

Creation Research Society Quarterly

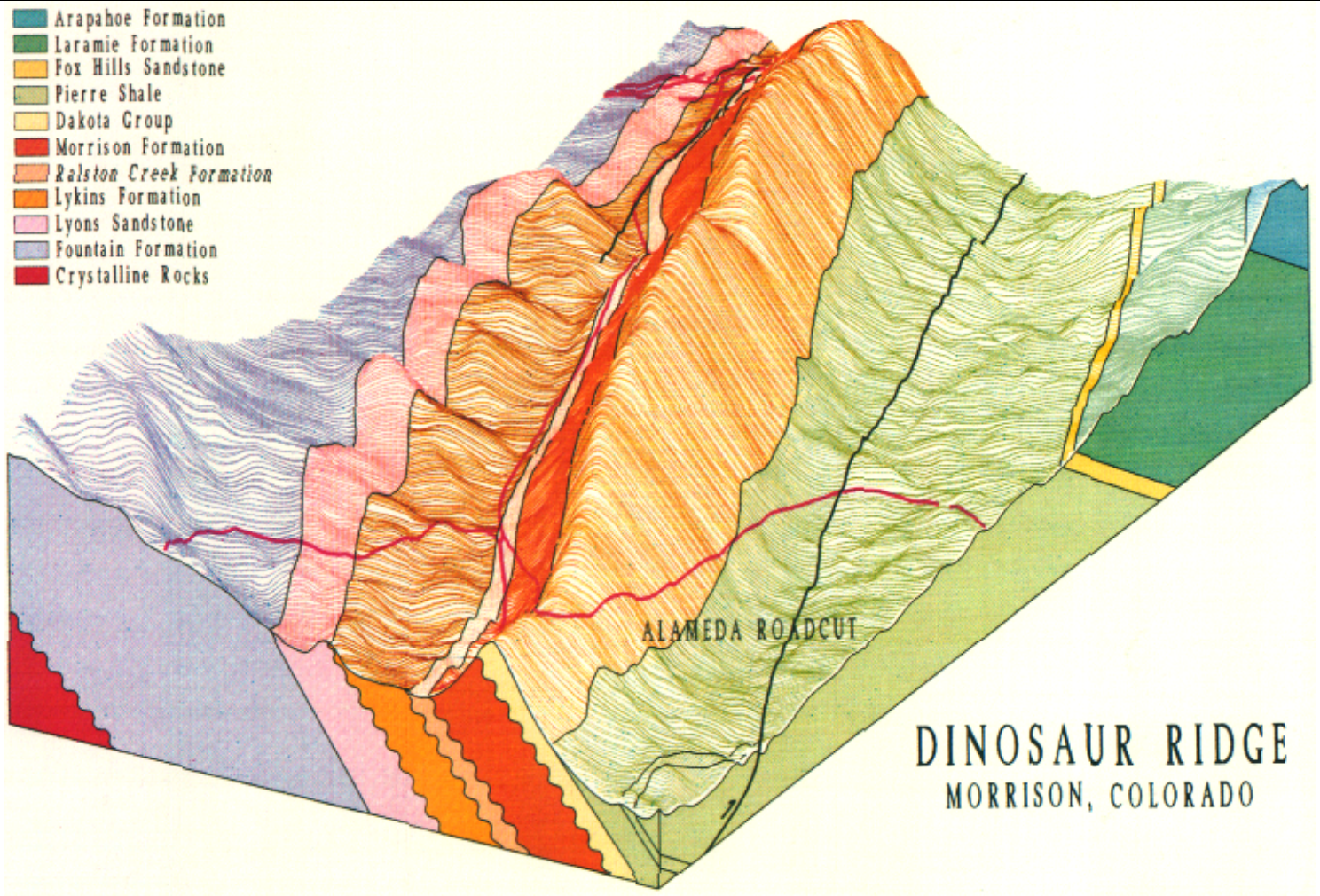
Haec credimus:

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

VOLUME 29

JUNE 1992

NUMBER 1



GEOLOGY FEATURES

MORRISON FORMATION

HYDROTHERMAL VENTS –

MODERN-DAY FOUNTAINS OF THE DEEP

EROSION OF THE GRAND CANYON OF THE COLORADO RIVER

CREATION RESEARCH SOCIETY QUARTERLY

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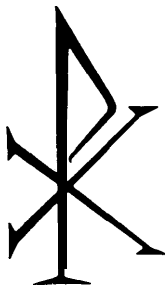
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Cover Illustration

A 3-D view to the northwest of the geology of
Dinosaur Ridge between West Alameda Parkway (fore-
ground) and Interstate-70. Created by Mark Tullius,
Geographies Environmental Consultants, Inc., 200
Union Boulevard, Suite 223, Lakewood, Colorado
80228, for the Friends of Dinosaur Ridge and for the
CRSQ. This ridge is famous for its fossils, as explained
in the lead article.

TABLE OF CONTENTS

Membership Application	3
Order Blank for Past Publications	4
Instructions to Authors	5
Editor's Comments	6
Comments on the Fossils of Dinosaur Ridge Edmond W. Holroyd, III	6
Hydrothermal Vents at Deep Sea Spreading Ridges: Modern-Day Fountains of the Deep?	13
Jacqueline S. Lee	
Erosion of the Grand Canyon of the Colorado River Part III—Review of the Possible Formation of Basins and Lakes on Colorado Plateau and Different Climatic Conditions in the Past	18
Emmett L. Williams, John R. Meyer and Glen W. Wolfrom	
Panorama of Science Reserved for Fire	24
Thermodynamics and Natural Processes	25
What is under the Surface?	27
Reprinted CRSQ Volume 8	28
Index to Volume 28 of the <i>Creation Research Society Quarterly</i>	30
The Biological Theory of Atavism: A History and Evaluation	33
Jerry Bergman	
Correlation of C-14 Age with Real Time	45
Robert H. Brown	
Carbon-14 Quarterly Bibliography	47
Book Reviews (4)	48
Letters to the Editor (4)	50

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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 creation, with a current membership of over 600 voting members (with graduate degrees in science) and over 1100 non-voting members. The *Creation Research Society Quarterly* has been gradually enlarged and improved and now is recognized as 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. The Society operates two Experiment Stations, the Grand Canyon Experiment Station in Paulden, Arizona and the Grasslands Experiment Station in Weatherford, Oklahoma.

Membership Voting membership is limited to scientists having at least an earned graduate degree in a natural or applied science. Dues are \$18.00 (\$22.00 foreign) per year and may be sent to Glen W. Wolfrom, Membership Secretary, P.O. Box 14016, Terre Haute, IN 47803. Sustaining membership for those who do not meet the criteria for voting membership, and et who subscribe to the statement of belief, is available at \$18.00 (\$22.00 foreign) per year and includes a subscription to the Quarterlies. All others interested in receiving copies of all these publications may do so at the rate of the subscription price for all issues for one year: \$21.00 (\$25.00 foreign).

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Michigan 49506. 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 humans, 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 a historical event worldwide in its extent and effect.

4. We are an organization of Christian men and women 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 Savior for all people. Therefore, salvation can come only through accepting Jesus Christ as our Savior.

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Edited by Walter E. Lammerts

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3. All submitted articles will be reviewed by at least two technical referees. The editor may or may not follow the advice of these reviewers. Also, the prospective author may defend his position against referee opinion.
4. The editor reserves the right to improve the style of the submitted articles. If the revisions of the editor and referees are extensive, the changes will be sent to the author. If the changes are not suitable to the prospective author, he may withdraw his request for publication.
5. Due to the expense involved, manuscripts and illustrations will not be returned to authors.
6. All references (bibliography) must be presented in the style shown in the Quarterly. If a prospective author is not familiar with the CRS format, the editor will furnish an example reference page.
7. All figures and drawings must be prepared professionally. No sloppy hand drawings or freehand lettering will be accepted. The editor reserves the right to approve submitted figures. Unacceptable illustrations will result in rejection of the manuscript for publication. Do not send slides.
8. Any manuscript containing more than 25 pages is discouraged. If a topic cannot be covered to the author's satisfaction in this length of pages, the author *must* divide his material into separate papers that can be serialized in the Quarterly.
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Editor's Comments

Every Spring students (and parents) face the challenge of a science fair project. It is not always enjoyable; a major obstacle is the choice of a suitable topic. Perhaps the Quarterly can be of help.

There are many worthwhile projects which involve creation science. Some are table-top experiments; others require data collection through the convenient interlibrary network. Such projects are suitable for the public, private, or home school setting. They may also lead to eventual publication.

Can you think of student research projects from your own discipline? Please send me a list with two or three sentence descriptions. They will be presented as letters or in a summary collection. Your suggestions may encourage and prime the next generation of creationists.

The lead article by Dr. Edmond Holroyd on Dinosaur Ridge in Colorado is quite interesting. Part III of the Grand Canyon erosion series is included in this issue as well as a fascinating discussion of deep sea hydrothermal vents by Jacqueline Lee. Dr. Robert H. Brown has done an excellent job on correlating C-14 ages with real time. The history and evaluation of the concept of atavism is presented by Dr. Jerry Bergman. Several shorter items make enjoyable reading. Please consider contributing either an article, technical note or letter to the editor to participate in developing the creation model of science.

Don B. DeYoung

COMMENTS ON THE FOSSILS OF DINOSAUR RIDGE

EDMOND W. HOLROYD, III*

Received 15 December 1991; Revised 11 January 1992

Abstract

The details of the strata associated with dinosaur bones and footprints and fossil plant matter in a hogback west of Denver are indicative of rapid burial. Physical evidence for millions of years of deposition of the Morrison and Dakota formations at this location is lacking. This paper summarizes interpretations that are shared with some of the public during monthly open house tours of the site.

Introduction

Southwest of Denver, Colorado, is a hogback formed by the tilting of the sedimentary strata by the uplift of the Rocky Mountains. It is sometimes named Dakota Ridge after the durable sandstone of the Dakota Formation that limits the erosion of the Morrison Formation shales and sandstones below. The ridge is cut in several places by creeks draining the mountainous Precambrian blocks to the west and also is cut by a few roads.

Of particular interest in this report is the section between the towns of Golden and Morrison. That portion between Interstate 70 and West Alameda Parkway, shown in Figure 1, has been set aside as Hogback Park by Jefferson County Open Space, which has placed a trail along its summit. At the north end the colorful Morrison and Dakota strata are well exposed in the deep road cut of Interstate 70. On both the north and south sides of the cut are parking lots and trails so that the public can walk beside the near-vertical strata and read the many large interpretive signs along the walkway.

The ridge has been unofficially designated "Dinosaur Ridge" by the Friends of Dinosaur Ridge, in association with the Morrison Natural History Museum. Their goal is to preserve and make accessible this ridge for its historical and educational value. The Friends of Dinosaur Ridge have placed numbered stops along West Alameda Parkway, in about the center of the ridge, to draw attention to the special geologic forma-

tions exposed by the road cut. That portion of the road is closed to vehicular traffic about once each month, especially the major holidays, during the warm parts of the year. Crowds numbering hundreds or thousands can then safely tour the stops. An interpretive Field Guide (Lockley, 1990) describes the highlights. Efforts are also made to have knowledgeable volunteers at most stops to amplify on the interpretive signs.

The Morrison Formation, named for the town to the south, nearly spans the north-south extent of the contiguous United States over the eastern Rocky Mountains and western Great Plains. It is famous for its preservation of dinosaur bones. It was from this ridge in 1877 that the first specimens were discovered of *Apatosaurus*, *Stegosaurus*, and *Diplodocus*. The quarries are no longer visible in the Morrison strata along the western side of Dinosaur Ridge, having been closed in 1879. The few bones that remain are typically radioactive because of the deposition of water-borne uranium into the organic matter during fossilization (Gentry, 1986, pp. 51-62).

On the eastern side of the ridge, dinosaur tracks were discovered in the top layers of the Dakota strata in the 1930's. They are generally identified as Iguanodon-like vegetarian dinosaurs and ostrich-sized carnivorous dinosaurs. The strata also contain symmetric ripples probably indicative of shallow water. In between, exposed by the rock cut of the hairpin turn at the crest of Alameda Parkway, are plant fossils. The sandstones and shales at this location are blackened by a presumably large carbon content. The fossils are

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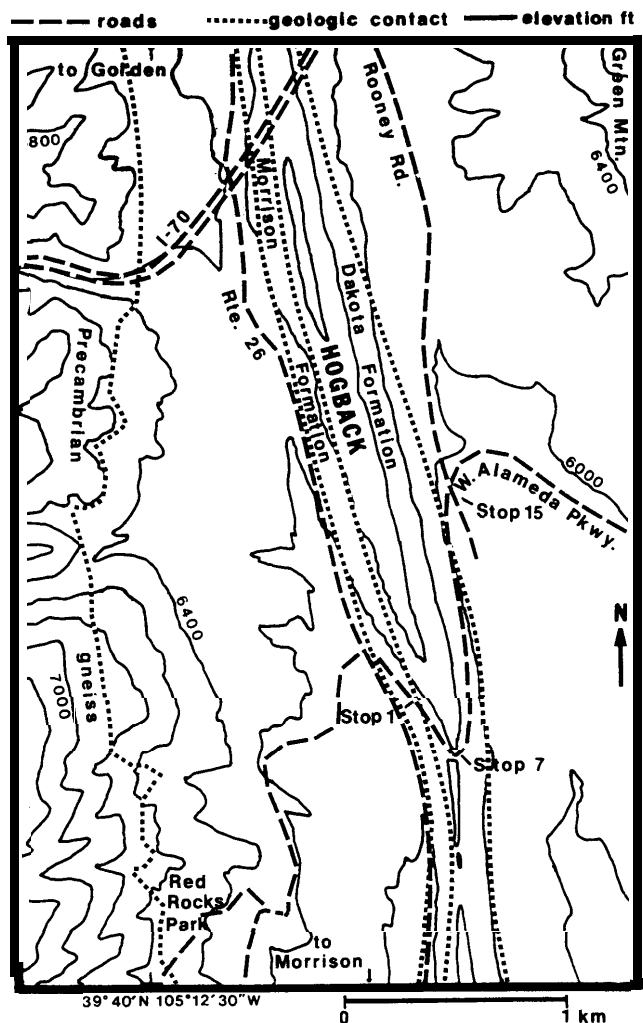


Figure 1. A map of the region near Dinosaur Ridge, labeled HOGBACK, showing elevation contours, roads, and some geologic formations.

highly disappointing because there are no impressions of anything complete, like perhaps a leaf. Though an exposed surface can be more than half covered with fossil plant matter, it is broken beyond recognition. The plant remains, when large, resemble pieces of low density charcoal. Weathering removes this black material, leaving hollow sandstone casts.

For the past two years I have been the volunteer speaker at Stop 7, labeled "plant fossils" in the Field Guide. It is at the left side of the south-facing panorama in Figure 2. The dinosaur bones, footprints and geologic formation exposures always attract speakers. However, no other volunteers fill in at Stop 7 when I have to be absent. Yet these otherwise disappointing plant fossils have an interesting story to tell. They call into question the scenario of millions of years for the deposition of the Morrison and Dakota strata.

The Stop 7 Message

Most people touring Dinosaur Ridge spend only several minutes at each of the 15 stops. The basic message at each stop therefore must be brief. I set up a card table (light patch on the left side of Stop 7 in

Figure 2) on which are placed rock samples from the adjacent ground, a zoom stereo microscope, and relevant literature.

A single sheet interpretive guide supplied by the Friends says,

7. Plant Fossils The sandstone layers in front of you contain impressions of plant stems and leaves. Identifying these plants helps paleontologists reconstruct the climate of this area 100 million years ago. These fossils are most important because it was while looking for plant fossils that Arthur Lakes accidentally found the dinosaur bones in the Morrison Formation!

Under the same heading Lockley (1990, p. 12) states:

The sandstone layers at this stop contain many impressions of plant stems and foliage. Such fossil evidence is useful in reconstructing the vegetation and climate of the area 100 million years ago. As early as the 1890's more than 25 species of plants had been identified from fossil remains in this area. In fact, it was a fossil-leaf-hunting expedition that led to the discovery of dinosaur bones at Stop 1.

Recent work by palynologists, paleontologists who study fossil pollen, has revealed a large number of different plant species that grew in this area in Cretaceous time.

The first figure on that page has a caption, "Plant fossils: remains of ancient Cretaceous vegetation from the sandstones of the Dakota Group." The figure shows complete leaves of *Ficus*, *Magnolia*, *Lomatia*, *Salix*, *Sequoia*, and *Torreya*. The second figure has a caption, "One-hundred-million-year-old fossil pollen attributable to a species of flowering plant." The image is of the side and top views of a pollen grain, magnified 1000 times, but the species is not identified.

The page does not specifically state that those six plant types were found at Stop 7. Nor does it state whether the identification is from leaf impressions or pollen analysis. I have yet to find any intact leaves there. The closest is a surface that resembles a willow (*Salix*) leaf, but it could also be interpreted as a fortuitous smooth crack (no veins or edges). Some broad linear impressions can be interpreted as bark fragments, the largest of which is 6 X 70 cm. Otherwise, everything at this stop is just junk fragments. The page therefore gives the impression of a scholarly study, but there are breaks in the logic.

My own verbal presentation is variable but goes something like this, as I point to rock samples, the microscope, and literature:

All of the black that you see in the rocks behind me is from carbonized plant material from long ago. In some places the carbon is powdered so fine that it simply stains the rock (referring to a dark gray shale sample). It can also be chunky, like charcoal fragments (pointing to another sample). Elsewhere the carbon can be thick and pure enough to be mined as coal. Weathering removes this black material, leaving behind these abundant hollow impressions.



Figure 2. A south-facing panorama of the West Alameda Parkway road cut. Stop 7, highlighting plant fossils, is at the left and

However, these plant fossils are fragments only. They are broken beyond recognition. Rarely do you see something that resembles a leaf, a stem, or a piece of bark. There is no way to identify the former plants at this stop from these pieces.

To identify the plant types we have to dissolve the rocks in strong acids and extract the pollen grains that are mixed with the sand. Every plant type has a distinctive size and shape for its pollen.

Under the microscope (at 40X magnification) is *modern ponderosa pine pollen*, gathered from the tip of this branch last June along with the entire milliliter of pollen in this sample bottle. Its large size and crease down one side are indicators for pine, as you can see in this book (Kapp, 1969, p. 38). When we find fossilized pine pollen in rocks, as shown in this picture (Figure 13, Howe et al., 1988), then we know that pines were present when the rock was laid down. In the same way, finding other species of pollen in the rocks proves the presence of those species of plants near the time and location of the rock deposition.

Everyone sees that the basic shape of the pine pollen under the microscope is the same as the fossil pine pollen illustrated in the research article published in the *Creation Research Society Quarterly*. The fossil pollen just has ends that are somewhat shorter, which may be a species difference or a result of preservation or extraction. For most people, this brief presentation and the look through the microscope seem to be about all the new information they are interested in absorbing at that time.

For those who linger longer, there are other sheets of paper to read. One points out that the fossil pine pollen comes from the Hakatai shale at the bottom of the Grand Canyon, below the Great Unconformity, in

Precambrian strata. A few realize the implication of functioning pine trees in Precambrian times. Another sheet compares average depositional rates for the evolutionary scenario with the thickness of the pollen grains. A third sheet questions how the sand and charcoal-like plant fragments got mixed and preserved.

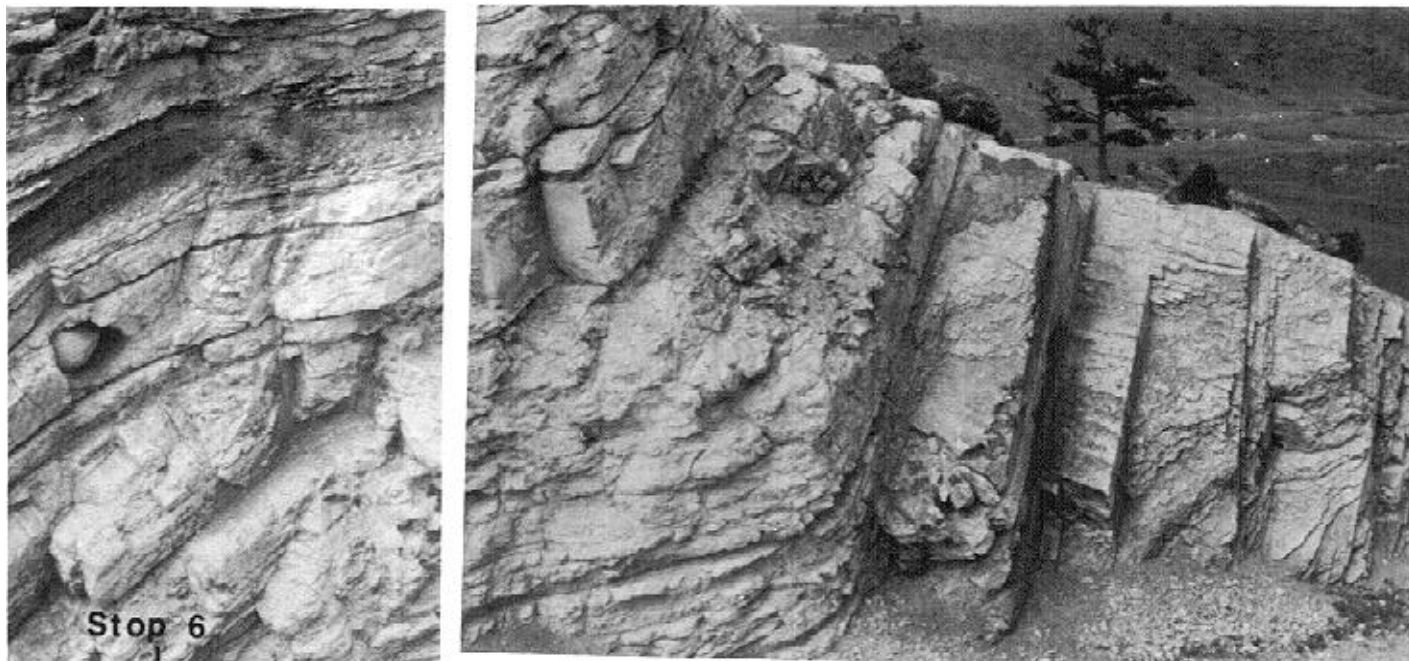
Fossil Pine Pollen

There are several questions that typically come from those who have the time to linger at Stop 7. Some ask, for clarification, if pines were so old that they contributed to the plant material at Dinosaur Ridge. I cannot confirm or deny that anyone has found pine pollen or fossils here; the Field Guide does not mention pines. However, the Hakatai strata is much older than the Dakota Formation. Since pine pollen was found in the Hakatai shale, then pines span the period from the Hakatai deposition to the present, including that of the Dakota Formation.

Others ask for more details about the fossil pollen, leading to an explanation of the original and confirmatory discoveries (Howe et al., 1988) of pine pollen in the Precambrian Hakatai shale. That gives the opportunity to point out that the evolutionary scenario indicates that only single-cell and simple multi-cell organisms should have been present in Precambrian times, not functional pine trees. Therefore the fossil pine pollen in the picture challenges the entire evolutionary time line.

Deposition Rates

Another question that is asked frequently is how long ago were these rocks of the Morrison and Dakota Formations laid down? The Field Guide gives 150 million years ago for the Morrison, in the upper part of the 208-144 million year ago Jurassic Period. A value of 100 million years ago is listed for the Dakota Formation, in the lower part of the 144-66 million year



Stop 6, highlighting a possible large concretion, is near the center. The location of Figure 3 is shown by the black outline.

ago Cretaceous Period. Scott (1972) lists each formation as about 300 feet (100 meters) thick.

A crude estimate of average depositional rates can be made by dividing 200 meters of strata by 50 million years, yielding an average of 4 micrometers per year. Being off by a factor of about 2 in either or both of these numbers does not really affect the illustration. For comparison, the pine pollen grains that are being observed under the microscope are about 60 ± 5 micrometers in length, though a few are as small as 40 micrometers.

Nearly everyone can see that nothing can be buried and preserved at that slow rate. Dinosaurs, especially, need to be covered with at least their own thickness of sediment before they rot or are scavenged. That means that a minimum depositional rate of one to a few meters per year is necessary for there to be fossil dinosaur bones.

Though not mentioned in his Field Guide, Lockley has verbally claimed to have found some dinosaur footprints in the area that are so perfect that he can even see the texture of the skin of the feet. Preservation of such features necessitates burial by about a cm of sediment in a fraction of a day in gentle, non-erosive conditions. Otherwise wind, water currents, rain, or other animals would obliterate the footprints. Waisgerber (1990) reminds us that fresh deposits are particularly vulnerable to erosion prior to consolidation and cementation. Though it varies with habitat and moisture conditions, the rate of destruction of footprints can be easily observed today. It can range from the time to the next wave on a beach, to a few weeks in a sheltered environment. Footprint preservation appears to require at least brief burial rates that are on the order of a meter or more per year.

Some apologists for the evolutionary / uniformitarian scenario acknowledge the great difference (six orders of magnitude in this case) between average and nec-

essary sedimentation rates. They claim that the sedimentation was not continuous. The abrupt changes between types of strata and colors in Dinosaur Ridge, some of which are visible in Figure 2, certainly point to discontinuous sedimentation processes. Today we can readily observe different surfaces respond to a variety of geological activity. Some receive sediments at a measurable rate. Others are eroding. Some seem stagnant when viewed from the human lifespan. Most of the rates of geologic activity that we can measure today are slow, but they are also inadequate for fossil preservation.

When deposition ceases and erosion is not strong, then biological activity usually leaves its mark on the surface. Roots penetrate the strata and worms homogenize the layers, making them indistinct. Soil layers develop and organic residues accumulate. There are no such soil layers observable on Dinosaur Ridge, even at the road cut of Interstate 70 which exposes nearly the entire multicolored sequence of the Morrison and Dakota Formations. Interludes between depositional periods cannot have lasted more than a century because, as we can easily observe today, a soil or a highly weathered surface layer would develop within such a period.

One person objected to this soil layer argument by referring to Stop 13, which is labeled "an ancient mangrove swamp" by Lockley (1990). Those strata are at the top of the Dakota group just under shales that are considered marine. There are impressions of what appear to be large branches in cross-bedded sandstone. The Friend's single sheet also mentions the presence of root impressions. The strata are undulating there like a chaotic wave pattern with an amplitude of many centimeters. I have yet to see any evidence that the impressions are from plants that were grown in that place, like roots that penetrate several layers of sand. The patterns of the branches and the cross-bedding

of the sand suggest instead that this is better interpreted as another dump of flood debris that was transported here from elsewhere. There is no thick or thin layer of black swamp muck mixed with roots here that would indicate decades or centuries of swamp growth in this place.

Surfaces which are dormant for many millions of years should also acquire some meteorites. Estimates vary, but if the arrival rate is something like one meteorite per square kilometer per million years, then in 50 million years there should be many meteorites within Dinosaur Ridge, some of which should have been found in the rock cuts and quarries. Furthermore, theories about the evolution of the solar system suggest that the rate of meteorite bombardment should have been greater in the past than it is today.

If a surface is not experiencing deposition or zero growth, the alternative is erosion. Ancient creek beds can be found in these formations, and their sand bars are good locations for possible fossils. However, there are no canyons or stream cuts comparable to those carved by today's creeks to the north and south.

Figure 2 shows to the right of Stop 7 a large light-colored sandstone lens with a thickness of over 3 meters. The lens is pinched out before it reaches the ridge top. The layers at Stop 7 are cross-bedded, as shown in Figure 3. That picture was taken within the black box marked in Figure 2; the rock hammer shows the scale. The relatively shallow angles of the cross-bedding may be more characteristic of water rather than air transport. These features may be indicators of minor erosion while the Dakota strata were being deposited. That erosion is limited and cannot reasonably represent the passage of millions of years. Referring to all mountains, Foster (1975) says "The present rate of erosion is such that, theoretically, all topography will be removed in about 12 million years. . . ." It is therefore hard to imagine million-year interludes that would leave the surface layers relatively untouched by sedimentation, erosion, or biologic colonization.

In order for dinosaur bones and footprints to be preserved, meter-per-year or faster sedimentation rates are required for at least a fraction of a year. Interludes appear to separate individual layers within these formations, but the lack of soil layers, meteorites, or major erosion features speaks against these interludes lasting more than centuries. There is no physical evidence at Dinosaur Ridge for interludes lasting even a million years, as required to achieve average depositional rates as low as several micrometers per year.

The Fragmentary Plant Fossils

Stop 7 was selected because of the plant fossils in the rocks. They are, however, highly fragmented and disappointing. It is appropriate to question what might have caused the breakup of the plant matter and texture of the sand and fossil mixture.

Two textures of carbonized plant matter from Stop 7 are shown in Figure 4. On the left are the typical irregular black chunks at several levels. In the upper right and bottom center the linear pattern suggests bark fragments. The pen gives the scale and the box in Figure 3 gives the location.

Over 300 km to the southwest, near Montrose, Colorado, the Morrison and Dakota Formations can be

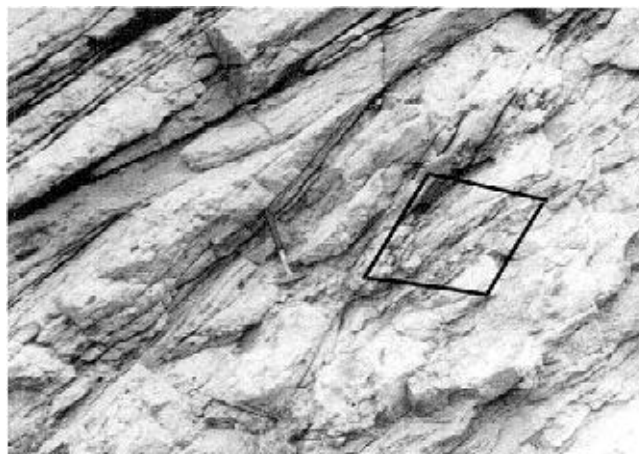


Figure 3. Cross bedding in the sandstone containing plant fossils at Stop 7. The location of Figure 4 is shown by the black outline.

seen in the Uncompahgre Plateau. In the same relative position within the Dakota Formation there is the similar texture of plant fossils and carbonization. Some particularly photogenic samples are shown in Figure 5 along with a metric scale. They were collected along Route 90 at about 38° 21' 43"N 108° 2' 49"W, 2415 meters above mean sea level. Notice the sharp edges to the black chunks. Green plant matter of that size that is broken by a flood usually exhibits frayed ends. Rotten wood and charcoal, however, can be broken more easily to resemble the samples in Figure 5.

A sandstone sample from Stop 7 that contained plant matter casts up to centimeter sizes, was easily crushed with finger pressure and examined under the microscope. Many sand grains were then observed to move violently when the sharp point of a straight pin was brought near, indicating possible piezoelectric charges lasting several minutes. Small clusters of sand grains were easily broken apart with a light touch of the pin point. There was only a small amount of a white powdery matrix holding the clear, yellowish quartz grains together. Most of the sand was in grains of 0.2-0.3 mm diameter with only slight blunting of grain edges. A lesser series of grains were in the 50-100 micrometer



Figure 4. Carbonized plant matter from the Dakota Formation at Stop 7, Dinosaur Ridge, north of Morrison, Colorado. The view is down onto the strata rather than the edge view of Figure 3.

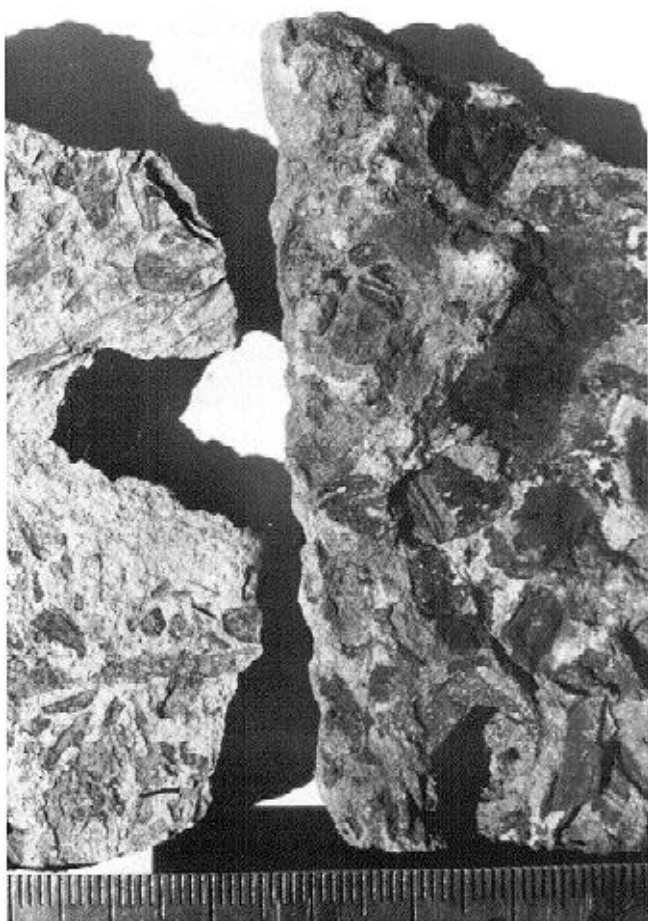


Figure 5. Carbonized plant matter from the Dakota Formation southwest of Montrose, Colorado.

range. In some places the matrix contained 10-25 micrometer particles. There were a few black grains of the size of the largest quartz grains. They were easily crushed by the pin point to the texture of a black paste. Apparently those were pieces of carbonized plant matter. No search was made for pollen in the crushed sandstone.

A working scenario was formed suggesting that the Dakota deposits might represent charcoal and sand washed from a slope denuded by a forest fire. The presence of the same texture over 300 km away on the other side of today's Continental Divide suggests that the same formation mechanism was likely to have been active there as well. To check the applicability of this scenario an actual forest fire site was visited. The examinations were made both before and after the Spring runoff season nearly two years after the major 1989 forest fire on Sugarloaf Mountain, west of Boulder, Colorado. In particular, the creek bed in Black Tiger Gulch was studied near 40° 0' 22"N 105° 23' 3"W, 2020 meters above mean sea level. There was still an abundance of charcoal falling from the dead ponderosa pine trees, as shown in the upstream view of Figure 6.

There were numerous places adjacent to the creek bed where stream overflow deposited sand since the fire. Occasionally there were charcoal pieces on top

of the sand. Numerous pits were dug into the sand to look for buried charcoal, searching for a mixture of sand and charcoal resembling that found at Dinosaur Ridge. Figure 7 shows one such pit with a pen for scale. Charcoal was never found within the sand layers. Sand bars just beyond small waterfall plunge pools were excavated, but no buried charcoal was found. Downstream the creek passes under a highway. Debris apparently choked the culvert in the past, forming a pool that filled with fresh sand. The culvert has since been cleaned, but layers of stratified sand still remain at the former sides of the pool. These recent strata, 1 to 2 meters thick, were searched for charcoal pieces but none were found within the sand.

A charcoal/sand mixture similar to that at Stop 7 at Dinosaur Ridge was not found at this forest fire site in the several environments checked. This is easy to understand. There is a large specific gravity difference between sand (2.65 for quartz) and wood or charcoal (perhaps 0.2 to 1.0, depending on waterlogging). The latter will tend to float in water (1.0) while the sand will sink. Only a turbulent flow will keep them mixed. Perhaps a consistency like a mud slurry or pancake batter would be sufficient to prevent buoyancy separation. Apparently the flow speeds, bulk density, and turbulence in even Spring runoff are inappropriate to deposit sand and plant matter together in a mixture resembling Figure 4 and 5.



Figure 6. Trees killed by the Sugarloaf Mountain fire in 1989 still shed an abundance of charcoal two years later.

The scenario must therefore be revised. Individual deposition layers vary greatly in thickness at Stop 7, as shown in Figures 2 and 3. Some shale bands are only millimeters in thickness. Just below the plant fossils there is the large uniform sandstone lens over 3 meters thick. The fossils themselves are frequently in bands 10-30 cm thick. The revised scenario is that a thick turbulent slurry of sand and plant debris was laid down so rapidly that the plant matter had no chance to float away. Residual water was later squeezed out by an increasing overburden, but the sand and broken plant matter were trapped together. This scenario requires that each entire band be laid down in a span of several minutes. A more precise sedimentation rate can be determined in laboratory simulations using sand grains similar to those found with the fossil plant matter. There might have been interludes between the deposition of successive bands, but they were not long enough for root establishment or homogenization of the strata by worms.

Under the revised scenario the entrapment of the fragmented plant matter with the sand indicates a very rapid deposition of the entire sequence of strata. Hours of direct deposition can be accounted for by these strata. Adding possible interludes can stretch the sequence to perhaps decades at most.

The upper Dakota strata, containing ripples and dinosaur footprints, must also have had periods of rapid burial for preservation of those features. There is no evidence there for interludes longer than decades. The lower Dakota strata of sandstones and shales do not have this texture of enclosed plant matter, ripples, or footprints. Some of the layers, especially the shales, certainly had slower deposition rates. Other layers are similar to those above that indicate rapid sedimentation. Again there is no evidence for interludes longer than decades. The entire Dakota sequence of about 100 meters thickness can therefore be accommodated within a year at high rates of deposition to possibly centuries if long interludes of no deposition are invoked. But there is no room at Dinosaur Ridge for multi-millions of years. The physical evidence speaks strongly of rapid sedimentation for the Dakota Formation.

Discussion

The efforts of Friends of Dinosaur Ridge to make this hogback more open to the public and to highlight the famous excavations of the last century are commendable. This allows thousands to visit the site each year and see the evidences themselves and perhaps learn something new about the past. Most volunteer speakers probably talk from the uniformitarian/evolutionary framework in which they were trained. Yet the presence of fossils speaks of catastrophic burial processes.

The plant fossils of Stop 7 are broken beyond recognition and disappointing to view. It is therefore appropriate to discuss pollen analysis for determining plant types. The abundance, large size, and distinctive shape for modern pine pollen makes it a worthy example for microscopic demonstration. Showing the photograph of fossil pine pollen completes the connection to the past. Together, the fragments and pollen make an interesting brief story for the casual visitor.

However, when the source of the fossil pollen (Precambrian Hakatai shale from the bottom of the Grand Canyon) is acknowledged, then it indicates that pine

trees were growing back when the evolutionary time scale says that only primitive life forms should have been present. Furthermore, pine tree pollen has not evolved to a different morphology during that time. The observed variations are relatively minor.

Estimating average sedimentation rates during the deposition of the Morrison and Dakota Formations gives answers that are about six orders of magnitude smaller than those necessary for the preservation of dinosaur bones or footprints. Physical evidence for long quiescent interludes between the deposition of distinct layers is not present. The multi-state geographic extent of those formations indicate that the mechanism for their formation was nearly continental in size. Gentle piedmont and seacoast scenarios are usually invoked for these formations. The preservation of the fossils, however, necessitates catastrophic processes. These processes cannot be simply due to local floods, earthquakes, or volcanoes but must operate catastrophically over the 1000 km scale of the formations. Morton (1984) elaborates on the implications of such large extents throughout the geologic record.

A charcoal deposition scenario was presented and revised according to the findings of field examinations. The conclusion was that a turbulent slurry with deposition in minutes is probably necessary for laying down



Figure 7. Pits dug into recent sand deposits along the Black Tiger Gulch show sand only. Charcoal pieces were occasionally on the surface but never mixed into the sand.

a mixture of sand and broken plant material like that found at Stop 7 and near Montrose. The suggestion of charcoal deposition indicates that carbonization occurred before burial. This is not vital to the deposition rate argument. Hydraulic sorting of the plant matter from the sand would occur just as easily with rotting wood fragments or pieces of green woody plants. Then the carbonization would have occurred after burial. The charcoal scenario came about because the fossil material visually resembles charcoal; no chemical tests were made, however. The charcoal scenario also resulted in an easy field check at a forest fire site. The important parts of the scenario are that 1) the plant material was broken up beyond recognition, requiring an adequate mechanical agent such as a major flood; and 2) normal floods do not mix sand and chunks of plant matter in the texture observed in the fossils. Catastrophic burial from a turbulent slurry is suggested as a mechanism.

Some of the arguments used in this report have logical weaknesses. They claim that something is missing: charcoal mixed into sand, soil layers, deep erosion cuts, meteorites, unbroken plant fossils. The search obviously did not examine every possible location because that would require dismantling the entire ridge boulder by boulder. Only readily available exposures were examined in a non-destructive way, and even then the search was not comprehensive.

These observations at and near Dinosaur Ridge challenge the evolutionary and uniformitarian scenarios for the geologic history of the Morrison and Dakota Formations at this hogback. Though the champions for those scenarios raise their objections when we meet at Stop 7, the general public tends to be sympathetic to the catastrophic scenarios. They can see the pollen samples with their own eyes and notice that the fossil pollen from the Hakatai shale looks similar to the modern pollen under the microscope. They can relate an average sedimentation rate over millions of years to the size of the pollen they are examining. They can see the mixture of plant matter and sand in the rocks and can relate to the density differences between plant matter, water, and sand. There is no problem envisioning the plant matter floating away under uniformitarian conditions. They can relate to the rapid decay and scavenging of dead animals along highways and to the obliteration of footprints at seashores, play-

grounds and feedlots, necessitating rapid burial if preservation is to occur.

Dinosaur Ridge is considered by some as a monument promoting the evolutionary scenario and the passage of millions of years. The physical evidence, however, speaks more loudly in favor of catastrophic processes. The contrast between the scenarios can give rise to sharper reasoning skills as one considers the evidence supporting each side.

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HYDROTHERMAL VENTS AT DEEP SEA SPREADING RIDGES: MODERN-DAY FOUNTAINS OF THE DEEP?

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Abstract

Deep sea hydrothermal vents associated with mid-ocean spreading ridges have implications for both creationists and evolutionists with regard to origins of terrestrial massive sulfides, geochemical flux into ocean waters, heat flow, and dating of mid-ocean rifting events.

Description

Spreading ridge hydrothermal vent systems are areas of emission of heated waters on the spreading ridges of the ocean floors. An explosion of research in recent years, using submersibles and sophisticated recording and collection equipment, has produced a huge amount of data, much of which is of interest to creationists.

Spreading ridge hydrothermal vent systems have been found in the Dead Sea, on slow spreading ridges, in back arc basins, and on fast-to-medium-spreading ridges (Rona, 1983). The term "fast" or "slow" spreading ridge does not refer to measured observations, but rather to assumptions of seafloor ages based on magnetic patterns on the sea floor in relation to radiometrically determined rock ages. The mid-Atlantic ridge is considered to be a slow spreading ridge and the Eastern Pacific ridge to be intermediate to fast.

This paper will concentrate on data gathered from hydrothermal systems located on the Eastern Pacific

Ridge (EPR) because these have been the most extensively studied thus far. These vent systems are characterized by massive sulfide deposits (mostly Cu, Pb, and Zn), by high temperature water emissions, often accompanied by particulate (vents may be called "black smokers" or "white smokers"), and by an unusual biota, including sulfur-oxidizing bacteria and odd-looking tube worms.

Although chance played a large part in the discovery of the first hydrothermal vents, the development of more sophisticated models of hydrothermal distribution now predict that hydrothermal activity should be found on topographic highs along the ridge crest (Francheteau and Ballard, 1983). Estimation of the distribution of hydrothermal mineral deposits or high intensity hydrothermal systems capable of producing such deposits range from one such occurrence every 15-100 km along slow spreading centers to every 1-100 km along intermediate-to-fast-spreading centers (Rona, 1983).

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Implications for Terrestrial Deposits

Modern hydrothermal vent systems should be taken into account in Nutting's model of evaporite formation, (Williams, 1989), which posits a hydrothermal vent origin for bedded salt deposits, but lacks observational support. In actuality, modern sea floor hydrothermal vents are found to produce massive sulfides, not bedded salt deposits, from interaction of seawater with basalt.

More and more, continental massive sulfide deposits are being reinterpreted in the light of hydrothermal origins. For example, Holmen and Delaney (1985) explained the differences in geochemistry between a quartz-sulfide vein and wall rock in the Bay of Islands ophiolite as reflecting alteration of wall rock gabbro by a hydrothermal fluid moving through the system. Robertson and Boyle (1983) have interpreted the huge region of metalliferous sediments around the Mediterranean and Persian Gulf in terms of deposition from hydrothermal processes, using comparisons with data from the EPR at 21°N, the Galapagos, the hydrothermal sites on the Juan de Fuca ridge in the Pacific, and from the Trans-Atlantic Geotraverse (TAG) hydrothermal field on the Mid-Atlantic Ridge.

The deposits most intensely studied have been the Troodos massif and associated sulfides in Cyprus. Oudin and Constantinou (1984) claimed to have identified black smoker chimney fragments and fossilized worm tubes in Cyprus sulfides. Fossil worm tubes have also been reported from the Semail ophiolite in Oman (Haymon et al., 1984).

Oudin et al. (1981) inferred similarity of origin between the EPR at 21°N and Cyprus sulfides because of: 1) similarity in petrologic texture and facies, and 2) paragenetic similarities, essentially the presence or absence of trace minerals. For example, jordanite, a rare Pb-As sulfide, is found in both 21°N and Cyprus samples, while tellurides and cassiterites, which are common and characteristic of major volcanogenic deposits, are unknown at the two sites. Moores and Varga (1985) examined three structural basins in the Troodos ophiolite and suggested that the normal faults defining the grabens once served as channels for the hydrothermal fluids that produced the massive sulfides. Schiffman et al. (1985) used the O-isotope composition of metamorphosed sheeted dikes of one of the grabens to correlate different grades of metamorphism with hydrothermal alteration. They found rocks with low $\delta^{18}\text{O}$ compositions and calculated that they were altered by fluids hotter than 350°C. The amount of oxygen isotope found in the rock can be correlated to temperature of the water at the time of rock alteration, with $\delta^{18}\text{O}$ decreasing with increasing temperature in natural waters.

Rates of Formation of Deposits

Measurements of heat flux from black smoker chimneys at 21°N show so great a rate of heat loss that it is unlikely that the vents are a steady state phenomena, and lifetimes of about 10 years are estimated for individual vents, in keeping with the time estimated for sulfide mounds to form by precipitation, and the age distribution of clams near the vents (Macdonald et al., 1980).

Converse et al. (1984) measured a precipitation rate of .45 grams FeS per second for a sulfide mound 15 meters (m) in diameter and 1.3 m in height. From this, they estimated that the sulfide mounds can form in 70-85 years from settling of sulfide particles alone. They noted, however, that the process of forming sulfide chimneys, as opposed to mounds of massive sulfide, is more efficient in extracting sulfides. Hekinian et al. (1983) actually witnessed a sulfide chimney being formed and measured a growth rate of 5-10 cm in length per day. They came to the startling conclusion that all the sulfides seen in the central graben of the study area (EPR near 12° 50'N) were formed within a time span as short as a few years. This was corroborated by Thorium dating of one dive sample, which gave 20 to 60 years as the sample's age. They extrapolated the measured rate of growth of the observed chimney and calculated that a cylindrical shaped chimney with an internal and external diameter of 3 cm and 10 cm respectively, with density of 2.9 gram/cm³ would increase its mass at about 1.6 kg/day, and an average sized conical shaped sulfide edifice (6 m in height and 3 m in base diameter), weighing about 41 tons, would be built in about 70 years. However, Converse et al. (1984) calculated that, at a 100% pyrrhotite removal rate, a single sulfide mound, if formed solely of broken fragments of sulfide chimneys could form in a minimum of 2-3 years.

Converse et al. (1984) estimated that hot springs are active for a maximum of 5000-40,000 years. What they were actually saying, however, is that, based on heat flow considerations, the maximum lifetime of a hot spring is 1/8 to 1/9 of the time required for the oceanic crust to move away from the ridge crest to the full length of hydrothermal convection cells in the ocean crust, which they assumed to be 7.5-10 km perpendicular to the ridge crest. The 5000-40,000 year lifetime figure came from assuming a steady state ridge-spreading rate of 3 cm/yr, so that, for example, crust which is 540 km from the ridge crest would be 18 million years old. The question of the actual age of the ocean crust is discussed in the last section of this article.

Implications for Geochemical Composition of Oceans

Understanding the chemical influx from hydrothermal vents into the ocean could lead to an understanding of the global geochemical mass balance and budget of the ocean.

The geochemical flux of hydrothermal waters at mid-ocean ridges has been used to explain the differences between the input of rivers into the ocean and the geochemical composition of the ocean. Specifically, if there were no buffering action, a continual flow of river water would turn the ocean into an alkaline, bicarbonate lake (Thompson, 1983). It has been shown that the overwhelming proportion of the mass flux of hydrothermal fluid is lost to the water column at mid-ocean ridges, with only a small percentage localized in vent precipitates, although ore retention is much more efficient in sediment-covered spreading centers such as the Red Sea and Guaymas Basin of the Gulf of California (Edmond, 1984).

Calculations utilizing data from the EPR at 21°N and the Galapagos Rift (Corliss et al., 1979; Edmond

et al., 1979; Von Damm, 1983) indicate that high temperature reaction sites in hydrothermal systems (at least 350°C) act as sinks of Mg and SO₄ and as sources of Si, Ca, K, Rb, and Li (Edmond et al., 1979; Thompson, 1983).

The calculations are especially successful in showing that the hydrothermal sites, acting as a sink for Mg, serve to balance the excess Mg supplied by continental inflow as compared to the composition of normal seawater (Thompson, 1983; Edmond et al., 1979; Edmond, 1982).

Similarly, the supply of Ca from hydrothermal sites could account for the apparent "excess" amount of calcium carbonate in the geologic column compared to that expected solely from the weathering of primary igneous rock (Edmond, 1982). For a vent field on the Galapagos spreading ridge, Edmond et al. (1979) calculated fluxes of between 4.3 and 2.1×10^{12} moles/year, compared to a river value of 12×10^{12} moles/year. Since approximately 75% of the latter is due to the weathering of carbonate rocks, they concluded that the ridge input doubled the flux of primary, igneous derived Ca to the oceans, sufficient to account for the anomalous abundance of carbonate rocks in the geologic record as deduced from a purely continental balance. From a creationist viewpoint, it could be that massive hydrothermal vent activity (reactions of seawater with hot, fractured basalt) during the Flood did indeed act as a source of Ca for the formation of the present-day terrestrial carbonate rocks.

The EPR and Galapagos data also indicate that hydrothermal ridge processes could supply the flux of non-radiogenic Sr necessary to maintain the observed ⁸⁷Sr/⁸⁶Sr ratio observed in seawater (Von Damm et al., 1983). In addition, variations in ⁸⁷Sr/⁸⁶Sr ratios over time observed in marine carbonates may be explained by variations in the relative importance of Sr supply from mid-ocean ridges and continents (Edmond, 1982; Turekian, 1983).

An important implication for creationist theories would be the contribution of any deep sea hydrothermal vents toward the heterogeneity of ocean waters. Particularly for a Flood model, the contribution of vent waters to the heterogeneity of ocean water could be important to the survival of freshwater and saltwater organisms (Smith and Hagberg, 1984). If the vents are the result of deep circulation of sea water in fractured crust, superheating of the water, and subsequent exiting, then it follows that increased volcanic activity and fracturing of ocean crust during the Flood could have increased the magnitude of vent activity and thus the influx of vent waters into the ocean.

Problems in calculating the geochemical fluxes of hydrothermal sites include: uncertainty of estimates of rock/water ratios and total amount of ocean crust affected by hydrothermal activity (Honnorez, 1983; Thompson, 1983), contamination and dilution of water samples (Von Damm et al., 1983), and lack of convincingly representative and complementary samples of both altered solutions and altered solids from a single system (Mottl, 1983). In addition, all experiments have been done with the assumptions that no significant recirculation occurs between the time of seawater entering permeable crust and exiting at hydrothermal

vent sites, and that the basalt that forms the ocean crust is of relatively uniform composition (Edmond, 1984). While the assumptions are not unreasonable, variations in these conditions at the limited number of sites sampled coupled with the geographic closeness of the sites requires that the estimates of geochemical fluxes at hydrothermal vents be regarded strictly as preliminary. In addition, the discovery of four sea-floor vents on the Mid-Atlantic Ridge (Rona et al., 1984) indicates that the contribution of slow-spreading ridges must also be considered when calculating total geochemical flux into the ocean (Mottl, 1983).

Biological Aspects of Hydrothermal Vents

Tube worms (phylum Pogonophora) and clams make up 90% of animal biomass at hydrothermal vent communities (Jannasch, 1983). Primary production of organic carbon by chemosynthetic sulfur-oxidizing bacteria has been proposed to provide the base of the food chain for the animal populations (Jannasch, 1983) and has been supported by radioisotope studies (Grassle, 1983). This is a unique trophic situation because, while terrestrial chemosynthetic bacteria are well known, the vent animals are the only ones known to thrive on chemosynthetic products derived from volcanic energy (Grassle, 1982). Analysis of fluids, direct observation, and analysis of animal specimens indicates three locations of chemosynthetic production: 1) within subsurface vent systems at elevated temperatures, 2) in microbial mats immediately surrounding the vents, and 3) in various symbiotic associations with invertebrates (Jannasch, 1983). The discovery of symbiotic bacteria/tubeworm associations at hydrothermal vents has led to the detection of similar relationships in pogonophorans in marine fjords, and may apply to other organisms as well (Desbruyeres and Laubier, 1983).

Another source proposed for the base of the food chain is particulate organic matter advected from the photic zone by bottom currents produced by rising hot water from vents (Jannasch, 1983). Strong evidence against this hypothesis, however, includes the dense distribution of well-separated populations around small vents (Desbruyeres and Laubier, 1983), calculations of the amount of matter necessary to support the community, and evidence that hot water does not rise above the bottom 10% of the water column (Jannasch, 1983; Desbruyeres and Laubier, 1983). At Axial Seamount on the Juan de Fuca Ridge, however, the biologic "halo" around the vents extends for hundreds of meters (Arquit et al., 1984). One possible explanation for this area is that the vent site is very shallow, about 1500-1600 m.

Species unique to the vent systems include a dozen new families or subfamilies and many more new genera (Grassle, 1983). Thirty-five new species have been collected from Explorer Ridge, Juan de Fuca Ridge, and the Oregon coast alone. Although the quantity of biomass is very high at vent sites, diversity of species is low compared with deep-sea environments elsewhere (Grassle, 1982). Four major species dominate the vents at 13°N, 21°N, and the Galapagos Rift: giant tube worms (*Riftia pachyptila*), large white clams (*Calypotegena magnifica*), an undescribed mytilid

mussel, and the Pompeii worm (*Alvinella pompejana*) (Desbruyeres and Laubier, 1983).

Metabolic rates and growth supply of mussels at hydrothermal vents are food-supply dependent. Growth rates are highest close to the vents, the presumed source of molecular and bacterial energy. Rates may also change in response to rapid changes in temperature of food supply due to fluctuations or cessation of hydrothermal activity (Grassle, 1982). Direct growth measurements and natural radionuclide shell contents of bivalves show very high growth rates, a 1-4 cm/yr average (Desbruyeres and Laubier, 1983). Because life spans of individual vents are short, less than 100 years, primary consumers must 1) be able to settle quickly, 2) grow fast and reproduce early, and 3) disperse easily when conditions deteriorate, by means of larvae or juveniles (Grassle and Grassle, 1974). Although conditions typify an ecologic strategy normally associated with small organisms, the vent site organisms are unusually large (Desbruyeres and Laubier, 1983). One exception is the southern Juan de Fuca ridge, whose vent organisms seem to be less robust than those found on the EPR and Galapagos (Koski et al., 1982).

The biology of dispersal states of vent organisms is an unsolved problem. Suggested means for dispersal include long pelagic life for larvae passively carried by along-strike currents, deduced for Galapagos mussels from morphology of larval shells; and actively swimming adults drifting along rift currents (Desbruyeres and Laubier, 1983).

The possibility that organic compounds may have formed abiologically in deep sea hot vents suggests to evolutionists that the vents may have been places where life originated (Jannasch, 1983; Corliss et al., 1981). The problem remains, however, of differentiating abiologically produced organic compounds from those produced by chemosynthetic bacteria within the vent system (Jannasch, 1983), although technology has improved to the point where scientists can collect samples of uncontaminated vent fluid in order to isolate the compounds.

Another puzzle for evolutionists is that two species have been found at hydrothermal vents that had previously been assumed to have become extinct in the Late Cretaceous: the limpet *Neomphalus fretterae* and the stalked barnacle *Neolepas zeviniae* (Jones, 1984). It has been postulated that these two species took refuge at relatively shallow hydrothermal communities near continents or around islands, and migrated to other spreading centers to escape predation pressure (Jones, 1984). In addition, the resemblance of modern organisms to fossilized worm tubes in the late Cretaceous Semail ophiolite of Oman (Haymon, et al., 1984) presents evolutionists with the problem of whether the Cretaceous worms were the ancestors of the present-day worms, or whether there was parallel evolution. Both the "survival" of supposedly extinct species and the resemblance of "ancient" fossilized worms to modern worms support the creation model better than the evolutionary model.

Implications for Measured Heat Flow in Oceans

Hydrothermal circulation at mid-ocean ridges appears to explain the discrepancy between measured heat flow through sea floor, and values predicted for

conduction through a convecting lithosphere (Macdonald, 1982a; 1982b; 1983). The basic model for hydrothermal circulation in the ocean crust was first formulated by Elder (1965): seawater in permeable ocean crust is heated above subaxial magma chambers and driven upward, dissolving metals from the rocks it passes through and re-precipitating them on the ocean floor as massive sulfides (Rona, 1982). See Figure 1.

Thermal models for spreading ridges differ in predicting steady state versus transient magma chambers. Factors that must be considered include the rate at which cracks propagate downward in the axial zone versus the rate of clogging of the cracks and hydrothermal precipitation (Macdonald, 1983). While some models postulate that no magma chamber at any spreading rate can remain in a steady state because of freezing of the magma (Lister, 1983), seismic and petrologic data indicate steady state magma chambers at faster spreading rates. Most petrologic studies indicate small steady state magma chambers even at slow spreading rates (Macdonald, 1982a; 1983; van Andel, 1983). Problems with models of hydrothermal heat flow include poorly constrained estimates for both the magnitude and areal distribution of hydrothermal heat loss at spreading centers, and also for the depth and rate of crustal fissuring. There are also assumptions of two-dimensionality (Macdonald, 1983).

Mid-Ocean Rifts, Hydrothermal Activity, and Continental Drift

Genesis 7:11 says "... on that very day, the springs of the great deep broke through" (New Jerusalem Bible, also translated as "fountains of the great deep" in the New American Standard). The deep sea hydrothermal vents are probably not the springs or fountains mentioned in Genesis 7:11, since they seem to be a side effect of seawater flowing through heated, fractured ocean crust, and not exit sites for an underground source of water. They are associated with mid-ocean spreading ridges, however, and the question remains of whether the mid-ocean rifts are relicts of volcanic activity during the Flood or afterward.

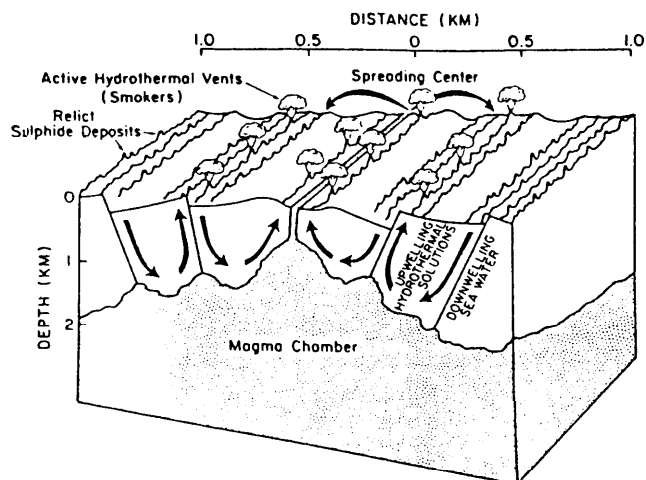


Figure 1. Schematic block diagram illustrating hypothetical hydrothermal ore-forming system at a seafloor spreading center like the East Pacific Rise. (from Rona, 1982)

Genesis 10:25 says "To Eber were born two sons: the first was called Peleg, because it was in his time that the earth was divided. . . ." (New Jerusalem Bible). Could this be a reference to a post-Flood continental rifting event (Peterson, 1986)? There is a large body of geologic and geophysical evidence supporting the concept of continental drift, including symmetrical magnetic lineations on either side of mid-ocean ridges, similar fossils and geologic strata on continents now separated by ocean, and geophysical records of subducted oceanic plates beneath continental edges. The question remains of how much of the present-day ocean's crust existed before the Flood, how much was produced during the Flood, and how much may have been produced during a post-Flood, Pelegian rifting event.

Deep fracturing of basaltic crust and circulation of ocean waters during the Flood, whether or not associated with continental drift, may have led to massive deposition of sulfide particulate and formation of sulfide chimneys on the ocean floor. If the present-day terrestrial massive sulfide deposits were all formed in the Flood, it seems unlikely that there would have been sufficient time or suitable conditions for establishment of vent communities of clams, tube worms, and mussels. However, if hydrothermal activity continued on a lesser scale after the Flood subsided, but before rifting was completed, this may have allowed the establishment of biological communities whose fossils have been found in the Troodos sphiolite (Oudin and Constantinou, 1984) and in the Semail ophiolite in Oman (Haymon et al., 1984). Uplift during the time of Peleg would then have brought the ophiolites and sulfide deposits above the ocean. In this sense, the massive sulfides produced by hydrothermal vents may act as a sort of time clock, in that the presence of fossils of vent communities in massive sulfides may indicate an area where uplift occurred after the Flood.

The possibility also exists that the biologic fragments found in terrestrial sulfides are relicts of pre-Flood vent communities, which were uplifted during the Flood. In this case, the terrestrial sulfides may mark an area where the pre-Flood ocean crust was close to a source of volcanic energy, an area of weakness along which later rifting occurred.

A question that does not appear to have been asked by researchers working on the vents is, if the ocean crust were formed by conveyor-belt type spreading away from the ridge crest, why is not the ocean floor as enriched in sulfides as the ridge crests? If sea floor spreading really has been occurring at a slow rate of cm/yr over millions of years, the surface of the ocean crust should be dotted with sulfide chimneys, sulfide mounds, and fossil vent communities, under a blanket of sediment of course. However, if spreading occurred very quickly, on a time scale of months or years instead of millions of years, there might not have been enough time for hydrothermal alteration and sulfide deposition, and the crust would retain a basaltic composition. This might be a fruitful field of investigation for creationists working on the Flood model.

Conclusion

The uniformitarian assumptions of most researchers on hydrothermal vents present them with many ques-

tions, including the origin of the strange life forms around the hydrothermal vents and the problems of size differences between present seafloor hydrothermal sulfide deposits when compared to terrestrial massive sulfides. For creationists, however, the vents serve as another example of the amazing accuracy of the Bible, and the intricate, intelligent design of the Creator of these present-day fountains of the deep.

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EROSION OF THE GRAND CANYON OF THE COLORADO RIVER Part III—Review of the Possible Formation of Basins and Lakes on Colorado Plateau and Different Climatic Conditions in the Past

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Abstract

The possible formation of basins and lakes on the Colorado Plateau is discussed. The likelihood of different climatic conditions (more precipitation) in the past is explored. All of these factors are related to a post-Flood model of the formation of the Grand Canyon of the Colorado River.

Introduction

The antecedent Colorado River hypothesis in relation to the formation of the Grand Canyon was presented in Part I (Williams, Meyer and Wolfrom, 1991, pp. 92-98). Also the postulation was offered that the major cause in the formation of the Canyon was the erosive work of large quantities of rapidly-moving

water laden with abrasive matter in a relatively short time span. The river capture and ancestral river hypotheses were discussed in Part II (Williams, Meyer and Wolfrom, 1992, pp. 138-145). Also piping on a large scale as a mechanism of formation of the Grand Canyon was reviewed.

The possible formation of vast basins and lakes on the Colorado Plateau is explored in this paper. Also the possibility of a more moist climate in the past is considered. These conditions, coupled with the possi-

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bility of extensive post-Flood volcanic activity, could have provided considerable water necessary to carve large canyons in a relatively short amount of time. In mentioning time estimates, the authors are quoting the opinions of the various workers involved. We do not subscribe to the standard geologic timetable.

Basins and Lakes

Several geologists have proposed the formation of lakes in the desert basins as the Rocky Mountain region was uplifted. Essentially the rivers, if they existed, were blocked in their path to the Gulf of California or to the Gulf of Mexico so that large lakes formed as the influx of water was greater than the evaporation from the lakes. Then as a lake rose, it eventually overflowed the rim of the impoundment, or possibly the natural dam was breached due to further uplift or some other tectonic event causing the dammed water to surge into another basin and erode canyons in its travel to lower elevations. Creationists could postulate vast lakes remaining after the Flood, trapped by the uplifting of land masses in the western United States, and eventually overflowing or breaching a dam sending considerable high-velocity water into lower elevations. It is instructive to read Henry Morris' comments concerning enclosed basins in relation to the retreating Flood waters (Whitcomb and Morris, 1963, pp. 313-317).

Newberry (1861, pp. 19-20) postulated basin filling and erosion of encircling mountains as a mechanism for the formation of short canyons that connected the basins below the Grand Canyon. Dutton (1882, pp. 216-217) stated that the formation of lake beds in a newly-emerging country was inevitable and the plateau country formed one continuous lake south of the Uinta Mountains. Dutton envisioned a process of slow erosion (p. 218) which he referred to as the great denudation forming the Grand Canyon (p. 77). He noted that the former presence of ample water in the western United States was indicated by evidence that deserts in that region were once covered with abundant grasses (p. 78).

Blackwelder (1934, p. 562) speculated that as the Rocky Mountains were uplifted:

... local streams on the higher, and more northerly, mountains extended themselves, forming lakes in the nearest desert basins. As this influx exceeded evaporation—and the rate of evaporation must have been reduced in the cooler climates of the elevated region—the lakes rose until they overflowed the lowest points of their rims and spilled into adjacent basins. In time, enough excess outflow may have developed to fill a series of basins all the way to the Gulf of California, thus forming a chain of lakes strung upon a river.

One of the great hindrances to the postulation of large lakes in the west is, as Blackwelder noted, that during the subsequent erosion cycle as canyons were being cut, any "unconsolidated lake deposits in the former basins ... were rapidly excavated and removed" (p. 563). He continued:

In time all vestiges of the earlier lakes were erased by erosion, unless in some places the deposits were below grade. The rapidity of the

processes that effect such changes is illustrated by the fact that the terraces that occupied Death Valley in late Pleistocene time have already been obliterated except at a few widely separated points.

He believed that the path of the Colorado River was determined by the process of basin overflow and/or capture through headward erosion as the uplift continued. Hunt (1969, p. 66) at one time considered basin filling and overflow as a means of integration of the drainage area in which the Colorado River flowed but he felt that the path of the river was antecedent across the Colorado Plateau. We strongly urge those who are interested in the erosion of the Grand Canyon and the development of the Colorado River to consult the excellent review (Hunt, 1969) of suggested hypotheses up to the late 1960's.

Gregory (1947, p. 703) speculated that the post-Miocene uplift brought the high plateaus "within the range of heavy precipitation." Considering the topography of the areas along with rain and melting snow, the streams forming on the plateau tops found a "resting place in the structural lowlands in the approximate position of the present Grand Canyon and the synclinal Little Colorado Valley" and the stream convergence

locally expanded into lakes descended from one to another plateau block over high cliffs and thus developed energy rarely acquired by running water (p. 703).

Hamblin (1976, p. 142), in discussing volcanism in the western Grand Canyon claimed:

that volcanic activity exerted a profound influence on the recent history of the Grand Canyon in that lava flows formed great barriers or dams across the Colorado River, and backed up water to form temporary lakes upstream.

In the area of Prospect Canyon, Hamblin (p. 161) stated that a lava dam 2,300 feet above the present river level ponded the waters of the Colorado River within the Grand Canyon. He postulated that erosion largely destroyed this and the other dams generated by lava flows. Note Figure 1.

Lucchitta (1988, p. 15) thought that between 5.5 and 17 m. y. a.* preexisting drainage patterns were interrupted by fast-moving faults in the Basin and Range Province and closed basins were formed. In 1964 a conclave of geologists, working with the information available at that time, concluded that pending may have occurred in three places. (McKee et al., 1967, pp. 56-58) in possibly late Miocene and early Pliocene times:

1. Around the Muddy Creek Formation in the Grand Wash trough and adjacent areas to the west.
2. At the Willow Springs deposit in the Peach Springs-Truxton area.
3. At the location of the lower member of the Bidahochi Formation in northeastern Arizona.

See Figure 2 for these locations.

Walter Brown (1989, pp. 74-75, 83) proposed a catastrophic mechanism for the erosion of the Grand Canyon in relation to the Genesis Flood. As the earth

*m. y. a. —million years ago.

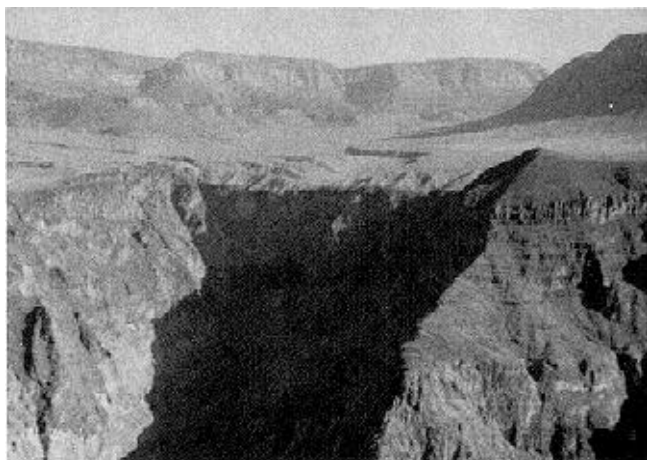


Figure 1a. As an indication of volcanic activity in Grand Canyon area, note the cinder cone across from Toroweap Overlook, western Grand Canyon (view to the south). Photograph by Glen Wolfrom.



1b. Looking upriver at Toroweap Overlook, western Grand Canyon. Colorado River is in lower center of view. Photograph by Emmett Williams.

began its recovery phase from the Flood, the rapid uplift of mountains occurred and the drainage of water from the higher elevations "left every continental basin filled to the brim with water" (p. 75). If these lakes gained more water than they lost by evaporation, they would overflow their rims at the lowest point.

Just the slight erosion of the rim allowed more water to flow over it. This eroded it even deeper and caused even more water to cut it faster. Thus, the downcutting process accelerated catastrophically. Eventually, the entire lake dumped through a deep slit which we today call a canyon (p. 75).

By continuing this sequence of events: 1. basin formation, 2. rapid erosion from overflow and/or dam breaching, canyon after canyon was formed in the canyon country of the west. Brown (p. 83) proposed that there were two large lakes, the Grand and the Hopi that eroded the Marble and Grand Canyons (Figure 3). Marble Canyon was eroded from the waters of Grand Lake, whereas the Grand Canyon was eroded by the waters from both Grand and Hopi Lakes by the processes just described.

The catastrophic dumping of Grand Lake took place through what is now the gap between Echo Cliffs and Vermilion Cliffs. Before the rapid erosion of this natural dam, those two cliffs were a single face of a block faulted mountain (Brown, 1989, p. 83).

Brown briefly discussed the erosion of soft, recently-deposited sediments as well as of harder material and he suggested how the barbed canyons along the Grand Canyon developed. Possibly this total erosion cycle was enhanced by a moist climate in the canyon country due to the presence of lakes in the basin areas. Interestingly, Dutton (1882, p. 218) claimed that the passage from brackish water to a freshwater condition was quite sudden as a considerable number of large lakes were being formed. Considering a Flood model, during the post-Flood "recovery period," did ample rainfall as well as precipitation of salts from the lake waters cause a rapid reduction of salinity?

Clifford Burdick (1974, pp. 26-27) also discussed a catastrophic origin of the Grand Canyon in relation to the Flood. He stated that the canyon is similar to a giant roof sloping in a north-south direction with the apex being miles north of the North Rim. When the uplifting occurred and the Kaibab anticline developed, the weakest point was at the apex of the fold. The uplifted anticlinal structure fractured at the apex in an east-west direction. Then surging or retreating Flood waters moved "down the newly formed Rocky Mountains at the Continental Divide, and when this Kaibab Anticline rose, it may have dammed up the water . . ." (p. 27). The waters from this lake emptied very rapidly (as they either overflowed the rim or breached the dam at the weakest point?). The erosion cycle occurred rapidly with sufficient, high-velocity water doing the work. Cunningham (1977, p. 2) suggested that the Colorado River may have followed a fault to form the Grand Canyon. The faulting would have occurred during uplift. He implied that the sedimentary strata may not have been consolidated when the uplift occurred. A fault may have developed at the apex of the uplift in the soft material and the waters of an

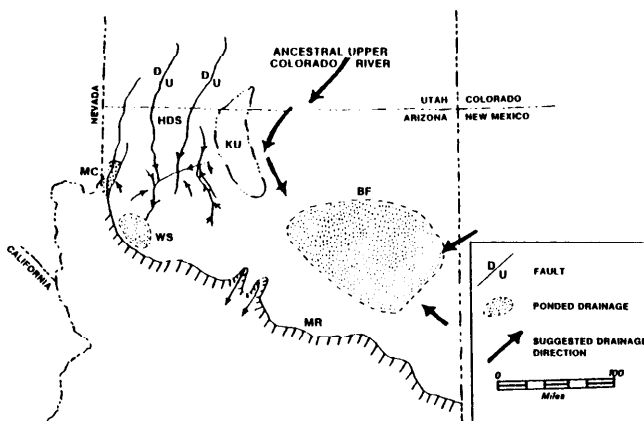


Figure 2. Suggested drainage patterns in northern Arizona during late Miocene and early Pliocene times (after McKee, et al., 1967) Drawing by Martha Smith. BF—Lower part of Bidahochi Formation, HDS—Hualapi drainage system, MC—Muddy Creek Formation, KU—Kaibab Upwarp, MR—Mogollon Rim, WS—Willow Springs Formation.

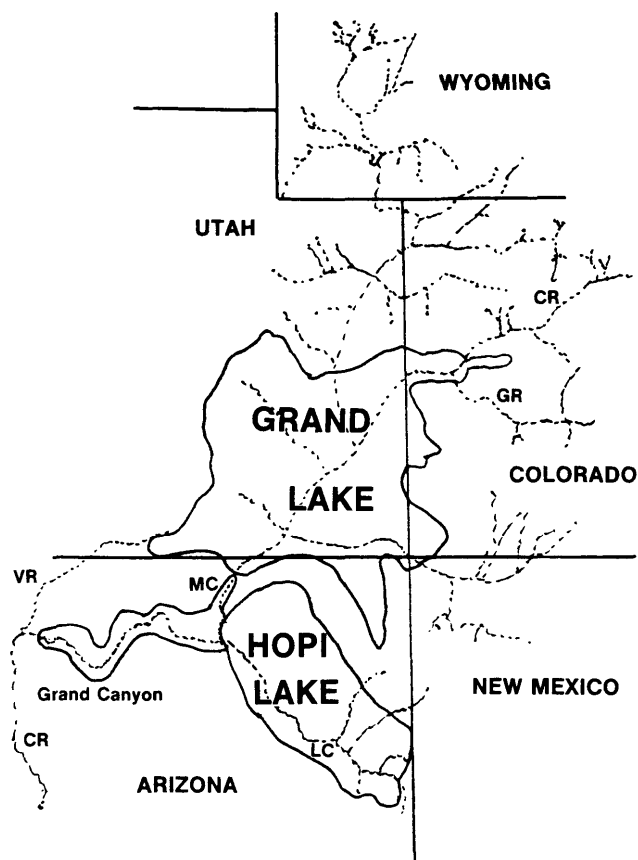


Figure 3. Map showing the area of the former Grand Lake and Hopi Lake. Once the dams holding the waters overflowed or were breached, catastrophic flow of high-speed water laden with abrasive material could have eroded the Grand and Marble Canyons (after Brown, 1989). MC—Marble Canyon, GR—Gunnison River, CR—Colorado River, LC—Little Colorado River, VR—Virgin River.

impounded lake poured through the fault eroding the landscape into the Grand Canyon.

In the finest creationist monograph (Austin et al., 1992) written on the Grand Canyon Steve Austin discussed the possible formation of lakes on the Colorado Plateau. (See pages 77-87 particularly.) He suggested "that Hopi Lake, a large Pliocene lake existed at high elevation east of the Kaibab Upwarp" (p. 80) in the area of the present Little Colorado River drainage basin. The Bidahochi Formation (see Part II of this series) was deposited by this lake. Austin speculated "that Hopi Lake overtopped a low point in the Kaibab Upwarp near Grand Canyon Village in the extreme eastern Grand Canyon area" (p. 86).

Also Austin related:

North of Hopi Lake, separated from Hopi Lake by the Echo Cliffs Monocline, was Grand Lake. It occupied a major area of the upper Colorado River drainage basin, including parts of the Green, Gunnison and San Juan Rivers. It appears that the catastrophic drainage of Hopi Lake caused the dam for Grand Lake formed by the Echo Cliffs Monocline to fail probably by piping (p. 86).

This thesis postulated by Austin is quite plausible. If a dam for Grand Lake existed near the Echo Cliffs

and Vermilion Cliffs gap around the Lee's Ferry area, the presence of the easily erodable Chinle Formation at the base of these cliffs on top of the Marble Platform, (Figure 4) could have provided a "piping" path for any impounded water causing a catastrophic failure. The surging high-velocity, abrasive particle-filled waters could have carved an immense canyon in a short amount of time. Austin considered a third lake, Lake Vernal, north of Grand Lake in the Green River drainage (northeastern Utah):

Drainage of Grand Lake could have initiated failure of the dam holding Vernal Lake. The breach through the Book Cliffs would have lowered the elevation of the upper Green River and caused downcutting in Flaming Gorge in Utah and Wyoming. (pp. 86, 87)

Austin claimed that the breached dam theory for the origin of the Grand Canyon could be placed within a Flood Model (p. 87). He has developed an all-encompassing, reasonable model for canyon formation in the Colorado Plateau in a short span of time. As can be noted by the opinions of Austin, Brown, Burdick and Cunningham, creationists prefer post-Flood basin and lake formation. The dam overflow or breaching sent rushing waters over the Colorado Plateau carving the Grand Canyon.

Different Climatic Conditions

Canyon cutting would have been enhanced if there were more water present through increased rain and snowfall at sometime in the past in the Rocky Mountains and in the canyon country of the west. Blackwelder (1934, pp. 558-559) noted that "... the western interior of the United States became more arid during late Tertiary times ..." Longwell (1946, p. 830) felt that "... a fairly moist climate prevailed in the western United States during early Tertiary epochs ..." Gregory (1947, p. 700) stated that in the Colorado drainage basin

... the former low altitude, arid surface was uplifted (late Miocene or early Pliocene), ... and that in its newly attained lofty position a humid climate made possible the development of fully-organized river systems. (Parenthesis added)

Then he assumed that these "favorable conditions" (along with the elevations from which the water had to fall, plus the rock systems encountered by the moving streams) caused the erosion or canyon-forming cycle (pp. 700-701). Hunt (1956, p. 87) postulated that the hastening of erosion was primarily due to a climatic change. Dutton (1882, p. 222) thought that the canyons and cliffs in the Grand Canyon area may have developed in a moist climate and that the climate appeared to have changed from moist to arid. He stated that the climate had become more arid in the 10 to 12 years before 1882 (p. 79).

Whitcomb and Morris (1963, p. 314) noted that in many parts of the world, including the western United States, the climate would have been more moist immediately after the Flood. Note their comments concerning a post-Flood climatic change (pp. 303-311). Walter Lammerts considered the lessening of rainfall with time in the western United States since the Flood.

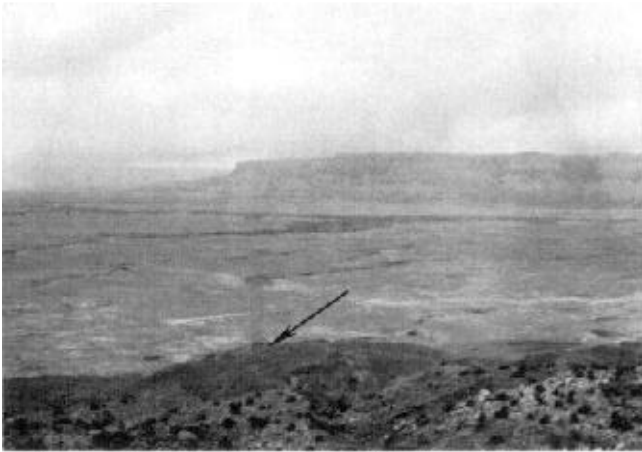


Figure 4a. Photograph from Echo Cliffs. Easily-erodable Chinle Formation seen in foreground indicated by arrow. Marble Platform and Marble Canyon seen in center of photograph. Vermilion Cliffs can be seen in the background.



4b. Outcrop of Chinle Formation at base of Echo Cliffs.

He postulated a recent origin for the Pacific southwest deserts (Lammerts, 1964, p. 54; 1971, pp. 50-54; 1978, pp. 6-7). Daly (1973, pp. 216-217) and Oard (1979, pp. 30-35) discussed climate changes in relation to a post-Flood ice age. Nash (1987, p.13) implied how a mountain uplift could affect climate in the western United States and speculated on possible climatic changes in the past. Also see Howe, 1987, pp. 9-12 for documentation of this change. In a recent monograph, Oard (1990, p. 78), in relating the ice age to a Flood model claimed:

In the post-Flood climate, heavy precipitation would occur south of the ice sheets, in the Northern Hemisphere. Overwhelming scientific evidence is found for a wet climate, in regions that are now desert and semi-arid. Large lakes filled the basins of the arid southwestern United States . . .

These creationist interpretations of a post-Flood climatic change deserve serious study.

Evidence for much of the volcanic activity around the Grand Canyon area (for instance, see McKee and



4c. Outcrop of Chinle Formation behind buildings at Lee's Ferry.



4d. Outcrop of Chinle Formation at base of Vermilion Cliffs across Colorado River from Lee's Ferry. Photographs by Emmett Williams.

McKee, 1972, pp. 1928-1930; Young and Brennan, 1974; Hamblin, 1976; Pewe and Updike, 1976; Austin, 1988) has been studied. From the creationist perspective, it is likely that much of this volcanic activity was post-Flood which would have encouraged more precipitation, maintained a more moderate climate and prevented excessive evaporation of possible Flood waters, even adding to them as a result of the eruptions. See Whitcomb and Morris, 1963, pp. 311-313; Oard, 1979, p. 30; 1990, pp. 33, 67-70. Considering the possible post-Flood climatic effects, residual Flood waters and tectonic activity, there likely would have been ample water available in the canyon country for rapid erosion as the water moved to lower elevations.

Remnants of Peneplanation?

In the late nineteenth century, the well-known W. M. Davis of Harvard developed a model of evolving landscapes by erosion which he labeled the cycle of erosion. Foster (1973, pp. 204-207) handled the ideas of Davis nicely from what has been observed in the erosion of landscapes. He suggested ". . . that the Davis cycle is not only a special case but an oversimplification as well" (p. 207). In this postulated ero-

sion cycle the final stage of the landscape is an almost flat surface condition referred to as a peneplain.

In the early 1900's some geologists studying the Grand Canyon area attributed the remnants of an erosion surface found under Tertiary basalt flows near the southern end of the Colorado Plateau as peneplanation before plateau uplift. McKee and McKee (1972, p. 1923) state that the later discovery of channels partly filled with gravel deposits in the walls of Oak Creek Canyon and the lack of soil on the erosion surface caused geologists to give up the peneplain explanation. Blackwelder (1934, p. 558) noted that if the Colorado River had developed on an extensive peneplain in the Tertiary period, "... it ought to have had a broadly extended system of tributaries." Since there is no trace of the tributaries or any valleys eroded by them, he dismissed the explanation of peneplanation. Longwell (1946, p. 833) postulated that if the uplifted plateau surface was a peneplain, the new drainage channel from the Colorado River would have started from this surface. In answer to this suggestion, Hunt (1969, p. 118) bluntly stated that it is known that there was no peneplain.

Interestingly the present landscape of the Grand Canyon area is thought to be youthful when considering the supposed cycle of erosion.

Conclusions

Why is it that there is so much diverse opinion about the origin of the Colorado River and of the Grand Canyon? It is not only the obvious differences of opinion between creationists and uniformitarians but also between uniformitarians themselves. In 1947 Gregory noted that often diverse views of geologists concern "... the same formation in a small part of the Colorado Valley" (p. 695). Blackwelder (1934, p. 554) offered an explanation for the confusion.

The Colorado River is in many ways an anomalous stream, but perhaps in no respect more so than in the course which it pursues. Rising in the high mountains of Wyoming and Colorado, it traverses a series of wide basins, each of which seems to be an entity almost unrelated to the others. It cuts through the Uinta Mountains and the Colorado Plateau in deep canyons and repeats the act on a smaller scale several times between the mouth of the Grand Canyon and the Gulf of California. It runs nearly south for hundreds of miles, then for no obvious reason turns abruptly west, crosses northern Arizona, and again turns due southward in an erratic course. It enters the long Salton trough, the southern part of which is occupied by the Gulf of California, not at the upper end of the trench but at one side; and it shows its lack of genetic relation thereto by building a delta out into the trough, thus forming the basin which is now occupied by the Salton lake.

Further he noted that the profile of the Colorado does not reflect an old age and it does not have a meandering channel or a wide flood plain except in places where weak rocks lead to rapid erosion.

Of course in dealing with historical geology or any so-called historical science, the interpretation offered will depend often on the preconceived notions of the

geologists doing the field work. Collier (1980, p. 6) explained that:

Geologists must often satisfy themselves with abstract solutions to equally abstract problems . . . Geology is more often a cerebral exercise than many people may realize.

Obviously what is involved is the building of a model constructed from the field evidence, often scanty and open to interpretation, in line with the preconceived notions of the field worker. Confusion and vast differences of opinion should be expected. Also any model may not satisfactorily account for all aspects of a natural situation or landscape. The complexity of the area may defy explanation and since no man was present when the landscape developed to *observe* the details of formation, conjecture is the only possible avenue of "reconstructing the past." Thus geological models of earth history can consist of 5% evidence and 95% speculation.

We tentatively adopt a working hypothesis of rapid erosion of the Grand Canyon by large quantities of water flowing at a high velocity over consolidated and unconsolidated sediments in the latter stages of uplift or shortly after uplift when they were in a relatively unstable condition. Involved in this model are the assumptions of ample available water to perform the task, a moist climate and a tectonically active landscape with uplift and much volcanic activity as the area adjusted to post-Flood conditions. Other factors in the formation of the Canyon will be considered in later papers but the authors believe that high-velocity water laden with abrasive material accomplished most of the erosion. As an example if water were dammed by natural means and a leak developed under 500 feet of impounded water, the initial water escaping at the 500 feet depth-level could flow away from the dam at a velocity of approximately 180 ft/s assuming all of the potential energy is converted into kinetic energy. Such high velocity water is capable of vast damage and scour, particularly if it contained abrasive particles. The area of the Grand Canyon is fascinating and as field workers uncover more evidence, new interpretations of its origin may develop. How the Canyon was eroded and when it was eroded definitely is not a closed subject.

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PANORAMA OF SCIENCE

Reserved for Fire

The same paragraph in 2 Peter 3 that contains the uniformitarian prophesy (verse 4) also speaks of the next global destruction being by fire (verse 7). For several decades many have thought that the fire might be from a nuclear holocaust. It need not be by natural or man-made causes because God is quite capable of using supernatural means. Indeed, the verse also speaks of the present heavens being included in that fire. Even so, we have a tendency to speculate, based on the physical world that we can study with our science.

The Voyager space probes to the outer planets have revealed details that were not predictable from any of the theories of solar system evolution. It is as if God purposely placed those features there by design to point out to us our ignorance and limited imagination. Many moons of the outer planets have a very low density, indicative of a composition more of ice than rock. Furthermore, some of the ices may not be from frozen water but from other substances. Those bodies, along with comets and perhaps some asteroids, are sometimes referred to as "dirty snowballs."

In some recent speculation I wondered if one or more of the small bodies could be made of frozen methane (natural gas)? What if such an object collided with the earth as it fell toward the sun? How large would it have to be to totally consume all atmospheric

oxygen when it burned? Simple chemistry reveals that 16 kg of methane burns with 64 kg of oxygen to yield 44 kg of carbon dioxide, 36 kg of water, and an abundance of energy. Using the average atmospheric pressure at sea level, the area of the earth's surface, and 0.23 fractional weight of oxygen in the atmosphere, a mass of atmospheric oxygen of 1.17×10^{18} kg is obtained. The appropriate methane mass is therefore 2.9×10^{17} kg. At a density of 0.466 at its -164°C melting point, a sphere of that mass would have a diameter of 10.6 km (6.6 statute miles).

That is not very large by planetoid standards. It might appear as a comet as it approached the earth, but we would have only a few months of advance warning. It would be sufficient to incinerate the entire earth's surface and asphyxiate all air-breathing life that might survive the fire. It would certainly make a loud noise and fulfill much, but not all, of the prophecy of 2 Peter 3:10. This speculation is therefore inadequate as an explanation of prophecy, but it shows how vulnerable we are to such a natural disaster. Just as most people were unable to predict and identify the precise events of Christ's first coming, so all such speculations about the special effects accompanying his second coming are certainly filled with error.

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Thermodynamics and Natural Processes

Introduction

Many scholarly dissertations have been written by creationists employing the principles of thermodynamics in the origins debate. Particularly applications of the first and second laws of thermodynamics have been a fertile field of creationist endeavor. This writer wrote a review of these efforts about 20 years ago (Williams, 1973a). Also Gish (1975) summarized some creationist efforts in this field. Readers interested in the subject are urged to consult these articles.

General applications of the first and second laws can be found in Morris, 1964, 1970, 1971, 1981; Williams, 1969; Lockwood, 1971; Penny, 1972; Holroyd, 1972, 1975; White, 1972; Armstrong, 1974a, 1975, 1978, 1980a, 1980b; Humphreys, 1978; Mulfinger, 1981; Peterson, 1982; Ancil, 1983; and Matzko, 1986. Applications to historical geology are found in Morris, 1965. Discussions concerning the formation of crystals (the solid state) have been elucidated by Williams, 1966 and Vardiman, 1990. Thermodynamic principles have been used effectively in the chemical evolution and origin of life debate (Williams, 1967; Gish, 1979, 1981; Thaxton, Bradley and Olsen, 1984). Shaw (1970) applied the second law to fossil man. Thermodynamic insights into the origin of the universe and stellar evolution have been provided (Mulfinger, 1970, 1971, 1973; Williams, 1970, 1983; Barnes, 1970; Hall, 1971). A model using the first law of thermodynamics as a means of preserving the created order and complexity was discussed by Armstrong, et al., 1970; Lammerts, 1970; McDowell, 1971; Hubert, 1976; Williams 1976. Thermodynamic principles have been applied to living systems (Williams, 1971, 1976; Boylan, 1978, 1981; Kaufmann, 1983). An interesting exchange on the possible interpretations of whether the second law operated before the Fall of Man can be noted in Kofahl, 1973, 1974, Williams, 1973b, 1975; Morris, 1973; Armstrong, 1973, 1974b; and Jansma, 1974. Helmick (1975) employed thermodynamics in his article on optical activity. An examination of fluctuation theory was presented by Williams, 1979. Ancil (1980) proposed a new creationist discipline which used thermodynamic insights. This list of creationist efforts is confined mainly to the Quarterly, but will allow an interested reader to become acquainted with the substance of creationist arguments.

Increase in Entropy and Natural Processes

Creationists claim that degeneration in the universe (as modeled by the second law) would prevent any proposed molecules-to-man upward development. Anti-creationists have objected to these arguments. These responses have been critically examined by Bluth, 1983; Williams, 1985, 1986, 1990; Mehler, 1987. Generally, anti-creationists allow for a rearrangement of prior created order and complexity in the universe. Then they claim that order spontaneously developed. Of course, this is no answer to creationist claims that the *original* order and complexity in the universe could not have come into existence by the operation of natural processes alone. Changes in an already created universe involve only the rearrangement of prior created order and complexity which is allowable in the creationist model.

Another ploy employed by anti-creationists is to "allow" an entropy decrease (increase in order and complexity) in one part of their system while in another part of the system, the entropy increase is much greater than the aforementioned "decrease." Then they claim that the second law is obeyed since an increase of order and complexity has occurred in one part of the system. For instance, if one considers the earth-sun system, the anti-creationist argument may proceed as follows. The sun emits high quantities of energy (bathing the earth with this energy). This energy can be used on the earth to drive the supposed molecules-to-man evolutionary processes. The entropy "decreases" on earth because of evolutionary development were checkmated and overcome by the greater increase of entropy on the sun (expelling considerable energy). This scenario is thermodynamically impossible. My discussion will employ the same line of reasoning as the cogent treatises of Harold Armstrong (1974a) and Russell Humphreys (1978).

Natural processes* must occur within the postulated earth-sun system or any other contrived system. Natural processes are also irreversible processes (Kestin, 1966; King, 1962). Likewise irreversible processes occur spontaneously (Fong, 1963; Socrates, 1971). Thus when anyone postulates an entropy decrease in a system, a non-spontaneous unnatural process occurs. The isothermal expansion and contraction of one mole of an ideal gas is used to illustrate these concepts. The entropy change (ΔS) is expressed as follows:

$$\Delta S = R \ln \left(\frac{V_2}{V_1} \right)$$

where R = universal gas constant
 V_2 = final volume of gas
 V_1 = initial volume of gas

When a gas expands, $V_2 > V_1$ and ΔS is positive (the entropy increases). The isothermal expansion of a gas is natural and spontaneous. Gases, ideal or otherwise, always expand *spontaneously*. Often it is said that the gas obeyed the second law of thermodynamics when it expanded. However Battino and Wood (1968) explain that "natural laws describe natural phenomena; it is misleading to say that phenomena 'obey' one law or another." In other words, the second law has been constructed in such a manner so that entropy increases when a natural spontaneous process occurs. What about the isothermal contraction of a gas? When a gas contracts, $V_2 < V_1$ and ΔS is negative (the entropy decreases). The isothermal contraction of a gas is neither natural nor spontaneous—it will not occur by itself. Generally when the discussion of the isothermal contraction of gases occurs in the classroom, a piston is "employed" to *force* the contraction. Work is done on the gas to *cause* it to contract. A negative entropy change, occurring when the volume of the gas decreases, does not mean that the second law has been violated. It means that a machine such as a piston forced the direction of the process contrary to the spontaneous, natural avenue. Thus when entropy decreases are proposed, there must be postulated either a mechanism, machine or external influence (not en-

*A natural process is defined as a spontaneous change occurring in nature in a sequence of steps over a period of time.

ergy flow) that causes the unnatural event to occur (on paper at least). Materialists constantly assert that the hypothesized process of upward evolution (mega-evolution) could develop by natural means alone and this implies that they are spontaneous i.e., the entropy increases. From a statistical mechanical interpretation of entropy, an increase in the entropy indicates the development of less order and complexity!

Allowing one part of an assumed system to decrease in entropy to be compensated by an increase in entropy in another part of the system is incorrect also. When considering irreversible (spontaneous or natural) processes, Prigogine (1967) stated that such a situation is prohibited. *All* natural processes cause an increase in entropy. If the process will occur *spontaneously*, ΔS is always positive. If an entropy decrease is postulated, a device or intelligent input also should be postulated to cause the unnatural to occur.

Often the tactic employed by a person wishing to avoid the consequences of his suggested process (A) being unnatural (ΔS_A is negative), is to increase the size of the system until it encompasses so many entropy sources (B spontaneous sources) such that $\Delta S_B > 0$ with $\Delta S_B > \Delta S_A$. Then he assumes that "the second law is satisfied." No! Both ΔS_A and ΔS_B must be positive for them to be natural processes. Increasing system size does not solve the problem of why a non-spontaneous process is occurring. For example one can have a gas being compressed by a piston and adjacent to it in the same system could be 5000 separate isothermal gas expansion processes in operation. They do not affect the isothermal compression operation. It must be analyzed alone to determine if an influence or machine that "causes" the entropy decrease is realistic. This means that if the influence is an intelligent, planned or designed effect, it cannot legitimately be employed in a materialistic argument.

There is no way to escape the consequences of degeneration that develop when natural processes occur in a *real* world. The postulated upward molecules-to-man evolutionary processes are unnatural and non-spontaneous. The creationist admits that such a circumstance is true and suggests that a supernatural origin of the original order and complexity (along with all of the subsequent interactions involved as the created order is maintained) by a powerful and intelligent being is necessary to understand the *real* world.

Fluctuation Theory

Several methods have been tried by scientists to overcome the degenerative tendencies of natural processes in a real world to allow for megaevolution. The use of fluctuation theory (for instance see Glansdorff and Prigogine, 1971) has been highly touted as a possible means of developing order in a system *far from equilibrium*. To creationists any natural system far from equilibrium already contains created order (Williams, 1983). Fluctuation theory has application on the microscopic level but is difficult to use on the macroscopic level. It has been admitted that it is not a theory of origins (Williams, 1979). The creationist arguments using thermodynamics are still viable and reasonable. Actually creationists present a more realistic model for the real world than do their naturalistic opponents.

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What Is Under the Surface?

Evolutionary/uniformitarian scientists have constructed models of the earth's interior based on various geophysical data. Plate tectonics and the properties of oceanic and continental crust are examples of these models. Seismic reflection profiles are especially used to decipher what is under the surface of the earth. Unfortunately, ground truth provided by deep drilling has shown that at least some aspects of these models are incorrect.

Leg 138 of the Deep Sea Drilling Project to the equatorial western Pacific was recently completed. Much good data supporting the Milankovitch or astronomical theory of the ice age was supposedly discovered from the cores (Leg 138 shipboard scientific party, 1991). One of the goals of leg 138 was to continue drilling a deep hole that had been previously drilled. Seismic reflection profiles had shown that the bottom layer of ocean crust, the gabbro layer, thought to have been generated at a mid ocean ridge would be reached. Richard Kerr (1991, p. 1456) reports:

Based on reflections from seismic waves sent down ahead of the drilling, the researchers expected that the bottom layer of the cake—the solidified remains of the magma chamber that gave birth to the crust millions of years ago at a midocean ridge—was only meters away. But once again in their long quest, the drillers came away without their goodies.

They drilled down to 2 km, a new record for ocean drilling, but found no sign of gabbro. Kerr quotes from one scientist aboard the ship: "Once again, we discovered you should take seismic interpretations with a grain of salt" (Kerr, 1991, p. 1456).

This failure to verify a geophysical model of the earth by deep drilling has been typical of the past 10 years. As indicated by Kerr, geophysical interpretations based on seismic reflection have often gone awry. Two years ago, he summarized surprises from several deep continental boreholes (Kerr, 1989). For instance, several unexpected discoveries were made in the deep Kola hole, drilled 12 km deep on the Kola Peninsula near Murmansk. Seismic reflection profiling and geophysical models indicated that a major crustal boundary lay at 5 km. At this depth, crustal models predicted that granite of the upper crust would give way to the basalt of the lower crust. However, they never found the basalt layer even at the bottom of the hole. They also could find no chemical change in the rocks at 5 km.

The Soviet drillers encountered two other major surprises: 1) the heat gradient jumped from the expected 1°C/100 meters to 2.5°C/100 meters at 3 km depth, and 2) "circulating fluids" were found throughout the predominantly igneous rock of the Kola hole (Kerr, 1984a). The unanticipated hot temperatures forced them to stop drilling at 12 km, instead of reaching their goal of 14 km. Fractured rocks and circulating fluids are a significant anomaly deep in the hole, where the bottom temperature was about 200°C and the pressure 3,000 bars.

Similar surprises were discovered in a moderately deep hole drilled in Germany (Kerr, 1989). They chose an area of supposedly low heat gradient so they could

drill deep, but unfortunately the heat flow was high. According to the plate tectonics theory, the place they chose was believed to be an old suture, where two continents had supposedly once collided and melded together. One of the continental blocks purportedly overthrust the other. Seismic reflection profiles indicated that the thrust plane was a gently inclined reflector. The drillers expected to hit the fault plane at 3.5 km, but not only did not find a break in the rocks, but also found no change in lithology at all.

Instead of finding near horizontal layers, they drilled through a series of vertically folded rock that did not show up on seismic reflection profiles. The Germans also ran into fluid filled fractures after drilling through 3.4 km of dry rock. It is likely this fluid caused the reflection on seismic profiles. One scientist remarked: "You can devise all these models, and no one even tests them, except in sedimentary rocks. But, invariably, when somebody drills, it messes it all up" (Kerr, 1989, p. 470).

It is true that drillers have had some modest success. The Cajon Pass, California, hole was drilled 3.5 km to verify if the San Andreas Fault was a weak fault or a strong fault. A weak fault is characterized by low heat flow and low rock stress. As shown in other areas of the San Andreas Fault, the heat flow and rock stress were low at depth closer to the fault, as predicted. This result seems anomalous for a supposed transform fault between two giant plates.

Another surprise was discovered by the Phillips Petroleum Company. They drilled 5.5 km into a pile of igneous rocks in southeast Arizona. Seismic reflection profiles had indicated a "thin-skinned overthrust," like the one believed to underlie the southern Appalachians. The drillers expected to find sedimentary rocks and oil below the "overthrust," of igneous rocks. However, they found neither the overthrust nor the sedimentary rocks. (Kerr, 1984a, p. 1418).

This string of surprises from deep cores reveals several problems. Models of continental and ocean crust, including the calculated heat flow and the supposed absence of fluid, need revising. At least some ideas on plate tectonics must be rethought. The interpretations of seismic reflection profiles, which underpin much of the geophysical interpretation of the crust and upper mantle, especially must be reworked. Besides changes in lithology, the reflection profiles may be due to the presence of fluids, sills, or crustal stretching (Kerr, 1984b, p. 492). One investigator drilling the German hole remarked: "It's ridiculous . . . We have these thousands of kilometers of reflection profiles, and we don't know what they show" (Kerr, 1989, p. 470).

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Reprinted CRSQ Volume 8

Introduction

The *Creation Research Society Quarterly* has been published since 1964 (28 complete volumes). Many of the early Quarterlies are out-of-print, yet these past issues contain articles of continuing interest and value. In an effort to make these volumes available, the Board of Directors has incurred considerable expense to reprint them. In order that those interested in good scientific creationist articles, sound criticisms of the evolutionary hypothesis, along with the needed literature citations accompanying the treatises will have a general idea of the contents of each volume, brief synopses will be written to appear in this and future quarterlies. See Williams, 1991 for reviews of prior volumes.

Astronomy

In a short article (1971, pp. 55-57), Harold Slusher discussed some astronomical evidences for a young solar system. Meteoritic dust influx onto the earth's surface, the presence of comets in the solar system, the destruction of the spiral arms of galaxies and the helium content of the atmosphere of the earth were noted. Harold Armstrong (1971, pp. 192-193) also explained that the presence of comets is evidence of a young solar system.

Biology

Howe and Davis (1971, pp. 30-43) examined natural selection and found it lacking as a mechanism for evolutionary development. As the authors claimed (p. 30):

The process of natural selection is defined from the standpoint of population genetics. Examples are presented to show how natural selection might act gradually to eliminate harmful mutant genes from the population or to maximize the reproductive potential of gene combinations which are successful in a given environment.

A harmful mutant gene which confers some definite advantage in the heterozygous condition may persist in a state of balanced polymorphism. It is shown that balanced polymorphism is of limited significance, producing variation within the kind but as far as is known, no innovative evolutionary development of new kinds.

Supposedly helpful mutations might conceivably accumulate in a population by action of natural selection, but such a process would be so exceedingly slow that it would not account for the major adaptations of plant and animal species. Although genetic drift might cause a more rapid shift in gene frequencies, it produces non-adaptive changes and is not a valid basis for evolutionary progress. It is concluded that natural selection may lead to variations within the created kinds but it gives no promise as a mechanism of evolutionary descent.

An article by Cousins (1971, pp. 99-108) noted the unsatisfactory nature of the so-called evidence for the evolution of horses. This careful study pointed out the weaknesses of materialistic reasoning and no evidence for evolution was found. In an interesting short article Koontz (1971, pp. 128-129) discussed the creation of Eve from a biological standpoint. William Tinkle (1971, pp. 183-185) presented the first in a series of articles

he wrote on pleiotropy: extra cotyledons in the tomato from a creationist viewpoint. Howe (1971, pp. 193-194) argued that the gift of speech in humans is by innate specification. He marshaled much evidence in favor of the view that man has an inborn capacity for language which makes him qualitatively different from other creatures.

Ecology

John Klotz (1971, pp. 13-15, 49), in an article entitled "Creationism and our Ecological Crisis," noted that many scientists blame the so-called rape of the environment on a Christian worldview (Genesis 1:28). The author explained how wrong this idea is and stated that Christians are exhorted to be good stewards of what the Creator has provided for them. Klotz explained that human greed and ignorance are responsible for the present "ecological crisis" and the worldviews of social Darwinism and survival of the fittest mentality have contributed to this destruction. Robbins (1972, pp. 280-284) outlined some of the problems with the "ecology movement" showing the incorrectness of some of the propaganda employed. An answer to Robbins was given by Klotz (1972, pp. 284-287). Two interesting treatises by Tinkle (1971, pp. 16-18) and Armstrong (1971, pp. 126-128) described the fitness of the earth for life and the fitness of the laws of nature as evidence of design.

Chemistry

In keeping with a design perspective, three scientists employed their talents to note how certain areas of chemistry indicate creation. Brauer (1971, pp. 9-12) showed the amazing number of organic compounds that can be synthesized and used this data as a tribute to the infinite wisdom of the Creator. Henning (1971, pp. 58-60) asked if the origin of life was inevitable as claimed by many physical scientists. An overview of enzyme chemistry, photosynthesis and mathematical probability led the author to the opposite conclusion. Intelligent design was needed to create life. Coppedge (1971, pp. 163-174) carefully explained the significance of proteins having only L-amino acids in their structure. The only possible viable answer is that proteins were designed and could not have evolved.

Engineering

Henry Morris (1971, pp. 142-144) discussed the ark from the principles of buoyancy, water displacement, weight and metacentric height. He concluded that the craft was eminently suited for preserving man and animals during the Flood.

Geology

Clark (1971, pp. 19-23) examined paleoecology and the Flood. As he stated (p. 19):

Modern uniformitarians assume long geological ages, but in recent years advocates of the Flood theory of geology have found many problems that make it more reasonable to interpret the fossil evidence in terms of catastrophism rather than long ages of evolution.

The complexity of the Cambrian and other lower Paleozoic strata creates a very difficult problem for the evolutionist, but indicates that

these rocks represent a natural habitat buried suddenly. The sudden extermination of the trilobites and the irregular distribution of the ammonites all point to catastrophism. The coal beds have many problems that evolutionists fail to explain, but which can be solved if such beds are assumed to represent an ancient type of habitat or life zone. The extinction of the dinosaurs fits well into the same explanation as also does the peculiar distribution of the mammals in the Tertiary rocks.

All in all, the Flood theory offers the most satisfactory explanation of ancient paleoecology in what has been designated the 'ecological zonation theory.'

Tom Barnes (1971, pp. 24-29), in the first of his famous series of papers on the decay of earth's magnetic field, explained the geochronological implications of this young earth interpretation. Walter Lammerts (1971, pp. 50-54) presented evidence that suggests that the origin of the Pacific Southwestern deserts was very recent. Dr. Lammerts correlated this data within a Flood framework. Springstead's (1971, pp. 175-182) excellent article, "Monoglaciology and the Global Flood" detailed evidence for a single period of glaciation (ice age) after the Flood. Steve Austin (1972, pp. 231-248) carefully developed a thesis that Capitan Limestone was not a fossil reef that required eons to form. Instead, the lack of large organically-bound structures which would grow during thousands of years, suggests that deposition of the limestone was very rapid. This article should be studied in detail by young-earth creationists. Lammerts (1972, pp. 251-255) examined the Glarus overthrust using the work of K. J. Hsu of Zurich and concluded that the limestone involved in the overthrust did not flow 21 miles as claimed. George Howe (1972, pp. 256-260), in a unique article, showed actual overthrust evidence at faults caused by the San Fernando earthquake of February 7, 1971. The actual overthrust activity was on a very small scale as would be expected by creationist geologists.

Thermodynamics

Williams (1971, pp. 117-126) was the first creationist to apply thermodynamic principles to living organisms. He noted life can best be viewed from a design perspective; macroevolutionary processes cannot account for the complexity of living systems. McDowell (1971, pp. 189-191) used information theory to develop a law of biological conservation. Penny (1972, pp. 261-269) employed thermodynamic principles to develop a creationist thesis on the origin and destiny of the universe.

Philosophy

Henry Morris, in two separate articles (1971, pp. 72-75; 1972, pp. 269-272) detailed the objections to the day-age theory and the theistic evolutionary philosophy. The inconsistencies of the positions were examined. Jones (1971, pp. 44-49) viewed the nature of evolutionary thought from a vantage point of the philosophy of science. Mendelism was discussed in relation to creationist strategy. John Grebe (1971, pp. 60-62) noted the impossibility of evolutionary improvement. John Moore (1971, pp. 76-77) briefly discussed

the evidences for macroevolution and noted how often nonexistent ancestors and nonobservable changes are employed on television and in books to propagandize the theory. The scientific nature of the evolution doctrine was examined by Ouweneel (1971, pp. 109-115). After reviewing the evidence, he concluded that evolutionism is not a theory or an hypothesis, but a dogma. The creation and evolutionary models were compared in a proposal for science framework guidelines by Morris (1971, pp. 147-150). Bliss (1971, pp. 185-187) explored how to teach origins in a public school classroom.

Summary

As can be seen from this review, another volume of *CRSQ* contained considerable valuable creationist scholarship. Also many technical notes, book reviews and other forms of creationist endeavors were presented in the pages of volume 8 which are a must for the library of any serious creationist.

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INDEX TO VOLUME 28 OF THE CREATION RESEARCH SOCIETY QUARTERLY

A

- A Classical Case of Mimicry Runs Afoul by Michael J. Oard, 111
- A Desert Millipede: Evolution or Design?—An Introduction by Emmett L. Williams, George F. Howe and Richard R. White, 7
- A Refinement of Biosystematics Which Reflects Baraminic Variation by Paul A. Bartz, 18
- Anderson, Kevin L.
New Trends in the Molecular Basis for Variation, 50
- Aufdemberge, Ted
Variation and Fixity as Seen in Climatology, 98

B

- Baked Rocks by Wilbert H. Rusch, Sr., 161
- Bartz, Paul A.
A Refinement of Biosystematics Which Reflects Baraminic Variation, 18
- Biological Variation by Frank L. Marsh, 54

Brown, Colin

- The Origin of Euglena, 112.
- Boulder Found in Coal Seam—Implications by Emmett L. Williams, 29

C

- Catastrophism and Rapid Erosion—III by Emmett L. Williams, 109
- Croft, Bill
The Family Blattidae: An Example of "Evolutionary Stasis," 149
- Croft, Bill and Raymond M. Seaman
Evolution: The Emperor's New "Science," 27
- Culp, G. Richard
The Limits of Variation, 102

D

- Death Knell for the Big Bang by George Matzko, 67
- DeYoung, Don B. and John R. Meyer
Dinosaur Update, 117

Dinosaur Update by Don B. DeYoung and John R. Meyer, 117

Dividing the Earth by J. Michael Fischer, 166

Does the Neo-Darwinian Principle of Homology Work at the Genome Level? by Dimitrij A. Kouznetsov and Andrey A. Ivanov, 33

E

Erosion of the Grand Canyon of the Colorado River: Part I—Review of Antecedent River Hypothesis and the Postulation of Large Quantities of Rapidly Flowing Water as the Primary Agent of Erosion by Emmett L. Williams, John R. Meyer and Glen W. Wolfrom, 92

Erosion of the Grand Canyon of the Colorado River: Part II—Review of River Capture, Piping and Ancestral River Hypotheses and the Possible Formation of Vast Lakes by Emmett L. Williams, John R. Meyer and Glen W. Wolfrom, 138

Evolution: The Emperor's New "Science" by Bill Crofut and Raymond Seaman, 27

F

Faulkner, Danny R. and Don B. DeYoung
Toward a Creationist Astronomy, 87

Fischer, J. Michael
Dividing the Earth, 166

Frair, Wayne
Original Kinds and Turtle Phylogeny, 21
Is *Scientific American* "Scientific"?, 156

Frangos, Apostolos Ch.
The Correct Approach to Scientific Theories, 17

Functional Proteins: Chaos or Logos by David A. Kaufmann, 64

G

Gaia and Lynn Margulis by Michael J. Oard, 108

Genesis Kinds by Frank L. Marsh, 109

H

Hamilton, H. S.
The Coelacanth's Finny Joints, 29

Heinze, Harold
Isotope Ratios and Variable Constants, 164

Historical Variation in the Human Creature by L. MacAoidh, 35

Hyperbaric Oxygen and Fracture Healing by Kevin C. McLeod, 60

I

Index to Volume 27 of the *Creation Research Society Quarterly*, 31

Is *Scientific American* "Scientific"? by Wayne Frair, 156

Is the Genome Sufficient, Where is the Design Information and What Limits Variation? by Robert E. Kofahl, 146.

Isotope Ratios and Variable Constants by Harold Heinze, 164

J

Javor, G. T.
Similarities and Diversity among Organisms: Which World-View Do They Support?, 25

Jones, J. B.
The Limits to Variation, 100

K

Kaufmann, David A.

Functional Proteins: Chaos or Logos, 64

Kautz, Darrel

The Limits of Biological Variation, 24

Keyword Index to Volume 27 by Glen W. Wolfrom, 114

Kofahl, Robert E.

Is the Genome Sufficient, Where is the Design Information and What Limits Variation?, 146

Kouznetsov, Dimitrij A. and Andrey A. Ivanov

Does the Neo-Darwinian Principle of Homology Work at the Genome Level?, 33

M

MacAoidh, L.

Historical Variation in the Human Creature, 35

Major, Trevor J.

Problems in the Interpretation of Variation within the Fossil Record, 52

Marsh, Frank L.

Biological Variation, 54

Genesis Kinds, 109

Matzko, George

Death Knell for the Big Bang, 67

Who Can You Believe?, 110

McLeod, Kevin C.

Hyperbaric Oxygen and Fracture Healing, 60

Minutes of 1991 Creation Research Society Board of Directors Meeting, 116

N

New Trends in the Molecular Basis for Variation by Kevin L. Anderson, 50

Number Game by David C. C. Watson, 158

O

Oard, Michael J.

A Classical Case of Mimicry Runs Afoul, 111

Gaia and Lynn Margulis, 108

Original Kinds and Turtle Phylogeny by Wayne Frair, 21

P

Plant Communication: "Calling All Wasps" by Glen W. Wolfrom, 156

Population Control Without Predation by Emmett L. Williams, George F. Howe and John R. Meyer, 157

Problems in the Interpretation of Variation within the Fossil Record by Trevor J. Major, 52

R

Reprinted *CRSQ* Volume 4 by Emmett L. Williams, 27

Reprinted *CRSQ* Volume 5 by Emmett L. Williams, 67

Reprinted *CRSQ* Volume 6 by Emmett L. Williams, 113

Reprinted *CRSQ* Volume 7 by Emmett L. Williams, 158

Rusch, Sr., Wilbert H.

Baked Rocks, 161

S

Similarities and Diversity among Organisms: Which World-View Do They Support? by G. T. Javor, 25

T

- The Coelacanth's Finny Joints by H. S. Hamilton, 29
 The Correct Approach to Scientific Theories by Apostolos Ch. Frangos, 17
 The Family Blattidae: An Example of "Evolutionary Stasis" by Bill Crofut, 149
 The Limits of Biological Variation by Darrel Kautz, 24
 The Limits of Variation by G. Richard Culp, 102
 The Limits to Variation by J. B. Jones, 100
 The Origin of Euglena by Colin Brown, 112
 Thermodynamic Analysis of a Condensing Vapor Canopy by Tracy W. Walters, 122
 Toward a Creationist Astronomy by Danny R. Faulkner and Don B. DeYoung, 87

V

- Variation and Fixity as Seen in Climatology by Ted Aufdenberge, 98

W

- Walters, Tracy W.
 Thermodynamic Analysis of a Condensing Vapor Canopy, 122
 Watson, David C. C.
 Number Game, 158
 Who Can You Believe? by George Matzko, 110
 Williams, Emmett L.
 Boulder Found in Coal Seam—Implications, 29
 Catastrophism and Rapid Erosion—III, 109
 Reprinted CRSQ Volume 4, 27
 Reprinted CRSQ Volume 5, 67
 Reprinted CRSQ Volume 6, 113
 Reprinted CRSQ Volume 7, 158
 Williams, Emmett L., George F. Howe and John R. Meyer
 Population Control Without Predation, 157
 Williams, Emmett L., George F. Howe and Richard R. White
 A Desert Millipede: Evolution or Design?—An Introduction, 7
 Williams, Emmett L., John R. Meyer and Glen W. Wolfrom
 Erosion of the Grand Canyon of the Colorado River: Part I—Review of Antecedent River Hypothesis and the Postulation of Large Quantities of Rapidly Flowing Water as the Primary Agent of Erosion, 92
 Erosion of the Grand Canyon of the Colorado River: Part II—Review of River Capture, Piping and Ancestral River Hypotheses and the Possible Formation of Vast Lakes, 138
 Wolfrom, Glen W.
 Keyword Index to Volume 27, 114
 Plant Communication: "Calling All Wasps," 156

BOOK REVIEWS

- An Ice Age Caused by the Genesis Flood by Larry Vardiman, 37
 Charles Darwin's Religious Views: From Creationist to Evolutionist by Wayne Frair, 70
 Darwin on Trial by Wayne Frair, 171
 Dictionary of Science and Creationism by Jerry Bergman, 172
 Environment of Violence by David J. Tyler, 73
 Genesis and the Dinosaur by Don B. DeYoung, 37
 God's Wedding Band—Reflections on the Creation Evolution Controversy by Don B. DeYoung, 70
 Inner Earth: A Search for Anomalies by Don B. DeYoung, 174
 Is God a Creationist? The Religious Case Against Creationism by Clifford L. Lillo, 38
 Origins: What is at Stake? by George F. Howe, 169
 Portraits of Creation by Don B. DeYoung, 72
 Portraits of Creation by David Newquist, 71
 Science Matters: Achieving Scientific Literacy by A. Jang, 175
 The Big Bang Never Happened by Danny R. Faulkner, 171
 The Genesis Debate: Persistent Questions about Creation and the Flood by Frederic R. Howe, 73
 The Practical Paleontologist by Clifford L. Lillo, 174
 "Vestigial Organs" are Fully Functional by John R. Meyer, 169
 Voyage to the Stars by Don B. DeYoung, 74

LETTERS TO THE EDITOR

- An Ancient Historical Test of the Setterfield-Norman Hypothesis by Robert C. Newman, 77
 An Open Letter to the Journal *Creation/Evolution* by William S. Parks, 177
 Archaeopteryx and a Cornish Rock by Rebecca J. Gring, 42
 Goiter and Plate Tectonics by Alex G. Stewart, 77
 International Conference on Science and Belief, 176
 Meteoritic Activity and Working Hypotheses by Emmett L. Williams, 76
 Millipedes and Adaptation by Walter E. Lammerts, 177
 Moon Dust by Glen J. Kuban, 74
 Reply to Gentry by Robert H. Brown, 41
 Response to Kuban by William S. Parks, 75
 Response to Lammerts by Emmett L. Williams and John R. Meyer, 177
 The Dry Land—A Creative Act by John Potter, 42
 The Fall of Evolution by Allen Bartley, 41
 Variation by Frank L. Marsh, 176

QUOTE

I must confess to a feeling of profound humility in the presence of a universe which transcends us at almost every point. I feel like a child who while playing by the seashore has found a few bright colored shells and a few pebbles while the whole vast ocean of truth stretches out almost untouched and unruffled before my eager fingers.
 Isaac Newton

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THE BIOLOGICAL THEORY OF ATAVISM: A HISTORY AND EVALUATION

JERRY BERGMAN*

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Abstract

The history of the biological atavisms, the theory that some individual animals, including humans, at times revert back to an earlier evolutionary type, was reviewed. In the case of humans, many behavioral scientists believed that the atavism response caused persons to revert in a major way, both physically and mentally, to their animal origins. Many criminologists once adopted this theory to explain crime, and partly for this reason it influenced public opinions and official policy. The "criminal physical type" stereotype is still very much with us, even though the theory of atavism as a causative factor in criminal behavior has been empirically disproved.

Examples of so-called atavism are discussed, including extra fingers, nipples, and various body abnormalities such as extreme levels of body hair. It is concluded that no known biological atavism mechanism is sufficient to account for this phenomenon. The probable causes are genetic malfunctions, hormonal problems, or diseases. The research is reviewed that shows why the concept of atavisms has today, like its relatives the vestigial and nascent organ theories, now been discarded.

Introduction

A concern of this review is the problem of theories or ideas which appear valid, once they are established in one discipline or context being uncritically adopted into other knowledge disciplines. Most fields often try to accommodate that which they believe are "accepted" conclusions from other fields without adequate examination of them. This acceptance is often without full awareness of the debate which may exist within the theory's own discipline. Both sociology and psychology have uncritically used for their theory building many theories from the life sciences, especially biology, which were later proved false. Psychoanalysis, the theory of differential association, the unified field theory, behaviorism theory, and the Pygmalion effect (labeling theory) have all borrowed uncritically from biology, and all were later forced to modify their ideas. As Gould (1977, p. 223) noted, the impact of evolution was especially enormous, which:

... illustrates the enormous influence of evolutionary theory in fields far removed from its biological core. Even the most abstract scientists are not free agents. Major ideas have remarkably subtle and far-reaching extensions.

A tragic example of the use of evolution by another field was its uncritical acceptance into the field of criminology. The result was the development of many unfounded theories which have now been completely discredited, some of which have had tragic consequences for multi-thousands of persons (Gould, 1981). The specific aspect of evolution discussed here is **human atavism theory**, or the view that certain physical traits can appear in humans which are the result of a "throw-back" to an earlier stage of our evolutionary history.

Although the influence of evolution on non-biological fields, such as psychology, sociology, and anthropology, has varied, sociologists have in general uncritically accepted the general theory since Comte published his *Polity* (Barnes, 1948, p. 106-107). And it profoundly

influenced many social theories—some of which were later rejected in a wholesale manner—Social Darwinism is a good example. As Vold (1958, p. 10) claims:

... Man's social organization has developed as a result of his biological evolution—hence, social evolution is subsequent to but essentially parallel with, and presumably a product of, biological evolution. Individual human characteristics and behavior are therefore to be understood as reflections of this common organic and biological inheritance, not free and intelligently self-determined, but biologically determined.

The behavioral sciences were not just influenced by biological evolution but, as Morris (1974) notes, in "the field of sociology, one quickly discovers that the study of man's cultures and societies is universally cast in the same mold as the study of his presumed biological evolution." This has been true for decades. Weatherwax (1909, p. 42) long ago noted that "Scientists in general recognize the principle of [biological] evolution, and its influence has carried over into the field of social problems and has had a profound influence on all thought."

A prime example of how evolution has influenced social policy is the theory of atavism in crime theory as developed by the man many regard as the founder of the science of criminology, Cesaro Lombroso (Papa, 1983). His views are covered in his 1876 book *The Criminal Man* (Lindesmith and Levin, 1937) in which Lombroso taught that:

... criminals are a form of evolutionary throw-back to a more primitive human type. The criminal, it seemed, was a "being who reproduces in his person the ferocious instincts of primitive humanity and the inferior animals. Thus were explained [the characteristics] found in criminals, savages, and apes: insensitivity to pain, extremely acute sight, tattooing, excessive idleness, love of orgies, the irresistible craving for evil for its own sake, the desire not only to extinguish life in the victim, but to mutilate the corpse, tear its flesh, and drink its blood." (Robertson, 1981, p. 183).

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In 1896 Dallemagne, a prominent French criminologist, assessed Lombroso's enormous influence on crime policy and thought with these words:

His thoughts revolutionized our opinions, provoked a salutary feeling everywhere, and happy emulation [of his techniques occurred] in research of all kinds. For 20 years, his thoughts fed discussions; the Italian master was the order of the day in all debates; his thoughts appeared as events (Gould, 1981, p. 135).

As to Dallemagne's assessment, Gould (1981, pp. 135-136) adds:

Dallemagne was recording facts, not just playing diplomat. Criminal anthropology was not just an academician's debate, however lively. It was the subject of discussion in legal and penal circles for years. It provoked numerous "reforms" and was, until World War 1, the subject of an international conference held every four years for judges, jurists, and government officials as well as for scientists.

Background

Throughout western history, most people have accepted the fixation of species view, the conclusion that each animal species was specially created in much the same form that they exist today. Most biological organisms were thus assumed to have changed very little, if at all, throughout history. It was also commonly believed that certain simple forms of life could spontaneously generate into a complete, functioning organism. These life forms were mostly the lower types, although they included some mammals such as mice which were believed to have come from carcasses of dead lions and assorted other places (Collier, 1968, p. 429).

These two core beliefs about the living world, their fixity and separate origins, were held by the masses for most of history. Although some ancient philosophers such as Lucretius taught that animal species had slowly changed or evolved because of various environmental influences, this theory did not receive wide support until Darwin introduced his *theory of evolution by natural selection* in the middle 1800's. Although not original, and discussed by several leading biologists (including some of Darwin's own relatives) long before he published his famous work, *The Origin of Species* in 1859, Darwin's views became the most famous. Once presented, they gained rapid acceptance, and to some degree influenced all other academic disciplines, especially the behavioral sciences (Papa, 1983; Lentini, 1980).

Atavism, A Definition

The term atavism is from the Latin *atavus*, which means "an ancestor," and *atavus* is a form of *avus*, which means "a great-great-grandfather." Atavisms are defined in biology as a reversion to an ancestral type. Atavism proper is a biological theory in which it is believed that some individuals, for unknown reasons, revert in certain ways both physically and mentally back to an earlier "evolutionary" type. This "degeneracy" was at one time believed by many crim-

inologists to have caused the victims to both look more like an "animal" and also to behave "in more savage ways than their civilized counterparts" (Vold, 1958, p. 28). These "animal-people" were also thought to be more apt to involve themselves in criminal behavior. Importantly, this theory was not an obscure view held by a few extremists, but was "probably the most influential doctrine ever to emerge from the anthropometric tradition" (Gould, 1981). To measure the "level of animal traits" a person had, scientists used a number of

... tests to measure the physical characteristics of prison inmates, [and therefrom] Lombroso identified certain features typically found in the criminal population. Among these characteristics ... were shifty eyes, receding hairlines, red hair, strong jaws, wispy beards, and the like. Lombroso came to the conclusion that criminals are a form of evolutionary throwback to a more primitive human type. (Robertson, 1981, p. 183)

The idea of human atavism was probably first suggested by Darwin (1881, p. 137) when he wrote, "with mankind some of the worst disposition, which occasionally without any assignable cause make their appearance in families, may perhaps be reversions to a savage state from which we are removed by many generations." Since atavistic persons had not only degenerated behaviorally, but physically also, it was commonly believed that criminals could often be identified by *physical traits alone*. Abnormal dentition, asymmetry of face, large ears, eye defects, "inverted" sexual characteristics and supernumerary (extra) nipples, toes and fingers, were all viewed as physical evidence of an atavistic human (Taylor, 1973, p. 41). Exactly how or why the atavistic criminal ended up with this physical and mental regression or degeneration was never fully explained. Nonetheless, atavism was at this time considered a major evidence of evolution (Pal, 1918). It rode close behind the theory of evolution in both respect and acceptance. An early 1940 booklet defending evolution concluded that one of the most compelling proofs of evolution was:

atavism, which means the reappearance in an individual of a character belonging to [one's] remote ancestors. It is an interesting phenomena ... if we had really descended from ape-like creatures, we might expect to find some of the characteristics of these ancestors appearing now and then among human beings ... This 'proof' reminds us that within the last few years a scientist solemnly suggested that the present jazz craze was an evolutionary [atavism, causing a mimicking] of the rhythmic movements of the jelly fish. (Pettit, 1942)

Many behavioral scientists once accepted the belief that rare individual "throwbacks" regularly occurred in "normal" families, producing different types of pre-humans. These researchers de-emphasized the effect of the environment and sociological factors in general in causing crime. They spent much time measuring body parts, especially foreheads and brain cases, concluding that the closer the person resembled an ape physically, the greater the behavioral "regression." This method, in contrast to the *experimental versus control*

group and other common research methods in the behavioral sciences, they felt was fully "scientific." Gould (1981, p. 124) notes:

Lombroso's theory was not just a vague proclamation that crime is hereditary—such claims were common enough in his time—but a specific *evolutionary* theory based upon anthropometric data. Criminals are evolutionary throwbacks in our midst. Germs of an ancestral past lie dormant in our heredity. In some unfortunate individuals, the past comes to life again. These people are innately driven to act as a normal ape or savage would, but such behavior is deemed criminal in our civilized society. Fortunately, we may identify born criminals because they bear anatomical signs of their apishness. Their atavism is both physical and mental, but the physical signs, or stigmata as Lombroso called them, are decisive. Criminal behavior can also arise in normal men, but we know the "born criminal" by his anatomy. Anatomy, indeed, is destiny, and born criminals cannot escape their inherited taint: "We are governed by silent laws which never cease to operate and which rule society with more authority than the laws inscribed on our statute books. [In conclusion] crime . . . appears to be a natural phenomenon" (Lombroso, 1887, p. 667).

Types of Atavisms

One of the most comprehensive discussions of the various types of atavisms is by Lull (1932, p. 97). His divisions are as follows:

(1) **Family atavism** is the transmission within a family of individual characteristics which are latent for several generations but occasionally reappear in a family member. Examples include red hair in a child whose immediate parents or grandparents do not display this trait, but which existed several generations back. This is not a true atavism, but is simply the appearance of one or more recessive genes and do not show themselves in the phenotype until enough chance combinations occur so that the two or more recessive genes for the characteristic of concern are present together in one genotype. This recognized phenomena is familiar to every student of genetics, and is not an atavism as the word is usually defined.

(2) **Race atavism** is the appearance of characteristics that are common to "primitive races" in someone who is classified in a more "advanced race." Race atavism is actually similar to family atavism except that it concerns itself only with *certain* characteristics, namely those introduced into the family by miscegenation. Examples Lull gives include the appearance of a large amount of body hair on a person of a race which normally does not have much that is due to the presence of genes that entered the family's gene pool from a racial intermarriage which occurred several generations previously. An example is a WASP child who possesses the traits of another race, and who had an ancestor that married an American Indian, a black, or one of another race two or more generations previously.

Of course, since "race" divisions are vague and arbitrary, what could be called a "race atavistic characteristic" is somewhat dependent upon the observer and

his or her opinions regarding the classification criteria used. Lull (1932, p. 97) uses as an example of race atavism the "profuse development of hair on the face and body which occasionally occurs in humans, such as the Russian 'dogman' Adrian Jeftichjew." It is doubtful that this is even a race trait—profuse body hair to the degree found on these individuals is not a characteristic of any known past race.

(3) **Teratology atavism** is from *Tepas* or *tera*, which is Greek for "wonder" or "monster." This atavism type consists of the appearance of certain physical characteristics in modern humans which are assumed to have been common in human evolutionary ancestors. This type is the only "true" atavism, and is what is referred to in the literature, and is the type referred to in this paper. Lull's example of a *Teratology atavism* is "the external hind limbs of which a single recorded incidence occurred in a hump back whale taken off Vancouver." Lull (1932, p. 97) notes that "ancestral terrestrial atavists of the whales undoubtedly had these structures, which were gradually lost during other adaptations to aquatic life." Their limbs are assumed to be a wholesale genetic throwback to multi-thousands of previous generations. An example that Lull (1932, p. 97) provides is the *fistulae*, in humans which refer to the "permanent abnormal openings of the neck which sometimes occurs in the human subject, [and] have been considered as relics of the ancient gill-slits of our piscine [fish] ancestry."

The Historical Importance of Atavism as Evidence For Evolution

The concept of atavism was a major line of evidence that Darwin used to support his theory. As he openly stated (1871, p. 427):

That this unknown factor is a reversion to a former state of existence may be admitted as in the highest degree probable. . . . [excepting that] man is descended from some ape-like creature, no valid reason can be assigned why certain muscles should not suddenly reappear after an interval of many thousands of generations in the same manner as with horses, asses, and mules, dark colored stripes suddenly reappear on the legs and shoulders, after an interval of hundreds, or more probably thousands of generations.

These various cases of reversion are so closely related to those of rudimentary organs given in the first chapter [of his book] . . . some parts which are rudimentary in man, as the os coccyx in both sexes, and the mammae in the male sex are always present; whilst others, such as the supracondyloid foramin, only occasionally appear, and therefore might have been introduced under the head of reversion. These several reversionary structures, as well as the strictly rudimentary ones, reveal the descent of man from some lower form in an unmistakable manner.

Lyell (1863, p. 504) even attributed genius in areas as diverse as religion, ethics, philosophy and the sciences to atavisms. In his words:

The occasional appearance of some extraordinary mental powers may be attributed to atavism; but

there must have been a beginning to the series of such rare and anomalous events. If, in conformity to the law of progression, we believe mankind to have risen slowly from a rude and humble starting point, such leaps may have successively introduced not only higher and higher forms or grades of intellect, but at a much remoter period may have cleared at one bound the space which separated the highest stage of the unprogressive intelligence of the inferior animals from the first and lowest form of improvable reason manifested by Man.

A common example of an atavism is extreme body hair called *hirsute*. The importance of this trait was noted by Drimmer (1973, pp. 162-163):

H. Kaulitz-Jarlow, a corresponding member of the Institution Ethnographique, has provided a "scientific" description of Krao at age six. It was the heyday of the controversy over Charles Darwin's theory that man was descended from ape-like creatures . . . and his followers were constantly hoping to turn up a creature intermediate between man and the apes. To some, Krao appeared to be just what they were looking for.

In his description, Kaulitz-Jarlow highlighted those features of Krao that he considered particularly simian. 'Thick, jet-black smooth hair covers her head and reaches far down her back,' he said. 'It forms a virtual mane on the back of the neck. Her eyes are shadowed by wide, silky, shiny eyebrows. Her pupils are sparkling and dark black.' Hair, he observed, covered her body from the top of her head to her feet. He went on to point out in detail how closely her facial structure resembled that of the gorilla.

Little Krao's character, . . . was amiable; she had an easily satisfied, cheerful disposition. She liked to play and was grateful when attention was paid to her. 'If she is annoyed,' he said, 'her wild nature at once comes to the fore; she throws herself to the ground, screams, kicks, and gives vent to her anger by pulling her hair in a very peculiar way.' Presumably these were also supposed to be ape-like characteristics.

Hirsute evidently does not occur because of the inheritance of a specific genotype, but as a result of hormonal system malfunction, problems in embryological development, or disease (Topping, 1981). A major difficulty in assessing the cause of this phenomenon is both its rarity (In China only about 20 of over one billion people) and the fact that it is usually not researched medically because it is at most a cosmetic problem. The cause of *hirsute* may not be known for some time because research resources are more likely to be expended in areas which are more directly relevant to saving lives and reducing misery. Thus, it is unlikely that much effort will be expended to determine the cause of the unusual cases which Lull (1932) claims are examples of race atavism.

Most of the examples used to "prove" atavism theory are actually a selection of a wide variety of medical conditions which fit the theory, and an ignoring of those that do not. Triple and double headed monsters

(humans and animals born with two or three heads) are not uncommon, but no one supposes that human ancestors had two or three heads. One well known class of human deformities are called *sirens* because of their resemblance to the mythological creatures with the same name due to major structural deformities in the lower extremities which causes the patient to resemble a fish or a snake (Gould and Pyle, 1896, p. 270). Yet, no one has claimed that siren monsters actually once existed in our evolutionary family tree, or any family tree.

Human Atavistic Tails

The most frequently cited modern example of an atavism is the occasional occurrence of "tails" in newborn humans. This proof of evolution was discussed by scientists from Darwin (1896, p. 22) to today. According to Gould and Pyle (1896, p. 277):

traditions of tailed men are old and widespread, and tailed races were supposed to reside in almost every country. . . . Struys, a Dutch traveler in Formosa in the seventeenth century, describes a wild man caught and tried for execution who had a tail more than a foot long, which was covered with red hair like that of a cow.

Struys quotes other cases, but notes that "whether tails were fleshy or cartilaginous was not known."

Although hundreds of cases were reported between 1850 and 1900 "during the heyday of recapitulation theory and the height of the debates over Darwinism," very few have been well documented until the latter part of the century (Ledley, 1982, p. 1212). Conclusions about human "tails" are typically based on a few cases, a major problem in understanding them because their cause is likely multiple and varied (Gish, 1983). Gould and Pyle (1896, p. 277) admit that many of the past cases could well be examples of people who wear artificial appendages either for show or to exploit others. Due to the difficulty of both researching and verifying these historical accounts—and they clearly vary greatly, both in accuracy and the extent of their believability—it is difficult to draw any conclusions from them. An example which illustrates the credibility problem of these accounts is the following first hand case history on the cause of human tails written by a medical doctor:

. . . I was called to attend a lady in the country during her accouchement, and seeing that she was likely to have a tedious labor, was very careful in eliciting her history prior to this trying ordeal. She stated she had not felt well for several months—ever since she had worried about some favorite young pigs that were being abused in the yard. Going out she carried the pigs into the house, lifting them fondly by the tail; and that occurrence bore on her mind . . . after labor was completed, the fond son also was blessed with a tail—a nice, well-formed . . . a five-inch tail. . . . the father, who was chagrined at so unusual an anomaly, requested its immediate amputation, which we reluctantly performed; after which he exclaimed: "Now, mine pig-boy does better." The mother, like most women in whom I have found this tendency to "spot" their young, was a very

frail and nervous temperament, and more than all was ignorant. But, in conclusion, I am convinced that such mothers can, and do often, transmit their mental impressions to the child in utero, thus developing the many so called mother's marks. I could relate several similar instances (Berry, 1894, p. 105).

A good example of the motivations for false reports in this area provided by Andrews (1945, p. 15-16):

In the Philippine Islands, in 1910, a native was brought to me for inspection. He possessed a blunt bony tail-stump two and one-half inches long. Obviously, it was projection of the coccyx, which, instead of being bent under as usual, continued in a direct line with the spine. A local photographer had retouched and extended the projection in a photograph to a pointed spike six or eight inches long, and sold the pictures to tourists like hotcakes. For years afterward they kept appearing in my mail as indisputable evidence of a "tribe" of people with tails.

As early as 1923, Klaatsch (1923, p. 40) reviewed several human tail claims that he located in the literature, including one that grew to three inches in six months and another two-and-a-half inch long soft tail that developed on a Tamil girl, concluding that:

Children are occasionally born with tails, and these sometimes have nerves, blood vessels, and muscles—in some cases even cartilage or bone. This type of human tail, is, however, scarce and is generally, at most, an inch long projection. 'Soft tails' are more frequently found, and they run to a length of ten inches or more.

Although many tail reports are false or exaggerated, some of the more recent accounts have been verified and studied (Gould, 1982). Tail-like appendages still occur in humans, and thus can be studied using the advantages of modern research knowledge and techniques. A recent human tail controversy was started by an article in the *New England Journal of Medicine* (Ledley, 1982) which discussed a 7-pound baby born in a Boston hospital with a slender, tapered, 5.5 cm long appendage located on the baby's lower back near the end of the spine. It was covered with hair and skin of normal texture and internally it had a soft, fibrous fatty core (1982, p. 1213). Although it contained nerves, it was not a true tail since it lacked both bone and cartilage. The report (1982, p. 1212) then claimed that the tail "presents a striking clinical confirmation . . . [of] the reality of evolution. . . . The caudal appendage brings this reality to the fore and makes it [evolution] tangible and inescapable [and is a rare glimpse of] the relation between human beings and their primitive ancestors" (1982, pp. 1212, 1215).

Among the many anomalies that have been falsely labeled "tails" include a variety of growths. The "tail" usually develops on the person's back, but is also found in many other areas in which they do not normally appear in lower animals—most commonly in the lumbar gluteal areas. They usually have hair and nerves, but rarely bone, cartilage or muscle. It is now known that the portion of the body which undergoes the most profound growth and changes during embryonic

development is the nervous system. Because of this rapid growth and the complexity of this system, anomalies are not rare. These finger-like projections, among which include those mislabeled "tails," are often some type of tumor, and many are lipomas. Ledley (1982, p. 1213) notes: "there are no well-documented cases of caudal appendages containing caudal vertebrae or an increased number of vertebrae in the medical literature, and there is no zoological precedent for a vertebral tail without caudal vertebrae."

Allford (1978, p. 37) concluded from her review on the pathological examinations of human tails that "these fingerlike projections were more than likely fibro-fatty polyps." Embryological studies have now emphatically concluded that most examples are some type of tumor or malformation. Further, their location is often definitely too high up on the back to be any type of atavism tail. Allford (1978, p. 37) further concludes that:

The reason that human tails are never described in medical books of pathology is because they do not exist. What is referred to as tails by some physicians are not true tails but congenital anomalies. In embryonic life, the area that undergoes the most profound growth changes is the nervous system. Because of these changes anomalies frequently result. The fingerlike projections, which are found in many areas on the surface of the body, and very commonly in the lumbar gluteal areas, are congenital lipomas. The congenital dermal sinus is frequently found in the lumbosacral area. Its attachment may be directly under the opening of the skin or may go several centimeters deep and be attached to the spinal canal. Frequently these contain hemangiomas or lipomas.

She found no evidence that these tails are able to 'wag' or move, although if muscle and nerve attachment existed and extended into these finger-like projections, movement was possible. Interestingly, it is not unusual for tailed animals to develop an *extra* tail. If the presence of one tail is an atavism, the development of two in the animal would indicate that many animals once normally had two tails—a conclusion that is totally lacking in evidence. Both of these abnormalities can be explained in other ways. Many causes and types of human tails exist and, although they are extremely rare (probably only a few cases or less per decade worldwide) they are not related to, and often they do not even resemble, animals tails. As Ledley (1982, p. 1214) concludes: ". . . The human caudal appendage does not represent a regression to a lower species . . . it is not a reversion . . ."

Other Atavistic Organs

Other examples of claimed atavisms include the supernumerary digits (extra fingers or toes) and both the suppression and hypertrophy of digits that sometimes occurs in humans and most animals. Both chromosomal information errors and developmental problems can cause an extra toe or finger to develop or, in the case of thalidomide babies, complete lack of, or partial development of, an appendage or even developmental flaws which causes them to look like seal flippers (Fine, 1972). If development in one area was

not suppressed at precisely the correct time, an extra appendage could result. A premature suppression can likewise cause the *lack* of a structure.

Another type are the presence of animal mammary glands on adult humans that resemble those of lower mammals. This was an important line of evidence for evolution because, as Rothenberg (1975, p. 148) notes: "The presence of accessory nipples is thought to substantiate the theory that humans have descended from lower forms of animal life." The cases on record of supernumerary nipples (*polythelia*) and supernumerary breasts (*polymastia*) amount to about 1% of all births, and include both human males and females (Greer, 1977, p. 104). The condition is frequently caused by abnormalities that result from genetic disorders and/or disease. As Rothenberg (1975, p. 147) notes:

. . . the supernumerary or accessory nipple, . . . found in pairs or singly, are usually seen on the chest wall beneath the true breast or in the upper abdominal region. Most accessory nipples are in a line with the normal nipples but in a minority of cases they are located on the breast itself or in or near the armpit. Extra nipples occur just as often in males as they do in females. As puberty progresses, the accessory nipple may enlarge somewhat. Sometimes, there is breast tissue beneath the accessory nipple but more often true breast tissue is lacking.

A similar but extremely rare deformity, is the total absence of one or both breasts. It affects females more often than males, and more commonly one breast rather than both are missing (Rothenberg 1975, p. 147). As expected, except as a throwback to premammal existence, no claims as to how *this* condition supports evolution have been made.

During the seventh week of human embryo development, the *mammary ridge* first appears. In the human, it develops in the thoracic region and becomes breasts in females and nipples in males and females. Occasionally, Allford (1978, p. 47) notes, more than one nipple develops on each side; an occurrence used as evidence of a human relationship to "lower" mammals because many of them have from six to ten pairs of nipples. Allford, in her practice as a medical doctor, notes that she has never seen more than one extra pair of rudimentary nipples and that chromosomal studies of these cases show that an increase in the number of X-chromosomes in the cells of such individuals often exists.

To be a true atavism, a supernumerary breast in humans would have to occur along the lateral line as they do in lower mammals. This arrangement is required if they are throwback to when human females supposedly had a set of teats similar to a dog. In most cases, though, they do not develop according to this pattern, and the number of added nipples, often which lack breast tissue, are usually no more than one or two. This actual pattern that exists in humans, the so-called "mammary line," forms a vase shaped single line. Its top extends from the armpits, and it narrows as it passes through the normal nipple area, the thinnest part being on the abdomen. They often occur in or near the armpits (as is normal in some kinds of bats) or in the inguinal region (as is normal in some whales) but they can occur almost anywhere on the

body—even in locations where mammals do not have mammary glands, such as on the back, arms, legs and buttocks (Klaatsch, 1923). The medical classification of this condition is a genetic or developmental deformity, and it is consistently treated as such by the health establishment. As Rothenberg (1975, p. 148) notes:

Accessory nipples in a child can be removed easily if their presence disturbs the parents, or if a mature individual with this anomaly finds them unsightly. Simple surgical excision results in a small, transverse, linear scar measuring about 1 inch in length. It can be accomplished readily in infancy, childhood, or in adulthood.

Among the many other putative atavisms includes excessive hair growth (such as the "bearded woman") hair color anomalies, growth of deer-like horns out of the head area, abnormal elasticity of the skin, an ability to move the body in extreme and unusual ways, and a body control which permits one to move the ears, or even the eyeball by their own muscles (for the latter in such a way that can literally pull the eyeball out of their eye sockets) *ad infinitum* most all of which have been shown to be due to disease or gene abnormalities. Citing the famous anatomist, Romer, what these things prove (or do not prove) about evolution is difficult to say. One can select examples such as the cases of individuals born with what seem to be rudimentary tails to prove that these anomalies are a reversion to previous developmental types, but unless compelling evidence exists otherwise, consistent interpretation is required in *all* of these cases, even those where individuals are born with mammary glands on their backs.

Atavistic Body Organs

Organs that are claimed to be atavistic occasionally appear in organisms which supposedly represent a 'throwback' to a condition found in some hypothetical ancestral type (Davidheiser, 1969, p. 239). Humans are occasionally born with a pair of ribs in their neck, and such cervical ribs are thought by some evolutionists to be an atavism throwback all the way back to our reptilian ancestry. Humans normally do not have neck ribs, but they naturally occur in many living and fossil reptiles. Yet, the presence of cervical ribs is better understood as a normal human variation. Extra ribs sometimes occur, and when they do they can develop in only two locations, i.e., above and below the normal set. Thus, extra ribs occur either in the neck or lumbar regions (the same reasoning is true of extra fingers or other supplemental organs, a condition which is not rare in humans and animals in general). Interestingly, the cervical ribs are *twice* as common in women as in men (Durham, 1960, p. 99). The logical but absurd conclusion from this is that women are more closely related to reptiles than men, or even that men evolved from reptiles before women. The extra ribs that sometime appear in the lumbar region are called gorilla ribs. This anomaly, incidentally, occurs three times more frequently in *men* than in women (Nordsiek, 1960).

Actually, many of the characteristics described as atavistic, according to Lull (1932, p. 136) "often occur in men, but rarely in women." Many so-called atavistic characteristics are therefore likely related to the

"X" chromosome, or at least the interaction of the "X" and "Y" chromosomes (actually more likely the lack of an "X" chromosome) with other genes. Other causes of atavistic traits include disease and diet problems or hormonal malfunctions that occur during early development.

Atavism and Race

The concept of atavism has clear racial implications. Mongolism, the condition in which an extra chromosome causes a person to be both retarded and have some superficial facial characteristics of this race, is an example. The belief that certain races are 'ancestral,' and thus less evolved than the modern white race, was once mainline science (Down, 1866; Chase, 1980). The term 'Mongolism' comes from the assumption that this condition is an atavistic throwback to an earlier primitive race which it was believed is extinct, but is close to the modern mongoloid race! The term 'mongoloid idiot' also has its source in this once common but clearly mistaken belief (Gould, 1980). Gould (1981, pp. 134-135) adds:

... unknown to most people today the supposed link between degeneracy and racial ranking has left us at least one legacy—the designation of "Mongolian idiocy" or, more blandly, "mongolism" for the chromosomal disorder properly known as "Down's syndrome." Down argued that many congenital "idiots" (a quasi-technical term in his day, not just an epithet) explained anatomical features, absent in their parents but present as defining features of lower races. He found idiots of the "Ethiopian variety"—"white Negroes, although of European descent" (1886, p. 260)—others of the Malay type, and "analogues of the people with shortened foreheads, prominent cheeks, deep-set eyes, and slightly apish nose, originally inhabited the American continent" (p. 260). Others approached "the great Mongolian family." "A very large number of congenital idiots are typical Mongols" (p. 260). He then proceeded to describe, accurately, the features of Down's syndrome in a boy under his charge . . . ("obliquely placed" eyes and slightly yellowish skin) . . . he concluded (1866, p. 261): "The boy's aspect is such that it is difficult to realize that he is the child of Europeans, but so frequently are these characters presented, that there can be no doubt that these ethnic features are the result of degeneration. Down even used his ethnic insight to explain the behavior of afflicted children: "they excel at imitation"—the trait most frequently cited as typically Mongolian in conventional racist classifications of Down's time.

These beliefs hardly did much to improve race relations in the Western world, and were a major contributor to the biological racism that developed in the middle 1800's in Europe and the United States.

Objections to the Atavism Theory

Since atavisms are "biological throwbacks" affecting both the appearance and behavior of the animal, a biological mechanism must exist for them to occur. Specifically, some physical means must exist to carry a complete set of intact genetic instructions or "blue-

prints of several past stages of human evolution" for eons up to contemporary humans. This would require a system which separately utilizes several separate sets of genetic codes, one for the current human and one for a previous stage or stages of evolution. Because human evolutionary development is believed by the largest school to be extremely slow, occurring by almost imperceptible changes from generation to generation, it would seem that humans would have to store either the genetic code of a certain specific period of human evolution, or the entire code for every stage. The latter would be impossible because, according to evolutionary theory, literally *multi-billions* of separate small changes must have occurred in the process of human evolution. Likewise, no evidence exists for a system which would select only a *certain period* of human evolution, and then record this blueprint somewhere in the genetic structure for future use. A whole set of blueprints must be stored because a whole set of structures is involved in most claimed atavisms. The complex mechanism would be required to, in essence, store templates for certain model years, or store the various sets of plans for traits at different and clearly distinct stages of the animal's evolution. The theory of "punctuated equilibria," a modern version of Goldschmidt's "hopeful monster" concept, suffers from many of the same problems.

The survival of the fittest concept would predict that selection favors *only* those biological structures which clearly enabled humans to experience a survival advantage over both other animals and those humans who do not possess the biological structures in question. And the biological structures producing the 'throwback' would in most cases confer little or no advantage to the animal, and thus would not be selected. Further, since many putative atavistic structures are clearly detrimental or fatal, selection would often work *against* their preservation.

It is difficult to even imagine how a biological structure necessary to accomplish that which is described above could possibly have evolved by random mutations. Obviously, the structure would be totally useless until it was completely evolved or developed, and even then, except as a curiosity, it would appear to be useless. In summary, contemporary evolutionary assumptions would conclude that structures which do not confer a survival advantage are unlikely to be selected for, and thus unlikely to be passed on to future generations. Lull (1932, p. 136) even concludes that atavistic characteristics,

are such as to make their owner more conspicuous and doubtless expose him to dangers from which the more obscure animal would be immune. Hence, [the continuance of some atavisms] is opposed to the principle of natural selection, as the results are a handicap and not an aid in the struggle for existence.

Thus, if some genetically atavistic characteristics would appear, they would be "selected out" and thus would in time no longer appear in the organism.

Atavism and Social Policy; the Major Tragedy of This View

The theory of evolution was most prominently introduced in corrections theory by Cesaro Lombroso.

How he did this was summarized by McCaghy (1976, p. 14) as follows:

Lombroso was a physician trained in psychiatry and biology, and he was aware of the . . . recent works of Charles Darwin, who connected modern humans with a nonhuman past through his theory of evolution. Lombroso had been involved for some time in the study of physical differences between criminals and normals, but his notion of atavism as a cause of crime emerged as a bolt from the blue during his autopsy of an infamous robber, whom Lombroso found to have skull depressions characteristic of lower primates.

No minor figure in criminology, Lombroso has been described as "one of the best known and possibly one of the least well understood figures in criminology." He was the founder of the positivist school in corrections which applied the scientific method to study the cause of behavior (Lentini, 1980; Scartezini, 1980). McCaghy (1976, p. 14) claims that:

his importance in spurring research on the criminal is undeniable . . . Lombroso's most important book was *L'Uomo delinquente* (*The Criminal Man*), first published in Italy in 1876. Here he presented his doctrine of evolutionary atavism. Criminals were seen as distinct types of humans who could be distinguished from noncriminals by certain physical traits . . . to identify persons who were out of step with the evolutionary scheme. Such persons were considered to be closer to apes or to early primitive humans than were most modern individuals; they were throwbacks (atavists) to an earlier stage in human development.

In his *The Criminal Man*, Lombroso included a long series of anecdotes to show that the *usual* behavior of all animals is criminal and amoral. Among the many examples that he provides include the behavior of some who eliminate sexual rivals by "murder," killing out of rage, such as "mad" elephants, and other animals going on stampedes, etc. He even used examples such as ants becoming impatient over recalcitrant aphids which were then killed and devoured as "punishment." Lombroso even concluded that insectivorous plants procure food in ways which are the "equivalent of crime." Having established, at least to his own satisfaction, that animals were "criminal" by our standards, he then proceeded to build a case for the view that humans who commit similar crimes must also have reverted back to their animal ancestry. Even the language use by atavistic criminals, he argued, showed this regression. He concluded that it was similar to "savage tribes" and included many onomatopoeias and personifications of inanimate objects. Said Lombroso (1911, p. 225), "they speak like savages, because they are true savages in the midst of our brilliant European civilization." He describes his conclusions further:

This was not merely an idea, but a revelation. At the sight that [criminal] skull, I seemed to see all of a sudden, lighted up as a vast plain under a flaming sky, the problem of the nature of the criminal—an atavistic being who reproduces in his person the ferocious instincts of primitive humanity and the inferior animals. Thus were

explained anatomically the enormous jaws, high handle-shaped or sessile ears found in criminals, savages, and apes, insensibility to pain, extremely acute sight, tattooing, excessive idleness, love of orgies, and the irresistible craving for evil for its own sake, the desire not only to extinguish life in the victim, but to mutilate the corpse, tear its flesh, and drink its blood. (Quoted in McCaghy, 1976, p. 14)

And, Lombroso's theory was not a work of abstract science. He founded and actively led an international school of 'criminal anthropology' that spearheaded one of the most influential of late nineteenth-century social movements (Papa, 1983). Lombroso's 'positive,' or 'new,' "school campaigned vigorously for changes in law enforcement and penal practices" (Gould 1977, p. 225). Specifically, as Gould (1981, pp. 140-141) noted:

Lombroso invoked biology to argue that punishment must fit the criminal, not, as Gilbert's Mikado would have it, the crime. A normal man might murder in a moment of jealous rage. What purpose would execution or a life in prison serve? He needs no reform, for his nature is good; society needs no protection from him, for he will not transgress again. A born criminal might be in the dock for some petty crime. What good will a short sentence serve: since he cannot be rehabilitated, a short sentence only reduces the time to his next, perhaps more serious, offense . . . The original Lombrosians advocated harsh treatment for 'born criminals.' This misapplication of anthropometry and evolution theory is all the more tragic because Lombroso's biological model was so utterly invalid and because it shifted so much attention from the social basis of crime to fallacious ideas about the innate propensity of criminals.

An example of the atavistic traits the criminal anthropology school evaluated include ears. For example, (Bean, 1894) describes one ear which at the top formed an almost acute angle, in contrast "to the graceful curve which is characteristic of the normal ear. This [sharp ear] form is very common in those who are tainted with criminal proclivities or who are inclined to abnormality of some sort." The author (1894, p. 261) then gives another example of an ear that is a "coarse unloving appendage to the human head [which] bespeaks a perverted or undeveloped mind. It is a mark of arrested or distorted development." After describing the criminal ear, the author concludes, "such ears as these are a badge of inherited poverty of moral instinct. Why should we not study these placards which nature has erected and thus prepare ourselves intelligently to labor for development of our race?" (p. 262).

The Fall of the Atavistic Criminal Theory

The most well-known early study which empirically disproved the atavism paradigm as a factor in causing crime was completed by Charles Goring (1919). In a study considered at the time to be a model of scientific and technical accuracy, Goring carefully compared approximately 3,000 English convicts with several large groups of Englishmen who did not have criminal rec-

ords. The convicts he studied were all recidivists, and for this reason he assumed that most were of a "thoroughly criminal type. In addition, comparisons were made with 1) university undergraduates, 2) officers in the British army, and 3) hospital patients. His conclusions was that "there were no more protrusions or other peculiarities of head among the prisoners than among the royal engineers" (Vold, 1958, p. 53). Although Goring's work resulted in the final death blow to the theory of atavism and crime, it took years to convince its many devoted followers that the theory enjoyed no validity. As Gould (1981, p. 134) notes:

Lombroso slowly retreated under the barrage [of the criticism of his theory]. But he retreated like a military master. Not for a moment did he compromise or abandon his leading idea that crime is biological. He merely enlarged the range of innate causes. His original theory had the virtue of simplicity and striking originality—criminals are apes in our midst, marked by the anatomical stigmata of atavism. Later versions became more diffuse, but also more inclusive. Atavism remained as a primary biological cause of criminal behavior, but Lombroso added several categories of congenital illness and degeneration: "We see in the criminal," he wrote (1887, p. 651), "a savage man and, at the same time, a sick man." In later years, Lombroso awarded special prominence to epilepsy as a mark of criminality; he finally stated that almost every "born criminal" suffers from epilepsy to some degree. The added burden imposed by Lombroso's theory upon thousands of epileptics cannot be calculated; they became a major target of eugenical schemes in part because Lombroso had explicated their illness as a mark of moral degeneracy.

The empirical evidence against the theory, the daily contradictions to it, and even the lack of evidence were only part of the reason for the theory's ultimate downfall (Moran, 1978). Another reason was that government experts and criminologists simply went on to new ideas and new hypotheses of crime causation. Other theories which implied that criminals were physically different from non-criminals, such as the work by Sheldon et al. (1940) later came into vogue, but the theory of atavism and crime has not been revitalized to any significant degree since the work by Goring. This raises the question, "How did the theory of atavism develop to take such a prominent place in corrections, complete with many examples which convinced many professionals of the correctness of the theory?" Several hypotheses are listed below:

1. Once a belief is established, its supporters can often find support for it if they look hard enough (Gould, 1981, 1976). In researching a population of "criminals," one can often locate many good examples of persons who supposedly had "ape-like" body characteristics. Unless a comparison group of non-criminals is used, limited insight can be gained by this technique. This is partly what occurred; many examples which supported the theory were located among the criminal population, and it was assumed that comparable examples did not exist, or rarely existed, in the non-

criminal population. Topinard (1887, p. 676) said of Lombroso's research,

He did not say: here is a fact which suggests an induction to me, let's see if I am mistaken, let's proceed rigorously, let us collect and add other facts . . . [rather his] conclusion is fashioned in advance; he seeks proof, he defends his thesis like an advocate who ends up by persuading himself . . . [Lombroso] is too convinced.

2. Certain nationalities or races of people, because of their social environment, discrimination, or for other reasons, are at times for various reasons more likely to involve themselves in crime. These races included several which had the characteristics that were supposedly typical of an atavistic. White Anglo-Saxon Protestants, because of their socioeconomic status and other reasons, were less commonly found among the convicted criminal populations compared to individuals who were members of minority groups such as blacks, Italians, Armenians and others. This explanation, no doubt, accounted for many of the so-called atavistic "evidences," just as it also now accounts for the highly disproportional number of blacks in American prisons.

3. Because of disease, health problems, poverty, etc., certain individuals may develop traits which were similar to the supposed "atavistic man." These traits in turn may make it more difficult to hold a job, or even achieve social acceptance and, as a consequence of these factors, exist within society's laws. Thus, for these reasons these individuals may be more likely to involve themselves in criminal behavior.

In view of these obvious facts, Lindesmith and Levin, (1937, p. 667) conclude that this biological theory of criminality rapidly spreads to the criminology elite because:

The immediate attention attracted by *L'uomo delinquente* was no doubt due to a number of factors in the intellectual life of the times which caused the acceptance of Lombrosianism [the theories of Atavism expounded by the famous criminologist Cesaro Lombroso] as a logical development of already existing tendencies in the social sciences. Chief among these was the spread of Darwinism. After the publication . . . of Darwin's *Origin of the Species*, Darwinian concepts not only swept through the biological sciences, but were also applied in a wholesale manner in the social sciences—in anthropology, political sciences and sociology. The ideas of Lombroso, although they were by no means new, were stated in an extreme form which attracted the attention of those who were preoccupied with Darwinism and its application to other fields of thought. In the same year that the *Origin of the Species* appeared, an anthropological society was founded in Paris and the next debate witnessed considerable development of interest in this field . . . In general, it may be said that an increased prestige of the natural sciences and especially biology led the beginning of a series of importations from one or the other of these fields into the realm of the social sciences.

Lombrosianism represents the first major importation of this character into criminology.

Lindesmith and Levin (1937, p. 671) also note that the development of science has included periods where "myth and fashion and social conditions have often exercised an influence quite unrelated to the soundness of theories or to the implications of accumulated evidence." Referring specifically to the Lombrosian theories, notably atavism, they state (p. 653):

From a sociological viewpoint, the advent of Lombroso represents a retrogression or an interlude in the progress of criminology rather than a step in advance. The eclipse of the earlier work may perhaps best be explained as a result of shifting prestige values associated with the importation of social Darwinism into the social sciences, with a growing popularity, in the latter part of the 19th century, of psychiatric and other individualistic or biological theories, and with the isolation of American criminology from earlier European developments.

In addition, Lindesmith and Levin (p. 661) stated:

the preoccupation of Lombrosians with anatomy and with Darwinian concepts and their assumption that the causes of crime were to be found in the nature of the criminal taken 'individually' rather than in relation to others led them to fail entirely to appreciate the importance of the type of historical research done by Ave-Lalemant and others. What Lombroso did was to reverse the method of explanation that had been current since the time of Guerry and Quetelet and, instead of maintaining that institutions and traditions determined the nature of the criminal, he held that the nature of the criminal determined the character of institutions and traditions.

It also should be stressed that, although Lombrosian theories of crime were very popular, they were also sharply criticized by many. Some biologists recognized the racism in Darwinism, and discerned where the theory was leading science. Others realized that the evidence upon which it was based was not solid, thus Gould (1981, p. 132) notes:

Lombroso's theory of atavism caused a great stir and aroused one of the most heated scientific debates of the nineteenth century. Lombroso, though he peppered his work with volumes of numbers, had not made the usual obeisances to cold objectivity. Even those great *a priorists*, the disciples of Paul Broca, chided Lombroso for his lawyerly, rather than scientific, approach.

Although Lombrosian authors later modified their theory to allow for the influence of some social factors, even in the case of supposed fully atavistic criminals, the fact is the theory gained considerable attention and was accepted by many for some time after it was proved wrong—and it is still accepted by many, even today, as a valid interpretation of the data.

The Concept of Atavism Today

Ironically, race atavism is still discussed by some scientists as a viable theory. As Gould (1976, p. 16)

concludes "despite its weak plot, this old—and dangerous—farce keeps reappearing." In Northern China, evidence of ambiguous footprints, samples of excretion and hair have been interpreted by scientists as evidence that ape-like atavistic creatures exist there. According to Topping (1981, p. 113),

Chinese scientists now have two theories about these strange creatures. Some believe that the wild men are atavisms—genetic throwbacks to an earlier form of the human species, resulting from chance combinations of ancestral genes. Others say the creatures are actually direct descendants of man's distant ancestor, the great ape, Gigantopithecus.

Genetic breeders occasionally claim that they achieved "reverse evolution" and produce a throwback. The German zoologist Heins Heck claims to have bred back a horse to a tarpan, a miniature horse which allegedly lived in the stone age.

Heck has spent 30 years in the Munich Zoo laboring to create beasts "the like of which have never been seen by living man—a beast, in fact, which had been dead for almost 600 years" (Carpenter, 1949, p. 28). Actually, what Heck has been doing is simply showing that a lot of animal types which were believed to be extinct can be bred back into existence. As Carpenter (1949, p. 28) describes "some freak animals, insects and plants seem to have inherited one or two of the characteristics of their ancient ancestors. They may possess hair in places where their breed has not grown hair in thousands of years. They may sport extra toes or feet that their ancestors discarded centuries before." Although called throwbacks or atavisms, they actually involve rather minor traits, nothing different than causing the set of conditions which allows genetic traits that once commonly existed in a population to again increase in number. An example of this is the breeding of horses so that either one or both of the side splints are functional but, as Gould notes (1980, p. 26),

horses have never lost the genetic information for producing side toes even though their ancestors settled on a single toe several million years ago. What else might their genetic system maintain, normally unexpressed, but able to serve, if activated, as a possible focus for major and rapid evolutionary change? Atavisms reflect the enormous, latent capacity of genetic systems, not primarily the constraints and limitations imposed by an organism's past.

These, though, are family atavisms, not true atavisms as discussed here. They are not different than a child having a trait which the family has not seen in generations, such as great-grandmother's red hair.

The problem is when we extend the occurrence of the expression of an inherited genetic trait to claiming the expression of a trait which allegedly existed millions of years in the animal's evolutionary history and which has not been expressed during much, or most, of this time. Although Gould referred to the horses with extra digits as atavisms, he himself (1980, p. 24) notes that they "had been admired and studied since Caesar's time." They are simply part of the gene pool which, for a variety of reasons, may not regularly be expressed and often skips generations, likely because

they are recessive genes and possibly require the uncommon event of a zygote that receives the recessive gene from both mother and father. Just as one would not call a daughter who has her grandmother's eyes an atavism or an evolutionary throwback, likewise, these examples would also not be properly termed such. If one insists on using the term atavism to apply to this occurrence, then it would be necessary to devise a way to differentiate the demonstrated property of various traits skipping a generation or two, for example, and the disproven scenario where a woman gives birth to a primitive evolutionary throwback with traits similar to her alleged ancestors of multi-millions of years ago.

As a whole, though, although atavisms were once commonly presented as proof of evolution in the textbooks for generations, the subject is generally not even mentioned today. Like vestigial organs, embryological recapitulation and nascent organs, the whole concept of atavism has largely been abandoned in the biological sciences. Most all of the conditions formally labeled "atavistic" are now seen as belonging in the domain of medicine and disease. It is yet another embarrassing chapter in the history of Darwinian evolution theory. And although disproved, it is tragically still very much with our culture. As Hicks (1986, pp. 130-156) concluded:

I only wish that Lombroso's ideas were passe; on the contrary, his atavistic criminal is ever with us. Check the Sunday comics: the conventional comic burglar is bald . . . has a jutting lower jaw, broken nose, low forehead, and isn't bright. During my days as a police officer I searched in vain to root out this criminal, but I discovered that his image was alive and well in the minds of law enforcers.

In 1977, while I was a police training officer (and a graduate student in anthropology), investigators from the Tucson, Arizona, office of the Internal Revenue Service invited a few of us . . . to view a new videotape on conducting interviews and interrogations. . . . My reaction to the tape—not shared by my companions—went from interest to disbelief as I watched the Army investigator explain how one can identify criminal types by the structure of the cheek bones, distance between the eyes, degree of eyebrow growth, composition of the nose and so on, all illustrated by large charts depicting typical criminal faces. I recall that eyebrows that do not separate but represent a more or less hairy continuum from one eye socket to the next indicated nefarious propensities. (My own eyebrows, I am ashamed to say, are connected.) . . . And the reactions of my companions, who had never heard of Lombroso? My boss was impressed. The detective commander wanted a copy of the tape. And the I.R.S. and the Army—I shudder.

Tragically, though, the theory still is reflected itself in modern theories of degeneration (Nachsohn, 1985; Hapham, 1976; Rothenberg, 1975) and even in some schools of "feminist criminology" (Brown, 1986; Klein, 1973; Faccioli, 1976.

Summary

The theory of atavism was examined as an example of the tendency for many sciences to borrow uncritically from other disciplines. Although the theory of atavism was soon found to lack empirical support, it was accepted uncritically for decades and was used in theory building by many criminologists and others. Part of the reason for this was the fact that it relied heavily on the assumption that evolution by natural selection was empirically supported and a valid scientific theory. Only part of this tragedy is the harm that this theory has caused science to progress by misdirecting much energy into non-productive and dead end areas. The far greater tragedy, though, is the fact that the theory probably influenced the criminal conviction of thousands of innocent victims. As Gould (1981, pp. 138-139) mused:

We do know that Lombroso's stigmata became important criteria for judgment in many criminal trials. Again we cannot know how many men were condemned unjustly because they were extensively tattooed, failed to blush, or had unusually large jaws and arms. E. Ferri, Lombroso's chief lieutenant, wrote (Ferri, 1897, pp. 166-167):

'A study of the anthropological factors of crime provides the guardians and administrators of the law with a new and more certain method in the detection of the guilty . . . [physical traits] will frequently suffice to give police agents . . . scientific guidance in their inquiries, which now depend entirely on their individual acuteness and mental sagacity. And when we remember the enormous number of crimes and offenses which are not punished for lack of inadequacy of evidence, and the frequency of trials, which are based solely on circumstantial hints, it is easy to see the practical utility of the primary connection between criminal sociology and penal procedure.'

Lombroso detailed some of his experiences as an expert witness. Called upon to help decide which of two stepsons had killed a woman, Lombroso declared (1911, p. 436) that one 'was, in fact, the most perfect type of the born criminal; enormous jaws, frontal sinuses, and zygomata [etc.] . . . He was convicted.'

In another case, based on evidence that even he could not depict as better than highly vague and circumstantial, Lombroso argued for the conviction of a certain Fazio, accused of robbing and murdering a rich farmer. One girl testified that she had seen Fazio sleeping near the murdered man; the next morning he hid as the gendarmes approached. No other evidence of his guilt was offered: 'Upon examination I found that this man had . . . a physiognomy approaching the criminal type. . . . In every way, then, biology furnished in this case indications which, joined with the other evidence, would have been enough to convict him in a country less tender toward criminals. Notwithstanding this he was acquitted (Lombroso, 1911, p. 437).'

As Macbeth (1971, p. 57) concluded, "When the first enthusiasm [of evolution] wore off and the bill

for the damages came in, the biologist realized that things had gone too far. There had been bad science as well as bad sociology, and they had to put their house in order." Unfortunately, it was too late for its many victims.

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In one way or another all the major texts of Victorian literature had grappled with this new deterministic naturalism. Struggling against a growing subversion of religious and spiritual authority, the work of Tennyson, Browning, Arnold, and the rest conveys an anguished struggle to hold on to ethical and social values which had formerly been securely grounded in revelation. Arnold's *Literature and Dogma* (1873) was an exemplary text in trying to salvage something of sacred writing—its ethical imperatives and aesthetic character—for an age of growing unbelief. But subsequent history made plain what the perceptive could already foresee: that the grounds for ethics had been eroded as religious orthodoxy shuddered under the destructive weight of deterministic naturalism. By 1929 in *The Modern Temper*, Joseph Wood Krutch acknowledged rather ruefully that the collapse of ethical certitude had been fully accomplished:

Historical criticism having destroyed what used to be called by people of learning and intelligence "Christian Evidences," and biology having shown how unlikely it is that man is the recipient of any transcendental knowledge, there remains no foundation in authority for ideas of right and wrong; and, if, on the other hand, we turn to the traditions of the human race anthropology is ready to prove that no consistent human tradition has ever existed.

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CORRELATION OF C-14 AGE WITH REAL TIME

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Abstract

A quantitative relationship is derived by which a C-14 age may be translated into a real-time equivalent that is consistent with the chronological data given in the Bible and also with C-14 age data for historic events. Two applications of this conversion formula are given that remove anomalies in the C-14 age estimates for the lifespan of a frozen musk ox carcass from Alaska, and dung accumulation rates in a Grand Canyon cave that served as a ground sloth den.

Introduction

The full spectrum of C-14 age data must be taken into account in the development of a model for Earth history that gives proper recognition to the data in the first chapters of Genesis. Appropriate use of biblical data and C-14 data in the development of such a model requires a quantitative conversion between C-14 age and real-time age. Noteworthy contributions to the need for this conversion have been made by Whitelaw (1970), Hefferlin (1972), and Hanson (1976). The following treatment develops an expression for radiocarbon age as a function of real-time in a mathematical equation that can be readily adjusted to meet the user's preferences concerning the real-time date for the Flood and the biosphere C-14 level at the time of the Flood.

The quantitative development presented here is limited to the period of Earth history following the refashioning of Earth's geography, climate, and ecosystems that resulted from the universal catastrophe described in the seventh and eighth chapters of Genesis (the Genesis Flood). There is no C-14 data on which to base a similar treatment for the pre-Flood era.

Mathematical Development

We can begin the quantitative development with Equation 1,

$$A = A_i[1 - (1-f) e^{-at}] \quad (1)$$

In which A represents C-14 activity, either as the ratio of C-14 to C-12, or as the number of C-14 spontaneous transformations per unit of time per unit mass of carbon. A_i represents the equilibrium value of A that would be reached after an infinite amount of time. The A without a subscript represents the activity t years after the Flood. The value of A immediately after, or during, the Flood, $t = 0$, is represented by fA_i . The exponential rate at which A changes after a disturbance from its equilibrium value is represented by a.

Equation 1 assumes that all factors influencing the level of C-14 in the biosphere after the Flood can be satisfactorily represented by a first-order exponential function. If this assumption is inadequate, and there was a fluctuation of A from a smooth simple exponential trend, there will be uncertainty in a real-time equivalent age based on Equation 1.

Variations in the exponential constant a of Equation 1 could result from variation in the rate at which CO_2 was taken out of the atmosphere by the reestablish-

ment of vegetation after the Flood. Other variables include the volatility of atmospheric CO_2 in the surface water of the ocean (CO_2 volatility increases with lower water temperature), the cosmic radiation level, and the geomagnetic field (a decrease in geomagnetic field allows more cosmic radiation to interact with the atmosphere and produce C-14). The constant a is an equilibration constant, not a nuclear decay constant. This can be illustrated by the changes in biosphere C-14 levels associated with nuclear weapon testing. By 1965 the atmosphere and fresh-growth C-14 levels in the Northern Hemisphere had increased 90% (nearly doubled) due to C-14 produced by nuclear explosions. After the testing of nuclear weapons in the atmosphere was discontinued, the excess C-14 level dropped exponentially, reaching 20% by 1986 (Kozak, et al., 1989).

Equation 1 is easier to use if time is measured backward from the present. Using T to represent time in years before present (BP), according to the radiocarbon age convention of zero time at AD 1950, and F to represent the date of the Flood in years BP, Equation 1 becomes

$$A = A_i[1 - (1-f) e^{-a(F-T)}] \quad (2)$$

Essential agreement of C-14 age with real-time historical age can readily be established as far back as the middle of the second millennium BC (3500 BP) [Libby, 1955]. Correlation beyond 4000 BP must be based on models that involve assumptions, due to lack of objects which can be precisely dated from historical records. To meet the requirement that A has been approximately equal to A_i (equilibrium of C-14 in the upper biosphere) over the past 3500 years, we can use a trial setting of $A = 0.95A_i$ at $T = 4000$, from which

$$\begin{aligned} a &= \{\ln[20(1-f)]\} / (F-4000) \\ &= [2.996 + \ln(1-f)] / (F-4000). \end{aligned}$$

With this expression for a Equation 2 becomes

$$A = A_i[1 - (1-f)e^{-\{2.996 + \ln(1-f)\}(F-T)/(F-4000)}] \quad (3)$$

Since we are not making observations at time T, but at the present ($T = 0$), we need an expression for the activity at zero BP, A_0 , of a specimen that had activity A at T years, BP. Over the time since T years ago the C-14 activity will decrease exponentially at the rate corresponding to the mean life of a C-14 atom. For simplification 8300 years can be used for the mean radiocarbon life (half-life 5730 years). Accordingly $A_0 = Ae^{-T/8300}$, with A given by Equation 3. Consequently

$$A_0 = A_i[1 - (1-f) e^{-\{2.996 + \ln(1-f)\}(F-T)/(F-4000)}] e^{-T/8300} \quad (4)$$

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The present activity A_0 is interpreted to indicate a C-14 age R by the relationship $A_0 = A_1 e^{-R/8300}$. With this expression for A_0 we can proceed from Equation 4 to a relationship between radiocarbon age R and real-time age T for specified values of F and f .

$$e^{-R/8300} = e^{-T/8300} \{1 - (1-f)e^{-[2.996 + \ln(1-f)](F-T)/(F-4000)}\}. \quad (5)$$

In my judgment the most suitable value for F is 5350. The reasons for this choice (Brown, 1990) are bolstered by the observation that amino acid racemization/epimerization rate constants for C-14 dated material are more consistent when computed with real-time age equivalents based on 5350 than on values a few hundred years less or greater (Brown and Webster, in press).

A value for f can be estimated from the evidence that fossils which are a consequence of the Flood (coal, e.g.) have C-14 ages in the 40,000 year range, and likely centering around 43,000 (Brown, 1988). Material deposited 5350 years ago and having a present C-14 age of 43,000 would have had an initial C-14 "age" of 43,000 minus 5350 (37,650 BP). The fraction of equilibrium activity represented by age 37,650 is 0.011. The range between 40 and 46 thousand years for a C-14 age placement of the Flood represents a range of 0.015-0.007 for f , so a suitable estimate for f would be 0.011 ± 0.004 . Neither the precision of C-14 age data nor the strictness of the relationship in Equation 5 justifies carrying the $\pm$ terms related to the uncertainty in f , so a working relationship from Equation 5 is

$$e^{-R/8300} = e^{-T/8300} \{1 - 0.989e^{-2.985(5350-T)/1350}\}. \quad (6)$$

The relationship of Equation 6 is easier to work with if ages are expressed in thousands of years, R_k and T_k ,

$$e^{-R_k/8.3} = e^{-T_k/8.3} \{1 - 0.989e^{-2.11(5.35-T_k)}\}. \quad (7)$$

A more convenient form of this relationship is obtained by taking the natural logarithm of Equation 7,

$$R_k = T_k + 8.3[\ln\{1 - 0.989e^{-2.11(5.35-T_k)}\}]^{-1} \quad (8)$$

Application

Values of C-14 age R for corresponding real-time age T , as calculated from Equation 8, are listed in Table I. A plot of these values is given in Figure 1. For a corresponding table and plot based on placement of the Flood at 5000 BP with negligible initial C-14 see Brown, 1990.

The buildup of C-14 in the biosphere from a level on the order of 1/100th the level that has been maintained closely over the past 3500 years probably did not proceed with monotonous uniformity. Some anomalies are to be expected in real-time ages derived from C-14 ages by use of a simple mathematical relationship such as given by Equation 8. Use of Equation 8 for C-14 ages greater than 34,000 is highly questionable. For C-14 ages in the range between zero and 30,000 C-14 years the associated real-time age probably may be significantly placed within a range of less than ± 100 years.

A test of the Equation 8 relationship can be made with C-14 data for a musk ox carcass frozen in Alaskan muck (Stuckenrath and Mielke, 1970). The C-14 ages of scalp muscle tissue and hair are $24,140 \pm 2200$ and $17,210 \pm 500$, respectively. The difference between

Table I. Tabulation of Representative Real-time Ages, T , versus Associated Radiocarbon Age, R , in years.

T	R	T	R	T	R
0	0	3800	4070	5000	10,060
1000	1000	3900	4240	5050	10,960
2000	2000	4000	4430	5100	12,090
2500	2510	4100	4630	5150	13,530
3000	3050	4200	4870	5200	15,470
3100	3160	4300	5150	5250	18,320
3200	3270	4400	5470	5300	23,290
3300	3390	4500	5860	5310	24,880
3400	3510	4600	6330	5320	26,880
3500	3640	4700	6920	5330	29,590
3600	3770	4800	7680	5340	33,750
3700	3920	4900	8680	5350	42,780

the age of hair and the age of underlying tissue should be a minimum value for the life span of the supporting animal. The conversions given by Equation 8 place this difference approximately in the 48-92 year range. A fully satisfactory determination of life span would require better than 0.2% precision in the real-time age equivalents. Such precision is beyond the capabilities of C-14 age determination techniques, and less than the confidence range for a conversion with Equation 8.

Another test can be made with data for the ground sloth dung deposit in Rampart Cave (Long and Martin, 1974). Approximately 39,000 dung pellets accumulated in the main area of this cave between 40 and 20 thousand C-14 years BP. An average of 1.9 pellets per year (39,000 divided by 20,000 C-14 years) is unrealistic for a viable population of sloths in the vicinity of the cave. Converting 40,000 and 20,000 to 5348 and 5271 years real-time gives a 77 year interval and about 1.4 dung pellets per day. The upper 50 cm of cave floor deposit accumulated between 12,000 and 10,800 C-14 years BP, and represents about 215 pellets per C-14 year in the main area of the cave. Conversion to real-time equivalents yields 13 pellets per day over a real time interval of 54 years. [These comparisons should be taken in place of the incorrect treatment I gave at the First International Conference on Creationism (Brown, 1986; specifically page 48, paragraph 3).]

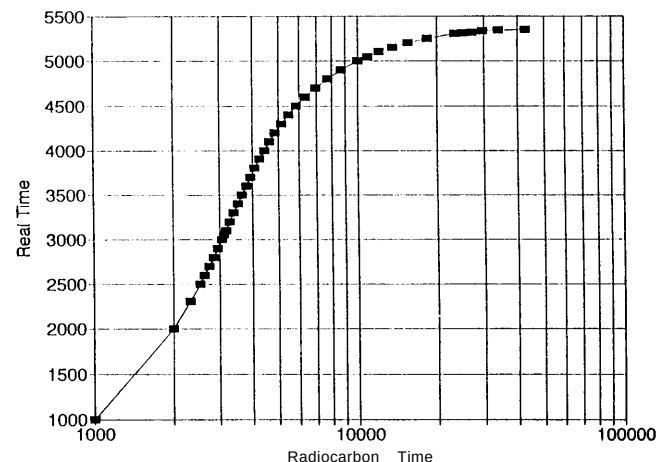


Figure 1. Plot of real-time (T) vs. radiocarbon time (R) from data in Table I.

Conclusion

There appears to be a sound basis for quantitative correlation of C-14 ages over the range between zero and the vicinity of 35,000 years BP with real time ages that are in conformity with biblical guidelines. It is the hope of the author that the treatment in this paper will increase the effectiveness with which C-14 measurements may be used in scientific research, as well as contribute to confidence in the biblical chronological data.

Acknowledgments

Appreciation is due Clyde L. Webster, Jr., for the many contributions he has made in conversations throughout the development of the correlation concepts presented in this paper, and for technical assistance in manuscript preparation. I am also grateful for the suggestions made by unnamed manuscript reviewers.

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CRSQ—*Creation Research Society Quarterly*.

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BOOK REVIEWS

Darwin On Trial by Phillip E. Johnson. 1991. Regnery Gateway. Washington, DC, 195 pages. \$19.95.

Reviewed by Wilbert Rusch, Sr.*

This latest critique of Darwinism is written by Phillip E. Johnson, a law professor at Berkeley.** He underlines what every reader of the works of Darwinism proponents usually encounters, namely, that they accept Darwinism as fact and then seek evidence to support it. I have always found this type of approach to be irritating and unscholarly. Such writers usually fail to heed the admonition of one of their mentors, Thomas H. Huxley, when he said:

. . . there is not a single belief that it is not a bounden (sic) duty with them to hold with a light hand and to part with cheerfully, the moment it is really proved contrary to any fact, great or small (Huxley, p. 469).

In this work, Professor Johnson combines a broad knowledge of biology with the incisive logic of a leading legal scholar to underline the validity of Huxley's admonition. Michael Denton refers to *Darwin On Trial* as "the best critique of Darwinism he has ever seen." He then adds "there is no doubt that this book will prove a severe embarrassment to the Darwinian establishment" (back cover).

Johnson discusses in turn the following topics;

- The Legal Setting
- Natural Selection
- Both Micro- and Macromutations
- The Fossil Problem
- The Vertebrate Sequence
- The Molecular Evidence
- Pre-biological Evolution
- The Rules of Science
- Darwinist Religion
- Darwinist Education
- Science and Pseudoscience
- Research Notes

I found the last section particularly useful. It served as an excellent study guide to the sources used in the production of this work.

In his concluding chapter, "Science and Pseudoscience," Johnson makes the point:

that if the purpose of Darwinism is to persuade the public to believe that there is no purposeful intelligence that transcends the natural world, then this purpose implies two important limitations upon scientific inquiry.

First, scientists may not consider all the possibilities, but must restrict themselves to those which

are consistent with a strict philosophical naturalism. Secondly, scientists may not falsify an element of Darwinism, such as the creative power of natural selection, until and unless they can provide an acceptable substitute. This rule is necessary because advocates of naturalism must at all times have a complete theory at their disposal to prevent any rival philosophy from establishing a foothold" (p. 154).

I have long noted this characteristic in many evolutionist writings.

I appreciated that Johnson was ready to discuss Dawkins' *The Blind Watchmaker* (1985) as well as Edey and Johanson's *Blueprints: Solving the Mystery of Evolution* (1989). Further, he also contends with the works of both S. J. Gould and Douglas Futuyma. Creationists would be interested in his answers to these works.

In general, *Darwin On Trial* is scholarly and well-written. I can heartily recommend its purchase by those interested in the creation approach to the matter of origins. It will serve as a valuable reference work for individuals who propose to write or speak on the subject of origins. I recommend Johnson's work as a valuable and necessary addition to the library of any Christian college. It also has its place in the library of the concerned pastor.

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A Scientific Approach to Christianity by Robert W. Faid. 1991. New Leaf Press, P.O. Box 311, Green Forest, AR 72638. 196 pages \$15.

Reviewed by Clifford L. Lillo*

The book jacket describes the author as a nuclear scientist and consultant to the nuclear power industry and claims:

Science proves these amazing facts:

Jesus was a historical person.

There is actual evidence for the Resurrection.

The Bible was dictated by the Holy Spirit and contains mathematical proof of this.

There is an afterlife, a heaven, a hell, and coming judgment.

Scientific evidence refutes the theory of evolution. However, a look within the covers reveals that Faid falls woefully short of such grandiose proofs. The author has used no footnotes but does quote from the

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**Another review of this book may be seen in *CRSQ* 28:171.

Bible and a few other texts, such as *The Origin of Species*, Encyclopedias and *Theomatics* (Lucas and Washburn, 1977), a book stressing statistical probabilities.

Faid claims that the Bible was written mathematically in both Hebrew and Greek (p. 69). In extolling the virtues of *Theomatics*, Faid selects certain words and verses and tells their mathematical equivalence. He then says,

In order for God to have placed this interlocking network of theomatic designs all through the Bible, He had to have directed the development of both of these languages.

. . . For these designs to appear from Genesis through Revelation the only logical conclusion is that God did not just inspire the writing of the whole Bible, *He has dictated it word for word* (emphasis is Faid's) [p. 76].

Faid's beliefs are, in some respects, similar to those of creationists. He points out flaws in the Big Bang theory (p. 95). He believes in a Creator, "For all of creation, there must be a Creator" (p. 119). And he believes that evolution is an unfounded theory, "Not one shred of hard evidence has come to light to prove that any single member of any genus has evolved from or into another genus" (p. 118). But, he departs from the beliefs of members of the Creation Research Society when he claims,

. . . some theologians barge into the realm of science. . . . Scientists explain that the earth is about five billion years old. The theologian insists that the total time required for all creation to be accomplished is six of our present days. . . . There is no actual argument between what the Bible says and the facts collected by scientists. It is only between theologians and scientists that a disagreement exists (pp. 88-89).

Another area of disagreement Faid has with the CRS is his concept of what happened on the first day of creation. After quoting Genesis 1:3, he says that God created the sun on the first day. He then quotes Genesis 1:19 and states,

At first reading, it seems that there is a duplication of events on different "days," such as God seemingly making the sun again on the fourth day when He had already created the sun on the first day. . . . when the text is translated to say "God created," the meaning intended in the context in which it was written should read, "God began to create" (p. 91).

Although Faid's bibliography on the last page includes two books by Henry M. Morris, *Science, Scripture and Salvation*, and *The Bible and Modern Science*, it is quite obvious that he does not endorse the views of Dr. Morris. Faid has taken a fence-straddling position that will please neither evolutionists nor creationists.

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Lucas, Jerry, and Del Washburn. 1977. *Theomatics*. Stein and Day. New York.

Catastrophic Episodes in Earth History by Clyde C. Albritton, Jr. 1989. Chapman and Hall. London. 221 pages. \$13.95.

Reviewed by Danny R. Faulkner*

This book is the second of a series on "Topics in the Earth Sciences" edited by T. H. van Andel and Peter J. Smith. Its title should pique the interest of special creationists and other catastrophists, especially with regard to identifying new sources and ideas. The prime purpose of the book seems to be a review of mechanisms for dinosaur extinction offered over the past decade. The volume is well documented, which should be of help for anyone who is researching sources on these topics.

The first third of the text recounts the development of modern geologic theory from the seventeenth century to the present. This is shown to be a gradual movement from biblical catastrophism toward uniformitarianism. Even while the process was being completed in this century, it was increasingly recognized that meteor impacts could play a role in geology. This neocatastrophism is developed with two chapters devoted to the discussion of known impact craters on earth and their possible effect on organisms.

Next, hypothesized periodic mass extinctions are discussed, especially in light of the suggestion made in 1980 of a large impact being the cause of the extinctions at the end of the Cretaceous Period. This so-called Alvarez hypothesis, named for two of the original authors, is based upon a spike of rare earth abundances, as indicated by iridium, at the K-T boundary. The last four chapters of the book critically discuss the Alvarez hypothesis. Quite a bit of information is given here, both for and against the impact idea. Given the coverage in the press, many would be surprised to find that the Alvarez hypothesis lacks a great deal of support in the scientific community. The American news media have given largely favorable coverage to studies supporting it, but largely ignoring opposing papers.** Being in this country, it is difficult to appreciate the fact that it has not been well received outside the United States. The author attributes its popular acceptance here to widespread fascination with dinosaurs, which he calls "dinosaurmania."

Given the limited scope of catastrophism discussed in this book, it is not a key source of ideas for creationists as the title would suggest. Its primary use would be a good review of the Alvarez hypothesis containing numerous original references on the topic.

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**Editor's Note: The American media's propensity toward presenting sensationalism and propaganda rather than any balanced approach to a subject may be at fault.

Those Mysterious Dinosaurs by Norma Whitcomb. 1991. Whitcomb Ministries, Inc., P.O. Box 277, Wiona Lake, IN 46590. 115 pages. \$10.95 paperback.

Reviewed by Don B. DeYoung*

Any book with the word *Dinosaur* in the title sells well, and this will be no exception, Norma is the wife of John C. Whitcomb, well known Bible-science lecturer and co-author of *The Genesis Flood*. Norma is

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also an excellent speaker, especially to children and ladies groups, and this book is one result of her efforts. The subtitle describes the work as "a biblical approach [to dinosaurs] for children, their parents and their teachers."

The book gives a straightforward creationist description of dinosaurs: types, chronology, diet, and extinction. Regarding this last point, the author suggests a combination of Post-Flood events: disease, increased

solar radiation, climate change, and hunting by man (p.99). The text is laid out in an appealing manner, with many clear line drawings and a spiral binding. Pronunciation is provided for dinosaur names, of special benefit to children. The gospel is also presented in a clear way. This is expected from a writer who spent 11 years as a missionary in the Philippines, and still carries on multiple ministries today. May this book continue her efforts to serve the Lord.

LETTERS TO THE EDITOR

Quarterly Astronomy Bibliography

Recently I collected an extensive bibliography of articles, notes, book reviews and letters to the editor on subjects in astronomy in past Quarterlies for a reader. I thought that possibly others might be interested in pursuing a given topic through back Quarterlies. Many of the citations are notes by the very productive former editor of the Quarterly, the late Harold Armstrong. His interest and insight enabled him to write on scores of subjects in astronomy.

I make no claim on the completeness of the list. If you have some references you would like to have included, please send the citations to me and I will add them to these and publish a more complete creationist bibliography at a later date.

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An Expanding Earth?

John Baumgardner (1990) raises the need for the abandoning, during Noah's flood, of time invariance in order to account for the rapid plate movements and subsequent rapid cooling of large volumes of lithosphere. While he may be correct, there are several points to be considered in any analysis of these ideas.

1. The primary assumption is that the driving force of plate movements both now and in Noah's time is buoyancy acting on the plates themselves. However, an alternative model for plate movements is the expansion of the earth from an original diameter of about 80 percent of the current size. King (1983) discusses this in detail, accounting for all known plate movements. The major argument in favor of this view is that the continents fit together better on such a reduced globe than the present size. Plate movement then becomes vertical, not horizontal, and while there is still need for ocean floor to be generated, it lowered as the continents rose.

2. Could the resulting heat in Baumgardner's view be dissipated in energy of movement? That is, could the expansion be driven by heat?

3. The albedo of a larger, more watery earth would be different from that of a smaller earth with a vapor canopy. The earth shows signs of a continued drying over the last 1500 years at least. Are we losing more energy than we receive because of the change in albedo? Could the albedo change account for the Ice Age?

4. A smaller earth would hold a heavy canopy of water vapor closer to the center of the earth than currently possible. This would increase the atmospheric pressure, as alluded to by McLeod (1991). McLeod also thinks that the oxygen content of the early atmosphere was higher than at present. Expansion of the earth may have caused disruption of the canopy by angular momentum changes and increased pressure from below. As the atmosphere was displaced outward, some would have been lost to space. Add to this the volcanic degassing from continental disruption and plate collision and it is likely that our atmosphere will be markedly different from the original.

5. The angular momentum of a smaller earth would shorten the length of day and night and increase the number of days in the year, as well as changing the tides by its effect on the moon-earth system.

6. The enlargement of the oceans is more easily explained by an expanding earth than the collapse of large water-filled chambers. The "fountains of the deep" could be the upsurging crust and continents, rather than outpouring water. This could enable some estimate of the water content of the canopy.

7. The greater concentration of mass in a smaller earth may have implications for the magnetism of the earth. King reiterates the magnetic anomalies along the mid-ocean ridges as not necessarily implying sea floor spreading, but arising from vertical movement.

8. The separation of the continents on an expanding earth might explain the wobble in the angle of rotation of the earth.

Many of these ideas are quantifiable since the atmospheric and plate tectonic implications alluded to affect the epidemiology of goitre and related diseases, now called collectively iodine deficiency disorders (IDD).

It is clear that the current understanding of iodine distribution across the world is inadequate. Iodine is supplied to soil and water and then to us through rainfall. The centers of continents are often dry but the low rainfall is still adequate to account for the soil and water concentrations of iodine found. However, many areas are classified as iodine deficient simply because of the occurrence of IDD. While *local* depression of iodine in water and soil can correlate with a *local* increase in IDD prevalence, a global picture has never been presented. Anomalies exist, giving rise to two questions: Why does environmental iodine deficiency exist? The prefall world would not have suffered from iodine deficiency, so what climatic changes occurred to bring about the maldistribution of iodine?

It is likely that globally there are other factors involved which interact with low iodine. I have suggested that plate collisions provide the source of these goitrogens (Steward, 1990), and also explain the worldwide distribution of IDD better than other ideas (Stewart, 1991). Do the creation and evolution models differ in how they may affect the type or emplacement of the goitrogens postulated? Since I am currently trying to identify these goitrogens, it may be possible to make predictions, based on the two models.

Many variables need to be factored into the creation-Flood model more clearly. But whether time invariance needs to be violated or not remains an open question.

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Creationist Astronomy

May I suggest two principles to guide the discussion of astronomy (Faulkner and DeYoung, 1992). First, we must have a respect for the observations. Too often I hear creationists attempt to merely explain things away rather than take a hard, serious look at what the observations are saying. It seems that no matter what secular astronomers suggest, creationists are "against it." But astronomers are not usually out to disprove creation; many discoveries are made by accident, or are contrary to expectations. Creationists need to deal honestly with the Hertzsprung-Russell diagram, interacting galaxies, supernova remnants, and other phenomena without force-fitting them into preconceived interpretations of Scripture.

Second, we must have a respect for the limitations of science. Astronomy is particularly vulnerable to a priori assumptions. For example, the cosmic distance scale is highly reliable for the solar system, but more and more subject to interpretation at cosmological dis-

tance, depending on one's opinion on the source of quasar redshifts or the Hubble parameter. Much of the time in astronomy and especially in cosmology, theory is the engine and observation the caboose.

Honest secular astronomers admit this. Geoffrey Burbidge's editorial in *Scientific American* (1992) was a reprimand to the majority of cosmologists, who maintain the Big Bang theory despite serious difficulties, and censor opponents. Yet is his own alternative any less a paradigm? There's a lot of politicking in science, and what is in vogue today may be passe tomorrow. We cannot base creationist astronomy on the shifting sands of current thinking; the best theory is not ipso facto a good theory. Perhaps before anything else, we need to discuss the question "when is an observation really an observation, and not an interpretation?"

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Micrometeoroids

In a recent exchange in the Quarterly (Kuban, 1991; DeYoung, 1991; Parks, 1991; Williams, 1991), the subject of micrometeoroid bombardment in the solar system was discussed. Readers may be interested in two other Quarterly articles on the same subject (Samec, 1975; Steveson, 1975) that appeared in the June 1975 issue (volume 12, number 1). The theme of this issue was the young earth and universe and many of the articles have continuing application to the creation model of science.

References

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Kuban, G. J. 1991. Moon dust. *CRSQ* 28:74-75.
Parks, W. S. 1991. Response to Kuban. *CRSQ* 28:75-76.
Samec, R. G. 1975. Effect of radiation pressure on micrometeoroids and evidence for a young solar system. *CRSQ* 12:7-10.
Steveson, P. A. 1975. Meteoritic evidence for a young earth. *CRSQ* 12:23-25.
Williams, E. L. 1991. Meteoritic activity and working hypotheses. *CRSQ* 28:76-77.

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I presuppose the Principles.

For our purpose, the metaphysical Principles with which we have filled in the world, and which many of us now acknowledge, are on the general order of the following:

Substances, which underlie certain phenomenal fields in order to support them and keep them from falling apart;

Causes, which permit the disparate items of a natural sequence to touch and affect each other;

Hypothetical Forms, which are assumed for objects of such magnitude as to be too great or too small for the senses to grasp—like the microcosm which Bohr assumed for the infra-sensible atom, and has now recalled;

Souls, minds, or selves, to which the conscious states are referred for the sake of constancy and permanence;

Ideas or Universals, as Forms endowed with the power and the will to create or reproduce their likenesses;

Individuals, as the cores of privateness or uniqueness in objects that we sense as exceeding their own recorded history;

An intelligence, behind the whole of the phenomenal universe to give it unity and stability.

The list is neither systematic nor complete.

Ransom, John Crowe. 1965. *God Without Thunder*. Archon Books. Hamden, CT. pp. 81-82.

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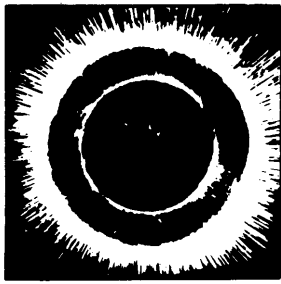
QUOTE

The effect of the Mechanist world view was felt first in the field of religion. Now, just as a clock runs by itself after someone winds it, so God had performed his only conceivable function when he wound up the world machine, after which he was bowed off the world stage. This was the outlook of 18th century Deism.

God's dismissal looked at first like mankind's gain; it meant that mankind had come of age! But if you retire God, the Spiritual Being, on the ground that only the material is real, it finally occurs to someone to hang a question mark on the non-material part of our own being—is the human mind real? Not unless it can be weighed and measured. What about thinking? Thinking was reduced to brain matter in motion, a mechanical response to an external stimulus, a matter of physiology merely.

Opitz, Edmund A. 1978. The uses of reason in religion. *Imprimis* 7(2):4. Hillsdale College, Hillsdale, MI.

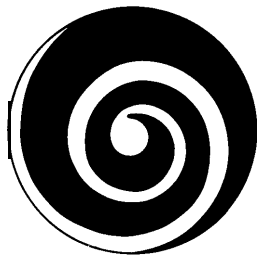
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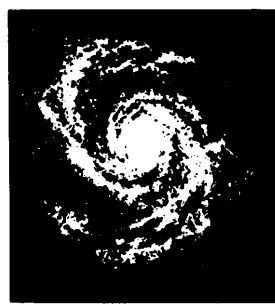
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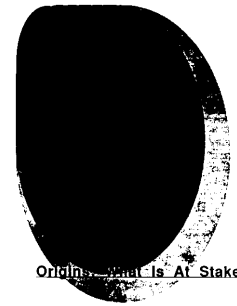
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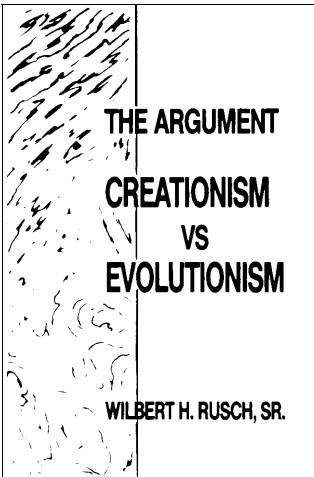
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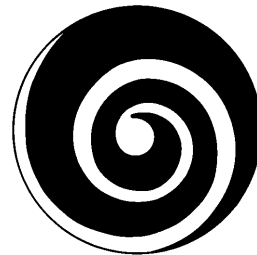
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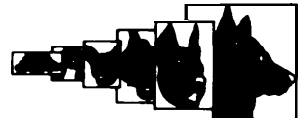
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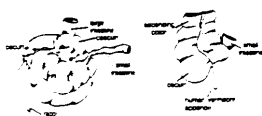
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