 and 5).

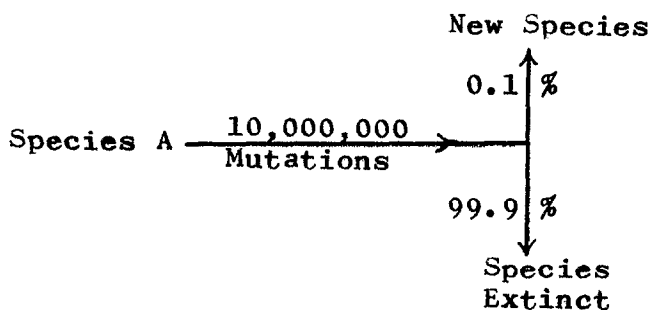


Figure 3. Only something like 0.1% of the mutations would be favorable, possibly leading to a new species. The rest are likely harmful, and would lead to extinction.

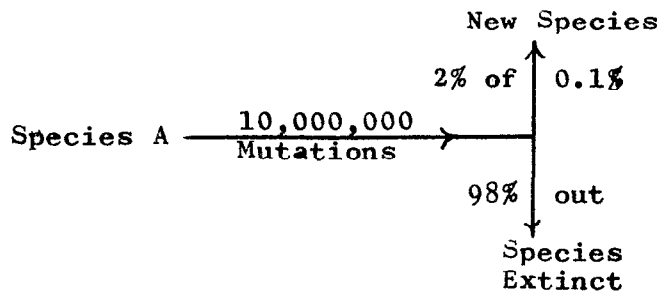


Figure 4. Moreover, the good mutations proposed in Figure 3 were along with bad ones, and would tend to be eliminated along with them. In fact, in the case proposed here, only about 2% of 0.1% of the original mutations would be good ones which would survive.

Problem Six: Mutation, Organismic Complexity and Adaptation

Another problem with gene mutations as the source of genetic variability for general evolution is cited by Lammerts. "The more complex the organism the less chance there is for mutations to occur of advantage even under new environmental conditons."²³ Also, some evolutionists²⁴ believe that due to selection of mutation suppressors, the rate of mutation decreases as a population becomes adapted and established. If this is so, it would seem that evolution would become increasingly more difficult, thus adding to the problem of time.

Problem Seven: Any Mutation is Likely to Upset the Delicate Gene Complex

The term gene complex refers to the sum total of all genes possessed by an organism. Any change in a gene affects the delicate balance of the whole gene complex and thus the steady state of the organism. The larger the change in the gene, the more likely it is to prove harmful. The suggestion that macromutations could account for the "explosive jumps" in the fossil record is certainly open to debate—especially in view of what is being learned about the many beautifully balanced physiogenetic systems in living organisms, which would have to mutate together.

Problem Eight: The Origin of Dominance Does Not Have a Suitable Explanation

Klotz²⁵ discusses the suggestion by Ford that a dominant gene can arise from a gradual process by which a recessive gene becomes neutral and then eventually becomes dominant. Other investigators suggest that certain suppressor genes cover up harmful mutations while other enhancer genes increase the potency of others and thus gradually transform some genes into recessive genes while others become dominant. Klotz then cites a critique of the above suggestions by Wright and Haldane.²⁶

Most wild type genes are dominant and most mutations are recessive. A dominant mutation would seem to have lethal effects on the balanced physio-genetic system of an organism. Klotz concludes that the origin of dominance does not have a suitable explanation at the present time.

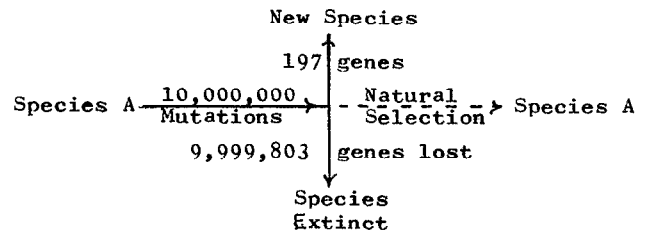


Figure 5. As for natural selection, it acts much more to preserve the status quo. For, as shown in Figures 3 and 4, only a few of the new genes survive; the net effect is to keep species A much as it was.

Problem Nine: Reverse Mutations Add to the Problem of Time Required For Mutations

According to Klotz²⁷ some evolutionists, such as Romer, give paleontological evidence for reversal of evolution. Klotz also discusses Muller's²⁸ research which indicates that most mutations in *Drosophila* are capable of reversing and that very often they revert back to the original gene. Others state that, in spite of reverse mutations, it is difficult to imagine evolution as actually reversing, since it would require identical or similar environments occurring two times. In any case, if a mutation takes three steps forward and then two steps backward, the problem of "waiting" is increased.

Problem Ten: Polyploidy is an Evolutionary Dead End

Polyploidy is also cited in B.S.C.S. texts as a proposed source of genetic variation. *Raphanobrassica* is given as an example. This plant is the F_2 plant of a cross between a radish and a cabbage. (See page 602 *B.S.C.S. Yellow Version*). In this experiment haploid gametes ($n = 9$) from a radish and haploid gametes ($n = 9$) from a cabbage produce a sterile F_1 hybrid ($2n = 18$). Occasionally this F_1 hybrid produces a diploid gamete ($2n = 18$), two of which may fuse to produce a F_2 plant ($2n = 36$) (See Figure 6).

The *Yellow Version B.S.C.S. Text* states that this F_2 plant is a distinct species because fertile offspring cannot be formed when it is crossed back with the original diploid and because it is fertile with itself and breeds true.

Lammerts²⁹ cites a more detailed study by Richaria and Howard³⁰ in which they obtained quite different results: (a) Many of the F_2 had fewer than 36 chromosomes; (b) Pollen of these plants with 36 chromosomes had from 17 to 19 chromosomes, not just the 18; (c) the F_2 plants were only partially fertile; (d) the F_4 plants had chromosome number of 33 to 37 and their fertility varied from 5 to 42%. Thus it would seem that the claim that a new genus or species had been produced is open to question.

Perhaps many polyploid species are not really different species but only different races or ecotypes of the same species. For example, Hancock³¹ describes three races of *Galium palustre*. The diploid ($2n = 24$) is found in damp places, the tetraploid ($2n = 48$) is found in wetter areas and the octoploid ($2n = 96$) is found in permanently wet areas.

Also, Lammerts³² cites some recent investigations which indicate that some so called polyploid species

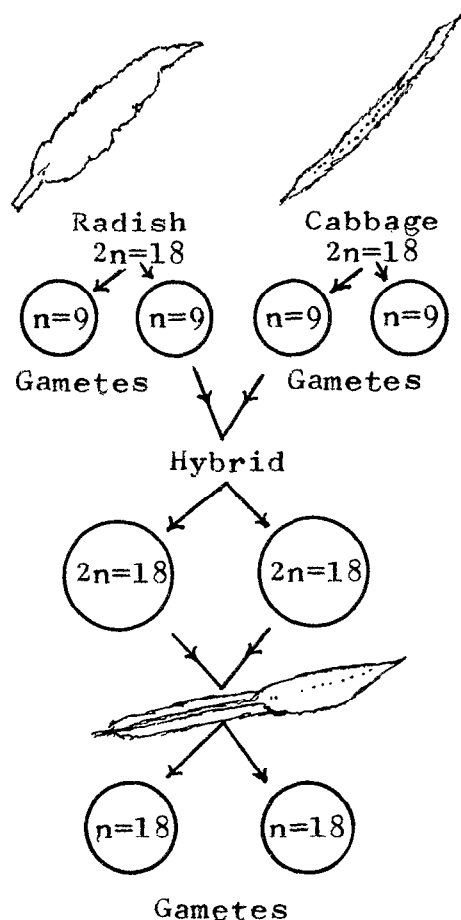


Figure 6. This shows how the radish and cabbage are supposed to produce a hybrid. The F_1 hybrid is usually sterile. But if it is fertile, an F_2 hybrid can be produced, and claimed to be a new species. But see the problems under "Problem Ten".

may not be the results of polyploidy but rather the result of a loss of chromosomes.

Colchicine treatment of plants has produced polyploidy in plants by inhibiting the development of the spindle, thus the chromosome number doubles. However, these tricks are artificial and cannot be used as evidence for polyploidy as a source of genetic variability in nature.

Aneuploidy occurs in a species where the chromosome numbers are not multiples (See Table 1).³³ The differences between these races are sometimes quite small.

Another kind of polyploidy is allopolyploidy (See Table 1). Here, two fertile species are crossed producing an infertile F_1 (a result of a lack of homology in chromosomes). The F_1 chromosome number then becomes doubled through some irregularity. Thus the cell can undergo homologous pairing during meiosis producing gametes. For example, when *Triticum* (wheat) ($2n = 42$, $n = 21$) is crossed with *Secale* (Rye) ($2n = 14$, $n = 7$) the F_1 diploid zygote ($2n = 28$) doubles its chromosome number and becomes Triticale (rye-wheat) with $2n = 56$, an allotetraploid.

Some cytologists and geneticists have made much of chromosome homology studies. In these studies the claim is that a relationship of two species can be inferred where the F_1 hybrids show loose pairing of

Table 1. this shows and compares the complement of chromosomes for the various basic types of polyploidy. In the right-hand part, C, B, A, and S are nonhomologous chromosomes. See reference 33.

Type of Polyploidy	Shorthand Formula	Chromosome Complement
Aneuploidy		
monosomic	$2n - 1$	(CBAS)(CBA)
trisomic	$2n + 1$	(CBAS)(CBAS)(C)
tetrasomic	$2n + 2$	(CBAS)(CBAS)(C)(C)
double trisomic	$2n + 1 + 1$	(CBAS)(CBAS)(CA)
Euploidy		
monoploidy	n	(CBAS)
diploid	$2n$	(CBAS)(CBAS)
triploid	$3n$	(CBAS)(CBAS)(CBAS)
autotetraploid	$4n$	(CBAS)(CBAS)(CBAS)(CBAS)
allotetraploid	$4n$	(CBAS)(CBAS)(C'B'A'S')(C'B'A'S')

chromosomes during metaphase of meiosis. The argument is that these chromosomes are at least partially homologous and thus the species are related.

Lammerts³⁴ describes a number of studies which indicate that this is non-homologous pairing, occurring at a stage at which the cells' regulatory mechanism normally would cause orderly pairing. However, when only non-homologous chromosomes are present, partial pairing may occur as a result of the functioning of this regulatory mechanism.

Lammerts identifies some criteria for an amphidiploid (See Table 1) to qualify as a species "(a) the original F_1 hybrids should show no pairing, yet give a reasonable percentage of diploid gametes, (b) the experiment should insure conditions such that *only* self-fertilization should occur, and (c) fertility and vigor of the F_2 should be at least comparable to that of the diploid species."³⁵ Using these criteria, some polyploid species may not actually be different species from the diploid but only races or subspecies.

Klotz³⁶ cites the work of Ehrlich and Holm³⁷ on polyploidy. It would seem from their work that polyploidy is generally disadvantageous. Klotz also states that polyploidy is an evolutionary dead end.

SRB, Owen and Edgar³⁸ state that, even though a third or more of the species of angiosperms are polyploids, one must observe caution in using this as an argument for the evolutionary significance of polyploidy. A number of problems are discussed:

- Autoploidy adds no new genes to gene complexes.
- The phenotypes of autoploidy are usually just exaggerations of what is already in the diploid.
- Allopolyploids are most often intermediates having no really new characteristics.
- Polyploidy once developed makes for a certain kind of inflexibility. Mutations to the recessive form of a gene have a reduced chance of expressing themselves phenotypically in polyploids.
- One of the frequent immediate consequences of polyploidy is reduction in sexual fertility.
- Polyploidy seems to become established more readily where asexual reproduction is possible. Thus there is also loss of genetic recombination through sexual reproduction.

Table 2. This is a list of the chromosome numbers in various species of animals and plants.

Species	Number (2n)
Copepode - crab	6
Drosophila	8
Broad bean	12
Garden pea	14
Onion	16
Corn (maize)	20
Opossum	22
Tomato	24
Mink	30
Fox	34
Pig	38
Mouse	40
Rat	42
Rabbit	44
Man	46
Deer mouse	48
Striped skunk	50
Spectacled bear	52
Cebus monkey	54
Donkey	62
Horse	64
Aulacantha Protozoa	1600

Klotz³⁹ discusses research and observations on polyploidy by Stebbins. It would seem that changes necessary to produce new genera, families, orders, and phyla probably did not come about because of polyploidy.

Problem Eleven: Chromosome Number and DNA Content Vary Widely Between Alleged Evolutionary Levels

According to the monophyletic explanation of relationship of living things, present day organisms evolved from unicellular organisms. Thus one would expect an increase in chromosome number and DNA with increased complexity. J. N. Moore⁴⁰ shows that there just is no pattern with respect to chromosome number or DNA content (Tables 2 and 3).

Some evolutionists hypothesize genetic redundancy at lower levels. However, J. N. Moore quotes Dobzhansky as stating "whether or not redundancy increases systematically from the less complex to the more complex organisms remains to be seen".⁴¹ Here again is an untestable spin-off hypothesis to account for data which contradict the evolution model. It would seem that present data best fit a polyphyletic explanation of variation within a kind.

A study of gene mutations, structural changes in chromosomes, and numerical changes in chromosomes shows that the genetic variability of a species is limited to variations within a "basic kind". Even allowing for "great" beneficial mutations and great epochs of time,

Table 3. This shows the estimated amounts of DNA, in units of 10^{-12} gram, per haploid chromosome complement, in various animals or other cell types.

Amphiuma	84
Protopterus	50
Frog	7.5
Toad	3.7
Man	3.2
Cattle	2.8
Green turtle	2.6
Carp	1.6
Duck	1.3
Chicken	1.3
Sea urchin	0.90
Snail	0.67
Yeast	0.07
Colon bacteria	0.0047
Bacteriophage T2	0.0002

can natural selection change one kind of organism into another?

Problem Twelve: Even Allowing for Beneficial Mutations, Natural Selection may be too Slow to Account for Alleged Evolution

One problem with natural selection is the rate. Howe and Davis⁴² cite a calculation by Klotz⁴³ of 1,000,000 generations for a recessive gene, with a generous selection coefficient of .01 to pervade 99.9% of a gene pool. (1% would mean that 1000 *aa*'s will survive for every 990 *AA* or *As*'s.) Also, Dodson⁴⁴ calculated 321,444 generations for a slightly helpful recessive gene to go from the level of .000,001 to .000,002 (from one in a million to two in a million) in the gene pool. Howe and Davis⁴⁵ conclude that a bear that gives birth to its young once each year would require 1,000,000 years to establish a new gene throughout all or nearly all of its population (See Figure 7).

Also, if it requires 1,000,000 years for one rarely occurring beneficial mutation to permeate a gene pool, one must seriously question Simpson's⁴⁶ estimation of 6,250,000 years for the production of a genus. Howe and Davis state how Simpson gets around this problem in the alleged evolution of the horse. Simpson estimates enough mutations (1,500,000) in enough individuals (1,500,000,000,000) to change *Hyracotherium* (an animal very similar to the *Hyrax* of today into the modern horse. But has he not just assumed natural selection and then calculated the mutation rate required?

A similar problem occurs when one tries to account for the "explosion" of fossils, of all major groups and subgroups of fishes, reptiles, amphibians, birds and mammals supposed to have evolved in a similar short period of time.

A number of evolutionists realize the above problem. Dodson⁴⁷ quotes Dobzhansky "... the number of generations needed for the change may, however, be so

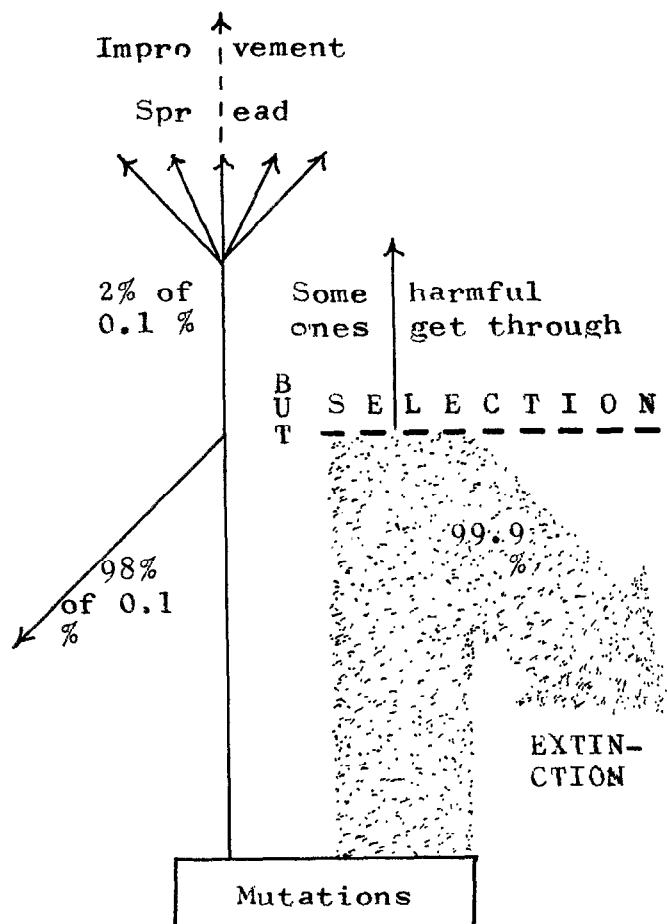


Figure 7. This illustrates how most of the mutations, good or bad, are lost, only a tiny fraction getting through to produce anything. But despite that, some bad ones do get through, as well as the good ones which are supposed to spread and to lead to improvement. This causes problems, as discussed "Problem Four", "Problem Five", and "Problem Twelve" in the article.

tremendous that the efficiency of selection alone as an evolutionary agent may be open to doubt, and this even if time on a geological scale is provided".⁴⁸

Gish⁴⁹ cites Goldschmidt as an ardent evolutionist who has argued a strong case against the neo-Darwinian natural selection mechanism of evolution, accepted by 99% or more of all evolutionists.

The facts of greatest general importance are the following. When a new phylum or other class appears, there follows a quick, explosive (in terms of geological time) diversification so that practically all orders or families known appears suddenly and without any apparent transitions.⁵⁰

Gish states the following:

Dr. Goldschmidt believed that all the major animal types must have evolved instantaneously. He called his mechanism the "hopefully monster" mechanism. He proposed, for example, that at one time a reptile laid an egg and a bird hatched from the egg! Every place in the fossil record where a gap exists, he proposed that a similar fantastic event must have occurred.⁵¹

Problem Thirteen: Too Rapid a Rate of Natural Selection May Eliminate the Entire Population

Klotz⁵² quotes Mayr as to yet another problem in natural selection. "Selection places a considerable strain upon populations. Too rapid a rate of simultaneous selection against too many genes might eliminate the entire population," (see Figure 7). The dilemma seems to be that too strong a selection would be lethal. Yet, selection must be very rapid to account for the "explosive" fossil record and even within the billion of years depicted in most geological tables.

It is of interest to note that the geological table as depicted in books is coming under heavy scrutiny today. For example according to the work of Gill and McDougall the Miocene-Pliocene division may not be 12 to 13 million years (See *B.S.C.S. Yellow Version* p. 620) ago, but only 4 to 5 million years ago.^{53, 54}

Similarly, Gish states that Leclercq has published the fact that spores and fragments of woody plants, including those of pine trees, have been found in Cambrian rocks.⁵⁵ Also Daniel Axelrod of the University of California, Davis, reports the finding of spores of 60 genera of wood plants in Cambrian strata. It would seem that some of these observations in paleontology and earth history may even require a greater strain on natural selection than what was required before.

Problem Fourteen: A High Percentage of Favorable Mutations Are Eliminated From a Population

Even favorable mutations are likely to be eliminated. Klotz⁵⁶ discusses Fisher's calculation "that out of 10,000 mutations which have a generous one percent selective advantage, 9,803 will eventually be eliminated".⁵⁷ Thus only 197 out of 10,000 favorable mutations can be expected to survive, others will be eliminated (by natural selection) together with unfavorable mutations.

The problem is that the mutation rate is low, the rate of beneficial mutation is very very low, and of these supposedly beneficial mutations only approximately 2% can be expected to survive (according to Fisher's calculation). Then one also requires that these two recessive mutations "all at once" come together simultaneously with the *right kind of environmental change* (As in Figures 2, 4 and 5).

Problem Fifteen: Genetic Drift Operates In Opposition to Selection

One way evolutionists propose to get around the slow rate of natural selection is through genetic drift occurring in a small population. Genetic drift is the statistical deviation that occurs in a small sample. Likewise, in 10 tosses of a coin you may get eight heads and two tails, but in 1000 tosses you would approach the theoretical 50:50 ratio.

Howe and Davis⁵⁸ investigate a squirrel population as an example of possible genetic drift. Squirrels with a recessive trait (aa) for albinism occurs in 1 out of 10,000 squirrels. Suppose that an isolated population of 20 squirrels in a remote part of a canyon suffer from some catastrophe, killing all but six of these 20 squirrels. If one of these six surviving squirrels happened to

be an albino, the frequency of albinism in the population would have risen very sharply.

Such genetic drift or high increase in the frequency of an allele could only be selected for if an environmental change occurred at the *same time*. In the above case it would perhaps be a rock slide exposing a new greyish area thus allowing for an advantage through camouflage. The question is, is the coincidence of this very likely, and can it account for the vast and rapid changes alleged to have occurred in general evolution? It would seem to me that a belief in this kind of timing of events would require a faith in the "miraculous".

Dowdeswell⁵⁹ rejects genetic drift on the theoretical grounds that (a) it is not likely that random survival can explain great fluctuations observed in large populations, (b) most genes have multiple effects which may complicate or negate a possible advantage to a mutation, and (c) a neutral gene (not advantageous or disadvantageous) could not exist neutrally long enough in the population for genetic drift to select for it.

Dodson⁶⁰ states that genetic drift results in the loss or fixing of genes without reference to selective value. That is, it tends to destroy or preserve genes without distinction. It would thus seem that genetic drift works in opposition to selection.

Problem Sixteen: Natural Selection Is Limited to its Effects on Population

H. T. Band⁶¹ has studied the natural selection of *D. melanogaster* in natural outdoor populations. Lammerts, in a discussion of her work, states, "One of her most remarkable conclusions was that natural selection *does not* increase the most viable or best true breeding lines or homozygotes in natural populations"⁶² See Figure 7.

Thus it would seem that natural selection is limited to what it can do about eliminating less advantageous variations and mutants. Also, species formation, by way of true breeding homozygous varieties, could be questioned.

Problem Seventeen: How can Mutation and Natural Selection Operate on Chemical Molecules?

Stebbins states:

The arrangement of these molecules into functional systems that were self-reproducing, and their evolution finally into the first cellular organisms, can be explained by processes of chemical mutation, recombination, and natural selection similar to the processes that have been experimentally demonstrated to be responsible for change of micro-evolutionary order in contemporary organisms. Experiments by biochemists have shown that these processes can operate to produce progressive change in acellular systems similar to the processes that are postulated to have preceded the development of cellular forms of life⁶³.

Elsewhere Stebbins states:

Organized structure, specific function, heredity, development, and evolution are the distinctive properties of life which are not even approached by those of the inanimate physio-chemical universe⁶⁴.

How can mutation and recombination work with chemical molecules? In one article Stebbins says it can occur (not how) but in another article he states that these processes do not occur with chemical molecules. It would seem that Stebbins wants it both ways and that he chooses the one that suits the particular circumstance in which he may find himself.

Summary

Dowdeswell states:

One of the great merits of the present neo Darwinian theory is that, unlike any of its predecessors, it provides a workable explanation of evolution susceptible of scientific test. From this brief account it will be clear that experimental studies are still in their infancy; no doubt great advances will be made in the next few decades⁶⁵.

Elsewhere Dowdeswell states:

Thus we know virtually nothing of the way in which hormone systems have evolved in plants and animals, and it is extremely difficult to picture the various transitional phases through which they must have passed⁶⁶.

It would seem that Dowdeswell realizes the problem; but notice that he is optimistic that someday somewhere a workable mechanism for evolution will be found. In the book, *The Mechanisms of Evolution* he describes observations and data in the lab and nature which support ONLY variation within a kind. Indeed, Dowdeswell states so in the last chapter, but then he writes that these limited variations help to explain the studies of paleontology, comparative anatomy, physiology and embryology. This seems to be an appeal for the reader to look elsewhere for the real evidence for evolution.

Comparative anatomy, physiology, embryology, and paleontology have lost much of their early appeal. This is a vast subject, but a few general observations may be made.

One cannot prove a theory by an observation, one can only refute it. Any similarities in anatomy and biochemistry can be accounted for equally well, if not better, within the special creation model. Indeed, if I eat the same food as a rat, why shouldn't my cells have molecules and structures similar to those of a rat⁶⁷?

Also, according to Gish, many evolutionists no longer consider vestigial organs and embryology as evidence for evolution⁶⁸.

Gish concludes his excellent book, *Evolution: the fossils say NO!*, with a number of quotes from very prominent paleontologists. Simpson, with respect to transitional forms leading up to 32 orders of mammals, states:

This regular absence of transitional forms is not confined to mammals, but is an almost universal phenomenon, as has long been noted by paleontologists⁶⁹.

Dr. Austin Clark of the U.S. Museum of Natural History has stated:

Since we have not the slightest evidence, either among the living or the fossil animals, of any intergrading types following the major groups, it is a

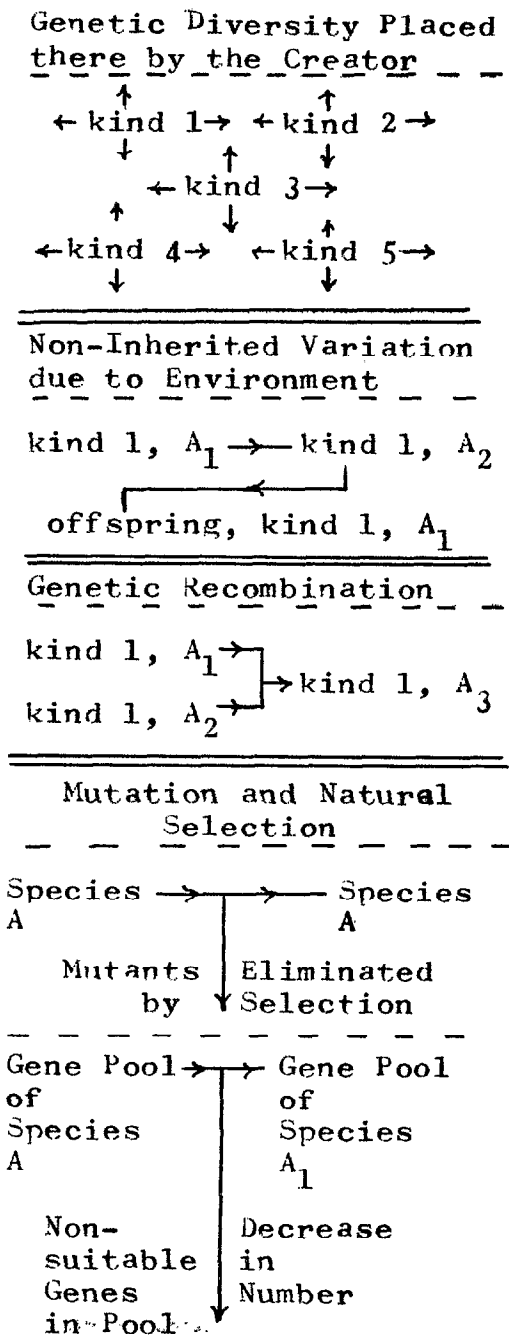


Figure 8. Creationists' views on the sources of diversity in living things.

fair supposition there never have been such intergrading types⁷⁰.

Dr. D. Dwight Davis, of The Chicago Museum of Natural History, has stated:

A few paleontologists even today cling to the idea that these gaps will be closed by further sampling, i.e., that they are accidents of sampling; but most regard the observed discontinuities as real, and have sought an explanation for them⁷¹.

Professor E. J. H. Corner, of Cambridge University Botany School, has said:

Much evidence can be adduced in favor of the theory of evolution—from biology, biogeography,

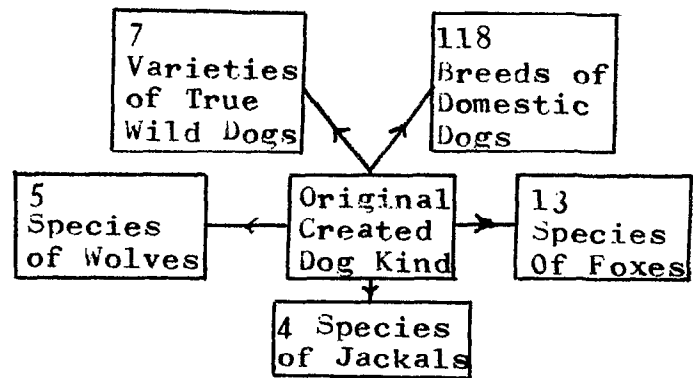


Figure 9. This shows how the original created dog kind (some creationists have called these created kinds "baramins") has diversified into many sorts of dog-like animal, all of which are known to interbreed. It should be noted that creationists do not necessarily hold that the originally created members of the kind (it is nowhere said that there were only two) were all identical. They might, perhaps, have differed as much as dogs and wolves now differ.

and paleontology, but I still think that to the unprejudiced, the fossil record of plants is in favor of special creation⁷².

The evolutionary model has led to predictions in genetics, embryology and paleontology which have failed empirical tests. Genetics and paleontology show only variation within a kind—exactly what is predicted by the special creation model.

What is the present status of the general evolutionary theory? Many evolutionists consider it to be only a working hypothesis. Still others consider it to be a well established fact.

Howe⁷³ quotes the famous botanist Herbert Nilsson as stating:

My attempts to demonstrate evolution by experiment carried on for more than 40 years, have completely failed. At least, I should hardly be accused of having started from a preconceived anti-evolutionary standpoint...

It may be firmly maintained that it is not even possible to make a caricature of an evolution out of paleo-biological facts. The fossil material is now so complete that it has been possible to construct new classes, and the lack of transitional series cannot be explained as being due to the scarcity of material.

The deficiencies are real; they will never be filled⁷⁴.

Klotz⁷⁵ quotes a number of prominent evolutionists. For example, Fisher states, "the explanatory content of a theory of evolution only reaches its absolute zero with the mutation theory"⁷⁶. Huxley states that "the complete proof of the utilization of mutations in evolution under natural conditions has not yet been given"⁷⁷. Goldschmidt believes, that at the most, mutations can bring about changes only within a species⁷⁸. Mayr states, with reference to Goldschmidt, the fact that some geneticists can come to conclusions diametrically opposed to those of other geneticists is striking evidence of our ignorance of the actual facts⁷⁹.

Klotz⁸⁰ quotes Ehrlich and Holm with respect to evolution: "It is, of course, a matter of debate as to where healthy conservatism leaves off and dogma begins. Suffice it to say that the discipline is at least

close enough to the danger area to call for some critical reexamination of its basic tenets."⁸¹

Klotz also cites Sylvio Fials:

... not a single step in the evolutionary mechanism has been clarified. Evolution means primarily an increase in the content of information in the case of DNA, but natural selection means only the elimination of error in information or mutation (in the most favorable case, only a modification of the information), not an increase in the quantity of information. Correcting a misspelled word or substituting one word for another is, after all, something quite different from writing down a sentence, an article, or a whole book⁸².

Can genetic recombination, mutation and natural selection, account for the alleged evolution of organic molecules to primordial gene, from primordial gene to "proto cell", from "proto cell" to amoeba, and from amoeba to man? It would seem that this question is certainly open to debate.

To hypothesize that these processes can and have done so *in the past* is to engage in an unfalsifiable hypothesis. It is unfalsifiable primarily because it is sufficiently vague to escape absolute refutation. The number of irrefutable spin-off hypotheses to account for contradictory data are many.

Also what has actually happened in the past (creation or evolution) is beyond experimental verification. Few textbook authors however, mention the many problems with respect to the alleged mechanisms of evolution. to the unsuspecting student it all seems very convincing, as if evolution were a fact.

I submit that widespread experimental studies on variation and population genetics give greatest support to the creationist model of variation within a basic kind. Also, the fossil record seems to show that these basic kinds have been distinct from the beginning, thus giving evidence of a unique instantaneous creation of these basic kinds.⁸³ This is illustrated in Figures 8 and 9.

Acknowledgement

As has been apparent, I have received much help in this work from the writings of many creationists, especially J. W. Klotz, Ph.D.; W. E. Lammerts, Ph.D.; J. N. Moore, M.S., Ed.D.; and D. T. Gish, Ph.D. I trust that this article reflects a true understanding of their research.

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REPORT OF THE 1977 MEETING OF THE BOARD OF DIRECTORS

The annual meeting of the Board of Directors of the Creation Research Society was held at Concordia College, Ann Arbor, Michigan, beginning at 6:00 p.m., 22 April, with a time of silent prayer. Present were: H. Armstrong, T. Barnes, D. Boylan, C. Burdick, D. Gish, G. Howe, J. Klotz, R. Korthals, W. Lammerts, J. Meyer, J. Moore, H. Morris, G. Mulfinger, W. Rusch, H. Slusher, W. Tinkle and E. Williams. W. Frair, the secretary, was still convalescing; William acted for him. There were two visitors: T. Aufdemberge and N. Skov.

T. Barnes, the President, who was in the chair, introduced the new member of the Board: D. Boylan.

Rusch, acting for Frair, reported on the election of members of the Board of Directors, held earlier in the year. Elected were: H. Armstrong, T. Barnes, D. Boylan, D. Gish, W. Tinkle and E. Williams.

Korthals, the Treasurer, reported on finances. The income for the year was \$34,266.85; the expenses \$28,853.11. The balance in accounts on 31 March was \$45,920.61.

Rusch, the Membership Secretary, reported that there are now 532 voting members, 1,037 sustaining members, 404 student members, 129 subscribers, 163 library subscriptions, 16 school subscriptions and 6 church subscriptions. This means a circulation of 2,287.

Moore reported on the sales of the C.R.S. biology books. As of 28 February, 49,594 textbooks have been sold, 2,621 teacher's manuals, 2,365 teacher's lab manuals, and 11,342 student's lab manuals.

Howe reported that the anthology, *Speak to the Earth*, can now be bought at \$6.00.

Meyer reported on promotion. Work is still proceeding on brochures, and advertisements. He suggested that we consider whether the term "Position Statement" means the same as "Statement of Belief", and might be better received in the scientific world.

Slusher reported on Student Chapters. A formal application is being made by students at the University of Texas, El Paso. There is interest at Kansas State, University of California at Santa Barbara, and East Texas State. So far, no Faculty Sponsors have been available at these three places.

Williams reported on research sponsored or encouraged by the C.R.S. A summary of the report is given elsewhere in this issue of the *Quarterly*.

Moore reported that several school districts in Indiana have adopted *Biology—A Search for Order in Complexity*. The controversies there, and the statement in *The Humanist*, Jan.-Feb. 1977, were discussed.

The meeting resumed at 9:00 a.m., 23 April, again with silent prayer. The same members were present.

An amendment to the Constitution, concerning Student Chapters, as printed elsewhere in this issue of the *Quarterly*, was adopted to be presented to the voting members for approval.

It was voted to recognize the Student Chapter at the University of Texas at El Paso, for which the Constitution had been presented. H. Slusher is to be the advisor.

A committee, with Slusher as Chairman, was appointed to deal with future applications for Student Chapters.

The following was added to the Bylaws: Article III Section 6. Officers and members of the Board of Directors shall serve until their successors are elected and qualified.

Meyer was instructed to go ahead with an advertisement in the *Scientific American*. A donation has been received toward it, and additional money, if necessary, voted.

A committee, with Mulfinger as chairman, was appointed to initiate a programme of publication of technical monographs and tutorial works of professional quality, and possibly the reprinting of some creationist classics.

Officers were elected as follows: G. Howe, President; E. Williams, Vice-President; W. Frair, Secretary; W. Rusch, Membership Secretary; R. Korthals, Treasurer.

The persons who are listed elsewhere in this issue of the *Quarterly* were nominated to run for election to the Board of Directors.

A motion was adopted that in future all research projects funded by the C.R.S. will have a principal investigator who is a voting member of the Society.

The theme for the next Annual Issue of the *Quarterly*, June 1978, will be scientific prediction based on the Creation model.

The meeting of the Board for 1978 is to be at Concordia College, Ann Arbor, Michigan, 21 and 22 April, beginning at 5:00 p.m., 21 April.

The meeting concluded at 4:00 p.m.

This report was prepared from minutes taken by E. Williams for W. Frair.

EXCERPTS FROM THE BYLAWS

Article III - Election of Directors

Section 1. The date for the annual election of directors shall be set by the secretary, but in no case shall it be later than March 1.

Section 2. The Board of Directors shall annually nominate at least one candidate for each vacancy on the Board of Directors, said candidate to have agreed to serve on the Board of Directors. The secretary shall report the names of those nominated by the Board of Directors together with the date of the election to all voting members not less than 120 days prior to the election.

Section 3. Any voting member may nominate one candidate for election to the Board of Directors by presenting a petition signed by not less than 25 voting members of the Society, said petition to list the name and address of the candidate, indicate the qualifications of the candidate in not more than 50 words, list the name of the individual nominating him, bear the certification of the nominator as to the authenticity of the signatures on the petition, and contain a statement by the nominator that the individual nominated is willing to serve on the Board of Directors. This petition must be mailed to the secretary and must be postmarked not less than 60 days prior to the election. On receipt of the petition, the secretary shall ascertain that at least 25 of the signers of the petition are voting members in good standing.

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Correction

In the article *A Classical Foundation for Electrodynamics*, by Barnes, Pemper, and Armstrong, in the *Quarterly* for June 1977, in the caption for part (b) Figure 5, and in the sentence following Equation (48), instead σ of there should be γ .

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Anticipation of Scientific Law?

"... fire causes heating but not cooling..."—Aristotle, *Physics*, Book VIII, Chapter 1.

"... what is actually hot is capable of moving what is potentially hot..." (i.e., of making what can be heated hot)—*Ibid.*, Chapter 4.

Proposed Amendment to the Constitution

Amendment 1. Student Chapters.

Section 1. Applications for Student Chapters shall be approved by the Board of Directors. Each Student Chapter shall submit its Constitution and Bylaws to the Board of Directors for approval. Each Student Chapter shall designate a voting member of the Society as its advisor and shall continue as a recognized Student Chapter only so long as it has as an advisor a voting member approved by the Board of Directors.

Voting members will have the opportunity to vote on this amendment at the same time as the election of members of the Board of Directors.

SPECIAL NOTICE

The following candidates have been nominated to the Board of Directors to serve for a three-year term beginning in 1978.

T. Aufdenberge
Clifford L. Burdick
Wayne Frair
George F. Howe
John Meyer
John N. Moore
George Mulfinger
David J. Rodabaugh
E. Norbert Smith
Erich von Fange

Six members are to be elected to the Board. The date of the annual election is 1 March, 1978. Biographical information on each nominee will be distributed with the ballot.

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"... fire is the hottest of things, for it is the cause of the heat of all other things..." — Aristotle, *Metaphysics*, Book II, Chapter 1.

"What is called most complete in any genus is the cause of all in that genus, as fire, which is the most complete form of heat, is the cause whereby all things are made hot..." — St. Thomas Aquinas, in the *Summa Theologicae*.

These quotations may be interesting in showing that the authors cited anticipated the second law of thermodynamics, even in one of the forms used nowadays: that the flow of heat is from hotter to cooler objects. St. Thomas, moreover, in the part cited, was using the argument in a proof of the existence of God, which was something like the modern creationists' use of the second law in arguing that the universe must have come about by the Creator.

— Editor

RESEARCH SPONSORED BY THE CREATION RESEARCH SOCIETY

This information about research has been compiled from the report by Dr. Emmett Williams, Jr., Chairman of the Research Committee, at the annual meeting of the Board of Directors in April 1977, and from other sources.

Investigations which are active at the present include:

(1) Studies of the formation of rings in the bristlecone pine.

(2) Two projects on the precipitation of salts by the mixing of brines, and related effects.

(3) An investigation of some of the processes which may have been involved in the formation of caves.

(4) Research into the viability, or otherwise, of mutant plants.

Two or three other items of research have been approved; but either have been delayed, or else reports on the findings are not yet available.

Dr. Walter E. Lammerts has been studying the growth of bristlecone pines, the trees being now about five years old. Despite initial troubles, in which many of the trees died from an infection, some results have accumulated. In particular, the question was asked whether bristlecone pines can grow more than one ring per year. Because of the conditions of the weather, some of the trees did go through two cycles of growth in one year, and in at least some cases formed two rings. This work is continuing.

Dr. Floyd Wilcox is continuing work on the results of mixing brines.¹ The purpose is to investigate ways in which deposits of salt, and other so-called evaporites, may have been formed. Data have been assembled about various mixtures of brines, usually sodium chloride and magnesium chloride.

Dr. Richard Herdtklotz is investigating other aspects of the mixing of brines, again with the object of clarifying some points about the formation of evaporites. Effects of varying concentrations, and of changes in pH, are being studied. These conditions may be important in understanding the rapid formation of deposits.

Dr. Emmett Williams is continuing studies of the solution and precipitation of calcium carbonate.² Some such process is generally supposed to be involved in the formation of caves.

Dr. William Tinkle is continuing studies of mutant plants, especially those which begin with more or fewer cotyledons.³ Plants studied have included tomatoes, peppers, and campion. The mutant plants have proved to be less viable. Clearly these findings cast much doubt upon claims that mutants may have been fitter, and thus favored by natural selection.

The Creation Research Society is interested in sponsoring more research in keeping with the aims of the Society. Any inquiries or proposals should be addressed to the Chairman of the Research Committee, Dr. Emmett L. Williams, Jr., Bob Jones University, Greenville, South Carolina 29614.

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PANORAMA OF SCIENCE

On the History of Domestic Plants and Animals

The trend for more and more people to be nourished by fewer and fewer plant and animal food sources has reached the point today such that most of the world's population is absolutely dependent on a handful of species.¹ This is the keynote statement of fascinating article in the *Scientific American* by Jack R. Harland. Wheat, rice, maize, and the potato contribute more than the combined total of the next 26 crops on his list! This recent trend was not characteristic of the original subsistence agriculture, abandoned over the past few centuries.

Contrary to N. I. Vavilov's conclusion that all domesticated plants came from eight "centers of origin", students now believe that many crops did not originate in the centers indicated by Vavilov; or that they originated in more than one center. The current evidence indicates that agriculture "evolved" through an extension and intensification of what people had already been doing for a long time.

Thus evidence for the domestication of the pig is found all the way from Europe to the Far East. Cattle

were tamed over the same range. The wild progenitors of rice in Asia, sorghum in Africa, and beans in America were widely distributed and manipulated by people in their entire range. The sunflower was a minor crop grown by the Indians in what is now the U.S. It became a major crop in eastern Europe only recently. One species of rice was domesticated in Asia and another in Africa. One species of cotton was domesticated in either India or Africa, another in South America, and a third in Mesoamerica. Different species of yams were domesticated in West Africa, Southwest Asia, and tropical America.

From the world point of view, the sugar cane, sugar beet, soybean, citrus fruits, tomato, peanut, sweet potato, and the sunflower are all *recent* contributions to the food supply of the world. Cottonseed oil as a major source came only in this century.

Crops cultivated today may be strikingly different from the forms of their progenitors. Thus the three kinds of wheat originally domesticated from wild grasses (if that is what really happened) are so obsolete today, they are hardly grown at all. One was einkorn,

and had seven pairs of chromosomes. It never reached Egypt from western Europe.

The second wheat was tetraploid (had 14 pairs of chromosomes) and was called emmer. It originated either in Palestine or Turkey about 7000 B.C., and was the dominant wheat for several thousand years. It was the wheat of Egypt until replaced by bread wheat after Alexander the Great conquered Egypt in the fourth century B.C.

The third domesticated wheat was a trivial one agriculturally. It has no common name-only the scientific one of *Triticum timopheevii*, and it originated in Transcaucasian Georgia. It also is a tetraploid.

All three of the above are glume wheats, since each seed is enclosed in a hard shell-like husk called a glume. Sometime after emmer was domesticated a mutation occurred causing the base of the glume to collapse at maturity. Also the spike became tough so it did not fall apart. Thus the free-threshing ancestor of our durum or macaroni wheat originated.

The modern hexaploid wheat (21 pairs of chromosomes) arose long after the domestication of the glume wheats. Its extra set of chromosomes, according to Harland, was contributed by the goat grass, *T. tauschii*, also known as *Aegilops squarrosa*. As a grass this species is worthless; but as a contributor of genetic characteristics it literally made a billion dollar crop out of a million dollar one.

Actually, there is considerable dispute yet about the origin of modern wheat; and mystery surrounds the exact details of its origin. For when the AABB component of modern wheat is crossed with *T. tauschii*, and the synthetic hexaploid obtained, it is not free-threshing as modern wheat.²

Evidently the goat grass contains a dominant factor for tenacious glumes and they are extremely hard, stiff, and tough. So in order for this species to be one of the ancestors of modern wheat a change to the recessive condition must have occurred after the origin of the hexaploid state. A number of other changes must be postulated also, in order for this hybrid to have all the qualities of modern bread wheat. Evidently whoever made the cross had a considerable knowledge of cytogenetics!

As regards animals, jaws and teeth of domestic dogs have been identified and dated (by C-14?) to about 12,000 B.C. in the Old World and 11,000 B.C. in Idaho. Aside from these, data are rather tenuous. About 9000 B.C., for example, there is evidence that man had considerable control over sheep populations, but not over goats.

Ali Kosh in Iran may have been occupied as early as 7500 B.C., according to finding of a hornless female sheep in one of the lowest levels. In wild sheep both sexes are horned, so the hornless skull is taken to mean domestic sheep were present at Ali Kosh.

The bones of domestic sheep, pigs, and dogs were found at Cayonu, Turkey, at a level indicating about 7000 B.C. The earliest remains of cattle now come from Greece and date to about 6500 B.C. The humped cattle we associate with India are represented by Mesopotamian figurines dating back to 3000 B.C. They are not found in India until 2500 B.C.! The donkey was known

as a domestic in Egypt by 3000 B.C. The horse is thought to have been tamed in central Asia or southern Russia by 3000 B.C. As for the camels the best guesses suggest 2000 B.C. for the one humped dromedary and 1500 B.C. for the two humped Bactrian camel.

In the New World, excavations at Tamaulipas and in the Tehuacan valley by Richard S. MacNeish give sequences of deposits suggesting plant manipulation certainly by 5000 B.C. and possibly by 7000 B.C. Maize was a crop in Tehuacan by 5000 B.C. By 6000 B.C. fully domesticated beans and lima beans were being cultivated near Ayacucho, Peru.

For reasons we can only speculate about, people in various parts of the world all seem to have begun the process of domestication at roughly the same time, i.e. not long after the last Pleistocene glaciation.

Harland points out the difference between merely cultivating plants, which can be done with wild types, and making genetic changes, thus better adapting them to man-made environments. Thus most animals, except sheep, can survive if they escape into the wild. By contrast, domesticated races of maize, wheat, rice, potato, sweet potato, and most other crops would all die out without human maintenance.

Most of our crops have weedy races which propagate themselves but require habitats disturbed by man. Thus there are weed races of wheat, rice, maize, potato, and barley.

Once man began planting seeds of species he cultivated, selection began for easier germinating or non-dormant seed types, larger seeds, seedling vigor, and ease of transplanting. One of the most striking plants to respond to man's selection is the kale species, *Brassica oleraceae* which exists as cabbage, kohlrabi (for the stem), cauliflower (for inflorescence), Brussel sprouts (lateral buds), broccoli (stem and flower), and kale (leaves).

Extreme types such as the Pekinese dog, bubble-eyed goldfish, chickens with five meter feathers, pouter pigeons, waltzing mice and fruit flies have been modified to the point where they depend on man for survival and so are fully domesticated.

This article by Harlan is remarkable in showing the recency of all the domestication even according to standard C-14 dating methods. Thus the potato was largely restricted to the Andean highlands until the Europeans arrived there in the 16th century. When brought to Europe soon after it was at first poorly adapted, especially to the long days characteristic of European summers. But it finally did adapt, no doubt through the selection of long day tolerant variations; and it became so productive that some historians credit it with provoking a population explosion, e.g. in Ireland. The number of varieties now grown are many indeed and all originated in only about 350 years of human selection.

Now if natural selection is the powerful builder of species and varieties that evolutionists would have us believe it to be, then why have not a similar array of varieties been originated in any species growing under natural or undisturbed wild conditions? Carolus Linnaeus lived and worked from 1707 until 1778, or about 200 years ago. He made extensive collections of plants;

and the herbarium sheets of specimens on which he based his descriptions of species still exist.

To the best of my knowledge *all* the species described by Linnaeus are still easily recognized by comparison with his original herbarium sheets. Except for the cultivated plants in which new varieties have been bred by horticulturists since the forms existing when he described them, all the wild species are still fully comparable to the herbarium sheet variations he then collected and recorded. Most certainly there has been no outburst of novelty in any of them even remotely comparable to mankind's accomplishment in breeding and selection of potato varieties in only about 350 years of time.

The same is true of the sunflower, which spread across the United States in the last one or two hundred years, following the plow and picking up "donations" of genes from different species situated in different locations and adapted to different environments as it went along. The number of sunflower varieties would astonish anyone familiar only with the huge-headed monsters usually grown for seed. Some horticultural varieties have beautiful red flowers and others are very graceful in habit. Black seeded varieties exist and some are perennials.

This article of Harlan's is most valuable to creationists in showing the recency even by uniformitarian dating, of plant and animal domestication and the amazing extent of change effected in the process. In comparison natural selection in a similar period of time has been shown to be either non-existent or has merely acted to preserve the species from alteration by mutation.

It may be stated here, as has already been implied, that the writer, in company with many other creationists, does not necessarily subscribe to the ages and dates quoted here. Reasons for believing that things may be considerably younger have often been given in the *Quarterly*, and elsewhere. But as relative figures, these dates are likely significant; and they do show what has been accomplished in what is by uniformitarian standards a very short time.

—Contributed by Walter E. Lammerts

Pressure in the Formation of Sedimentary Rocks

Some recent investigations have produced information which may be of great use to creationists. The problem is: how are sediments changed into sedimentary rock?

In the experiments, sediment, predominately a carbonated wackestone, taken from south Biscayne Bay, Florida, was compressed under about 8,000 pounds per square inch pressure for times of about three weeks. However, because of limitations of the equipment, the pressure was not applied continually during all of the time.

At the end of the time, the material had been compacted to about one quarter of its original volume, and seemed very much like ordinary fine-grained limestone.³

Two points were especially interesting. First, it was not necessary to bring in any material from outside to

act as cement. Secondly, there was very little crushing of the small fossils, such as shells, which were present, although crushing had been expected.

It was concluded, then, that the fact that fossils are found in good condition in rock does not necessarily mean that the rock was not compacted under high pressure.

From a creationist viewpoint, this experiment is interesting in showing that stone can be produced in a short time. (As, indeed, the artificial stone called Angelstone actually is.⁴) Also, there is now no reason to doubt that the rocks may have been formed under considerable pressure.

The 8,000 pounds per square inch, mentioned above, is of the same order of magnitude as, although a little more than, the pressure which would be caused by the depth of water which has been suggested as existing during the Flood.⁵ It would be exerted also by a mile or so of the sediment.

It has been suggested that if rocks formed under great pressure, things which happened when the pressure was released may have had a great geological effect.⁶ According to the results mentioned here there is no evidence to show that such pressures were not once present. This point certainly needs further investigation.

It would appear also that more experiments on these matters are much to be desired; and it is to be hoped that someone who has access to equipment for exerting such pressures will try some experimenting.

Possible Evidence that Mammoth Remains Date from the Flood

In a recent article, each of the mammoth finds which have been reported to date in South Sweden is described, and datings obtained by radiocarbon discussed.⁷

Of particular interest is the fact that these finds were all from drift gravel, so-called glaciofluvial material or outwash. This is typical drift gravel with cross stratified sand.

In the article, this fact is interpreted by supposing the fossil bones, tusks and teeth etc. have been redeposited. The mammoths are assigned to an interglacial period, and supposedly their bones were transported in ice-sheets and deposited with the gravel when the ice melted.

One mammoth tusk, from Lockarp, was discovered in a gravel pit in a kame. At Dosebacka, 3 mammoth finds were made in drumlins, and it was supposed these were "probably derived from a lower till bed."

A list of the mammoth finds in Northwest Europe includes the following: from Denmark, 85; from Norway, 16; from Finland, 9; North and Central Sweden, 8; Southern Sweden, 14; and many others from Germany and Poland.

It would seem from the information in this paper, that the mammoths cannot have been post-glacial in age. Since they are found in the drift, they may well have been buried in flood sediments, which became disintegrated. Fragments of the fossils were left unaffected by disintegration. It need not be supposed that the greatly varying radiocarbon dates given in this arti-

cle for the mammoth remains are valid, or that the drift in which the fossils occur was caused by glaciation.

—Contributed by Douglas E. Cox

Solar Heating in Arctic Flowers

There is a Biblical admonition to "Consider the lilies of the field, how they grow . . ."⁸ A recent report in *Science* should be of special interest to creationists.

In the report, "Sun-tracking Solar Furnaces in High Arctic Flowers: Significance for Pollination and Insects",⁹ The author describes a new significance to heliotropism for plants living under conditions of extreme cold. (Heliotropism is defined as mechanisms by which flowers face or follow the sun. Sun flowers are common examples.)

The arctic flowers described in the report *Papaver radicum* (Papaveraceae) and *Dryas integrifolia* (Rosaceae) both have open bowl shaped flowers that can be described as parabolic and in both cases the flowers are heliotropic. *P. radicum* follows the sun for 24 hours under optimal conditions, and *D. integrifolia* can solar track for 6-8 hours. Solar radiation is apparently reflected from the parabolic corollas and focused on the sporophylls. (A parabolic reflector is very suitable, being used in solar furnaces.) Flower temperatures 4 to 10 °C above surrounding air temperatures were obtained.

These plants live in a hostile environment with an extremely short growing season (about 6 weeks). The sun shines more than half the time. From Van't Hoff considerations most biochemical events double in speed for each 10 °C increase in temperature. The concentration of solar radiation on the developing seeds obviously hastens development.

Insects also take advantage of the solar furnaces. Insects collected in the flowers were found to have body

temperatures 10 °C above air temperature. This is no doubt a symbiotic relation as *Dryas* at least relies partly on the basking insects for pollination.

The combination of complex behavioral and anatomical structures has always been a problem for evolutionists. To believe in the evolution of something as complex as flight with required orchestration of anatomical, physiological and behavioral intricacies requires much more faith than belief in a Creator-God.

Solar tracking and focusing of radiation on the developing seeds is much the same. The parabolic shaped flower and heliotropism must be fully functional in order to work at all. No doubt future studies will reveal special reflective properties of the corolla and exaggerated absorptive properties of the sporophyll. Indeed much can be learned by "considering the lilies of the field".

—Contributed by E. Norbert Smith

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BOOK REVIEWS

Student Essays on Science and Creation, Volume 1. 1976. Published by the Creation Society of Santa Barbara, P. O. Box 203, Goleta, California 93017. Paper cover, 150 pages, \$2.50.

Reviewed by Arthur C. Custance*

This is a collection of 14 papers by Science students (all but one still undergraduates) who believe that special Creation is a viable scientific alternative to the theory of evolution. They deal briefly with the philosophy behind modern theories regarding the past history of the earth and man, with certain aspects of biology, geology and dating, and cultural and physical anthropology.

These papers were written by five authors as individual research projects, class term papers, answers to exams, critiques of lectures, and almost always reflect

thinking along lines seldom allowed and virtually never encouraged in the classroom.

The stated object is to re-examine the questions of the origin, purpose, and destiny of man. However, this object is only partially addressed in the papers, the purpose and destiny of man receiving little attention. The papers run from two pages ("Why Creation?") to 42 pages (on pitfalls of dating methods). All are well documented, with one or two instances of incomplete documentation (e.g. p. 142 ref. 2 and 10; and p. 150 ref. 10).

The format is a normal single spaced type sheet with tidy but "unjustified" copy, which has then been reduced by about 50% for offset reproduction. The type is therefore rather small and on a number of pages the printing is not the best, so that it is a little tiresome to read. Some of the diagrams have particularly suffered in this respect. The diagram on p. 133 for example is almost valueless since the key equation is illegible (in my copy), and the associated graphs are virtually mean-

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ingless without some explanatory material. It should be noted however that this is also true in the original from which this diagram was taken.

Most of the papers are refreshingly short, but a busy reader will need considerable dedication for some of the longer ones because of the small type and poor reproduction. No doubt this will be corrected in a new edition.

One also wonders what was the target audience in the minds of the authors. In some papers there is a tendency towards journalese and a kind of "gee-whiz" vocabulary, punctuated with occasional sarcasm. In others the technical detail tends to become quite overwhelming for the non-specialist. This is evidence of considerable sophistication on the part of the writers and the expert will find himself at home, but the ordinary reader no matter how intelligent he is may not benefit as he should, being out of his depth.

Perhaps the solution to this problem in all such symposia is for each author to predigest his data more thoroughly and then regurgitate it in a slightly less concentrated form. The data are most valuable; but the meal is a little indigestible. The paper by Wilkerson on dating methods, by Rice on language, and by Johannsen on the question of the erect posture of the Australopithecines illustrate this problem. These papers involve highly technical information that a specialist is likely to know already but a non-specialist will find difficult to follow. The paper on the origin of language is not altogether appropriately titled. One has the feeling that the author is trying to "slay this audience with science".

On the whole the quotations are well chosen and appropriate. It must be remembered that all the authors are still at the beginning of their writing careers, and all show promise. They have each made a worthwhile contribution. As a source of reference this little symposium contains much well documented material. I recommend it highly, and hope it will be expanded and put between hard covers in due course.

☆ ☆ ☆

Tree Rings and Climate by H. C. Fritts. 1976 Academic Press, N.Y. 567 pp. Price \$35.00.

Reviewed by Harry V. Wiant, Jr.*

This book will be of interest to some creationists, especially those involved in dendrochronology. The author emphasizes the techniques used to attempt to reconstruct past climatic patterns from the analysis of tree rings. Discussions of statistical methods utilized are very detailed, ranging from the simple sign test through multiple regressions and the use of principal components.

The point is made that the width of tree rings are related to the widths of adjacent rings, as the climate of a given year influences growth for several years. This tendency, called autocorrelation, introduces a non-randomness which alters the interpretations of standard statistical tests.

*Harry V. Wiant, Jr., Ph.D., is Professor of Forestry, West Virginia University, Morgantown, West Virginia 26506.

Several chapters are dedicated to describing the growth and physiology of trees. Unfortunately for creationists, techniques used for crossdating of living trees and old logs receive limited coverage. Through crossdating of bristlecone pines a chronology of 8200 years is claimed. The author does admit in the preface that he was at one time skeptical of tree-ring dating and the possibility of climatic inference, having read criticisms of the science by others.

☆ ☆ ☆

The Battle for Creation: Acts/Facts/Impacts, Volume 2. Edited by Henry M. Morris and Duane T. Gish. 1976. Creation-Life Publishers, San Diego. Paper, 321 pages. \$3.95.

Reviewed by Arnold D. Ehlert*

As the title indicates, this volume brings the reader into the open forum where the battle between evolution and scientific creationism is being waged. Scientists of the Institute for Creation Research meet professors in secular universities on the common ground of science, rather than religion.

The book tells all about the increasing interest in creationism, not only on secular campuses, but among scientists, in the news media, in the public schools, and in other important streams of national life. Articles from the 1974 and 1975 issues of the ICR publication, *Acts and Facts*, are categorized by subject.

The Impact Series articles, which appear as inserts in each issue of *Acts and Facts*, are also included as Chapter X. These are original prime contributions to creationist literature.

Chapter I of this volume chronicles all the creation-evolution debates that were held during these two years, showing the contrast between the scientific arguments of the creationists and the arguments of the evolutionists. This could well be a significant document in the history of science.

☆ ☆ ☆

The Great Brain Robbery by David C. C. Watson. 1976. Moody Press, Chicago. 128 Pages. Price: \$1.65.

Reviewed by Douglas E. Cox*

This is a concisely written, lively, popular account of "the world's greatest delusion"—evolution. Written from a Christian perspective, the book upholds the accuracy of the scriptures, providing an outline of creationism and a refutation of evolution.

This is done in an admirable way. One sees evolution in the setting of history, its role in modern education, and its effect on the Christian Church.

A stated purpose of the author is to summarize the main arguments of *The Genesis Flood*. It is suggested that this book is one of the few epoch-making books of history.

*Arnold D. Ehlert is Director of Libraries at Christian Heritage College, San Diego, California.

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

Faith is necessary for the study of scripture. Belief in a 6-day creation, and a young universe, encounters the problem of light from distant stars, which seems to show an ancient universe. Faith is required to believe the account of the miracles performed by Christ, also to believe that "in one day He flung the stars billions of light-years into space, at the same time causing their light to fall upon the earth."

Chapters are devoted to refuting attempts to harmonize the geologic time scale with Genesis, effects of the curse, theistic evolution, objections to the scriptural account, and a chapter on catastrophism cites coal seams, fossil graveyards, mountains, overthrusts, etc., as evidence for the deluge.

Watson supports the idea of a canopy of water vapor as a source of the waters of the deluge. It is suggested that the presence of such a vapor canopy may have influenced results of C¹⁴ dating. (An appendix shows radiocarbon dating supports a recent creation and a subsequent catastrophe.)

Archaeological interpretation, and dating based on the dynasties of Manetho, contrary to the scripture, are questioned. Studies of language show not evolution, but that speech was a gift of God to man at his creation.

Comparing modern scientism with ancient gnosticism, Watson predicts the following evaluation may one day be given of present day science:

The new scientism was very attractive, and throughout the nineteenth and twentieth centuries it made considerable headway among the more intellectual Christians of the Western world. While it was pre-Christian in origin, deriving elements from pagan thought, it developed a variety of definitely Christianized forms (e.g., theistic evolution). However, it was finally exposed as nothing but another "hollow and delusive speculation" of men who totally misconstrued the evidence deposited by the Noachic Deluge. Christians at last awoke to the fact that all the fossils could be explained in terms of the Flood, and that one of the determining forces of scientism was a *fantastic occidental imagination* which could explain every irregularity in the solar system without explanation, leap the gaps in the atomic series without evidence (by "sheer magic"), postulate the discovery of fossils which have never been discovered, and prophesy the success of breeding experiments which have never succeeded. Of this kind of science it might truly be said that it was "knowledge falsely so called"!

Hoaxes and delusions have gripped civilization in the past; examples are the gnostic heresy and the medieval belief in relics. "What is certain is that civilization has once again been the victim of a gigantic hoax; in almost every university of the world a stupendously improbable nonfact is being taught as if it were true."

Evolution, the philosophy of Epicurus revived, is in for a head-on clash with Christianity; a return to the bible for factual explanations is urged, and that the arguments for special creation should be presented to young people.

The chronologies of Genesis 5 and 11 are the subject of an appendix, and it is argued that postulating "gaps"

in these chronologies, (which some creationists believe would provide time for Ice Ages following the Deluge), makes nonsense of scripture.

For the size of this book, it contains a powerful wallop. Many readers will not be content to own just one copy; they will want an extra one to pass on to their friends.

☆ ☆ ☆

Questions and Answers on Creation/Evolution by John N. Moore. 1976. Baker Book House, Grand Rapids, Michigan. \$2.95.

Reviewed by Bruce Perry*

Dr. Moore of Michigan State University has put together a book of frequently asked questions with concise and readable answers. Through this question and answer technique, he answers basic questions as What is Science?, What is Evolution?, and What is Creation?. There is a wide spectrum of concerns dealing with the evidence for the age of the earth, the origin of the universe and the origin of life, especially that of man.

Dr. Moore concludes with questions concerning the recent impact of evolutionism in man's affairs.

The addition of a brief dictionary of scientific terms, examples of scientific activity and a book list of recommended reading makes the book a useful handbook for students, parents and teachers.

☆ ☆ ☆

Myths and Miracles: A New Approach to Genesis 1-11 by David C. C. Watson. 1976. H. E. Walter, Ltd., 26 Grafton Road, Worthing, Sussex England BN11 1QU. 119 pages. &1.50 UK.

Reviewed by Mrs. Richard H. Graves^o

David C. C. Watson's *Myths and Miracles* is lucid and entertaining, simple and profound. He examines Genesis 1 and 2 verse by verse, with short notes containing explanation, comparison, references to other books, projects and experiments for classroom or home. Genesis 3 through 11 are examined in the same way but not in as much detail for each verse. The book is illustrated with drawings by Brian Newton.

The question-and-answer format is appealing to young minds; the substance of the explanation is sound, never swerving from the principle of Genesis as "a true account of real events at the beginning of the world."

Left casually in the classroom, the book drew spontaneous interest from several 15 and 16-year-old students enrolled in a major-works biology course. They praised Watson's clear language—non-technical but not misleading—and found the book easy to read straight through, challenging enough for deeper study. Teachers for fourth through sixth grades should find the book a treasure for both science and history classes, while Sunday Schools and Bible study groups for ages 10-18 could use it as well.

*Bruce Perry has taught in schools in Ontario for many years, chiefly Science. His address is 404 Edward Street, Exeter, Ontario, Canada.

^oMrs. Richard H. Graves teaches at St. Thomas Episcopal School, Houston, Texas.

Truly *Myths and Miracles* is a valuable addition to the home and school libraries of those whose joy and hope is in the wondrous Creator of all things.

☆ ☆ ☆

Physical Aspects of Natural Catastrophes by Adrian E. Scheidegger. 1975. Elsevier Scientific Publishing Co., New York. xiii + 289 pages. Price \$29.95.

Reviewed by H. L. Armstrong*

Natural catastrophes are considered, in this work, to be events of such a nature, and on a large enough scale, to be at least potentially very destructive. They are classified, in an interesting way, according to the medium or situation in which they happen.

Catastrophes of the earth include earthquakes, volcanic eruptions, and landslides. Some of them have to do not with strictly earth, but rather snow or ice; thus avalanches are included.

Catastrophes of, or having to do with, water include floods, and also erosion. There are also events under water which must be admitted to be on a catastrophic scale, such as turbidity currents.

Then there are catastrophes of the air, or arising from happenings in the air, such as hurricanes and tornadoes.

The physical principles involved in these catastrophic happenings are discussed in some detail. Also, examples are quoted.

Most Creationists have occasion sometimes to consider catastrophes. For instance, they may need to con-

sider the Flood, and what effect it may have had on the Earth. The book contains much information bearing on such questions.

NOTICES OF BOOKS

It is intended, under this heading, from time to time to mention books which have been received or seen, but which, because for instance they are quite short, or only peripheral to Creationism, do not seem to call for an extensive review.

Sometimes also, books which are to be reviewed later will be mentioned here.—Editor.

A Biblical Cosmology published by the International Christian Crusade, Room 31, 205 Younge Street, Toronto, Ontario, Canada. Price 25 cents, or \$2.50 per dozen, plus postage. This is a pocket-size booklet, which contains a defence of Creationism, and answers many of the arguments commonly proposed in favor of evolution. However, many members of the Creation Research Society would likely consider that the book depends too much on the gap.

The Triumphant Third Century by Robert Bergin. Published by Fatima International, Box 647, Hamilton, Ontario, Canada. 71 pages, price, \$1.00. This book, published by a Roman Catholic organization, deals much with matters in the United States, even though it is published elsewhere. It is concerned, not so much with Creationism directly, as with national morality and with eschatology. Many Protestant readers might be surprised to see how close they are on these matters to (presumably) a good number of Roman Catholics.

*H. L. Armstrong, M.Sc., teaches Physics at Queen's University, Kingston, Ontario, Canada.

LETTERS TO THE EDITOR

Creationist Literature in Russian

I was interested to read, in the *Quarterly*, Meyer's comment that creationists, who have occasion to visit Russia, might be able to meet with dissident scientists there.¹ Since my book, *Creation vs. Evolution Handbook*, has recently come out in a Russian edition, I feel a special interest in this matter.

The book in English I might mention, had a part in the conversion of a Russian Jew, who thereupon began translating it into Russian. I know another Russian who was also converted partly as a result of reading the book in English. He is now working for the British Broadcasting Corporation, and has plans for beaming creationist programs into Eastern Europe.

The *Handbook* has also been translated into German, French, Chinese, Japanese, and Italian; and there is a British edition. The Russian edition is considerably updated from the English. For instance, it contains a summary of Gish's work on (or rather against) the evolution of the first life.

I should like to suggest that anyone who is able to visit scientists in Russia take along one or more copies of a suitable creationist book. They would find, I believe, that they can do so without fear. Many Russians seem to

be quite receptive to the message of creation, when they are able to hear or read it.

It would seem also that the translation of other creationist literature into Russian would be very much worth while.

Sincerely in Christ,
Thomas F. Heinze
2405 First

Tillamook, Oregon 97141
Received 23 March 1977

Reference

¹Report of the 1976 meeting of the Board of Directors, *Creation Research Society Quarterly* 13(2):124-125.

Antediluvian Topography and the Flood

The following remarks arose from some thought about the amount and source of the water involved in the Flood, a matter which has recently been discussed in the *Quarterly*.

From the account in the first chapter of Genesis, one would judge that the water, when it covered all of the

Earth early in Creation Week, was of an appreciable depth. The antediluvian ocean, then, into which it was gathered, must have been of considerable extent, although not necessarily as great as the present ocean. As a working figure, suppose that the antediluvian ocean covered half of the Earth's surface, and that its average depth was the same as the average height of the land above antediluvian sea level.

Suppose, moreover, that the Flood was caused primarily by the bringing of more water to the surface of the Earth, whether from above or from underground. That is, the Flood was not primarily caused by a surging of the antediluvian ocean over the land, as some have thought. Suppose besides this that the water which was at the surface of the Earth at the end of the Flood is still there.

The oceans now contain about 1.3×10^{18} cubic metres of water. This would suffice to make a layer of water 2,540 metres, or 8,330 feet, deep over all the Earth, if the Earth were smooth. It is easily seen that, under the assumptions made above, that much water on the antediluvian Earth would make a layer reaching 8,330 feet above antediluvian sea level.

The account of the Flood seems to say that the highest mountains were covered by 15 cubits, about 22 feet by the common reckoning, of water at the height of the Flood. It would seem, then, that the highest antediluvian mountains were only 8,000 feet above antediluvian sea level.

At present, Great Ararat, the mountain sometimes called Agri Dagi, on which the Ark is commonly believed to have rested, is about 17,000 feet high. However, it does not seem incredible that it might have doubled, or thereabouts, in height after the Flood. Especially is this so in view of such parts in Scripture as Psalm 104:5-9.

It may be interesting to note that if all of the extra water came to the Earth's surface in the form of rain in 40 days, that would mean rain at a rate of 5.79 feet per hour! The destructive effects of such a rain would go beyond anything which can be imagined.

It is not proposed that the water which fell from above necessarily came about by the processes which lead to rain on an ordinary scale. However, the account in Genesis would seem to suggest that the rain, which might mean just water which came from above, was at least comparable in amount with that from any other source, such as the fountains of the great deep, if that was really a separate source.

Indeed, one might suggest that maybe Genesis 7:11, the last part, might be rendered: "... all the fountains of the great deep broken up, that is to say the windows of heaven were opened". Incidentally, the term "windows of heaven" occurs in 2 Kings 7:2 and Malachi 3:10, and in both cases it suggests supernatural, or at least providential, action.

May I add one further point? Many have looked to the supposed antediluvian canopy not only as a source for much of the water of the Flood, but also as an explanation for the supposed uniform mild antediluvian climate.

However, if a world-wide Flood is admitted, there is less reason to believe in the former world-wide mild climate. For evidence from fossils, on which the idea

seems to be based, would lose much of its force. During a world-wide Flood remains might have been swept all over the Earth; they might have become fossils thousands of miles from where they had formerly lived.

In His service,
 Ronald G. Samec
 Elkton Baptist College
 P. O. Box 707
 Elkton, Maryland 21921
 Received 17 January 1977

Genesis and Documents

Creationists rightly repudiate the critical documentary hypothesis, according to which unknown scribes, acting according to their own whims, supposedly assembled Genesis, and some other parts of the Old Testament, from discrepant documents and traditions, in the last few centuries B.C. Many may not have noticed, however, that there is a legitimate documentary view: that Moses, acting under inspiration, assembled and edited Genesis from documents which had come down from the times of the events actually described, having originally been written, probably, by the patriarchs.

Luther, among others, held some such opinion.¹ More recently, Wiseman set forth this view at some length.² And Morris has explained it briefly in his book *The Genesis Record*.³

Both of the latter writers have seen that the key to the composition of Genesis is to be found in the statements: "These are the generations of . . .".⁴ The Hebrew word for "generations" is *toledoth*; the Greek of the Septuagint uses "Genesis", or a related word; and almost the same formula is found in St. Matthew 1:1.

Morris noted 11 uses of the formula: at Genesis 2:4, 5:1, 6:9, 10:1, 11:10, 11:27, 25:12, 25:19, 36:1, 36:9 and 37:2. Wiseman considers that six of these are of primary importance: Genesis 2:4, 5:1, 6:9, 11:10, 25:19 and 37:2. The others are secondary or parenthetical, and are concerned almost wholly with genealogies, whereas the primary divisions contain also much history. Wiseman dealt with the contents of these sections, and Morris has summarized them.

There is one thing that is not entirely clear at first sight: whether "these are the generations of . . ." refers to what has preceded it, or to what follows. Wiseman and Morris have both concluded that it refers to what precedes, so that the words at Genesis 2:4, for instance, would refer to all of Genesis up to that point.

This way of placing a title can be seen in other places in the Pentateuch, such as Leviticus 7:37. Perhaps it originated when much writing was done on clay tablets, such as those recently found at Ebla. For it is as easy to look at the end of a tablet as at the beginning.

The title of a scroll, on the other hand, would need to be at the beginning; otherwise one would have to unroll it to see what it was about. So maybe that became the custom, and persisted when, about the beginning of the Christian era, books, bound in the way familiar nowadays, came into use; although it is as convenient to look at one end of a book as the other.

How does it help a Christian to know these things? Although he would have believed in the inspiration of Genesis anyway, it strengthens his belief to have some idea about the actual process of transmission. Also, he need not be troubled by differences in style in different parts.

For Moses, in editing under inspiration, may have preserved something of the original writer's styles. Some, for instance, have suspected gaps in the genealogies of Genesis Chapter 11, because the formula is a little different from that in Chapter 5. But if there were different original authors, some differences of style could be expected.⁵ Moreover, one is encouraged to take details of the account of the Flood, for instance, seriously, when he knows that they came originally from eyewitnesses.

References

- ¹Luther's Table Talk 1970. (Reproduction of the edition of 1907) A.M.S. Press, New York. Volume 54, p. 373.
²Wiseman, P. J. 1946. New discoveries in Babylonia about Genesis. Marshall, Morgan, and Scott, London.
³Morris, Henry M. 1976. The Genesis record. Creation-Life Publishers, San Diego, California, and Baker Book House, Grand Rapids, Michigan, pp. 26-30.
⁴van der Werff, P. H. 1977. Genesis, *Bible-Science Newsletter* 15(4): 4-5. (April).
⁵van der Werff, P. H. 1977. The Septuagint may not provide independent evidence on chronology, *Creation Research Society Quarterly* 14(1):78.

Yours sincerely,
 P. H. van der Werff
 R. R. 4, Thamesford
 Ontario, Canada

Received 29 December 1976

Comments on the Canopy and the Flood

Kofahl is certainly correct in holding that there is no valid reason for eliminating the miraculous as the ultimate cause of the Noachian Flood¹. The establishment of that original system for supplying moisture to plant life without rain (Gen. 2:5) was part of the creation act. The spoiling of that system, whatever its nature may have been, can be reasonably presumed to have had a similar cause and origin.

In agreement with Kofahl is also the deduction that this does not eliminate *per se* the possibility or probability that this original system involved in part a canopy above what is now our atmosphere. As he has pointed out, any model used as an explanation of the Flood should not assume situations which are totally incompatible with the presently acting laws of nature. Let's leave it to the evolutionists to assume laws no longer in action as a means of explaining theoretical concepts or models.

On the other hand, I am unable to follow the reasoning which would limit the canopy to water equivalent to a small amount such as six inches. It would seem that the *lower limit* for such a canopy demanded by the Biblical data must be sufficient to account for a rain of forty days duration. Even today, it is not unknown to have a rain-fall locally of as much as or more than six inches in a day. To be sure, assumptions of such a canopy composed of either liquid water or ice with a

depth of a thousand feet, or even ten feet, are totally untenable.

Such concepts have their origin in the further assumption that *all* the waters of the Flood came from the spoiling of this canopy arrangement. While one might assume here that God miraculously brought in water from elsewhere to accomplish His purpose, such an assumption is quite unnecessary in terms of the information provided in Scripture.

Scripture refers to the opening of 'the windows of Heaven' (Gen. 2:11) which one may take as figurative and referring to the spoiling of that canopy system. But in the same verse, there is reference also to the "fountains of the great deep" being broken up, an expression which may just as logically be taken to refer to an antediluvian system involving vast stores of subterranean water. One may rationally presume that by far the greater part of the flood waters came from this source, not from the rain.

Such an interpretation has been held by some Bible scholars and commentators over the last century or more, and should not be eliminated from consideration in devising a model of the antediluvian world as it came from the act of creation. This is further suggested in Gen. 2:5 which, I believe, indicates such a subterranean water source.

I see no reason why the currently known laws of nature prevent a recognition of a canopy of *water vapor* (as distinguished from liquid water or ice) amounting to 10-15 feet of liquid water as a basis for accounting for the 40-day rain. It is in the form of water vapor that water exists in the atmosphere at the present time.

Such a canopy would increase the atmospheric pressure by a factor of only about 1.5, which presents no difficulty. As for the visibility through such a vapor canopy, this would represent little more of a problem than the present visibility through the atmosphere. If the atmosphere were liquified, it would represent a layer some 25-30 feet in depth. The only effect on visibility through this amount of air is the light blue color of the heavens due to scattered light. Such a canopy floating on the atmosphere, but mingling with it to some minor degree, violates no law of nature. If one understands also that this water vapor canopy may well have existed at an elevated temperature, the problem is still less.

Such a model provides rational explanations for a significant number of problems which have more or less defied solution otherwise. These include explanations for: (1) the forty-day rain, (2) the problem of where the flood waters went after the flood (i.e., into the formation of our present oceans which did not exist in the antediluvian system), (3) the evidences for incomprehensible volcanic action (i.e., from the redistribution of pressures on the earth's surface), (4) the finding of fossils of simple forms of marine life on the tops of our highest mountains (i.e., in the elevation of certain land levels to heights not existing in the antediluvian world), (5) the distribution, and later isolation, of certain forms of animal life over the earth's surface (i.e., by the sinking of land bridges that continued to exist for some time after the flood), (6) the existence of a salubrious climate in the antediluvian world from pole to pole (i.e., by the greenhouse effect of a higher carbon dioxide content of

the atmosphere, by the protective action of the canopy, and by the circulation of this subterranean water from equatorial regions to the polar regions and reverse, and (7) the abnormally high ages obtained by the carbon-14 dating method in the "paleolithic" (antediluvian) period and that immediately following during which a new equilibrium of atmospheric carbon dioxide was in progress.

Surely, such a model should not be dismissed or overlooked in seeking a rational explanation of the Biblical accounts just as they read.

Sincerely yours,
Donovan A. Courville
42 Dart Street
Loma Linda, California 92354
Received 15 June 1977

Reference

¹Kofahl, Robert E., 1977. Could the Flood waters have come from a canopy or extraterrestrial source? *Creation Research Society Quarterly* 13(4):202-206.

Creationist Activity in Spain

Under the name of "Servicio Evangelico de Documentacion e Informacion", my wife Cathy and I are trying to serve our fellow Christians here in Spain, by making available to them the scientific case for Creation. Also, we try to reach honest inquirers, people who are really in anxiety about the emptiness in their lives, but who are hindered in coming to a Biblical faith because of the current belief in evolution.

We are grateful for help which we have received. For instance, the Institute for Creation Research at San Diego has allowed us to publish material of theirs, to help in our work. We are now printing Dr. D. Gish's *Creation, Evolution, and the Historical Record*, as well as the chapter of Dr. H. Morris' *Scientific Creationism* dealing with the alleged links between ape and man. In Spanish, that has been called *Creacion, Evolucion, y el Registro Fossil*. Plans include Dr. Gish's *Speculations and Experiments Related to Theories on the Origin of Life: a Critique*.

Incidentally, there are others in this work; an evangelical publishing house in Barcelona is having *The Genesis Flood* translated and hopes to publish it next year.

Now may we request a little more help? We should like to buy a set of the *C.R.S. Quarterly*, volumes 1 to 9 inclusive, if a set should be available. It would be very useful to us. Also, we should be interested in getting slides on the fossil record, documenting the systematic gaps in it.

Sincerely yours, in the service of Jesus,
our Lord and Saviour,
Santiago Escuin
Servicio Evangelico de Documentacion e Informacion
Avda. Paraires, 23, 11º, A
Sabadell (Barcelona) Spain
Received 13 June 1977

☆ ☆ ☆

Quotable Quote

"Perhaps he (a certain author) wishes the authors (of opposing works) to be considered as still living in the dark ages . . . No doubt such strong language is meant as a sort of scarecrow symbol to keep off trespassers from this domain of thought which has been seized upon as their own . . .

"No doubt we ought to be duly impressed when those who at least speak so authoritatively, have their authority so nearly universally granted . . . But perhaps some may suspect that so much noise is not at all a sign of complete sureness . . . but rather a cloak for a certain amount of misgiving, and an effort to keep up a valiant front, as a boy is supposed to whistle noisily to keep up his courage in passing through a cemetery by night."

— From Callahan, J. J. 1931. *Euclid or Einstein*. The Devin-Adair Company, New York, pp. xiv and xv. (Callahan was writing about some of the new mathematicians; but is this not very applicable to evolutionists who wish to overturn what everyone has believed? —Editor)

ANNOUNCING SPECIAL REPRINT

Some Christians believe that Charles Darwin, toward the close of his life, repudiated evolution and became enthusiastic for Christianity. That this did not occur has been reported by Dr. Wilbert H. Rusch, Sr., in a 1975 investigative paper on what Darwin wrote, and presumably believed, in the last two years of his life.

Now a special reprint of that paper "Darwin's Last Hours" is available for twenty-five cents (\$0.25)/postpaid per copy from the College Bookstore of Concordia College, 4090 Geddes Road, Ann Arbor, Michigan 48105. This will be a fine publication to give to those people who inquire about a possible Christian conversion of Darwin.

CREATION RESEARCH SOCIETY

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

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

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

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

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

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

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

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

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

Board of Directors *Biochemistry*: Duane T. Gish, Ph.D., Institute for Creation Research, 2716 Madison Avenue, San Diego, CA 92116. *Biological Sciences*: Wayne Frair, Ph.D., Secretary, The King's College, Briarcliff Manor, NY 10510; George F. Howe, Ph.D., President, Los Angeles Baptist College, Newhall, CA 91321; Lane P. Lester, Ph.D., 110 Wisteria, Orlando, FL 32806; John R. Meyer, Ph.D., University of Louisville, KY 40208; Wilbert H. Rusch, Sr., M.S., LL.D., Membership Secretary, Academic Dean, Concordia College, Ann Arbor, MI 48105. *Genetics*: John W. Klotz, Ph.D., Academic Dean, Concordia Seminary, St. Louis, MO 63105; Walter E. Lammerts, Ph.D., Freedom, CA 95019; William J. Tinkle, Ph.D., Timbercrest Home, North Manchester, IN 46962. *Geology*: Clifford L. Burdick, M.S., D.Sc., 924 N. 6th Avenue, Tucson, AZ 85705. *Geophysics*: Harold Slusher, M.S., D.Sc., University of Texas at El Paso, TX 79902. *Physical Sciences*: Harold Armstrong, M.S., Publications Editor, Queens University, Kingston, Ontario, Canada; Thomas G. Barnes, D.Sc., University of Texas at El Paso and Consultant to Globe Universal Sciences, Inc., El Paso, TX 79902; Richard G. Korthals, M.S., Treasurer, Dean, Concordia Teachers College, River Forest, IL 60305; Henry M. Morris, Ph.D., Institute for Creation Research, 2716 Madison Avenue, San Diego, CA 92116; George Mulfinger, M.S., Bob Jones University, Greenville, SC 29614; Emmett L. Williams, Jr., Ph.D., Vice-President, Bob Jones University, Greenville, SC 29614. *Science Education*: John N. Moore, M.S., Ed.D., 136 Brody Hall, Michigan State University, East Lansing, MI 48824.

Quotable Quotes

"Empedocles, then, was in error when he said that many of the characters presented by animals were merely the results of incidental occurrences during their development; for instance, that the backbone was divided as it is into vertebrae, because it happened to be broken owing to the contorted position of the foetus in the womb. In so saying he overlooked the fact that propagation implies a creative seed endowed with certain formative properties. Secondly, he neglected another fact, namely, that the parent animal pre-exists . . . For man is generated from man; and thus it is the possession of certain characters by the parent that determines the development of like characters in the child. The same statement holds good also for the operations of art . . . the statuary's art . . . must necessarily precede the statue, for this cannot possibly be produced spontaneously."

— From Aristotle, *On the Parts of Animals*, Book I Chapter 1. Translated by William Ogle.

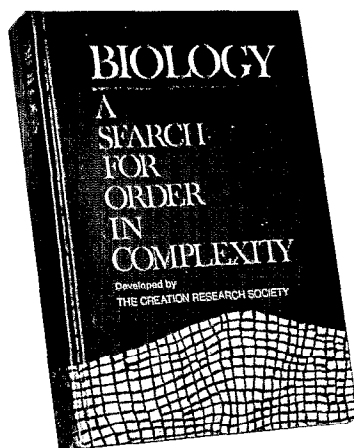
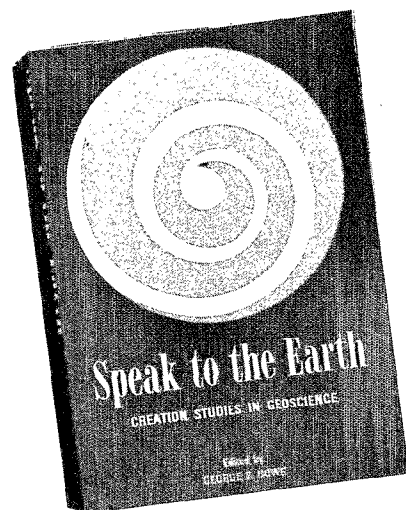
"It is unfortunate that in so much modern work more effort must be given to the labor of debunking than to that of actual development. The field must always be kept clear of inordinate growth of weeds, if we are to produce the useful. This is a process which is always required, but in no age more than the present, and in all branches of science. It seems that the law of labor made for man when he was driven from the terrestrial Paradise applies to his intellectual as well as to his physical life. Thorns and thistles are as large a part of his work as the useful crops. Even here he is bound to earn his living by the sweat of his brow. For the labor of debunking is what makes him sweat. Growth itself is painless and pleasant. There are even enemies that sow their cockle in the field of science, but here at least it may not be left till the time of harvest before being bound into bundles and burned."

— From Callahan, J. J. 1931. *Euclid or Einstein*. The Devin-Adair Company, New York, p. xix.

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

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

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



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

A textbook for high school presenting creation AND evolution.

595 pp., 436 illustrations, \$9.95.

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

Paperback, \$1.95.

INVESTIGATIONS INTO BIOLOGY: STUDENT'S LABORATORY MANUAL

Paperback, \$1.95.

INVESTIGATIONS INTO BIOLOGY: TEACHER'S LABORATORY MANUAL

Paperback, \$1.95.

WHY NOT CREATION?

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

Baker Book House, Grand Rapids, Michigan and Presbyterian and Reformed Publishing Company, Nutley, New Jersey. \$7.50.

SCIENTIFIC STUDIES IN SPECIAL CREATION

Additional articles from *Creation Research Society Quarterly*, 1964-1969.

Baker Book House, Grand Rapids, Michigan and Presbyterian and Reformed Publishing Company, Nutley, New Jersey. \$6.95.

SPECIAL REPRINT AVAILABLE

The primary purpose of the Creation Research Society is to carry out, or to encourage, Creationist research in the natural sciences, and to publish the results of such research. In an article in the June, 1975 issue of the *Creation Research Society Quarterly*, Dr. Duane T. Gish published a summary report of Creationist research in the last decade.

His report was organized under these headings: Geology, General Geological Reports, Genetics, Natural Selection, General Biology, Taxonomy, Thermodynamics, and A Research Challenge.

So that members of the Creation Research Society and other interested persons might distribute this summary of a decade of Creationist research a special reprint of the Gish article has been made available. The 16-page reprint is priced at 75 cents per copy, with price reduced to 50 cents each for orders of 100 copies. Orders for the reprint may be placed through the College Bookstore of Concordia College, 4090 Geddes Road, Ann Arbor, MI 48105. Postage will be paid by the bookstore.