

Creation Research Society Quarterly

Haec credimus:

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

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THE CASE FOR THE CALAVERAS SKULL — P. 248

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Front Cover Illustration

This is the earliest known picture of the Calaveras Skull taken before all the original matrix surrounding the Skull was removed. The Calaveras Skull was found in 1866 at Bald Hill near Angels Camp in Calaveras County, Calif. The original photo dates from sometime between 1866 and 1868 when the Skull was transported to Cambridge, Mass., and there thoroughly cleaned and examined scientifically. (From a photo in the University of California library.) For article by Edward Lain and Robert Gentet, see p. 248.

Back Cover Illustration

Back view of Zuiyo-maru carcass. Photograph by Michihiko Yano. See pp. 292-295 for article by Todd Wood.

Instructions to authors are in the September 1996 issue.

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CREATION RESEARCH SOCIETY

History The Creation Research Society was 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 The Van Andel Creation Research Center in Chino Valley, Arizona.

Membership Voting membership is limited to scientists having at least an earned graduate degree in a natural or applied science. Dues are \$22.00 (\$27.00 foreign) per year and may be sent to Glen W. Wolfrom, Membership Secretary, P.O. Box 8263, St. Joseph, MO 64508-8263. Sustaining membership for those who do not meet the criteria for voting membership, and yet who subscribe to the statement of belief, is available at \$22.00 (\$27.00 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 or one year: \$25.00 (\$30.00 foreign).

Statement of Belief Members of the Creation Research Society, which include research scientists representing various fields of successful scientific accomplishment, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution), both of the universe and the earth with its complexity of living forms. We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. 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.

Editor's Remarks

The present issue of the Quarterly has some interesting analyses for various aspects of the rapidly developing young-earth Flood model. Geologist Dr. John Reed offers part III of his series on the philosophical basis of creation-oriented geology. Dr. Reed points out that the study of origins overlaps various fields of study and no one discipline should monopolize the discussion. In this part of the series, he examines the constraints that different fields of study would require for the systematic interpretation of geologic strata. Dr. Steve Deckard examines similar questions, exposing how a person's worldview may color their interpretations of science, giving examples of historical personalities.

The CRS Treasurer, Robert E. Gentet, and his colleague Edward C. Lain present evidence that a skull found in the 1800's was a modern human found in what should have been pre-human times; a great embarrassment for evolutionism.

D. Ashley Robinson presents a study of mitochondrial DNA of turtles in his interesting study of taxonomy and the Genesis kinds. This work is based on

cutting-edge techniques, and we hope that it will stimulate many more studies of the same nature. Some similar taxonomy papers by various authors are already involved in the peer review process.

Other short features, book reviews, letters, and photo essays complement this issue, and we hope that they will clarify various aspects of the creation viewpoint and expose the failures of evolutionism. We also trust that the readers and the authors will redouble their efforts to promote this magazine—encourage other persons and institutions to subscribe. We believe that many present-day problems of society can be traced to a failure of academia to fairly treat the origins subject, and promotion of the *Creation Research Society Quarterly* will help to alleviate this problem.

With great sadness we also note that the Associate Editor for Biology, Dr. Richard Lumsden, passed away January 12 from double pneumonia. We are planning a feature honoring Dr. Lumsden for the next issue.

Please send all biology manuscripts to me.

Eugene F. Chaffin

Quote

Psalms 65

5 You answer us with awesome deeds of righteousness, O God our Savior; the hope of all the ends of the earth and of the farthest seas,

6 Who formed the mountains by your power; having armed yourself with strength,

7 Who stilled the roaring of the seas, the roaring of their waves, and the turmoil of the nations.

8 Those living far away fear your wonders; where morning dawns and evening fades you call forth songs of joy.

9 You care for the land and water it; you enrich it abundantly. The streams of God are filled with water: to provide the people with grain, for so you have ordained it.

10 You drench its furrows and level its ridges; you soften it with showers and bless its crops.

11 You crown the year with your bounty, and your carts overflow with abundance.

12 The grasslands of the desert overflow; the hills are filled with gladness.

13 The meadows are covered with flocks and the valleys are mantled with grain; they shout for joy and sing.

Holy Bible, New International Version, NIV publishers.



Small scale and large scale joint sets in Warren Point Sandstone member of the Gizzard Formation along crest of Lookout Mountain, GA. The joints give the appearance of a "patterned ground" to the sandstone. Stresses operating as a result of the folding and uplift of the adjacent Appalachian Mountains resulted in the formation of these stress related surface features. These stresses would appear to suggest that the sandstone was lithified and then subject to tectonic folding and faulting. This would either require deep burial or only partial lithification, of which the latter better fits with the young-earth Flood model (Lower to Middle Flood Event Timeframe). Photo and caption by Carl R. Froede Jr.

LETTERS TO THE EDITOR

Large-Scale Ripple Marks in The Lower Cretaceous Rocks of Texas

Introduction

Uniformitarians propose that during much of the Mesozoic a broad epeiric seaway covered most of the central portion of the North American continent. This seaway extended from Alaska across to Canada and down to the Gulf of Mexico (Williams and Howe, 1993, Figure 3). However, Froede (1995) suggested that this epeiric seaway was actually Floodwaters receding from the North American continent. Water movement within this seaway would form a variety of current ripple marks on some of the unconsolidated sediments on the seaway floor.

Large-Scale Ripple Marks in the Fredericksburg Group Strata

The occurrence of large-scale ripple marks with crests as much as five feet apart in strata dated to the middle Comanchean/Lower Cretaceous were originally investigated by Scott (1930, p. 53). These sedimentary structures were located in several counties west of Fort Worth, Texas. He noted:

They (ripple marks) have been examined in a large number of localities, and in all places the direction of their crests is northeast-southwest, or in a direction approximately parallel to the old Cretaceous shoreline [Scott, 1930, p. 53] (parenthesis ours).

Although the large-scale ripple marks across this area trended in the same direction there were differences noted in the spacing and heights of the crests. This variation would be expected based on the differences in water depth and energy levels as the water flowed across the sediments at the time these sedimentary features formed. Shells and shell hash were also noted in the troughs of many ripples. These fossils were suggested to have been derived from the ripple marked sands by winnowing (Scott, 1930, p. 56).

Scott (1930, p. 56) postulated:

It is possible to imagine that in Texas during the Goodland time there was a broad, but relatively shallow sea where friction on the bottom might have caused an abnormal development of waves, particularly during storms.

Preservation of Ripple Marks

Scott did not explain the preservation of the ripple marks. He concluded his report with an observation that many other ripple marks are found in strata across the eastern United States. The preservation of these sedimentary features is interesting in that in most cases

these features were noted close to the ground surface. Obviously, the preservation of these large-scale ripples required rapid burial by additional sediments.

We would suggest that several hundred feet of strata once covered this area and has been eroded away exposing these current ripple marks at or near the surface. What eroded away this material and when did it happen? We would suggest that these sedimentary layers were removed during the latter portions of the Flood—with the receding of the Floodwaters from the North American continent (see Oard, 1996, p. 262).

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Dauphin Island, Alabama: Radiocarbon Dating and Questions About Age

It is commonly proposed that the age dating of plant materials using radiocarbon techniques supports the uniformitarian interpretation of Earth history. However, when the resulting dates fall outside the accepted range, already estimated by the geologist working in the field, they are rejected as contaminated. This occurs if the age is either too young or old. Hence, the "science" of radiocarbon dating and its associated techniques are almost always subject to revision. Such has recently been the case for the radiocarbon dates of tree stumps found in the surf zone along various sections of Dauphin Island, Alabama.

I reported on the existence of a number of tree stumps presently found in the surf zone along the southern (Gulf of Mexico) side of Dauphin Island (Froede, 1995a). These stumps directly correspond to a former paleo-maritime forest that grew within this area. Unpublished, but commonly cited, age dates for these trees is based on similar tree stumps found in the surf zone on the adjacent beaches in Mississippi. Tree stumps exposed within the surf zone along various

portions of the Mississippi Gulf Coast had previously been radiocarbon dated to Late Pleistocene and this is believed to place them within another older sea-level cycle (Foxworth, Priddy, Johnson, and Moore, 1962). These dates were later reinforced by the investigations of Otvos (1979) along both the Alabama and Mississippi Gulf Coasts. He conducted an extensive well-drilling program in an attempt to understand the geologic and stratigraphic history of this area. He also conducted radiocarbon dating of shallowly buried woody materials and humus to understand when these deposits were formed. While most of his age dates for the surficial woody materials were within the age range of Holocene to recent, he suggested that this "younger" woody material had been contaminated by ground-water and other (unnamed) things because directly beneath this shallowly buried material were underlying sedimentary and peat deposits which dated to the much older Pleistocene, i.e., >40,000 years before present (Otvos, 1979, p. 297). Because he believed that contamination was a problem, he then suggested that the "younger" materials (i.e., wood, paleosols, and sediments) all dated to the Pleistocene too (Otvos, 1979, p. 297). The few studies of this area that have occurred subsequent to this time have only served to reinforce the Pleistocene dates for the paleosols and tree stumps found within the surf zone at Dauphin Island, Alabama.

Recently the Pleistocene age issue for the tree stumps found within the surf zone at Dauphin Island has again been called into question. In June of 1996, the Alabama Geological Society conducted a portion of their annual field trip to the Dauphin Island area. As part of this trip the issue of the age of the paleo-maritime forest within the surf zone was a point of focus for the group. New radiocarbon dating of the tree stumps found within the surf zone was conducted as part of this field trip and the age of the wood was estimated to be 235 ± 80 years before present (English and Haywick, 1996, p. A-10). Hence, what were once Pleistocene ages for these tree stumps become very recent ages—ones which Otvos and others had previously rejected. Rather, these more recent dates support what the field trip leaders suggested as reflecting rapid erosion of the island.

Previously, I had suggested that although I had no means to date the tree stumps I did not believe them to be more than 200 years old (Froede, 1995, p. 148). Additionally, I suggested that the island is continuing to erode at an alarming rate (Froede, 1995, p. 146). It is satisfying to have uniformitarian confirmation of my present research. I share this with CRSQ readers in an attempt to show that we too can conduct successful research apart from a university setting. Let us get out there, look at the earth, and interpret it within the Young-Earth Flood Model! (Froede, 1995b).

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 Foxworth, R. D., R. R. Priddy, W. B. Johnson, and W. S. Moore. 1962. Heavy minerals of sand from recent beaches of the Gulf Coast of Mississippi and associated islands. *Mississippi Geological Survey Bulletin* 93. University, Mississippi.
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Precambrian Pollen—A Response Editorial Comment and Introduction

Recently a message critical of CRS-sponsored research was forwarded to the CRSnet. The work in question had to do with a finding of pollen grains in Precambrian rocks from the Grand Canyon. The author of the message refused to grant permission to publish his letter in the *Creation Research Society Quarterly*. Dr. Emmett Williams, the CRS president, prepared a response to the message, which is printed below. Due to the refusal of the author of the attack to allow his name to be used, he is referred to as "A" in Dr. Williams's response. According to conventional science, vascular land plants did not exist during the Precambrian. Hence, A took issue with whether there was contamination of the rock, the Hakatai shale, with modern day pollen. The original research was done by the late Clifford Burdick, but it was followed subsequently by more detailed studies by Emmett Williams, Walter Lammerts, George Howe, George Matzko and others. A mentioned some work by Arthur V. Chadwick, which initially gave negative results. Since the CRS sponsored research produced positive results, A accused the CRS of using sloppy technique, and also of being unwilling to publish Dr. Chadwick's research, which was instead published in *Origins*, a creationist publication based at Loma Linda University. A went on to criticize a tract by D. Russell Humphreys called "Evidence for a Young World" published by *Answers in Genesis*. Below is Dr. Williams's reply.

Recently a message was posted on CRSnet which took issue with the various field and laboratory efforts of the Society in isolating fossil material from Hakatai shale in Grand Canyon National Park. The post contains misrepresentations and outright falsehoods. Apparently,

from the abysmal ignorance shown in the post, the author has not studied the original papers!

The work on Hakatai shale is contained in the following Quarterly reports and letters.

1. Burdick, C. L. 1966. Microflora of the Grand Canyon. *CRSQ* 3:38-50.
2. Burdick, C. L. 1972. Progress report on Grand Canyon palynology. *CRSQ* 9:25-30.
3. Burdick, C. L. 1982. Reply to Rusch. *CRSQ* 19:144.
4. Chadwick, A. V., P. DeBord and H. Fisk. 1973. Grand Canyon palynology—a reply. *CRSQ* 9:238.
5. Howe, G. F., E. L. Williams, G. T. Matzko and W. E. Lammerts. 1986. Pollen research update. *CRSQ* 22:181-182.
6. Howe, G. F. 1986. Creation Research Society Studies on Precambrian pollen. *CRSQ* 23:99-104.
7. Lammerts, W. E. and G. F. Howe. 1987. Creation Research Society studies on Precambrian pollen—Part II: Experiments on atmospheric pollen contamination of microscope slides. *CRSQ* 23:151-153.
8. Howe, G. F., E. L. Williams, G. T. Matzko and W. E. Lammerts. 1988. Creation Research Society studies on Precambrian pollen, Part III: A pollen analysis of Hakatai shale and other Grand Canyon rocks. *CRSQ* 24:173-182.

Also another paper on the palynology of the Hakatai shale (HS) that was often referenced and discussed in the 1986-1988 CRS reports was:

9. Chadwick, A. V. 1981. Precambrian pollen in the Grand Canyon—a reexamination. *Origins* 8(1):7-12.

Individual comments by this anonymous author (A) will be examined and discussed.

A claimed that Burdick (Ref. 1) employed scanning electron microscopy in examining pollen from HS. This is not true. Burdick used optical microscopy.

A noted that. “The pollen isolated was pine, juniper, and Mormon tea.” He failed to mention that fungal structures, plant stems and lycopods were also detected (Ref. 1, p. 45).

Later A stated that Burdick took no precautions against contamination. This is another falsehood. Burdick took precautions against contamination (Ref. 3). Then A said, “The work of Howe et al. (Refs. 5 and 8) was interesting in that they didn’t guard against contamination as much as Chadwick (Ref. 9) did.” [parenthesis ours] Earlier A mentioned that Chadwick “. . . washed the samples in filtered water, trimmed the samples to remove the exterior surfaces and took care to analyze his samples in a clean and sterile lab. Guess what? No pollen?

A failed to mention that in an earlier investigation Chadwick, DeBord and Fisk (Ref. 4) found fossil material in HS. When Howe et al. processed the HS samples, they trimmed them to remove the exterior surfaces. Then samples were cleaned in Varsol and non-ionic

detergent and later cleaned in distilled water within an ultrasonic bath in clean laboratories with filtered air supplies. All containers were carefully cleaned with distilled water and soap, acetone, etc. where necessary. Matzko has a Ph.D. in analytical chemistry and Williams worked in a scanning electron microscopy (SEM) laboratory. We understand and practiced careful laboratory techniques. One does not perform SEM work without keeping the laboratory clean and samples contamination free, for any foreign material on SEM samples is readily apparent upon examination in the microscope.

The processing of samples was done according to Doherty (1980) except that in some cases, the sample dissolution step using HF was unnecessary. Chadwick (1981) employed the Doherty (1980) technique including the final step of placing the samples in an HF solution. Actually, we used the entire Doherty/Chadwick method (with time in HF solutions) on two HS samples and obtained positive results in one instance!

Before undertaking the laboratory work, we discussed the sample dissolution procedures with several palynologists and analytical chemists. They warned that if the fossil pollen was silicified within the shale matrix, excessive time in HF solutions would destroy the grains. Many of the samples were completely dissolved in the HCl solution rendering the HF dissolution step unnecessary. The HF dissolution was only to be employed if the rock had not been completely dissolved in the HCl solution.

We repeat, lengthy exposures to HF can destroy fossil pollen incorporated in the shale matrix without affecting any possible contaminating modern pollen. We demonstrated that HF exposure would not destroy modern (contaminating) pollen. Fresh oak and pine pollen were placed in 48% HF solutions for periods of 64-70 hours. The pollen grains were still present after these exposures (Ref. 8, Figures 43-46).

Likewise, the samples were collected in the field in February on a bitterly cold day to avoid the pollinating season of native plants if possible. The collection technique was described (Ref. 8, p. 173) illustrating the careful procedures we employed. Howe et al., noted that “Scrupulous care was taken throughout the procedure to avoid contamination of the sample by atmospheric pollen in the laboratory” (Ref. 8, p. 174). This was done in all phases of the field and laboratory work. Thus the probability of field or laboratory contamination with modern pollen was extremely unlikely. Contamination of another sort will be discussed later. Again A observed “. . . that the positive results (finding fossil pollen in HS) comes from either one or two rock samples. Don’t they even know?” [parenthesis ours]. If A had consulted the original report and the tables of collected data (Ref. 8), the answer to his question would have been evident. A concluded by stating that

"No graduate student in any geology department I've been in would have gotten away with such sloppy work." An amazing conclusion from a person who never read our reports or observed our work in the laboratory.

Another phase of our work included a study of contamination of laboratory slides during the pollinating season of various trees by Lammerts and Howe (Ref. 7). They showed that it is difficult to contaminate greased slides with pollen (outdoors and in the laboratory) even when you are trying to accomplish that goal! Lammerts was a plant breeder and geneticist and Howe is a botanist, so such work was within their area of expertise. A did not mention this study.

A continued by claiming that Chadwick's (1981) results were not reported in *CRSQ* — another lie. "The *CRSQ* simply will not publish results critical of young-earth creationism." Chadwick's work (Ref. 9) was discussed in detail in Refs. 5, 6, 7, and 8. More evidence that A had not consulted the original reports when he attacked our work.

Then A wrote that Chadwick stated that "Some of them regarded me as an evolutionist by then, . . ." We do not know who is meant by "them" but a careful reading of all *CRSQ* papers will reveal that Chadwick was never regarded as an evolutionist and all of us held his work in high regard. In all conversations and correspondence with the workers on this project, no one ever referred to Chadwick as an evolutionist. Possibly since A so easily misrepresented our work on this project, he did the same to Chadwick?

Finally A criticized Russell Humphreys for mentioning our pollen work in his tract *Evidence for a Young Earth* and accused Humphreys of dishonesty because he did not mention Chadwick's work. Humphreys had read our reports (More than A can claim—we wonder who is really dishonest?) and realized that we discussed Chadwick's work. Thus anyone that consulted our reports would have known of Chadwick's studies.

Comments by Burdick and Rusch

Burdick (1974) noted the discovery of pollen grains in formations designated as Precambrian by other geologists. Later Burdick (1975) and Rusch (1982) referenced reports concerning the detection of microspores of vascular plants and tracheids having bordered pits in Cambrian strata. None of these studies were isolated incidences "... since several workers in India, Australia, and the U.S.S.R. have reported these findings" (Rusch, p. 143). The point being that the results of the *CRS* studies were not unusual!

Another Type of Contamination and Models of Earth History

Realizing that HS is classified as Precambrian using the standard geologic column, could the shale have

been contaminated later in geologic history? For instance, could the catastrophic forces of the universal Flood with associated massive erosion, deposition and tectonic activity have affected the HS if the formation had been deposited before the Flood? Also if the conjectures of Austin (1994) and Brown (1995) are viable, could the draining of the postulated lakes on the Colorado Plateau after the Flood to form the Grand Canyon have affected the HS? (Also see Williams, Meyer and Wolfrom, 1991; 1992a; 1992b; Oard, 1993.) Would the violent processes involved in these two events have deposited pollen and other plant material from more "modern" eras into the HS which was later incorporated into the rock structure? We think that such a circumstance may be possible, but we have no way of knowing if it happened.

Creationist models of earth history also will determine how an individual creation scientist will view our findings. For instance in 1991, Snelling asked the question, "Where do the Precambrian strata fit?" He suggested that much of the Precambrian fossil-bearing strata should be considered as Flood deposits. However, Wise (1992, p. 70) felt that "... Precambrian sediments were formed in a pre-Flood global water catastrophe." He suggested a regression of water in day three of the Creation week as a possibility. Steve Austin (1994, pp. 58, 62-67), in his excellent monograph on the Grand Canyon, listed Precambrian rocks as pre-Flood and Creation week formations. Also, old earth creationists would reject the presence of fossil material in HS for there would be no "advanced" plant life on earth at that time according to their model.

If a portion of HS was a Flood deposit, there would be no problem with our findings. Also, if the standard geologic column is not a reliable basis for any earth history model as discussed by Reed (1996), our results would cause no problems. However, if it is assumed that a Precambrian sediment was formed during the Creation week or before the Flood, there should be no fossils of any significance in HS. Thus as always the model determines "reality." This is one of the weaknesses of scientific models. How you visualize earth history is how you determine the validity of scientific evidence. You pigeonhole evidence based on which model you believe. Thus any fossil pollen and trachids in HS have to be, by definition, a result of contamination.

This circumstance was realized a few years ago when the former editor of the *Quarterly*, Don DeYoung, received a belligerent letter from a creationist criticizing an article. Since our HS work was mentioned in the paper the critic proclaimed that what we found was certainly not Precambrian pollen! We respect all creationist positions on various subjects, even if we do not agree with them. We admire those who have developed comprehensive creationist models and appreciate the

professionalism required to outline the necessary details. We have no argument with those who disagree with us if they prefer to believe that the fossil material we detected is from later contamination due to the Flood or other catastrophic activity. We realize it is a matter of personal opinion.

As a matter of interest, as Howe and Williams descended from the south rim of the Grand Canyon, sliding along the icy North Kaibab Trail to collect the rock samples, Howe asked Williams what he expected we would find. The answer was that we would find no fossil material in the rocks. Howe agreed. We were astonished at our findings! We have "no axe to grind" and realize that the results of our work have caused much disagreement among creationists.

It was not our intent to be self-serving in that investigation. However, we deeply resent any accusations that our field and laboratory techniques and procedures were remiss and that we contaminated the rock samples. We have spent the majority of our professional careers involved in laboratory work. We know how to follow and develop procedures to avoid contamination. It is easy for someone to sit in front of a computer and claim contamination when he has not read the original reports or does not know what was done! It is the height of arrogance and laziness and we reject such allegations as spurious.

Those readers who are interested in this investigation should obtain and consult the various articles and notes mentioned and decide for themselves how to interpret the evidence.

Recently a fellow creationist and I exchanged amiable letters over the pollen grains found in Hakatai Shale. The gentleman noted that a person who he thought was familiar with the Society's palynological work had claimed that all of the pollen detected in the shale was closely similar to the pollen of plants which grow in the Grand Canyon region today. This statement is not correct and a portion of my answer is given as follows:

In one place in your letter you mentioned that you were puzzled as to why there should be such close similarities between the pollen found in Hakatai Shale and the plants which grow in the region today. Below are two paragraphs from the Burdick paper *Microflora of the Grand Canyon* (CRSQ 1996. 3(1)38-50)

It is important to note also that an entirely different type of vegetation is indicated by the fossil spores than that which is now growing in or near the Grand Canyon. Thus *Podocarpidites* simply means a fossil plant resembling the genus *Podocarpus*, a group of species in the yew family or Taxaceae. This genus is found in rather moist areas, such as Japan, and indicates that prior to the depo-

sition of the formations of the Grand Canyon, the climate was not so dry and arid as now.

None of the plants resembling the fossil species or rather genera with the exception of *Ephedra* now live near the Grand Canyon. Thus the pollen grains of the yellow pine, pinion pine, spruce, and Douglas fir do not resemble those found in the various formations. This also indicates that the climate in the past was warmer and less arid than now. In other words these species survived because of their genetic variability potential to adapt to the increasingly arid conditions.

Burdick noted that most of the pollen found by him was different from pollen released by plants now. In other words these species survived because growing the region now. And fossil genera names were assigned to them. Also algae and fungal spores were detected. Once Burdick showed slides of his fossil pollen to the CRS Board. The ones removed from the Hakatai shale had the red color of the shale indicating they have been incorporated in the shale matrix and were not modern contamination.

In our study (Howe et al. 1988. CRSQ 24:173-182), the palynologist suggested that one pollen grain may be maple. Another set of pollen may be hemlock (Figures 15,16). Figure 21 may be elm pollen. Much of the pollen could not be identified but a great deal of it was not similar to plants which grow in the region today.

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Comment on "Mississippian and Cambrian Strata Interbedding . . ."

As a licensed professional geologist (TN-0129) with 24 years experience working in Nashville, I keep track of the creation/evolution controversy as a diversion. My attention was called to Mr. Douglas S. Sharp by an article on Talk.Origins Archive (<http://earth.ics.uci.edu:8080/faqs/knee-joint.html>) that showed him willing to correct errors when errors were demonstrated. There was one file on his web site, (<http://www.sojourn.com/-revev/download.html>), "The Faults Say No!," that I found to contain errors. I pointed these out to him in two e-mails and, to his credit, he withdrew the article from his web site.

One of the articles he used as a reference was: Waisgerber, William, George F. Howe, and Emmett L. Williams. 1987. Mississippian and Cambrian strata interbedding: 200 million year hiatus in question, *Creation Research Society Quarterly* 23:160-165.

Sharp's article stated, "Mississippian Redwall limestone and Cambrian Muav limestone are interbedded, with the rock strata alternating back and forth? As this was unconventional, to say the least, I considered this worthy of further exploration. I was supplied a copy of the CRSQ article by the National Center for Science Education. I found the article to contain numerous instances of less than rigorous application of the scientific method. These are:

1. First sentence of abstract. "Two field trips were made to study" Two trips to study a purportedly very important outcrop in depth is entirely too little time to do a credible job. In the next phrase "the supposed unconformity," the author's use of the word "supposed" and later in the article "alleged" violates the scientific method rule of tentativeness, and implies all previous work is faulty. Indeed, it borders on an *ad hominem* against all of science. The authors use the words "supposed," "supposedly," and "alleged" 24 times in the paper. They have announced their conclusion in the first sentence!
2. Third sentence. The seven criteria of an unconformity are absent in the case of a paraconformity, the existence of which as a type of unconformity was not mentioned in the paper. Most paraconformities do not show any lithologic or structural evidence and generally require detailed work to map.
3. "Do great damage to the macroevolution model of origins." What a positive statement! Was the writers' purpose to do science or act like Sherman in Georgia?
4. In "Nature of the contact line," The Temple Butte was mentioned as "appears absent" at the locality.

They recognized its existence at other locations but failed to report an unconformity at the trail site which was required whether the Temple Butte is present there or not. When the Temple Butte is present, there are actually two unconformities at this horizon. The first between the Cambrian Muav and Devonian Temple Butte, and the second between the Devonian Temple Butte and the Mississippian Redwall Limestone. Not recognizing this was a very serious error.

5. A formal description of the lithologies and a detailed stratigraphic study of the two formations at the contact was not given. Little in the way of lithologic description of the strata was given, and no thin sections were reportedly prepared on the rock samples to properly classify them. From what little information was presented, one cannot determine from the article if there is or is not an unconformity present.
6. What specifically are the facies changes at the site? From Figures 5 and 6 the transition appears sudden and knife sharp. If true, it is a channel cut rather than a facies change. Facies reflects a change in the environment of deposition, which is reflected in different lithologies and occurs over considerably longer distances.
7. Figure 2 (10 meters along trail) and Figure 5 would appear to show a 6 m deep erosion channel cut in the Muav. The break in lithologies seems sharp at the vertical contact. In Figure 1 (Shelton, Fig.

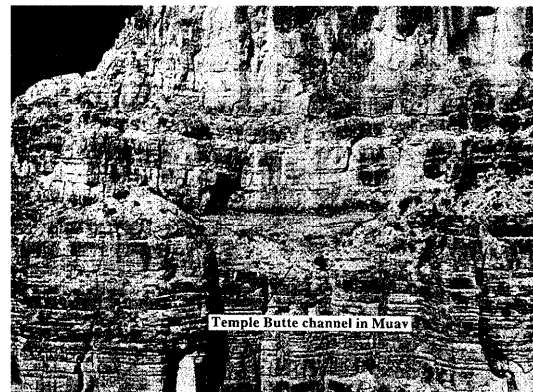


Figure 1. Shelton, Figure 270, p. 274.

270, p. 274) is a photograph (permission for use granted by Dr. John S. Shelton) of an exposure of the Temple Butte Limestone in the east wall of Pipe Creek, west of Kaibab trail. Shelton describes it as:

Between them (Redwall and Muav) is the most *inconspicuous* formation in the Canyon, the *Temple Butte Limestone*. In this view its upper contact is sharply defined and slightly wavy. Its

lower contact is partly concealed by talus but is distinctive for its sag just below the center of the scene. No strata are bent, no deformation is involved; in this place the uneven, gnarly beds of the Temple Butte fill a channel about 30 feet deep cut into the top of the Muav Limestone. A dozen or more such filled hollows can be found in the Canyon walls, most of them in relatively inaccessible places and partly obscured by loose debris. Between some of the channel fillings, and throughout many miles of the Canyon, the Temple Butte Limestone is missing altogether and the Redwall Limestone rests directly on the Muav Formation.

8. The other supposed Muav that was shown as interbedded with the Redwall may well have been either misidentification of the lithologies or a Muav-like facies in the basal Redwall. These alternatives were not mentioned. The lack of an alternate hypothesis was a substantial violation of the scientific method. Other alternate hypotheses must be advanced.

9. On page 165 of the article, they quote from Shelton (1966, p. 276) to show how flat a surface the disconformity is. The quote presented in the paper is:

The extraordinary flatness of the disconformable contact at the base of the Redwall limestone, which generally lacks even the minor channeling seen beneath the Temple Butte, implies that the landscape that developed in the interval between the accumulation of the two formations possessed remarkably little relief.

One would expect that this was the end of the statement by Shelton, but the authors deleted the final, most important sentence. "Some of the smoothing may have been accomplished by wave action as the sea advanced, for *the basal Redwall beds contain recognizable detrital ingredients derived from the Temple Butte Limestone.*" (Emphasis added).

Here the authors have made that most egregious error, the out-of-context quote. The "recognizable detrital ingredients derived from the Temple Butte Limestone" satisfies the author's requirement number 2 (p. 162) for an unconformity. Given the author's apparent desire to show the opposite, it is unsurprising that they deleted this sentence. It destroys their entire thesis.

10. The authors, while trying to show the conformable nature of the contact between the Muav and Redwall, appear to have ignored other pertinent parts of Shelton's book. On page 288 is figure 288 (Fig-

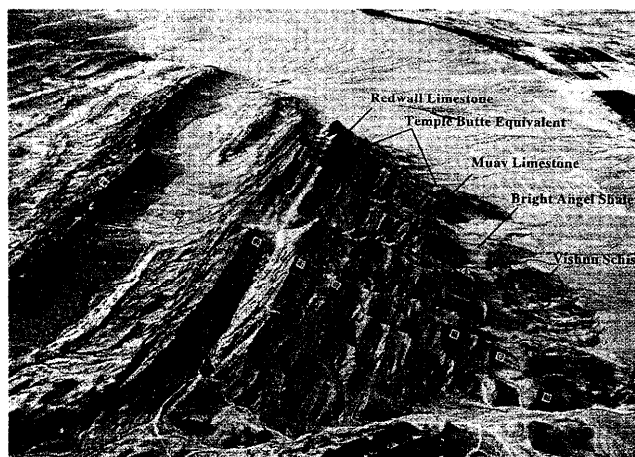


Figure 2. Shelton, Figure 288, p. 288.

ure 2 of this letter) showing an aerial view of the west face of Frenchman Mountain 10 miles east of Las Vegas, Nevada. Describing it on page 289, Shelton says:

In short, here is the whole Grand Canyon Paleozoic section, tilted about 55 degrees to the left, (down to the east). The top and bottom formations and the Redwall Limestone near the middle are almost identical in lithology and fossil content with their counterparts in the Canyon walls, but the total thickness here is a little over 8,000 feet—twice that of the Paleozoic strata in the Canyon. Two changes are noteworthy. Between the Muav and Redwall, where in the Canyon we found less than 100 feet of Temple Butte Limestone, there are here over 2,000 feet of limestone and dolomite, much of it undoubtedly deposited during the time represented by the two pre-Redwall disconformities in the Canyon.

11. Conclusions: The conclusions reached were entirely unjustified on the basis of two field trips to the site. Resting their evidence on a two-day examination of one outcrop, the authors would have us rend asunder all of geology.

On the basis of the agenda stated by the writers in the very first sentence, the cursory and unsubstantiated examination of the exposure, the failure to report pertinent information in a quoted reference, the use of an out-of-context quote, the failure to report an obvious disconformity, and the conclusions reached, this paper is deemed to have no scientific merit. Its unimportance is witnessed by being ignored in the refereed journals in the nine years since publication. Had the authors uncovered something of importance, further study would certainly have been performed and published.

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A Reply to James Moore's Comment on "Mississippian and Cambrian Interbedding . . ."

Thank you for allowing me to respond to the Moore critique. It has been nine years since the aforementioned article was published. I will answer parts of the critique even though time may diminish ones remembrance for details.

Before I do, allow me to establish my credentials. I am a licensed geologist in California (No. 58) and Oregon (No. 11) and a practicing engineering geologist in California (No. 33) and Oregon (No. 11). I have had a consulting practice in California since 1962.

I have been a member of the Geological Society of America since 1958 and a member of the Association of Engineering Geologists shortly thereafter. I am also a member of the American Institute of Professional Geologists.

Rebuttal of Parts of Mr. Moore's Letter to the Editor

Moore's opening statement that he, "... found the article to contain numerous instances of less than rigorous application of the scientific method." must itself be subject to questioning with reference to earlier investigators of the Grand Canyon. What is meant by "rigorous?" In reading the works of earlier investigators of the Grand Canyon, I have found a decided lack of a, "... rigorous application of the scientific method." among them because the earlier investigators applied western European geologic time to Grand Canyon formations as though western European geologic time was truth. Need I remind Mr. Moore that, during the 19th century, western European geologic time was determined on the bases that 1) there was an unconformity at the commencement of a geologic period, and 2) there was an unconformity at the end of that same period. This belief in unconformities delimiting geologic periods was discarded though the results (the belief in a Paleozoic Era, Mesozoic Era and Cenozoic Era) were continued as truth the world over.

Why did early Grand Canyon investigators not make use of multiple working hypotheses when each viewed supposed Grand Canyon unconformities? It is my opinion, that they did not suggest alternative explana-

tions because these geologists did accept evolution and geologic time (ever changing in duration during the 19th century) as factual. Therefore, Mr. Moore and those of like mind have never made "rigorous application of the scientific method." because belief in evolution and geologic time has blinded them to alternative options.

Moore's first page indicates that Waisgerber, Howe and Williams made a "... less than rigorous application of the scientific method." in 12 instances. Some of these "instances" will be discussed by Waisgerber herein.

Instance No. 1 (part a). "Two trips to study a purportedly very important outcrop is entirely too little time to do a credible job."

What is a "purportedly very important outcrop"? Since the word "purport" can mean "false being," or "false appearance," or a "false intention," the use of the word "purportedly" in "purportedly very important outcrop" seems to suggest a geologic structure exhibiting false features. I could agree with such a definition except that is not what Mr. Moore meant.

Also, what is the definition of outcrop in "purportedly very important outcrop"? My definition of "outcrop" has always been that part of a formation which crops out of the ground, thus implying that other parts of the formation nearby are concealed. Along the study site, both the Redwall and Muav are totally visible. There are no outcrops in the study area. The supposed unconformity is open for macro-inspection.

In my opinion, two trips to study an outcrop can be sufficient when one is able to conclude (based on 25 years of professional field studies) the weakness in the belief that 200,000,000 years elapsed from the end of Cambrian (Muav) depositional time and the coming of Mississippian (Redwall) depositional time. Where is the geologic evidence for a withdrawal of the sea after Cambrian time and a return during Redwall time? The mere presence of detritus from a lower formation within the upper formation is not evidence for 200,000,000 years of geologic inactivity. It can be evidence for localized submarine dynamism on unconsolidated sediments which have not yet been raised from beneath the sea and consolidated diagenetically as are the formations seen today.

Instance No. 1 (part b). Along with the first criticism regarding only two days of field study comes another Moore criticism. Mr. Moore states that the phrase "supposed unconformity" and other words used the writers "... violates the scientific method of tentativeness, and implies all previous work is faulty."

Our rebuttal comes with questions. Firstly, where and when in the known geologic literature did the

geologic column developed for the Grand Canyon conform to a “scientific method of tentativeness. . .”?

Secondly. Where in past literature and current literature does any evolutionary geologist admit that geologic time is “a trial study done on a provisional basis,” for that is a meaning of the word, “tentative”? Since evolutionists declare evolution, geologic time and paraconformal unconformities to be factual, it becomes mandatory that all previous work be labeled faulty because evolution, geologic time and paraconformities are not now deemed “tentative.”

Instance No. 1 (part c). Mr. Moore objects to usage of words as “supposed” and “alleged” because it “. . . borders on an *ad hominem* against all science.”

Let me make it clear that “supposed” and “alleged” were never intended to border on an *ad hominem* against “all science.” It is most decidedly an *ad hominem* aimed directly at all those scientists who have abandoned scientific skepticism as an attribute because they accept evolution, geologic time and paraconformities as settled questions and then pontificate accordingly.

Instance No. 2, on page 1. Mr. Moore criticizes that the word “paraconformity,” was not mentioned in our report as a geologic structure lying between the Cambrian and Mississippian strata, even though Mr. Moore admits that: “The seven criteria of an unconformity are absent. . .” in paraconformities.

Are not the absences of seven criteria of an unconformity sufficient grounds for a conclusion that “paraconformity” is merely a convenient word of evolutionary derivation which was brought into existence by those who prefer evolution and geologic time to any other explanation?

A common understanding of the word, “paraconformity” is that it is an unconformity at which strata of different ages are parallel and the contact is a simple bedding plane. The identification of a “paraconformity” therefore, is based less on Moore’s “. . . detailed work . . .” philosophy and more on the questionable use of fossils as time markers. Considering the “detailed work” aspects offered by Mr. Moore, if that is part of the definition of a paraconformity, then there might be hundreds of intraformational paraconformities within Grand Canyon along with known interformational unconformities. Most Grand Canyon strata lie horizontally; the bedding plane of one stratum lying on a lower stratum. All that is needed therefore is an observed difference of fossil content, above and below a selected bedding plane to “prove” intraformational paraconformities and interformational paraconformities.

Since other unconformities can be determined usually via lithologic and/or structural evidence, and since, by Mr. Moore’s own admission, the seven criteria of an

unconformity are absent in paraconformities, it can be concluded hypothetically that a paraconformity is an evolutionary crutch. It is a convenient word, much like the word “peneplain” conjured up by evolutionists, to satisfy their own deficiencies in the application of multiple working hypotheses. They do not practice the scientific method rule of tentativeness themselves, because evolution and geologic time are permanently imbedded in their literature.

Instance No. 5, re: The Temple Butte formation being absent at our study site, and whatever follows in the remnant part of Mr. Moore’s Instance No. 5 paragraph.

Mr. Moore is wrong in suggesting that the Temple Butte’s existence elsewhere demands the presence of an unconformity between the Mississippian Redwall and the Cambrian Muav at our locality. Mr. Moore will not admit to any other hypotheses as to why the Temple Butte is absent along our study area, which is his professional shortcoming.

Where the Devonian, Temple Butte Formation associates with the superjacent Mississippian Redwall and the subjacent Cambrian Muav is a study in itself. Conclusions drawn from elsewhere within Grand Canyon and applied to the trail site we studied seems no more correct than Mr. Moore’s objection to our conclusion about geologic time determined along the trail site, except that nowhere along the trail site is there any kind of evidence for a withdrawal of the Muavian Sea 200,000,000 years before the return of a Redwallian Sea.

Our hypothetical conclusion (based in small part on the two-day Grand Canyon study) will continue to be that there is no such segment of geological time as the Paleozoic Era anywhere in the world. The term Paleozoic Era was given to the world, non-tentatively, because of 19th century misunderstanding of one of the great sacred cows of evolution and geologic time; the principle known as Uniformitarianism. Nineteenth century “stratigraphers” did not apply it to their own studious efforts.

If *the present is the key to the past*, as suggested by *Uniformitarianism*, then the seas of ancient times could have supported contemporaneous environments that differ one from another in faunal content. Any lands which were raised from beneath the sea could have supported continental life forms on a contemporaneous basis.

The hypothesis of faunal contemporaneity suggests that there were littoral, neritic, bathyal, abyssal and hadal benthic, marine environments which existed contemporaneously, much as they do today. Fauna were created to fit the various environments. If such a hypothetical conclusion were accepted as an alternative

option then the Grand Canyon formations would reveal to the currently blind that “what you see is what you got.” The formations within Grand Canyon could have been deposited continuously, with differences in deposition and in minor structures occurring within different localities.

During the course of deposition (alternative geologic time), minor erosional sequences could have occurred because submarine dynamism was as functional then as the modern sea is today. The Temple Butte Formation need never have been deposited along the trail site.

Instance No. 6. “A formal description of the lithologies and a detailed stratigraphic study of the two formations at the contact was not made.”

There was no need to prepare a detailed petrologic (including a thin section) study of the two formations at the contact because a paraconformity does not exist along the trail site.

As for the need for thin sections, anyone viewing the supposed contact between the Muav and the Redwall along the trail site would have recognized that preparation of thin sections would be meaningless because both the Muav strata and the overlying Redwall strata varied vertically and horizontally. What was done instead was to make “field calls,” along the trail of the kind with which the writer has had great success in courts of law. The “field calls” indicated that Redwall and Muav strata along the trail exhibited lithologic similarities as well as lithologic differences. A five power hand lens view of the strata and the absence of geologic structures indicative of an erosive, off lapping sea followed 200,000,000 years later by a depositional on lapping sea were sufficient to conclude in the field that a belief in a 200 million year hiatus was in fact, beyond belief.

Instance No. 10. Moore’s belief that “. . . the authors have made that most egregious error, the out-of-context quote concerning Shelton (1966, p. 276), because we did not admit to an added, following statement by Shelton that: “. . . the basal Redwall beds contain recognizable detrital ingredients derived from the Temple Butte Limestone.”

The criticism by Mr. Moore that we deliberately deleted Shelton’s added statement is invalid because those suggested detrital ingredients are not part of our field site. Even so, the fact of detrital inclusion in a higher formation from a lower formation, when not related to dynamic derived erosive structures suggests the need for alternative explanations.

Shelton’s statement “The extraordinary flatness of the disconformable contact at the base of the Redwall limestone, which generally lacks even the minor chan-

neling seen beneath the Temple Butte . . .” was cited because it offers similarities to the Redwall-Muav relationship along the trail. It was important that Shelton’s implication: “. . . that the landscape that developed in the interval between the accumulation of the two formations possessed remarkable little relief” be applied to our trail site. His “detritus” statement is of no local value.

Had we the time and intent to analyze the Shelton article to its fullest, we could have questioned Shelton’s opinion that there was an: “. . . interval between the accumulation of the two formations . . .” We could have asked for proof of such an opinion. Our objective, however, was to study the trail site rather than argue with anyone.

Instance No. 12. The conclusions reached were entirely unjustified on the basis of two field trips to the site.

We will stand with our conclusions. Our intent with the report was to “rend asunder all of geology” because the Mr. Moores of the world, geologists and biologists, have misled the world the past 150 years, that geologic time and evolution are the only scientific explanations worthy of consideration.

That our opinions are being ignored “. . . in the refereed journals in the nine years since publication. . .” mean nothing to me. The history of science is replete with examples of ignorance in “refereed journals.” Ignorance often associates with the development of pseudoscientific standards developed by technicians who support narrowly devised explanations in accordance with their own technically inspired biases. There will come a time in the 21st century when more rational, learned men will re-evaluate the work done in the 19th and 20th centuries and find that evolution and geologic time are as mythical as any Babylonian, Egyptian or Greek myth, because evolution and geologic time were framed originally in a context of insufficiency of data.

I challenge Mr. Moore and any other believer in evolution and geologic time to go to the trail site and take photographs of the Redwall-Muav “paraconformity” along the trail and across the canyon from the trail, along the opposite wall. Then identify the “paraconformity” on the photographs. Then send the photographs to the *Creation Research Society Quarterly* for inclusion in a later publication. After that, I will critique your “paraconformity” photographs.

Should George Howe and Emmett Williams desire to critique those “Instances” not discussed herein, they are welcome to them. As for me, my answers herein are deemed sufficient to challenge Mr. Moore.

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THE CASE FOR THE CALAVERAS SKULL

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Abstract

The Calaveras Skull was discovered in 1866 in a gold-bearing gravel dated by conventional geology as tens of millions of years older than man's supposed origin. It initiated one of the greatest controversies over American fossil finds of ancient man. All individuals connected with the original find believed it to be genuine, including the famous nineteenth century geologist J. D. Whitney who made it widely known. Later, a ferocious attack by both evolutionists and some religionists branded the skull as merely a trick played upon the unsuspecting finder (Mattison) and the geologist examiner (Whitney). Close examination of the historical facts shows the skull should be taken seriously as one of the most mysterious and probably most significant human fossil finds on the North American continent. The authors believe the Calaveras Skull and hundreds of associated human artifacts have withstood the test of time and constitute remarkable evidences of ancient Man existing in America before the commencement of the Post-Flood Ice Age.

Introduction

On June 18 of 1866, Dr. William Jones of Murphys, California, sent a letter to the state geological survey of California regarding a recently discovered fossil human skull. A Mr. Mattison had personally found this skull in his mining shaft at Bald Hill in Angels Camp, California, 130 feet below the surface, beneath a cap of lava.

The skull had been embedded in auriferous (gold-bearing) Tertiary gravels adjacent to a petrified log. This would place the time of the skull before the commencement of the Pleistocene and long before the accepted time of man's arrival on the earth, according to evolutionary geology. Mr. Mattison had first thought it was a root of the petrified log. Later, after some close examination and probing, he was surprised to discover it was a human skull.

Mr. Gabb, a California state paleontologist, asked that the skull be delivered to the State Geological Survey in San Francisco. Dr. Jones complied and the skull was received by the Survey on June 29, 1866. A few days later, the prestigious head of the California Geological Survey, J. D. Whitney, who had been out of town at the time of notification, returned to San Francisco and first examined the skull.

Mr. Mattison, the discoverer of the fossil skull, later related to Whitney how the skull had been found. Mattison said he personally dug the skull from gold-bearing gravels in his Bald Hill mine shaft in February of 1866. He took it to John Scribner, a store owner and agent for Wells Fargo in Angels Camp. When Scribner received the skull it was

... so imbedded in and encrusted with earthy and stony material that he [Scribner] did not recognize what it was . . . Mr. Scribner's clerk cleaned off a portion of the encrusting material, discovered that the article in question was a human skull [not a tree root, as first supposed by Mattison], and shortly after, gave it to Dr. Jones [in nearby Murphys], who was well known in that region as an enthusiastic collector of objects of natural history . . .

When delivered into the writer's hands its base was imbedded in a conglomerate mass of ferruginous earth, water-worn pebbles of much altered volcanic rock, calcareous tufa, and fragments of bones. This mixed material covered the whole base of the skull and filled the left temporal fossa, concealing the whole of the jaw. A thin calcareous incrustation appears to have covered the whole skull when found; portions of it had been scaled off, probably in cleaning away the other material attached to the base (Whitney, 1880, p. 268).

Further Investigations

On July 16, 1866, Whitney read a brief paper about the skull before the California Academy of Sciences (*Proceedings of the California Academy of Sciences*, Vol. III. 1868. pp. 277-278). In his 1880 book, Whitney (p. 270) makes the following significant comment:

The debris in which the skull was imbedded were not, however, removed, nor any chemical examination made of it, until some two years later, after it had been taken to Cambridge [where, it may be noted, it still resides after nearly 130 years, as this CRSQ paper is being written in 1995].

The site of the fossil skull was visited "several times" (Whitney, 1880, p. 271) by Whitney, the state geologist, and three assistants of Whitney, as well as by several of Whitney's personal friends not connected with the Geological Survey. In the words of Whitney (1880, p. 271):

... and to all these Messrs. Mattison and Scribner have given exactly the same statement in regard to the finding of the skull. All of these gentlemen have returned from the place strongly impressed with the idea that there was no mistake, and certainly no intentional misstatement, on the part of either of the principal parties whose names are associated with the find. . . . The skull remained on and near the place where it was obtained for several months after it was discovered; and no doubts were expressed by any one as to the good

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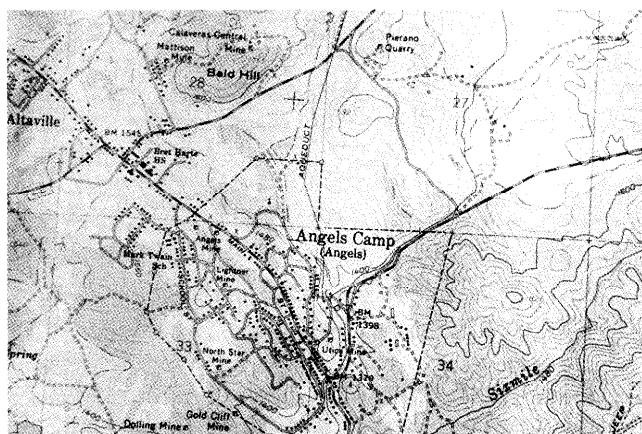


Figure 1. Insert shows general location of Calaveras County, California, where Angels Camp is located. This Angels Camp Quadrangle 7.5 Minute Series Topographic map of the Angels Camp area shows the precise location of Bald Hill located just to the northeast of Murphy Grade Road and Highway 49. Notice that the Mattison Mine is shown on the western side of the Hill. The top of Bald Hill is given as 1765' and the base as around 1560-1600' so the relief is about 175'. Murphys, California, is located a few miles further up Murphy Grade Road to the northeast of Bald Hill. Map published (1962) and photoinsected (1973) by the United States Geological Survey.

faith of the parties concerned, until after it had been sent to San Francisco and had been much written about in the newspapers.

Two or three years after the skull's discovery, the San Francisco religious newspaper, *The Pacific* sent a reporter to the area of the discovery. The reporter "... received—apparently—almost, if not quite, exactly the same statements from them which had previously been given to the writer by the same men, and then returned to San Francisco and wrote and published the following: 'Strange memory this, we thought, to retain such minute particulars of such a supposed unimportant discovery, two years before' " (Whitney, 1880, p. 270).

About 1883, three years after the publication of Whitney's monumental book (1880), Dr. A. S. Hudson, of Stockton, California, was reported by William Holmes to have visited Angels, California, and interviewed Scribner and Mattison. In the words of Holmes, Dr. Hudson was convinced after talking with Scribner "that no deception whatever had been practiced" (Holmes, 1899, p. 631).

When Dr. Hudson interviewed Mattison, he showed Mr. Mattison and his wife "the figure or cut copied from Professor Whitney's book. . . . Mrs. Matson [Mattison is also known by the name of Matson] at once recognized the picture as representing the specimen in question. It was said the cemented gravel so adhered to it as to fill out the back head and make it look a natural occipital portion' " (Holmes, 1899, p. 631, quoting from Dr. Hudson).

Dr. Hudson's evaluation of Mr. Mattison's character, as reported by Holmes (1899, p. 634), was highly favorable:

It may be proper here to say that Mr. Matson [or otherwise known as Mattison] is a plain, hard-working day laborer, a blacksmith by calling. He

seems to be a very honest appearing man. He evidences no disposition to magnify, falsify, or to depart from the correct line of truth.

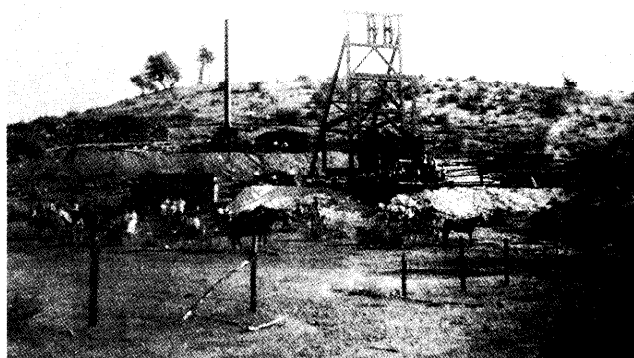
More than One Skull Involved

One of Dr. Hudson's purposes was to investigate the accusations made by those who opposed Whitney by saying the Calaveras Skull was a deliberate hoax. The information regarding this "hoax" interpretation is convoluted. The varying accounts conflict as to who perpetrated the hoax and upon whom the supposed hoax was played. What emerges from all these conflicting accounts is that a joke—not a hoax—was played on someone (certainly not Whitney) at a *later* date. The joke involved a *different* skull from the famous Calaveras Skull found by Mattison.

The later joke apparently was an idea hatched when someone read a humorous poem written by Bret Harte entitled "The Pliocene Skull" which made fun of the skull. The poem was first published July 28, 1866, only 12 days after Whitney first officially alerted the scientific world at the California Academy of Sciences of the Calaveras Skull find.

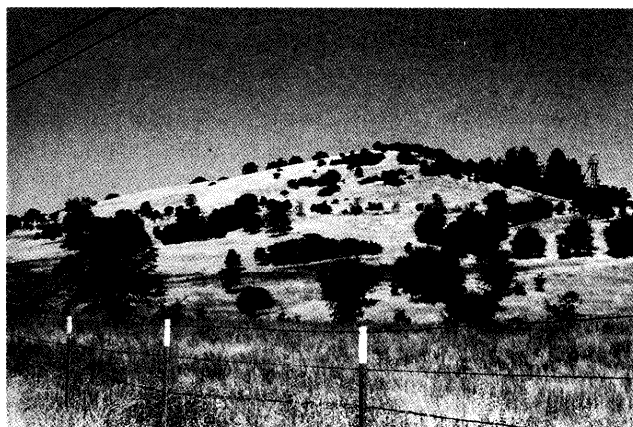
Some believed the "joker" skull—not the Calaveras Skull found by Mattison—originally came from a cave burial before being planted in the mine. In reviewing the circumstances of the Calaveras Skull and the later "joker" skull, John C. Merriam (1910, p. 157) writes:

If the Calaveras skull came from a cave, it still remains to show how it finally passed into Whitney's possession as a relic from the auriferous gravels. In this connection several interesting items of information have come to light. One of these seems to show that even if a joke had been played upon the miner, Mattison, this particular joke had failed to reach the geologist Whitney. Some years



RENIER MINE—Bald Hill, 1907.

a.



b.

Figure 2. Contrast of how Bald Hill near Angels Camp looked in 1907 (picture a) compared with 1995 (picture b). Mattison's discovery of the Calaveras Skull in his mine at Bald Hill was in 1866. The mine was located *further to the left on the other side of the hill* from the mine shown on the extreme right of picture (b). See topographic map (1) for more precise location. (The 1907 Renier Mine picture is courtesy Angels Camp Museum; Nancy Carson, Curator. 1995 photo by Robert E. Gentet.

ago Professor F. W. Putnam exhibited a small photograph, showing the skull in nearly the condition in which it was first seen by Whitney, to residents of Angels Camp who claimed to have been concerned in putting the joker skull into Mattison's mine, and was *informed that this was certainly not the skull which they had put in the shaft* [emphasis ours]. In this connection Dr. Sinclair has recently shown that skulls from the locality at which the jokers were supposed to have obtained the specimen used to fool Mr. Mattison are buried in a matrix quite unlike that which covered Whitney's specimen.

This seems to be the origin of the claim that the Calaveras Skull was from a recent American Indian burial which someone had found and planted in Mattison's mine as a joke. However, it is important to note that from the very beginning of the discovery of the

Calaveras Skull, everyone acknowledged the Calaveras Skull was truly a fossil. (In fact, the skull is so completely fossilized that only a trace of organic matter remains in the skull thereby preventing direct dating by Carbon-14.)

Calaveras Skull an Uncommon Human Fossil

G. F. Becker (1891, p. 194) of the U.S. Geological Survey pointed out that:

A rhinoceros jaw from the same horizon contained more than two and a half times as much phosphate as carbonate, and was thus much less completely fossilized than the human bone. Truly fossilized human bones are very great rarities, and to suppose that the miners were not only successful in 'salting' the mine with human bones, but that they procured truly fossil bones to do it with, requires a painful stretch of the imagination. *But, further, when the skull was found a mass of gravel indistinguishable from the surrounding material adhered firmly to it and remained thus attached until, long afterwards, Dr. Jeffries Wyman removed it in Cambridge, Massachusetts. Hence the miners must have found it, if at all, in a formation similar to or identical with the auriferous gravels. The supposed joke would therefore be quite without point [italics ours].*

Another individual who personally examined the Calaveras Skull soon after it was discovered was William H. Dall. On January 10, 1899, he reported the following to the Academy of Natural Sciences of Philadelphia: "The evidence has generally been regarded among scientific men as convincing and sufficient" and that "no sufficient reason had been adduced for doubting the genuine character of the skull and its original situs [location] below the lava." (Dexter, 1986, p. 367).

In 1899, Vice-president Thomas Wilson of the American Association for the Advancement of Science also defended the skull's genuineness. In his address before the AAAS, Wilson quoted from an earlier address at the same meeting by Putnam who said "That man was on the American continent in Quaternary times, and possibly still earlier, seems to me as certain as that he was in the Old-World during the same period." (Dexter, 1986, p. 367).

In addition to these men, other noted men such as L. G. Yates (1887), E. T. Newton, President of the Geologists' Association (1899), and W. O. Ayres (1882) were all in agreement with Whitney that the Calaveras Skull was not a hoax and was originally embedded in the auriferous gravels at the time of their deposition before the Ice Age.

In the words of George F. Becker (1891, p. 195):



Figure 3. Contrast these views of the Calaveras Skull after being thoroughly cleaned and examined with the one shown on the cover of this issue of *CRSQ*. The skull is not “primitive,” or in the words of Dr. Wyman who gave the craniological peculiarities of the skull in Whitney’s book (1880, p. 273): “That the skull presents no signs of having belonged to an inferior race.” If the fossil were truly found in the Tertiary auriferous gravels beneath Bald Hill, then evolutionary theory would require it to be very “primitive.” Furthermore, full extent of the condition of the skull when found as a fossil is revealed. In the words of Whitney: “The skull . . . had been broken, and broken in such a manner as to indicate great violent and protracted motion. . . . The appearance of the skull was something such as would be expected to result from its having been swept, with many other bones, from the place where it was originally deposited down the shallow but violent current of a stream, where it would be exposed to violent blows against the boulders lying in its bed. During this passage it was smashed, and fragments of the bones occurring with it were thrust into all the cavities where they could lodge. It then came to rest somewhere, in a position where water charged with lime salts had access to it, and on a bed of auriferous gravel” (Whitney, 1880, p. 272).

I find that many good judges are fully persuaded of the authenticity of the Calaveras skull, and Messrs. Clarence King [first Director of the USGS], O. C. Marsh, F. W. Putnam and W. H. Dall [see our earlier quote from him] have each assured me of his conviction that this bone was found in place in the gravel beneath the lava* [his footnote here says: “This statement is made by permission.”]. Dr. Alfred R. Wallace, too, who has seen at least some of the auriferous gravels and table mountains, in speaking both of the implements found and the Calaveras skull, stated that these remains ‘present all the characteristics of genuine discoveries’ [Here Becker has another footnote which reads: “*Nineteenth Century Magazine*, Nov. 1887, p. 667. See also ‘Darwinism,’ 1889, p. 456.”].

Whitney Familiar with Cave Skulls

There were those, Blake (1899), Hrdlicka (1907), Sinclair (1908), and others who contended that the Calaveras skull was nothing more than a modern Indian cave skull. Could Whitney have been fooled in this manner? The evidence would indicate “no.” First of all, Whitney was familiar with California cave skulls, as shown by Moratto (1984, p. 305):

Long ago, Whitney (1867) removed a number of crania from the Cave of Skulls (Cal-29), west of the Stanislaus River near Abbotts Ferry. Like the bones from Mercers and Moaning caves, these calcium carbonate-encrusted skulls reposed on the cave floor and had not been buried deliberately.

This clearly shows that Whitney was familiar with cave skulls in the area and would have been very unlikely to have confused the Calaveras Skull with a cave specimen.

In support of Whitney’s truthfulness and scientific accuracy, no less an opponent than Ales Hrdlicka confirmed in 1907 that differences existed between the original condition of the Calaveras Skull and nearby cave specimens. Though Hrdlicka argued that the Calaveras Skull was a cave specimen, he nevertheless made the following significant statement: “None of the cave skulls [taken by J. S. Hittell from caves in Calaveras county in 1857] showed any adhesion of gravel” (Hrdlicka, 1907, p. 25). If the Calaveras Skull were originally from a cave deposit, then why did it have gold-bearing gravel adhering to it?

Hrdlicka (1907, p. 27) also acknowledged that “It is known that animal fossils with somewhat similar coating have been recovered from ancient sands or gravels.”

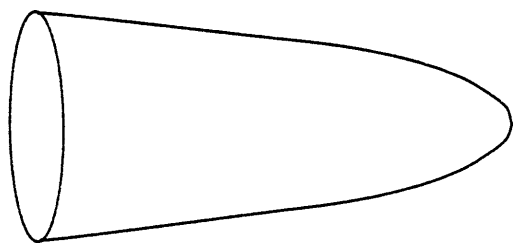


Figure 4. C. J. King, the first director of the USGS, found this broken pestle in 1869 in the gold-bearing gravels under Table Mountain near Tuttleton, California less than 50 miles from the discovery site of the Calaveras Skull. King failed to publish his find in 1869 and it was much later in 1891 before it was published in the literature, not by King, but by fellow geologist G. F. Becker. However, the implement was presented to the Smithsonian Institution on Jan. 20, 1870. and was U.S. National Museum. Cat. No. 9237 until it was broken and the museum discarded it in 1935. Becker reported that: "This mass [of stone—the broken pestle] he [C. J. King] forced out of its place with considerable difficulty on account of the hardness of the gravel in which it was tightly wedged. It left behind a perfect cast of its shape in the matrix, and proved to be a part of a polished stone implement, no doubt a pestle . . . It is difficult to imagine more satisfactory evidence than this of the occurrence of implements in the auriferous, pre-glacial, sub-basaltic gravels" (Becker, 1891, pp. 193-194). Miners reported finding hundreds of pestles, mortars, and other types of human artifacts in the Tertiary gravels in a span of over 30 years during the last half of the nineteenth century (Gentet, 1991).

Hence, Hrdlicka acknowledged that fossils can receive a stalagmitic coating in a location apart from a cave setting, even though he vigorously fought the idea that the fully human Calaveras Skull was from the pre-Ice Age Tertiary deposits in this area and therefore much too ancient according to evolutionary-based thinking. In conclusion, Hrdlicka (1907, p. 28) stated the following: "A mass of gravel, bones, etc. adhered to the base of the [Calaveras] skull when discovered. But this was not firmly solidified and could be removed without injury to the bone." This statement, taken with the earlier one acknowledging that "none of the cave skulls showed any adhesion of gravel," shows that even the most adamant opponent, Hrdlicka, saw something unusual about the Calaveras Skull.

Cave Theory Origin Stems from Evolutionary Bias

The belief that the Calaveras Skull originally came from a cave deposit stems from a tenacious belief in the theory of evolution, as shown by the following quote from Merriam (1910, pp. 154-156):

The scientists who have investigated the history of the human race have accumulated a great volume of evidence indicating the close relationship of physical man to an ancient group of large brained animals including the existing apes and monkeys, and have traced the evolution or geological history of the human type in the Old World step by step from ape-like forms up to the present man . . . The sudden appearance of highly developed man in America at the time the auriferous gravels were being deposited would be entirely contrary to the laws of evolution with which our history is in

accord elsewhere . . . The writer's attention was first attracted to the question of auriferous gravel man by coming into contact with several persons of high standing who knew definitely of stone implements being obtained from deep gravel mines since the completion of Whitney's studies [emphasis ours]. Note the acknowledgement that human artifacts were found even after Whitney's 1880 comprehensive report.] At that time a list was compiled which included about a dozen apparently well-authenticated instances of occurrences of human remains in the auriferous gravels. The problem taken as a whole seemed to the writer to represent as remarkable a case of absolutely contradictory evidence as ever appeared in science or in law [emphasis ours]. On one side men with high reputations of veracity gave affidavits to the effect that they had personally seen human bones and relics taken from undisturbed layers in supposedly ancient formations. On the other hand, scientists claim that such occurrences are impossible [emphasis ours] . . . The writer has also been unwilling to suppose that the miners of California are more inclined to play practical jokes or that the scientists of the West were more easily fooled than those in other portions of the world or that the word of the average man with reference to scientific matters is less reliable here than elsewhere.

It only becomes "impossible" when the theory of man's evolution and of his supposed late arrival in the geological record is assumed and all valid evidence to the contrary is therefore rejected.

Carbon-14 Dating and the Calaveras Skull

A recent attempt to date the Calaveras Skull was done by R. E. Taylor and others at the Radiocarbon Laboratory, University of California, Riverside (Taylor, Payen, and Slota, 1992). It should first be kept in mind that the Calaveras Skull itself could not be dated by C-14 directly because it lacked sufficient organic material. The actual human bone dated by Carbon-14 was said to be one of several fragments found in association with the Calaveras Skull. It is not known whether this associated bone is from the same individual as the Skull, but Whitney (1880, p. 268) acknowledged that fragments of human bones were found associated with the Skull when material covering the face and base was removed.

Taylor and others (1992) attempted to establish the C-14 age of the bone fragment by assuming that it originally came from a local cave deposit and was a plant. Note what is said (Taylor et al., 1992, pp. 271-272):

The carbonate matrix encrusting the bone (UCR-2157C) had a ^{14}C activity equivalent to an apparent age of $2,170 \pm 60$ ^{14}C years BP [Before Present]. If we assume that a correction for the

initial ^{14}C activity for carbonates in this environment [an initial cave environment is here assumed for the bone] would be similar to the 710 years that has been reported for carbonates from nearby (about 7 km) Moaning Cave (Broecker et al. 1960), then a reservoir-corrected ^{14}C age for the carbonate matrix removed from the skull would be about 1,500 (+100) years. The inorganic carbonate fraction of the bone sample yielded an age of $1,260 \pm 210$ ^{14}C years B.P. (ICR-2161 A/AA-1878) and the total HCl-insoluble organic fraction an age of 740 ± 210 ^{14}C years B.P. (UCR-2161 B/AA-1879).

After obtaining three different C-14 dates, two for one of the bones said to be associated with the Calaveras Skull and one for the matrix in which the associated bone was found, and after adjusting for needed corrections due to an assumed original cave origin, Taylor et al. (1992) concluded:

The ^{14}C age exhibited by an organic fraction of the Calaveras human metatarsal bone (UCR-2151B) indicates an age of less than 1,000 years. The AAR-deduced age [Note: amino-acid racemization is a non-radioactive method of dating objects] for the Calaveras human metatarsal bone indicates a somewhat older age—about 4,000 years. In light of the problems with the AAR method for bone, we suggest that, in this case, the ^{14}C -based data probably more accurately reflect the age of the bone. We interpret the overall weight of the dating evidence to indicate that the age of the bone tested, and by extension, the Peabody Museum Calaveras skull, to be late Holocene in age—probably younger than 1,000 years [all emphasis ours].

Since the calculations were based upon the fundamental assumptions of an original cave burial, we believe even the calculated dates obtained for the bone associated with the Calaveras Skull are most likely invalid. As shown throughout this paper, there appears to be no real evidence that the Calaveras Skull ever originated from a cave.

We realize that others firmly believe the Calaveras Skull to be a hoax. (It is significant that the article title by Taylor et al. calls the Skull the “Piltdown Man” of the New World). But, the Carbon-14 date of “probably younger than 1,000 years” (p. 273) for the associated metatarsal bone becomes invalid because unlike cave skulls found in the area, the Calaveras Skull was acknowledged by all the original researchers to have been found embedded with gravels.

Age of Auriferous Gravels Critical

The presence of any datable Carbon-14 material associated with the Calaveras Skull (whether adjusted for supposed cave environment or not) indicates a time frame quite different than demanded by the accepted geological time scale. A future CRSQ paper by the authors will more closely examine the geological

setting of the auriferous gravels from which numerous human remains and artifacts have been discovered. This future paper will assign a post-Flood deposition and erosion time frame for the Cenozoic here, mainly in a catastrophic setting.

In further corroboration that the Calaveras Skull was not originally from a cave environment, we have the following first-hand account by Ayres (1882, pp. 853-854):

. . . Wherever it might have first been found it surely was embedded in the auriferous gravel and it had been become so embedded at the time the gravel was originally deposited. You say that is a bold assertion? How do you know? I will tell you. I know it because the skull told me so [emphasis ours]. I saw it and examined it carefully at the time when it first reached Professor Whitney's hands. It was not only encrusted with sand and gravel but its cavities were crowded with the same material. And that material was a sort—a peculiar sort—a sort which I had occasioned to know thoroughly. It was the common cement or dirt of the miners, that known in books as the auriferous gravel . . . It is not easily imitated. No skill possessed by Mr. Mattison or anyone else could have been sufficient to give the skull the characters which it had when I saw it. It is most certainly no fabrication. But it has been said that it is a modern skull which has become encrusted after a few years of interment. This assertion however is never made by anyone knowing the region. The gravel has not the slightest tendency toward an action of that sort. The skull would either decay and waste away or it would remain unchanged and added to this comes in the fact that the hollows of the skull were crowded with the solidified and cemented sand in such a way as they could only have been only by its being driven into them in a semi-fluid mass. A condition which the gravels have never had since they were first laid down. Let the skull tell its own story and believe what it says because it brings its own proof. Whatever age belongs to the gravel . . . belongs to the Calaveras Skull entirely irrespective of the question of honesty or dishonesty in the alleged finder [emphasis ours]. Wherever he found it, I believe its age to be beyond cavil.

Thus, we also dispense with any thought that the Calaveras Skull was originally a cave specimen later planted in the mine below Bald Hill to fool Mattison or anyone else. Those who examined the skull in its original condition said that it had, without question, come from the gold-bearing gravels.

Other Human Remains Found in the Gravels

Another matter often overlooked by those seeking to discredit the Calaveras Skull is the fact that numerous other human remains have been reported as having been found in the auriferous gravels. Whitney in 1880

makes mention of numerous human, fossil remains in his book *The Auriferous Gravels of the Sierra Nevada of California*. It now bears repeating Whitney's reports of some of these finds. The Calaveras Skull was only one of many human remains found in the gravels during last century's digging by gold miners. Numerous "jokes" or outright lies would have to be involved in these other cases, and there is no basis for such a conclusion. Some of these human remains date prior to the discovery of the Calaveras Skull in 1866 and the great controversy it generated. These earlier finds are also strong indication that the Calaveras Skull is no fluke of the fossil record in that area.

Whitney (1880, p. 264) writes:

Soon after the writer's communication to the American Association for the Advancement of Science at the Chicago meeting, in 1868, of some of the principal facts connected with the discovery of the 'Calaveras skull,' and when that remarkable relic had begun to be talked about a good deal, he was informed by Dr. J. Wyman that there was in the Museum of the Natural History Society of Boston a small fragment of a skull, which he had identified as being human, and which bore the following label: 'From a shaft in Table Mountain, 180 feet below the surface, in gold drift, among rolled stones and near mastodon debris. Overlying strata of basaltic compactness and hardness. Found July, 1857 [This would place it about 9 years before the discovery of the Calaveras skull]. Given to Rev. C. F. Winslow by Hon. Paul K. Hubbs, August, 1857.' It was also soon ascertained that a similar fragment of a human skull existed in the Museum of the Philadelphia Academy of Natural Sciences, with a similar label. And it appeared that Rev. Mr. Winslow divided the specimen given him by Mr. Hubbs between the two societies in the manner indicated. In Volume VI. of the Proceedings of the Boston Natural History Society, page 278, under the head of October 7, 1857, is a communication from Rev. Mr. Winslow sent with the skull fragment, from which the following extract is made (date not given): 'I sent by a friend, who was going to Boston this morning, a precious relic of the human race of earlier times, found recently in California, 180 feet below the surface of Table Mountain . . . My friend Colonel Hubbs, whose gold claims in the mountains seem to have given him much knowledge of this singular locality, writes that the fragment was brought up in pay-dirt (the miner's name for the placer gold-drift) of the Columbia Claim, and that the various strata passed through in sinking the shaft consisted of volcanic formations exclusively.

Whitney then makes the statement that "this find evidently excited no attention at all." (Could this lack of excitement be at least partly due to the fact that 1857 is two years prior to the publication of Charles Darwin's book on evolution and the revolution it caused

and therefore the 1857 find tended to not ruffle any evolutionary feathers?) Whitney, however, pursued the matter when he heard of it and ended up with a full report of the find. Whitney's investigation persuaded him that the find was genuine and originated in the ancient gold-bearing gravels: "The evidence seems very clear, in all respects, so far as the fact of the occurrence of human remains in the strata underlying the Table Mountain basalt is concerned. Unfortunately the piece of skull preserved is too small to be made the basis of any craniological investigations" (1880, p. 265).

Furthermore, Whitney (1880, p. 266) records:

In the Proceeding of the Boston Society of Natural History, Vol. XV p. 257, under date of January 1, 1873, will be found a communication of Dr. Winslow's relating to another discovery of human remains in Tuolumne County [This county is located adjacent to the county where the Calaveras Skull was found]. Captain David B. Akey is the authority for the statement that a complete human skeleton was found in a tunnel under Table Mountain; the name of the tunnel, however, he did not remember. He saw the bones after they had been brought out from the excavation by the miners. This occurrence the writer [Whitney] has had no opportunity to inquire into or verify, as it did not come to his notice until after he had left California [Whitney was appointed California State geologist in 1860 but by 1868 he had left California to return to Cambridge]. The date of this find seems to have been 1855 or 1856.

While it is clear that these other human finds cannot be subjected to the same scientific examination as the Calaveras Skull, the point is the Calaveras Skull does not stand alone. Other human remains—besides the hundreds of finds of various kinds of human artifacts (Gentet, 1991)—have been reported from the gravels.

One of the most famous human artifact finds—a broken piece of pestle—was found in 1869 beneath the Table Mountain lava southeast of Tuttletown, California, by none other than C. J. King, who was confirmed as the first Director of the United States Geological Survey in 1879. (The original report is found in the *Bulletin of the Geological Society of America*, Vol. 2, Jan. 10, 1891, pp. 193-194 by George F. Becker. See also Macgowan and Hester, 1962, p. 178.) These hundreds of artifacts found over the span of over three decades by numerous miners and by geologist C. J. King complicate the story for those who would label the Calaveras Skull as a hoax or as a mere oddity.

W. H. Holmes, Head Curator of the Department of Anthropology, United States National Museum, studied the controversial issue for many years and in his final comprehensive report, even though basically rejecting the idea of Tertiary Man in California, acknowledged:

Although, as thus summarized, the writer finds the weight of evidence rather against than for the great antiquity of man in California, he does not believe that the evidence recorded by Whitney

and others should be disregarded. Certain portions of the deep gravels appear to have yielded traces of human occupancy of the region during the formation of these deposits and science cannot afford to let the matter rest until their age is determined and the exact manner of inclusion is known; meantime chronologists can be on their guard against too hasty acceptance of conclusions not absolutely warranted by the evidence (Holmes, 1919, p. 69).

It should also be noted that J. D. Whitney was not the President of the local creationist society! So far as is known to the authors, he was an evolutionist. He was an outstanding scientist, a California State geologist, in fact, the head of the Society, who found himself surrounded by intense controversy for objectively looking at all the data—the human remains, the human artifacts, and the geology of the area. Whitney was attempting to place the data into the framework of then-uniformitarian belief. He was an individual who stood his ground, even when it did not meet the current theories of his time.

Whitney's Conclusions

In his 1880 book, Whitney concluded that:

... there is a large body of evidence, the strength of which it is impossible to deny, which seems to prove that man existed in California previous to the cessation of volcanic activity in the Sierra Nevada, to the epoch of the greatest extension of the glaciers in that region, and to the erosion of the present river canons and valleys, at a time when the animal and vegetable creations differed entirely from what they now are, and when the topographical features of the State were extremely unlike those exhibited by the present surface (p. 288).

Surely, the total picture—as emphasized by Whitney—is to be kept in mind, and one should not focus unduly on the Calaveras Skull alone, however important it may be, in realizing the geologic importance of the auriferous gravels in relationship to man's history. To leave this matter buried with Whitney because of evolutionary bias concerning man's origin is not true science. The objections brought forth since Whitney's death (1896) against the finds do not, in the main, depart from the original ones which Whitney spent large amounts of time and space answering in his 1880 book.

In the end, Whitney's contribution to science will be seen for what it has always been—a fair and detailed study of human fossils and artifacts found in a place little suspected by past and present widely-held evolutionary theories of man's origin.

Now, one hundred years after Whitney's death, it's time to re-examine his monumental work on the auriferous gravels of California to see how early Man fits into geology.



JOSIAH DWIGHT WHITNEY
(1819-1896)

Geologist, mineralogist, educator
Courtesy Smithsonian Institution

Geologist Josiah Dwight Whitney made famous the Calaveras Skull and other human remains and artifacts found in the Tertiary gold-bearing gravels in his 1880 book *The Auriferous Gravels of the Sierra Nevada of California*. He was a highly educated person and greatly respected by his peers.

Whitney was born in late 1819, the oldest of eight children, to Josiah Dwight Whitney a prosperous banker, and Sarah Williston, the daughter of a minister, herself a teacher. His parents placed a strong emphasis on education and he graduated from Yale in 1839 with an awakened interest in science. He worked for a time with the geological survey of New Hampshire, but while in Boston he heard a lecture on geology by none other than Sir Charles Lyell. This set Whitney on the path to becoming a scientist. He left for Europe in 1842 for five years and received advanced scientific training with Elie de Beaumont at the Paris Ecole des Mines, Karl F. Rammelsberg and Heinrich Rose in Berlin, and Justus von Liebig in Giessen. Upon returning to the United States in May 1847, J. D. Whitney was a fully trained professional geologist and began immediate employment as an assistant in a geological survey of Michigan. Working geologists then were few, and state-surveys were a novelty.

After two years in Michigan and five more years as a mining consultant with offices in Massachusetts, he

Credit for Whitney picture: *Dictionary of American Portraits*; Edited by Hayward and Blanche Cirkner, 1967, p. 671. Photo courtesy Smithsonian Institution.

wrote *The Metallic Wealth of the United States* which became a standard text for twenty years in the literature of ore deposits. The book contributed to the establishment of mining geology as a scientific discipline. This book helped Whitney to be appointed professor of chemistry at the University of Iowa where he taught from 1855 to 1858 while at the same time serving under three state geological surveys (Iowa, Illinois, and Wisconsin).

Thus, in 1860, Whitney was well suited to be the director of the newly formed California Geological Survey, serving intermittently until 1874. While in California, Whitney also participated in founding the California Academy of Sciences, the University of California, and Yosemite National Park. He published, in several editions, "The Yosemite Guide-book" and trained a number of younger scientists who themselves later became famous, including Clarence J. King, the first head of the United States Geological Survey.

In 1865, Whitney, on a leave of absence from the California Geological Survey, was appointed professor at Harvard College where he also established a school of mines. Unfortunately, in 1868 the California state legislature refused to pass an appropriation for the continued existence of the state geological survey. Whitney remained director of the nominal survey until 1874. Three volumes of his findings were published by the state. When *The Auriferous Gravels of the Sierra Nevada of California* was published in 1880, the Harvard Museum of Comparative Zoology assisted with financing the publication. Two years later, Whitney privately brought out a volume on general geological observations. His last major work was *Climatic Changes in Later Geological Times* published in 1882, the same year that his wife of twenty-eight years and also his only child, a daughter, died.

Whitney contributed to the development of his profession in his book *The Century Dictionary and Cyclopaedia* which defined terms used in the fields of mining, metal and metallurgy, geology, lithology, physical geography, and fossil botany. He was a founding member of the National Academy of Sciences and the fourth American to be elected a foreign member of the Geological Society of London.

The *National Cyclopaedia of American Biography* (1899 Vol. 9, p. 120) characterizes Whitney by saying: "He was a remarkably versatile man in both knowledge and faculty, seemingly with talents in every direction, and with a phenomenal memory for facts in every field. His great library was full of foreign literature, as well as scientific works. He had extraordinary taste and knowledge in music and art; his set of musical scores was one of the finest collections, public or private, in the country. His standard of personal and professional honor was the highest; hence, he never owned a share of mining stock, nor in any other way used his great opportunities to enrich himself by his discoveries."

Whitney returned to Cambridge permanently in 1875 and continued to teach at Harvard for the remainder of his life. The highest point in the state of California, Mt.

Whitney (14,494') was named in his honor by a government exploring expedition. Whitney died at his summer retreat, Lake Sunapee, New Hampshire, at age 76, on August 19, 1896. Considering all the accomplishments of his life, it is no wonder that Whitney's thought-out endorsement of the Calaveras Skull and other human remains and artifacts found in the ancient gold-bearing gravels of California raised the interest level of these remarkable finds to national and even international prominence.

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THE CAPABILITIES OF SCIENCE IN THE FORMATION OF A MODERN WORLDVIEW

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Abstract

My purpose in this paper is to review relevant literature regarding the use of science and evolutionary theory as a basis for the development of a personal worldview. The development of a useful, truth-providing worldview is an important part of intellectual and spiritual growth. It is also important that a person be able to discern the worldviews of others. It is asserted that the formation of a modern worldview requires more than an understanding of science and evolutionary theory. Because the formation of a worldview deals with the question of truth, only a creationist based worldview will prove fruitful. Science in and of itself is incapable of creating a useful worldview because it is subjective in nature.

Introduction

I am convinced that for a person to be fully conscious intellectually he should not only be able to detect the world views of others but be aware of his own—why it is his and why in the light of so many options he thinks it is true. (James Sire, 1976).

Throughout modern history, human beings have attempted to answer questions and obtain knowledge about their world in a variety of ways. Experience, authority, deductive reasoning, inductive reasoning, the scientific method, and revelation from God are all methods that have been used historically to find knowledge. Many have used an eclectic approach as they combined one or more of these ways of knowing. Some have rigidly stuck with only one method, the scientific method, of finding knowledge. These ways of knowing are used by individuals for the purpose of gaining a knowledge base upon which a worldview is built.

The Purpose of Worldview Formation

It is my assertion that formation of a modern worldview necessitates more than just knowledge and understanding of the scientific method (science in general) to reach truth. I believe a source of knowledge outside of science must be considered in order to form a comprehensive worldview. More specifically, I assert the basic presupposition that only a "Christian Creationist" framework will lead to the formation of a truthful, and therefore a fruitful, worldview.

The primary concern regarding the formation of a worldview should be the question of truth. What is ultimate truth and how is it translated into the formation of a worldview? Science itself is not seeking to answer this question. According to Donald Ary (1990), science "seeks not absolute truth but rather theories that explain and predict phenomena in a reliable manner."

However, the formation of a worldview must include within its framework the idea of seeking after truth.

This should be the ultimate purpose in forming a worldview. If truth-seeking is not one's ultimate purpose, the whole exercise of worldview formation becomes folly. All that is accomplished is the compiling of a never-ending string of knowledge into a useless matrix of unconnected ideas.

Science and Worldview Formation

In terms of science and worldviews there are two basic alternatives. Watson makes this clear when he states that:

... the theory of evolution, a theory universally accepted not because it can be proven by logically coherent evidence to be true, but because the only alternative, special creation, is clearly incredible (Watson, 1929, p. 233).

Douglas Futyma echoes a view similar to Watson's:

Creation and evolution, between them, exhaust the possible explanations for the origin of living things. Organisms either appeared on the earth fully developed or they did not. If they did not they must have developed from preexisting species by some process of modification. If they did appear in fully formed state, they must have been created by some omnipotent intelligence . . . (Futyma, 1983, p. 197).

Futyma and Watson bring the controversy into clear focus. The issue is one of belief, either in evolution (as Watson advocates) or in the clear teaching of scripture, which states "In the beginning God created the heavens and the earth" (Genesis 1:1).

Watson, however, is at odds with Donald Ary's view of science as merely a theory to explain phenomena. Watson and many others elevate the theory of evolution to factual science. This is done although evolutionary theory does not bring to the table the ability to explain and predict phenomena in a reliable manner.*

*Dr. Walter Brown in his book *In the Beginning* offers 127 categories of scientific evidence which show that the theory of organic evolution is invalid; that the universe, solar system, earth, and life were recently created; and that the earth has experienced a worldwide flood. This evidence is in contradiction to the theory of evolution.

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By advocating the blanket acceptance of evolutionary theory, the boundaries and capabilities of science in explanatory terms are extended to a new realm. Science moves into the realm of metaphysics and belief. Watson's reason for such a leap of faith is based solely on the rejection of the "incredible" alternative view known as creationism. The scientific evolutionary worldview is based, not on truth or even a scientific evaluation, but on the rejection of the alternative.

The fact that evolutionary theory affects thinking in other disciplines (and thus one's knowledge base and worldview formation) is explained by Julian Huxley:

The concept of evolution was soon extended into other than biological fields. Inorganic subjects such as the life-history of stars and the formation of chemical elements on the one hand, and, on the other hand, subjects like linguistics, social anthropology, and comparative law and religion, began to be studied from an evolutionary angle, until today we are enabled to see evolution as a universal and all pervading process (Huxley, 1955, p. 272).

This universality is advocated by Huxley in calling for the United Nations Educational Scientific and Cultural Organization (UNESCO) to adopt evolutionary theory as the worldwide standard. Huxley emphasized this when he stated:

It is essential for UNESCO to adopt an evolutionary approach . . . the general philosophy of UNESCO should, it seems, be a scientific world humanism, global in extent and evolutionary in background . . . Thus the struggle for existence that underlies natural selection is increasingly replaced by conscious selection, a struggle between ideas and values in consciousness (Huxley, 1979, pp. 35, 36).

Huxley has support from many in the scientific community. These scientists see evolutionary theory as the ultimate explanation for all things; thus evolutionary theory has reached the status of "god." What is the basis of this conclusion? It is subjective, because it only exists in the mind of men. Recall that Watson stated evolutionary theory could not be proven by the evidence.

When comparing the creationist paradigm and evolutionary theory, some may maintain that the evolutionary paradigm deals with facts and the creationist paradigm deals with faith. This is a false conclusion. The truth is both paradigms are firmly grounded in certain unprovable presuppositions. Both explanations must be accepted on a faith basis. In creationism, the faith presuppositions are based on the holy scriptures. For example the writer of the book of Hebrews said, "Through faith we understand that the worlds were framed by the word of God, so that things which are seen were not made of things which do appear" (Hebrews 11:3). In the evolutionary paradigm, the faith

presuppositions are based on ideas and conjecture from the minds of men.

The reality that evolutionary theory is based on faith is supported by those from both the Christian theist worldview and the evolutionary worldview. For example,

The fact of evolution is the backbone of biology, and biology is thus in the peculiar position of being a science founded on an unproved theory—is it then a science or a faith? Belief in the theory of evolution is thus exactly parallel to belief in special creation—both are concepts which believers know to be true but neither, up to the present, has been capable of proof (Matthews, 1971, p. xi).

Planck, in support of the creationist view states:

Anyone who has taken part in the building up of a branch of science is well aware from personal experience that every endeavor in this direction is guided by an unpretentious but essential principle. This principle is faith—faith which looks ahead. It is said that science has no preconceived ideas: there is no saying that has been more thoroughly or more disastrously misunderstood. It is true that every branch of science must have an empirical foundation: but it is equally true that the essence of science does not consist of this raw material but in the manner in which it is used. The material always is incomplete . . . [it] must therefore be completed, and this must be done by filling the gaps; and this in turn is done by means of associations of ideas. And associations of ideas are not the work of the understanding but the offspring of the investigator's imagination—an activity which may be described as faith, or, more cautiously, as a working hypothesis (Planck, 1936, quoted in John E. Silvius, 1985, pp. 6-7).

If evolutionary theory is based on faith and creation theory is based on faith, what makes one more truthful than the other? The evidence holds the key.

Roots of the Evolutionary Worldview

The scientific approach according to an evolutionary worldview is built upon integration of induction and deduction. This modern day scientific method is attributed by some to Charles Darwin (Ary, 1990). His endeavors in the pursuit of knowledge and development of the theory of evolution led to this particular scientific approach. In a letter Darwin wrote:

My first note-book (on evolution) was opened in July of 1837. I worked on true Baconian principles, and without any theory collected facts on a wholesale scale, more especially with respect to domesticated productions, by printed inquiries, by conversation with skillful breeders and gardeners, and by extensive reading. When I see the list of books of all kinds which I read and abstracted, including

whole series of Journals and Transactions, I am surprised at my industry. I soon perceived that selection was the keystone of man's success in making useful races of animals and plants. But how selection would be applied to organisms living in a state of nature remained for some time a mystery to me.

In October 1838, that is, fifteen months after I had begun my systematic inquiry, I happened to read for amusement "Malthus on Population," and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habitats of animals and plants, it at once struck me that under these circumstances favorable variations would tend to be preserved, and unfavorable ones to be destroyed. The result of this would be the formation of new species. Here then I had at last got a theory by which to work (Darwin, 1899, p. 68).

There is no doubt among scientists that natural selection exists as a mechanism and that it works. The issue is whether or not new species can be produced from existing ones, as theorized by Darwin. The answer appears to be a resounding no. The evidence is nil at this point in history. Several leading scientists have also come to this conclusion. For example, Dr. Cohn Patterson states:

There is no doubt that natural selection is a mechanism, that it works. It has been repeatedly demonstrated by experiment. There is no doubt at all that it works. The question of whether it produces new species is quite another matter. No one has ever produced a species by mechanisms of natural selection. No one has ever gotten near it and most of the current argument in neo-Darwinism is about this question: how a species originates and it is there that natural selection seems to be fading and chance mechanisms of one sort or another are being invoked.*

Writing about the famous moth experiments, Matthews states:

The experiments show the effects of the predation on the survival of the dark and of the normal forms of the Peppered Moth in a clean environment and in one polluted by smoke. The experiments beautifully demonstrate natural selection—or survival of the fittest—in action, but they do not show evolution in progress, for however the populations may alter in their content of light, immediate or dark forms, all the moths remain from beginning to end *Biston betularia* (Matthews, 1971).

Darwin's idea of "favorable and unfavorable variations" was a move away from Baconian induction. His idea was soon labeled as natural selection. His argument

*Dr. Colin Patterson, on the subject of Cladistics, in an interview on British Broadcasting Corporation (BBC) television, March 4, 1982. Dr. Patterson is Senior Paleontologist at the British Museum of Natural History, London, England.

for natural selection is a deductive one in a syllogistic form. This can be seen in the following example:

1. living things reproduce (major premise),
2. living things show variations,
3. these variations can be favorable or unfavorable (minor premise), and
4. therefore, variations with favorable effects will succeed, unfavorable ones will be destroyed and the result will be change (conclusion).

Generally, if the premises are true the conclusions are necessarily true. However, Darwin made a leap in logic. He concluded that there would be change from one species to another. The problem is where is the evidence for such a conclusion? This has been the crux and focus of much effort on the part of evolutionary scientists for over 136 years. What has been the result of this search?

The fossil record does not hold the answer. It is a record of stasis, which is the absence of change—not the change predicted by Darwin. There are in fact several "living fossils" appearing today in the same forms they supposedly had millions of years ago. This stasis is confirmed by such notable evolutionary authorities as Stephen J. Gould who states:

Stasis is now recognized as an intriguing puzzle by evolutionists. No definitive resolution is in sight, but geneticists and embryologists have offered this counsel, I am tickled that our often maligned profession (dull, descriptive paleontology) has provided such a puzzle to kings of the theoretical mountain (Gould, 1991, p. 16).

Gould even sheds more light on the issue when he admits that the fossil record best fits a creationist model.

. . . our ability to classify both living and fossil species distinctly and using the same criteria fit splendidly within creationist tenets. But how could a division of the organic world into discrete entities be justified by an evolutionary theory that proclaimed ceaseless change as the fundamental fact of nature? (Gould, 1979, p. 18-26).

The evidence truly does fit a creationist model. Billions of highly complex fossils such as corals, jellyfish, mollusks, and crustaceans are found in the Cambrian sedimentary deposits without a single trace of the needed Darwinian transitional forms.

Darwin had another agenda beyond just proving that natural selection existed. He was interested in showing that God was not part of the process. This is asserted by Julian Huxley, who states:

Darwin pointed out that no supernatural designer was needed; since natural selection could account for any known form of life, there was no room for a supernatural agency in its evolution . . . we can dismiss entirely all idea of a supernatural overriding mind being responsible for the evolutionary process (Huxley, 1979, p. 45).

Most modern evolutionary scientists, even though the evidence is lacking, insist on viewing the theory as established fact and a foundation of all science. For example, note the words of Pierre Teilhard de Chardin,

Is evolution a theory, a system or a hypothesis? It is much more: it is a general condition to which all theories, all systems, all hypotheses must bow and which they must satisfy henceforward if they are to be thinkable and true. Evolution is a light illuminating all facts, a curve that all lines of thought must follow (de Chardin, 1965, 218).

Purves and Orians help to bring the discussion into a concise focus:

Biology (and all other major disciplines of Western thought) began a major change in paradigm a little over a century ago with the general acceptance of Darwin's theory of evolution by natural selection. The change over has taken a long time because it required abandoning many components of a different worldview. The pre-Darwinian world was thought to be a young one in which living organisms had been created in essentially their current forms. The Darwinian world is viewed as an ancient one . . . in which he would not recognize former living organisms of the future if we were transported forward in time, nor organisms of the past if we were transported back in time. Acceptance of this paradigm involves not only the acceptance of the process of natural selection, it also involves accepting the view that the living world is constantly evolving, but without any future "goals" (Purves and Orians, 1987, p. 19).

Purves and Orians openly state that the decision to accept Darwin's view regarding the origin of life is based on a choice. By rejecting the creationist view of God as Creator, they accept evolution as "god" instead.

Others have written about this new found "god" in more vivid terms. For example, Jeremy Rifkin writes:

Evolution is no longer viewed as a mindless affair, quite the opposite . . . one eventually winds up with the idea of the universe as a mind that over-sees, orchestrates, and gives order and structure to all things. We no longer feel ourselves to be guests in someone else's home and therefore obliged to make our behavior conform with a set of preexisting cosmic rules. It is our creation now. We make the rules. We establish the parameters of reality. We create the world. And because we do, we no longer feel beholden to outside forces. We no longer have to justify our behavior, for we are the architects of the universe. We are responsible for nothing outside ourselves, for we are the kingdom, the power, and the glory forever (Rifkin, 1983, pp. 188 and 244).

Rifkin helps one see many of the real issues behind the acceptance of evolutionary theory as a worldview. He boldly asserts that evolution gives order to the

universe. This assertion is given without one shred of evidence.

Second, Rifkin makes it clear this "god of change" affects behavior and beliefs. He claims that the absolutes of creationist's God's (preexisting rules) are not relevant. He then states who makes the rules—man. Clearly, humanism is his religion of choice. In a final act of blasphemy he states there is nothing outside of the mind of man.

This argument against an objective standard outside of the mind of man is nonsense. If one buys this argument it logically follows that truth can be established only in the minds of men. This is the essence of what he is saying. This leads to absurdity, for among the billions of persons on the planet, we wonder who holds the truth? With this line of reasoning we then see the crucial issue—there must be an objective truth outside of the mind of man. There is truth outside of man and that truth is found in the person of Jesus Christ the Creator.

The True Base for Worldview Formation

In reality it was creationist-based thinkers (thinking the thoughts of God), and not Charles Darwin who established the basis for modern science. These men include a veritable hall of fame of scientists. Among them are Louis Pasteur (1822-1895), Isaac Newton (1642-1727), Johann Kepler (1571-1630), Robert Boyle (1627-1691), James Clerk Maxwell (1831-1879), Michael Faraday (1791-1867), Carolus Linnaeus (1707-1778), Lord Kelvin (1824-1907), and Gregor Mendel (1822-1884).

The foundation that many of these men laid was in place long before Darwin and his infamous book of 1859: *The Origin of Species*. It should also be noted that the fruits of the labor of many of these men are of much greater "scientific importance" than Darwin's unproven theory of evolution. Among their notable "scientific" contributions were the following: Lord Kelvin's absolute temperature scale, Pasteur's law of biogenesis, Linnaeus' classification system, Newton's law of gravity, and Bacon's scientific method. This is just a sample of the accomplishments of men who based their thinking on God's Word.

These men established limiting principles for the discipline of science. These men viewed science as properly limited by (1) the senses and thus being empirically based; (2) an understanding that there is order in the universe; (3) quantitative nature of measurement; (4) a corrective nature which relies on replication, and (5) cause and effect or the law of first cause.

Thus, they have laid the foundation for a useful world view based on supernatural creationism. John Silvius clarifies how supernatural creationism fits into worldview formation:

On the basis of faith in God's objective revelation, Christians can conceive a reality beyond the senses, and make rational judgements that shape their view of a sovereign God, His creation, and His

sustaining power and purposes. This epistemology is the basis for a Christian world and life view, or worldview (Silvius, 1985, p. 5).

On the other hand, Darwin's thinking regarding the theory of evolution caused a paradigm shift and thinking that was not God-centered. This shift led to the modern day worldview based on the theory of evolution.

The Crucial Symmetry of a Creationist Paradigm

Science can be defined as a framework of information dealing with the design and the causal (or working) relationships of material and time-space aspects of the cosmos. Creationist theology, on the other hand, presents and verifies the knowledge of God as revealed in the Holy scriptures of the Bible.

It is evident that science has extended our understanding of our universe. This can be noted from the fact that we are exploring new realms on three fronts; space, the past, and the minute. Science thus pushes us toward thinking of things beyond our understanding of our senses. We begin to think of things of the heavens, the past, and the invisible. This thinking is not foreign to scripture. The believer is told to set his mind on the things above (Colossians 3:2), and Christ created all things (even those things which are invisible) (Colossians 1:16). We are also instructed to remember the Creator and the things He has done. This type of reasoning requires thinking about things of the past (Genesis 1-11).

Without such a basis for looking at these new realms, science is pushing our thinking into a realm of speculation. This is true since science cannot be done in a vacuum. Some context is forced to arise out of the exploration of data. Some assumptions must be made for data to be translated into knowledge.

The scientific method supports two basic assumptions: (1) truth can be derived from observations, and (2) phenomena conform to lawful relationships. Because the scientific method relies on observations (the use of our senses), a scientist must have faith that his senses are giving him an accurate picture of the natural world. Thus it is clear that "science requires faith" based on assumption number one.

Assumption number two leads to the same conclusion. Because a "scientist must have faith" that there is order in the universe and that he can discover this inherent order. At this point in the discussion it becomes clear that there must be something beyond man. Clearly man did not impose the order in the universe. The evolutionary worldview explanation of this issue would be that the order came out of the matter from which the universe came. This begs the question because it leaves us questioning the source of matter itself.

One's worldview is based on a belief system requiring faith in some object or thing that is outside of the individual holding the particular worldview. Thus truth is outside the mind of man and is, therefore, objective. This objective truth is not dependent on man for its

validity, which is consistent with the teaching of scripture (Romans 1:17-20, Hebrews 11:3).

The idea of such an objective standard broaches the question "what is truth"? The Romans passage deals with the non-believer's response to truth, in "that which may be known of God is manifest in them . . . Because that, when they knew God, they glorified Him not as God, neither were thankful; but became vain in their imaginations, and their foolish heart was darkened." This passage teaches that even though man knows there is a God he is in denial of the evidence of the creation because of his rebellious nature. This denial and rebellion leaves the non-believer "without excuse" or defenseless (Romans 1:20).

In contrast, the Christian is encouraged to examine reality carefully (1 Thessalonians 5:21). The Christian is encouraged to study and understand the earth and universe. The Christian is confident that truth is knowable.

In and of itself science is incapable of creating a worldview for mankind. Because it limits knowledge to the subjective mind, there is no way for science to evaluate itself or to create an explanatory structure for itself. In contradiction, creationism constructs a worldview from truth outside of man and then actively and obediently uses scientific evidence to explore the scientific workings of the mysteries in the universe.

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A MITOCHONDRIAL DNA ANALYSIS OF THE TESTUDINE APOBARAMIN

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Abstract

Baraminology is a biosystematic discipline for reclassifying organisms within the young-earth creation model. The method is presently dependent on 15 theoretically-defined membership criteria that are designed to reveal patterns of phylogenetic discontinuity in nature. This survey examines the utility of the molecular criterion for resolving phyletic divisions. As a case study, the non-trionychoidea cryptodires (turtles with hard shells and retractable necks) have been analyzed with a panel of nine mitochondrial genes. Sequence comparisons with non-testudines supported a previous hypothesis that the turtles were apobaraminic or phylogenetically distinct from other vertebrates. Analyses within the testudines suggested the non-trionychoidea cryptodires were composed of at least two monobaramins including the Cheloniidae family and Gopherus genus.

Introduction

The theory of special creation suggests the biota is composed of phylogenetically distinct units. Marsh (1941) proposed the word baramin as a technical term for these groups. He hypothesized the baramin could be identified as a reproductively isolated and morphologically distinct entity. The observable processes of organic evolution were interpreted as a mechanism for propagating diversity within the baramin (Marsh, 1976). Jones (1972) and Siegler (1974; 1978) concluded such biological distinctions generally occur at the family level of taxonomic classification. A framework for systematically characterizing baraminic boundaries was provided by the introduction of discontinuity systematics (Remine, 1990; 1993). The method was offered as an alternative to traditional systematic approaches, which are inherently incapable of recognizing phyletic divisions. Bartz (1991) encouraged the adoption of discontinuity systematics, and Wise (1990) incorporated its terms and methods into the young-earth creation model.

A battery of membership criteria have been offered to elucidate the baramin (Wise, 1992a). The molecular criterion is of special interest because it allows the investigator to quantify phylogenetic gaps at a fundamental level. For years creationists have suggested such analyses could provide powerful evidence for their position. Marsh (1971) stated:

One basic kind is unlike all other basic kinds because of its peculiar internal chemistry, the DNA of its genes. If different kinds are present we know these different chemistries are present also and effectively isolate one kind from another by bridgeless chemical abysses.

Denton (1985) demonstrated that the nested pattern of protein sequence diversity among major taxonomic assemblages was more consistent with a typological rather than macroevolutionary origin. Wise (1992b) suggested molecular similarities among adult organisms was evidence of a common Creator, much like a characteristic style is evidence of a certain artist. The current survey was designed to explore the utility of the molecu-

lar criterion for identifying phyletic divisions. In order to test previous systematic hypotheses the study has been placed within the context of turtle baraminology.

The history of turtle systematics has been marked by a long search for natural groups (Gaffney, 1984). Since the baramin is hypothesized to be a real biological entity it is possible that turtle phylogeny can be more accurately understood in terms of discontinuity. The current viewpoint of Frair (1991) is that all turtles form a single phylogenetically related baramin. A hypothesis by Wise (1992a) is that turtles are composed of two unrelated baramins including the pleurodires (side-necked), the cryptodires (hidden-necked). An earlier suggestion of Frair (1984) and the recent conclusion of Wise (1992a) suggests turtles form four baramins including the pleurodires (side-necked), the trionychoidea (soft-shells), the chelonoids (marine), the remaining cryptodires (an assortment of terrestrial and aquatic species).

Materials and Methods

Successive Approximation

Baraminology research involves a unique nomenclature that can be used to communicate the phylogenetic status of an organism or group of organisms. Since the goal of baraminic research is to recover the identity of phyletically distinct baramins it is necessary to prune an evolutionary tree. The tree can be approached from two directions (Figure 1). The root of a tree involves a unit called the apobaramin, which is defined as a group of organisms that may contain unrelated subgroups. Subtractive criteria such as stratomorphologic gaps are used to split these groups into smaller apobaramins. The tips of a tree involve the monobaramin, which is defined as a group of organisms related by common descent. Additive criteria such as the ability of organisms to hybridize are used to lump these phylogenetically related groups into larger monobaramins. The taxonomic distance between the apobaramin and monobaramin will decrease as the tree is pruned with more efficient criteria. The process of successive approximation theoretically will lead to an overlap in the apobaramin and monobaramin. The taxon constructed by this juncture is called the holobaramin, and is de-

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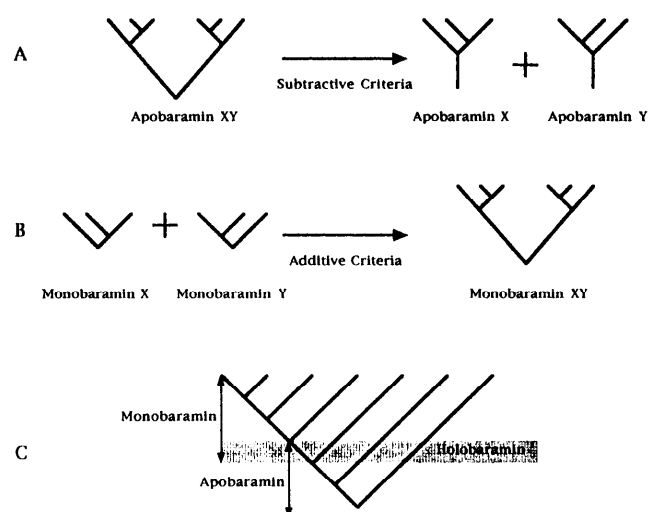


Figure 1. An illustrated description of successive approximation using baraminology nomenclature. The apobaramin is defined as a group of organisms contain phylogenetically unrelated subgroups. Subtractive criteria are used to split an apobaramin into smaller apobaramins (A). The monobaramin is defined as a group of organisms related by common descent. Additive criteria are used to lump monobaramins into larger monobaramins (B). The taxon constructed by the juncture or overlap of an apobaramin and monobaramin is called the holobaramin, which is defined as a complete set of organisms related by common descent (C).

defined as a complete set of organisms related by common descent. It is the primary goal of baraminology to identify the holobaramin, which is an estimate of a created biological unit. One advantage of identifying holobaramins by successive approximation is that the technique allows for incomplete knowledge regarding the organism's biology. Researchers are not obligated to hypothesize beyond the resolving power of their criteria.

Character Selection

The interest in understanding biological phenomena from a molecular perspective has led to exponential growth in the number of reported DNA and protein sequences. The availability of this information through the internet provides baraminologists with a rich source of comparative data. It is suggested that DNA sequences have a greater baraminic utility than protein sequences. Due to the degeneracy of the genetic code a pair of identical protein sequences can have a divergent underlying DNA sequence (Figure 2). This property makes DNA a preferable molecule for biosystematic studies, which are designed to measure differences among organisms.

In the 1950s mitochondrial DNA (mtDNA) was discovered. Avise et al. (1987) noted that mtDNA was an ideal molecule for biosystematic analyses. It generally contains no pseudogenes, introns, or highly repetitive sequences, which tend to complicate biosystematic studies. For most organisms mtDNA was found to be maternally inherited, and did not undergo recombination or other genetic rearrangements. Due to its mode of inheritance mtDNA would be especially sensitive to population bottlenecks. Wilson et al. (1985) stated:

Sequence 1:	Thr	Arg	Leu	Gly
	ACC	CGA	UUA	GGG
Sequence 2:	Thr	Arg	Leu	Gly
	ACG	AGG	CUC	GGA

Figure 2. DNA sequences are more powerful for resolving subtle differences between molecules. In this example the protein sequences are identical, but the underlying DNA is 50% divergent.

Because a single breeding pair of diploid animals contains four nuclear genomes and one transmissible mtDNA, a population that goes through an extreme bottleneck could lose all of its mtDNA variability and retain a significant fraction of its nuclear variability.

The young-earth creation model assumes at least one extreme population bottleneck during the Flood. This catastrophic event would have reduced most terrestrial vertebrates to two or seven representatives per holobaramin. Thus, for holobaramins with strict maternal inheritance of mtDNA one might expect more variability to exist across the member's nuclear genomes rather than their corresponding mitochondrial genomes. It is possible that such a pattern could be blurred due to the higher mutation rate of mtDNA. However, turtles are noted for having extremely slow mtDNA mutation rates (Bowen, Nelson, and Avise, 1993; Avise, Bowen, Lamb, Meylan, and Bermingham, 1992).

Sequence Acquisition

Mitochondrial DNA sequences were extracted from the GenBank and European Molecular Biology Laboratories (EMBL) databases via the internet and from the literature. All available testudine sequences were reviewed, and those representing the most taxa (Table I) and containing the most characters were used for analysis. Two protein coding genes (PC: cytochrome b, NADH dehydrogenase subunit II) and seven non-protein coding genes (NPC: 12S-rRNA, tRNAs for tryptophan, alanine, asparagine, cysteine, tyrosine, proline) were selected. The gene map (Figure 3) depicts the relative positions of sampled molecules within the human mitochondrial chromosome (Anderson et al., 1981).

Systematists frequently employ outgroup taxa to polarize their taxonomic characters against a presumptive ancestral state. Since baraminologists have not widely identified monobaramins it would be premature to focus on ancestral versus descendant characters. Outgroup taxa in this survey are defined as organisms that are taxonomically distinct from the group of interest. For example, to explore turtle/non-turtle relationships, sequences from five of the major vertebrate classes were accrued including: common carp (*Cyprinus carpio*), chicken (*Gallus gallus*), human (*Homo sapiens*), African clawed frog (*Xenopus laevis*), (GenBank/EMBL accession numbers: X02890, X52392, J01415, X61010). A variety of reptilian outgroups were chosen because no single reptile was represented by the selected molecules. These included: American alligator (*Alligator mississippiensis*), whiptail lizard

Table I. List of turtles included in this study.

Taxon	Number of Sequences	References
Bataguridae		
<i>Cuora amboinensis</i> ^a	1	c
<i>Malayemys subtrijuga</i> ^a	1	c
<i>Rhinoclemmys pulcherrima</i> ^a	1	c
Cheloniidae		
<i>Caretta caretta</i> ^a	7	a, f
<i>Chelonia agassizi</i>	1	a
<i>Chelonia mydas</i> ^a	5	a, e
<i>Eretmochelys imbricata</i> ^a	1	a
<i>Lepidochelys kempi</i> ^a	1	a
<i>Lepidochelys olivacea</i>	2	a
<i>Natator depressus</i> ^a	1	a
Chelydridae		
<i>Chelydra serpentina</i> ^a	1	a
Dermochelyidae		
<i>Dermochelys coriacea</i> ^a	1	a
Emydidae		
<i>Clemmys marmorata</i>	1	e
<i>Graptemys barbouri</i> ^a	2	c, d
<i>Graptemys caglei</i>	1	d
<i>Graptemys flavimaculata</i>	1	d
<i>Graptemys gibbonsi</i>	1	d
<i>Graptemys nigrinoda</i>	1	d
<i>Graptemys oculifera</i>	1	d
<i>Graptemys o. ouachitensis</i>	1	d
<i>Graptemys o. pseudogeographica</i>	1	d
<i>Graptemys pulchra</i>	1	d
<i>Malaclemys terrapin</i> ^a	4	c, d, f
<i>Trachemys scripta</i>	1	b
Testudinidae		
<i>Geochelone denticulata</i> ^a	1	c
<i>Geochelone gigantea</i>	1	c
<i>Gopherus agassizii</i> ^a	3	c
<i>Gopherus berlandieri</i>	1	c
<i>Gopherus flavomarginatus</i>	1	c
<i>Gopherus polyphemus</i>	2	c
<i>Manouria emys</i> ^a	1	c
<i>Testudo horsfieldi</i> ^a	1	c

^aBowen et al., 1993; ^bHedges, 1994; ^cLamb and Lydeard, 1994; ^dLamb et al., 1994;

^eKumazawa and Nishida, 1995; ^fSeutin et al., 1995.

^{*}Taxon selected for dendrogram construction.

(*Cnemidophorus uniparens*), western landed gecko (*Coleonyx variegatus*), Hydrophiid sea snake (*Emydocephalus ijimae*), tuatara (*Sphenodon punctatus*), (GenBank/EMBL accession numbers: D31621, S71826; References: Kumazawa and Nishida, 1995; Seutin, Lang, Mindell, and Morais, 1994). Chimpanzee (*Pan troglodytes*) sequences were selected for comparisons with human mtDNA (GenBank/EMBL accession number: D38113).

Sequence Alignment

In order to quantify differences among molecules their sequences must be properly aligned. This task was accomplished with the computer program CLUSTAL W (Thompson, Higgins, and Gibson, 1994). Many of the problems encountered with sequence alignment have been reviewed by DeSalle, Wray, and Absher

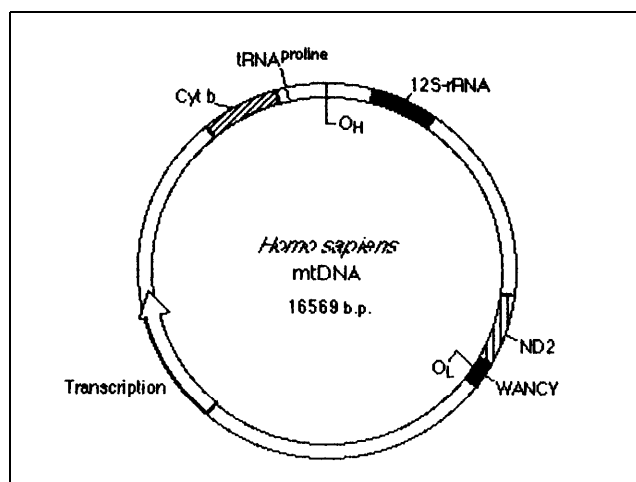


Figure 3. Gene map of human mitochondrial DNA showing relative positions of sampled genes.

(1994) and Wheeler (1994). Sequence alignment involves the identification of homologous nucleotide positions within homologous molecules, and is used as a basis for phylogenetic comparison. Some have suggested that sequence alignment cannot be treated separately from the construction of phyletic trees (Mindell, 1991; Feng and Doolittle, 1987; Hogeweg and Hesper, 1984). Since creationists do not assume all organisms or homologous molecules are related this approach has not been considered.

Sequence Analysis

When comparisons of nucleotide sequences are made, various differences can exist including substitutions and insertion/deletions or indels (Figure 4). Substitutions can be further divided into transition and transversion differences. A transition exists when a pyrimidine (T or C) is substituted by another pyrimidine; or a purine (A or G) is substituted by another purine. A transversion exists when a pyrimidine (T or C) is substituted by a purine (A or G) and vice versa. An indel exists when a nucleotide is inserted or deleted, which results in a longer or shorter sequence respectively. The relationship between transition differences and taxonomic distance is especially interesting. Substitutions between similar organisms are mostly transitions, and as taxonomic distance increases the proportion of transition differences decrease (Holmquist, 1983). Many

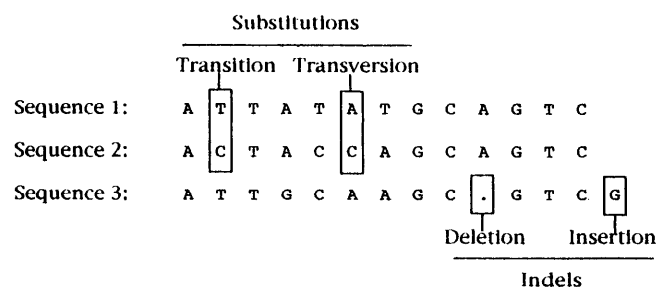


Figure 4. Diagram of three aligned DNA sequences illustrating nucleotide substitutions and indels.

explain this phenomena as homoplasy, and suggest that the genomes of divergent organisms are saturated with back mutations (Kraus and Miyamoto, 1991). Homoplasies are defined as similarities between organisms that are not a result of common descent. Wise provided a hypothesis for interpreting homoplasy within a baraminic context (1990, p. 351):

When a large number of characters is examined cladistically in a polybaraminic group of organisms, a young-earth creationist would expect that homoplasies would be unavoidable and frequent between organisms of different holobaramins. Conversely, for the organisms in the group which are part of the same holobaramin, it should be possible to construct a cladogram with few or no homoplasies.

Another explanation for the high proportion of transitions among similar organisms rests on the molecular structure of purines and pyrimidines. Since transitions involve the substitution of structurally similar molecules, perhaps the bias towards similar organisms is indicative of a baramin-specific mutation. Members of a baramin are hypothesized to be morphologically and physiologically similar, though not identical (Marsh, 1976). Transitional mutations may reflect a process of limited variation at the molecular level.

Sequence differences are commonly corrected for the unequal occurrence of transitions and transversions (Kimura, 1980). Since these assumptions deserve more study from the creationist perspective this survey uses raw uncorrected sequence differences calculated as the number of differences divided by the total sequence length. The program CLUSTAL W was used to calculate total sequence differences, and the differences attributable to transitions and transversions. As a method of summarizing the diversity of sequence differences among taxonomic groups, a plot of taxonomic rank versus average percent sequence difference was constructed. The percent sequence difference for species was calculated as the average difference for a subspecies and geographical variants within a given species. Genus differences were calculated as the average difference of species within a given genus, and so on for higher taxonomic levels. Class differences were calculated as interorder comparisons of turtles with the reptilian outgroups. Subphylum differences represent turtle comparisons with the four remaining vertebrate outgroups. For taxonomic rank the classification of Gaffney (1988) was used.

Hierarchical patterns encoded in turtle mtDNA were illustrated with unrooted dendrograms for cytochrome *b* using distance and parsimony methods. A variety of clustering techniques exist for analyzing sequence data (Felsenstein, 1988), and a given topology (i.e. branching pattern) should be considered a hypothesis. Congruence among topologies using several techniques indicates the pattern is supported by the data. Statistical confidence can be assigned to a topology using the bootstrap resampling method (Felsenstein, 1985). The

data set is randomly resampled and patterns that cannot be attributed to chance are recovered. Branches appearing at least 95% of the time are considered significant, but Hillis and Bull (1993) have noted that bootstrap proportions of 70% can be significant. The neighbor-joining algorithm (Saitou and Nei, 1987) was selected as the distance method because it is free from the assumptions of an evolutionary clock. CLUSTAL W was used to calculate neighbor-joining distances and evaluate the taxonomic patterns with 200 bootstrap iterations. Parsimony analysis was accomplished using the PAUP 3.1.1 computer package (Swofford, 1993). The aligned sequences were evaluated with a bootstrapped (200 iterations) 50% majority rule consensus tree using the heuristic search option, random addition of taxa, and TBR branch swapping. A pairwise matrix of homoplasies was calculated from the cladogram. The number of homoplasies divided by the total sequence length was used to explore the diversity of homoplasies among taxonomic levels. Since the computer time required to generate a dendrogram increases dramatically with the number of species involved, only one species from each genus that contained a cytochrome *b* sequence was selected for dendrogram construction (see Table I).

Scriptural Considerations

In baraminology the Scriptures can be used to generate biosystematic hypotheses. The Authorized Version mentions a tortoise *min* in Leviticus 19:29-30. Jones (1972) has argued that the Hebrew does not refer to the modern tortoise, but actually indicates a variety of lizard species. Regardless of the implied species, characteristics of the testudine baramin can be inferred from other Scripture. The ecological and morphological requirements that clean water swimmers contain fins and scales would categorize aquatic and marine turtles as unclean. The requirement that clean land swimmers have split hooves and display rumination would likewise categorize the terrestrial turtles as unclean. From Genesis 6 and 7 it is learned that unclean land vertebrates, such as the terrestrial turtle baramin, were preserved on the Ark in pairs. Many organisms including fish, invertebrates, and some amphibians were not required to be taken on the Ark (Jones, 1973; Woodmorappe, 1994). Marine turtles are designed to survive at sea, which indicates they would be excluded from the Ark. However, the geophysical upheavals associated with the Flood would have caused high mortality in free swimming marine turtle populations. It is doubtful that aquatic turtles could have survived an extended period outside the Ark. These species are much smaller than marine turtles and are weaker swimmers.

The diversity of turtle mtDNA from different habitats can be evaluated for patterns consistent with Biblical history. If modern turtles are monobaraminic and descended from a single pair preserved on the Ark, we might expect to observe an even distribution of mtDNA variability among the various aquatic, marine, and terrestrial species. In contrast, if modern

Table II. Summary of mitochondrial DNA sequence data used in this study.

Gene	Sequence Length ^a	Number of Variable Sites ^b	Number of Comparisons
Cytochrome <i>b</i>	213 b.p.	128 (0.60)	980
NADH dehydrogenase subunit II	164 b.p.	141 (0.86)	11
12S-rRNA	64 b.p.	47 (0.73)	11
WANCY ^c	355 b.p.	204 (0.57)	26
tRNA ^{proline}	52 b.p.	49 (0.94)	18

^ab.p. = base pairs.^b(proportion of variable sites).^cGene cluster of five tRNAs with single-letter abbreviation of amino acid anticodon (W = Tryptophan, A = Alanine, N = Asparagine, C = Cysteine, Y = Tyrosine). Spacer sequences were not included in the analysis.

turtles are polybaraminic and descended from several pre-Flood monobaramins the mtDNA might reflect differing degrees of variability. Specifically, we would expect the marine turtles to display more mtDNA variability because the population bottleneck in these species could have been less extensive than in terrestrial species.

It has been asked whether thresholds in overall DNA similarity exist, which could be used to consistently identify baraminic boundaries (Remine, 1990). To explore this question the sequence differences among monobaraminic turtles have been compared with a biologically similar but baraminically distinct standard, human-chimpanzee sequences. Scriptures indicate these taxa are phylogenetically unrelated even though they share many similarities. Thus, if thresholds in overall DNA similarity exist we would expect sequence differences between humans and chimpanzees to be greater than or equal to the differences between monobaraminic turtles.

Results

Sequence Variation

The mtDNA sequences averaged a length of 169 bases with 113 variable positions (Table II). The WANCY gene cluster generated the longest sequence alignment, but was the least variable. Alternatively, tRNA^{Proline} was the shortest sequence and the most variable. Cytochrome *b* was the most speciose gene available with 980 comparisons. It is preferable to analyze sequences at least several hundred bases in length (Graybeal, 1994) because longer sequences are analogous to larger sample sizes. The relatively short sequences used in this survey would indicate the data set was of minimal baraminic utility.

A plot of taxonomic rank versus average percent sequence difference summarizes the nucleotide comparisons (Figure 5). Four patterns are notable. First, NPC genes are more divergent at higher taxonomic levels (i.e. subtractive comparisons between turtles and outgroups), whereas PC genes are more divergent at lower taxonomic levels (i.e. additive comparisons within turtles). The large standard deviations associated with higher-level comparisons indicates an excess of

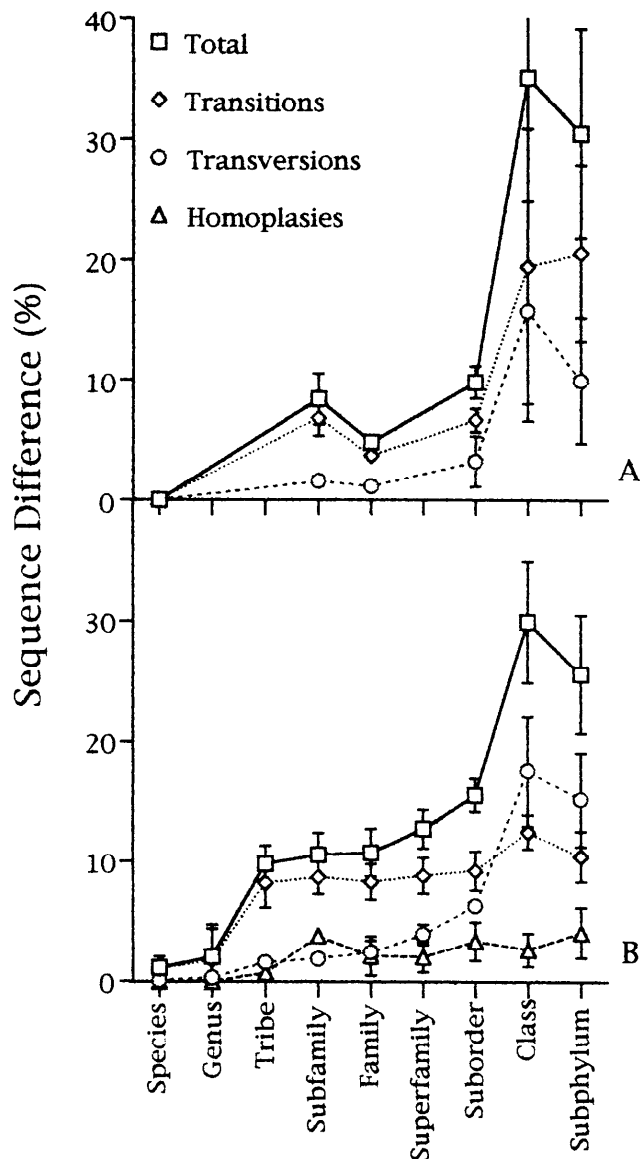


Figure 5. Sequence differences averaged ($\pm$ SD) across taxonomic ranks for non-protein coding (A) and protein coding (B) mitochondrial genes.

variation at these levels. Secondly, for PC genes the transition and transversion lines intersect near the turtle outgroup boundary. Thirdly, for both PC and NPC genes there are two areas of large sequence divergence, which will be designated the tribe “hill” and class “mountain.” Finally, the sequence differences attributable to homoplasies remain relatively constant beyond the level of subfamily.

Subtractive Comparisons

Holobaramin identification is accomplished by successive approximation of apobaramins and monobaramins (see Figure 1). The outgroups in this analysis were chosen to assess the relationship of turtles to non-turtles, which is a subtractive comparison for approximating apobaramins. The sequence differences between turtles and outgroups for cytochrome *b* and the

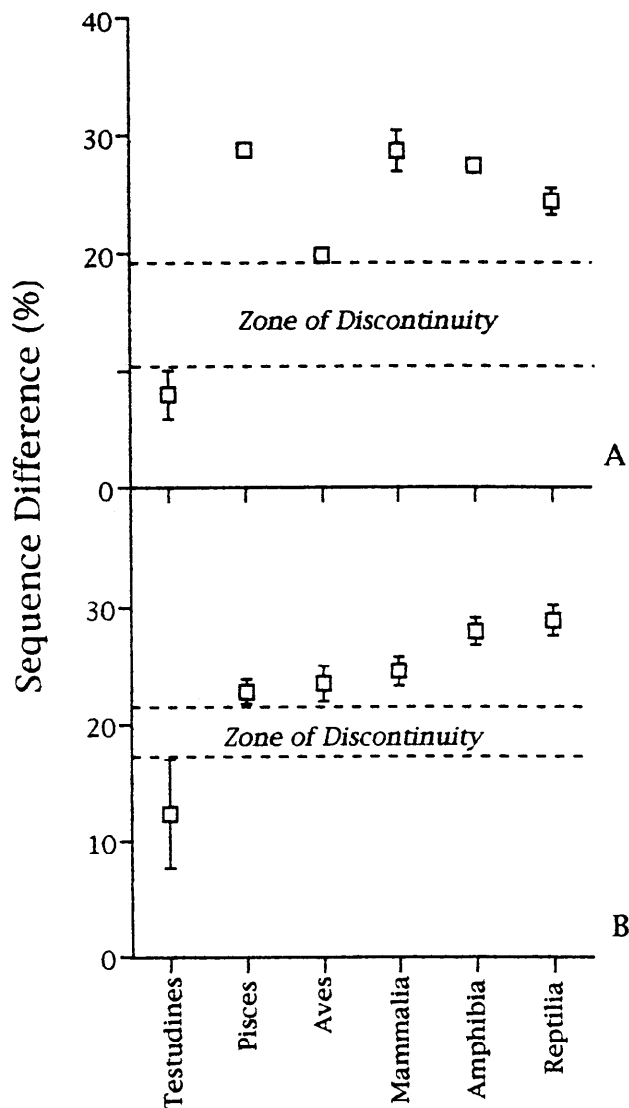


Figure 6. Sequence differences averaged ($\pm$ SD) for turtle-turtle and turtle-outgroup comparisons using WANCY (A) and cytochrome *b* (B) genes.

WANCY gene cluster demonstrates a gap between these taxa (Figure 6). It is noted that for cytochrome *b* the turtle-reptile comparisons were more divergent than the other outgroup comparisons. Denton (1985, p. 293) noted such phylogenetic discrepancies commonly occur, "the molecules provide little support for this 'sequential' interpretation of the vertebrate classes." Both baraminologists and macroevolutionists have suggested that the differences between genes might not coincide with the differences between species, but given enough gene comparisons the historical patterns would become apparent (Patterson, 1987; Wise, 1992a). In this study nearly one-fourth (9/37) of the mitochondrial genes were sampled and macroevolutionary relationships were still not revealed.

As previously noted total sequence difference can be partitioned into transition and transversion differences. When these components are plotted against each

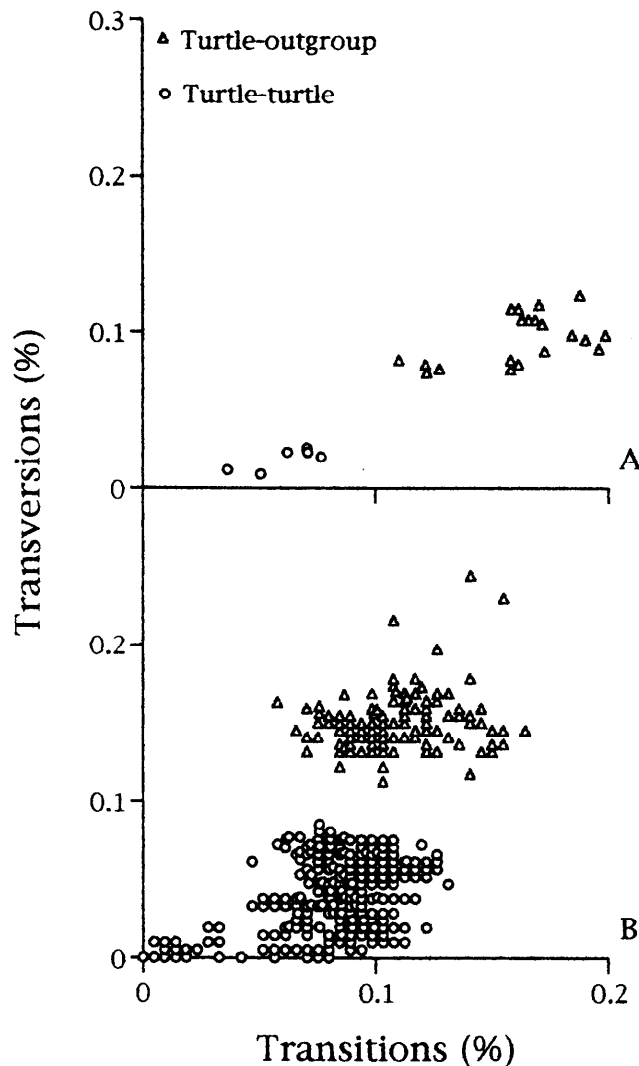


Figure 7. Transition versus transversion sequence differences for WANCY (A) and cytochrome *b* (B) genes.

other an intriguing pattern emerges (Figure 7). In addition to the two obvious clusters (one purely turtle, one purely outgroup) note the absence of transitory data points. There is a definite chemical abyss separating these two groups. In addition to the previously mentioned outgroups, 21 other vertebrates were compared to determine if the pattern was merely an artifact of small sample size. All comparisons confirmed the validity of the pattern (data not shown).

Additive Comparisons

The hybridization criterion has been emphasized for grouping phylogenetically related taxa (Scherer, 1994). For n species in a given taxon there are $(n^2 - n)/2$ possible hybrids. Approximately 236 extant turtle species have been identified (Pritchard, 1979a), which amounts to 27,730 possible hybrids for the testudine order. A list of 84 turtle crosses has been compiled by Frair, but only 42 of these experiments involve inter-specific comparisons or higher (Frair, personal communication). Among the turtles included in this study

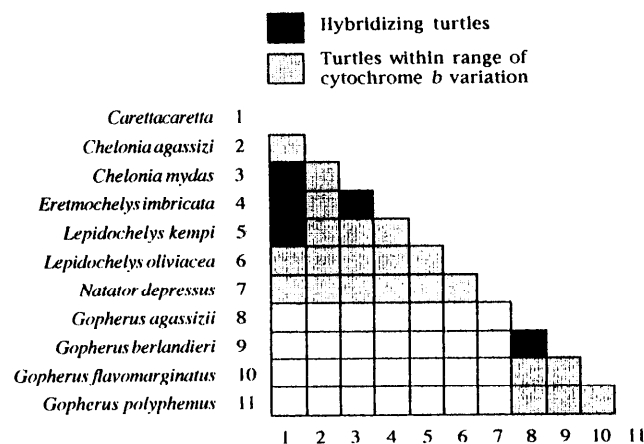


Figure 8. Hybridogram characterizing the Cheloniidae and *Gopherus* monobaramins.

six species are accurately known to hybridize: *Caretta caretta* x *Chelonia mydas*, *Eretmochelys imbricata*, *Lepidochelys kempii*; *Chelonia mydas* x *Eretmochelys imbricata*; *Gopherus berlandieri* x *Gopherus agassizii* (Conceicao, Levy, Marins, and Marcovaldi, 1990; Karl, Bowen, and Avise, 1995; Shaw, 1946; Wood, Wood, and Critchley, 1983; Woodbury, 1952). Turtles that are not known to hybridize, but fall within the range of cytochrome *b* sequence variation of hybridizing turtles can be lumped to form larger monobaramins. This approach was originally proposed by Remine (1990) and expounded by Wise (1970, 1992a) as the experimental or artificial variation criterion. Using this technique, two monobaramins were constructed including the complete Cheloniidae family, and the *Gopherus* genus (Figure 2). Among these turtles the distribution of cytochrome *b* sequence variation is peculiar (Figure 9). The bimodal appearance suggests two distinct assemblages of turtles can hybridize.

Clustering

The neighbor-joining dendrogram for cytochrome *b* DNA (Figure 10a) depicts branches that are proportional to total sequence differences. Turtles and outgroup taxa cluster as separate units with long branches leading to the later. The cladogram (Figure 10B) was notably congruent with the neighbor-joining dendrogram. The Testudinoidea cluster (i.e. Bataguridae + Testudinidae + Emydidae) was more highly resolved in the cladistic analysis, but received little bootstrap support. The Dermochelyidae + Chelydridae cluster is probably artificial since the group received negligible bootstrap support for both dendrograms. A homoplasy index can be calculated for parsimony-based dendrograms as $1 - R/L$, where *R* is the minimum number of synapomorphies and *L* is the length of the dendrogram (Kluge and Farris, 1969). The value has a range of 0 to 1 in order of increasing homoplasy, and is a goodness-of-fit measure indicating convergence in the data set.

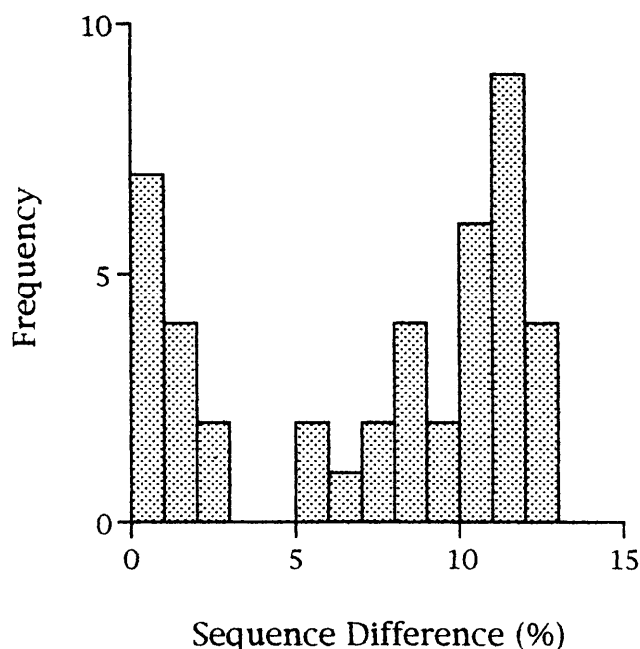


Figure 9. Frequency distribution of cytochrome *b* sequence differences for monobaraminic turtles.

Table III. Comparisons of sequence differences among turtles, hybridizing turtles, and human-chimpanzees.

Comparison	Average Sequence Difference (%) ^a				
	Cytb	ND2	12S	WANCY	tRNA ^{Pro}
All turtles	12.34 (4.67)	16.77 (0)	12.07 (0)	7.97 (2.08)	6.41 (5.55)
Hybridizing terrestrial turtles	3.99 (2.03)	—	—	—	—
Hybridizing marine turtles	7.38 (4.30)	—	—	5.92 (0)	6.41 (5.55)
Human-chimpanzee	9.39 (0)	8.54 (0)	4.69 (0)	2.93 (0)	3.92 (0)

^a(±SD).

The cladogram in Figure 10B required 467 steps and generated a homoplasy index of 0.597 as calculated by PAUP. Excluding the outgroup taxa from the data set reduced the cladogram to 261 steps, but still maintained a large homoplasy index of 0.586.

Similarity Thresholds

Sequence comparisons between humans and chimpanzees are summarized in Table III. Only cytochrome *b* differences between monobaraminic turtles were less than human-chimpanzee differences. The variation among marine turtle WANCY and tRNA^{Proline} sequences was approximately twice the value of human-chimpanzees. This data indicated that NPC genes may be unsuitable for evaluating threshold similarities, but a larger sample is necessary to make generalizable conclusions.

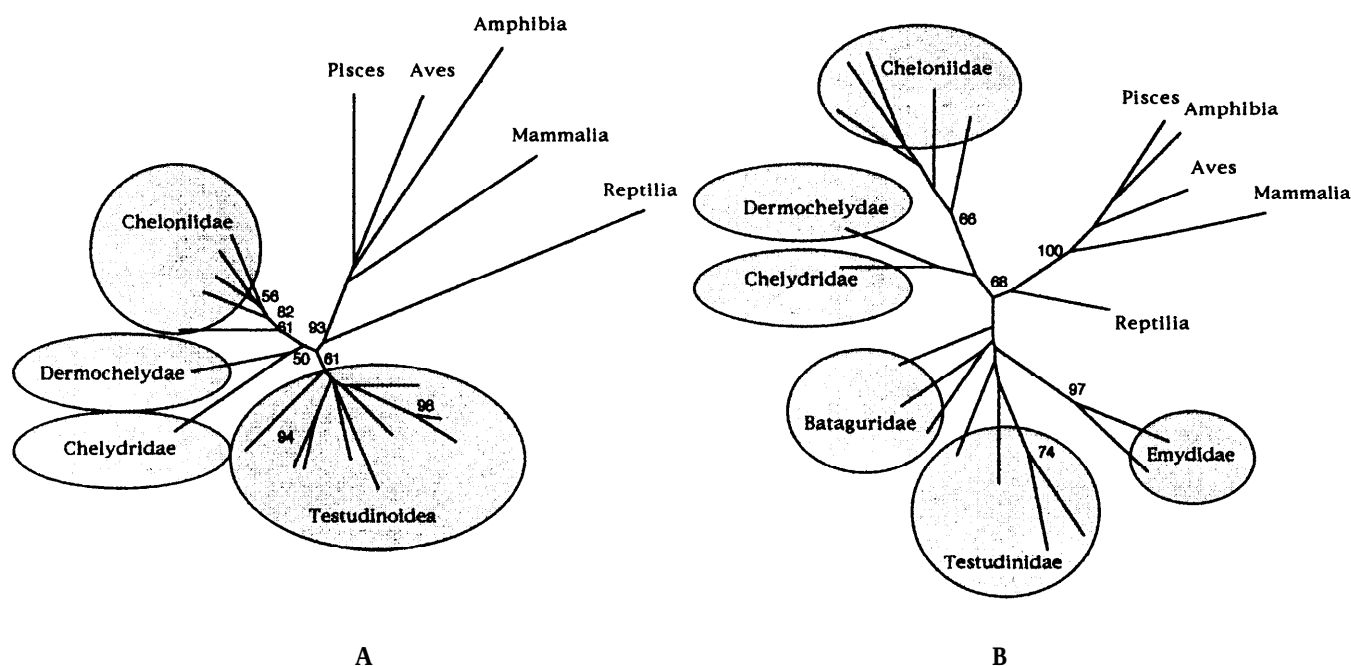


Figure 10. Unrooted dendrograms of cytochrome *b* constructed by distance (a) and parsimony (b) methods. The branch lengths are proportional to sequence differences in the neighbor-joining dendrogram. Numbers at nodes refer to bootstrap proportions. Only nodes recovered at least 50% of the time are reported. The ellipses denote natural groups within the testudine apobaramin.

Discussion

Systematic Hypotheses

Subtractive comparisons provided four lines of evidence supporting the hypothesis that turtles are apobaraminic:

- (1) The class "mountain" of Figure 5 is indicative of a large gap between the PC and NPC mtDNA genes of turtles and other vertebrates.
- (2) The transition and transversion intersection for PC genes between turtles and reptiles (Figure 5). Nucleotide substitutions between similar organisms are largely transitions, but transversions are predominant when turtles and outgroups are compared.
- (3) Clearly definable gaps between turtles and outgroups as revealed by total sequence differences (Figure 6) and transition/transversion sequence differences (Figure 7). The data in Figure 6 also implies discordance between the mtDNA sequences of turtles and the supposed phylogenetic lineage of the vertebrates. If turtles had evolved from reptilian ancestry the reptilian sequences should have been more similar to the turtles than the other vertebrates.
- (4) Topological congruence and strong bootstrap support for the separation of turtles and outgroups (Figure 10). The large homoplasy index calculated for the cladogram in Figure 10b was also supportive of phylogenetic discontinuity.

The exclusion of outgroup taxa from the parsimony analysis only reduced the homoplasy index by 0.011.

The remaining high degree of convergence indicated that additional apobaraminic boundaries existed within the testudine apobaramin, and further challenged Frair's hypothesis (Frair, 1991) that turtles are holobaraminic. The gaps identified by the molecular data are corroborated by morphological and paleontological criteria. Pritchard stated:

The first unquestionable turtles are of Triassic age, but despite the numerous primitive features of these early representatives, they shed little light on the evolution of the Order Testudines from its presumed cotylosaurian ancestors (1979a, p. 5). One can only speculate how the Proganochelyiidae evolved from the primitive reptile stem (1979b, p. 73)

In a cladistic survey of turtle morphology Gaffney and Meylan (1988, p. 160) noted, "Although there have been efforts to discover the 'ancestor' or closest relative of turtles, no consensus has been reached."

Hybridization is considered one of the most reliable additive membership criteria (Wise, 1992a). Since only 0.15% (42/27,730) of the possible turtle crosses have been reported it is likely that current turtle monobaramin estimates are very conservative. The Cheloniidae and *Gopherus* monobaramins were constructed based on reasonably strong data:

- (1) Hybridization and cytochrome *b* sequence variation (Figure 8).
- (2) Bootstrap supported clusters based on phenetic (Figure 10A) and cladistic (Figure 10B) dendrograms.

Monobaramin Characteristics

The increase in cytochrome *b* homoplasies at the level of subfamily suggested an appreciable amount of homoplasy can exist within monobaramins, which questions the hypothesis of Wise (1990). Separate analyses of marine turtle and *Gopherus* mtDNA yielded homoplasy indices of 0.230 and 0.159 respectively (Dutton, Davis, Guerra, and Owens, 1996; Lamb and Lydeard, 1994). The latter index is probably inflated because the study included the genus *Manouria* as an outgroup, which in this survey was 8.72% ($\pm 0.97\%$) divergent from *Gopherus*. These data clearly indicate that convergent evolution can occur within the monobaramin.

Wise (1992a) postulated that members of a holobaramin might occupy similar habitats and trophic levels. Species of the Cheloniid monobaramin share a marine environment by partitioning its resources through different migratory patterns and food preferences (Hendrickson, 1980). Diverse trophic categories such as herbivory, omnivory, and carnivory are represented by the marine turtles. Conversely, the gopher tortoises occupy a more diverse habitat from the humid south-eastern United States to the arid highlands of central Mexico. All taxa comprising the *Gopherus* monobaramin are herbivorous (Bury, 1982). These conflicting data indicate the ecologic and trophic membership criteria may be of little significance for defining baramins. However, these criteria can be used to provide a better understanding of monobaramin biology. Tyler (1996, p. 1) recently raised important questions regarding the range, of trophic variation within baramins:

we are only beginning to address the question of how much variation can occur within a created Kind and, in particular, whether the genotype carries the information necessary for a herbivorous ancestor to develop a carnivorous descendant.

All members of vertebrate holobaramins were originally created as herbivores (see Genesis 1:30). The expression of carnivorous behavior appeared later, either after the Fall (Stambaugh, 1991) or after the Flood (Lambert, 1983). The observation that the Cheloniid monobaramin exhibits a variety of trophic categories is supportive of a large amount of created diversity within the holobaraminic gene pool.

The hypothesized turtle monobaramins are composed of endangered and threatened species (Bury, 1982; Bowen, Nelson, and Avise, 1993). Human activities are responsible for a majority of the excess mortality, but natural factors are also involved. This observation is significant in light of the fact that modern conservation measures discourage the production of interspecific hybrids (O'Brien and Mayr, 1991). Hybridization tends to obscure the boundaries of biological species, and

modern conservation biology aims to protect species. The creationist position suggests that holobaramins have historically been the units of natural conservation, since the *min* not the species was preserved during the Flood (see Genesis 6:20, 7:14). Biologists have traditionally viewed hybrids in a negative context as unfit mutants, but recent data challenges this approach. Hybridization can result in rapid microevolution (Arnold, 1992) and increased fitness (Arnold and Hodges, 1995). If hybridization is a natural mechanism for generating diversity within the holobaramin, then the preservation of monobaramins could prove more efficient and successful than current procedures

Cytochrome *b* sequence variation was consistent with a polybaraminic origin for post-Flood turtles (Table III). The variation within monobaraminic marine turtles was nearly twice that for terrestrial species, which could indicate the population bottleneck caused by the Flood was more severe in terrestrial turtles. Alternatively, it could be argued that the observed sequence diversity is an artifact caused by taxonomic structure. Since comparisons within the Cheloniidae monobaramin (i.e. family) involve greater taxonomic distances than comparisons within the *Gopherus* monobaramin (i.e. genus) one would naturally expect a larger degree of sequence variation among the marine turtles.

Method Reliability

Wise (1992a; 1992b) noted that not all molecules would be useful for identifying phylogenetic discontinuity. The effects of a common Creator, optimally efficient structural and functional motifs, common metabolic needs, etc. would tend to reduce a molecule's holobaramin specificity. The baraminic utility of a molecular data set is dependent on several factors including: the type of molecule selected, sequence length, and the proportion of variable sites within the molecule. When these parameters are maximized the efficiency of the molecular discontinuity criterion should increase.

It is crucial to develop a statistical framework for evaluating molecular data from a baraminic perspective. Wise (1992a) had suggested ANOVA and principal components analysis, but these techniques are not used in molecular studies. A related technique called ordination analysis (Higgins, 1992) might prove useful, and a least-squares method for evaluating the statistical significance of sequence differences has been published (Tyson and Fieldes, 1992; Tyson, 1992). While multi-criterial approaches for resolving baraminic relationships should prove most efficient, molecular data sets will be of prime importance. Fitch and Atchley (1987) documented that among life history, molecular, and morphological characters the molecules recovered the correct phylogeny for a group of laboratory mice of known genealogy.

Summary

Successive approximation has been shown to be a conservative approach for identifying holobaramins that is limited by the baraminic utility of the data set. In this study holobaraminic relationships were unresolved because there was no juncture of the apobaramin with the monobaramin. Further research with more powerful data will be required to accurately approximate the holobaramin. An apobaraminic boundary was characterized, which separated the turtles from other vertebrates. Two biologically significant monobaramins have been identified including: the Cheloniidae or marine turtle monobaramin and the *Gopherus* or desert tortoise monobaramin. The boundaries elucidated by molecular data suggested the homoplasy criterion was sensitive to monobaraminic divisions, while the baraminic utility of the ecologic and trophic criteria was questioned. Several practical techniques have been outlined for analyzing sequence data, which are widely available through the internet. The application of these methods to a variety of organisms will advance our knowledge about a creation shaped in perfection, but now marred in decay.

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Polystrate tree cast in oolitic dune ridge, New Providence Island, Bahamas. This tree cast reveals the rapid build-up of carbonate sand from probably just one storm. Vast amounts of ooids would be available for dune development with a drop in sea-level during the Ice Age Timeframe. Current climatic models for the Pleistocene fail to provide the storm energy necessary to account for this rapid build-up of carbonate ooids and their subsequent lithification. Young-earth atmospheric studies support storm tracks and associated energies necessary to account for the rapid burial of this tree by migrating ooids. Photograph and caption by Carl R. Froede, Jr. See *CRSQ* 3:21-25 for an article on polystrate fossil trees.

ARCHAEOLOGICAL AND GEOLOGICAL FEATURES AT FALLING WATERS STATE RECREATION AREA, FLORIDA: A YOUNG-EARTH FLOOD MODEL PERSPECTIVE

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Abstract

The Florida Panhandle provides numerous examples of solutional limestone features, also referred to as karst. Archaeological evidence indicates that paleo-Indian cultures used many of these sites as both water sources and communal areas. One specific site, the Falling Waters State Recreation Area, is a locale where paleo-Indians are suggested to have once hunted mammoth. Additionally, this site provides a location where several different types of karst features are observed. Uniformitarians suggest that all of these karst features formed over the course of tens to hundreds of thousands of years. In following the Young-Earth Flood Model we would suggest that these features developed over the course of a few thousand years. We would interpret these features as probably originating at the close of the Flood with continued development extending throughout the single Ice Age Timeframe. Wet weather conditions coupled with changes in sea-level were the greatest factors in forming this karstic terrain.

Introduction

Falling Waters State Recreation Area (FWSRA), located in Washington County in the Florida Panhandle, boasts several interesting geological features (Figures 1 and 2). The centerpiece of this area is the 100-foot deep by 20-foot wide cylindrical Falling Water Sink (Figures 3 through 5). During wet seasons a small stream cascades into this feature and disappears into the subsurface (Rupert and Lane, 1992). Adjacent to the waterfall are a series of sinkholes which interconnect in the subsurface forming a small cave network (Figures 6 and 7). These limestone solution features, also referred to as karst, are somewhat common to sections of the Florida Panhandle due to the presence of limestone layers immediately beneath the thin cover of clastic strata and surficial soils. Uniformitarians suggest that all of these karst features formed over the course of tens to hundreds of thousands of years. In following the Young-Earth Flood Model we would suggest that these features have formed over the course of a few thousand years. We would interpret these features as probably originating with local tectonic uplift during the late stages of the Flood coupled with changes in sea-level caused by the ensuing ice age. Additionally, we suggest that the wet climate associated with the approximate 700 year single ice age (Oard, 1990, p. 191) provided sufficient time and the necessary conditions to further develop these karstic features into what we observe today.

Area Geomorphology

The FWSRA lies within a broadly dissected area commonly referred to as the Marianna Lowlands Province (Maddox, 1993, p. 3; Rupert and Lane, 1992; Scott, 1991, 1992; Vernon, 1942). This province is believed to

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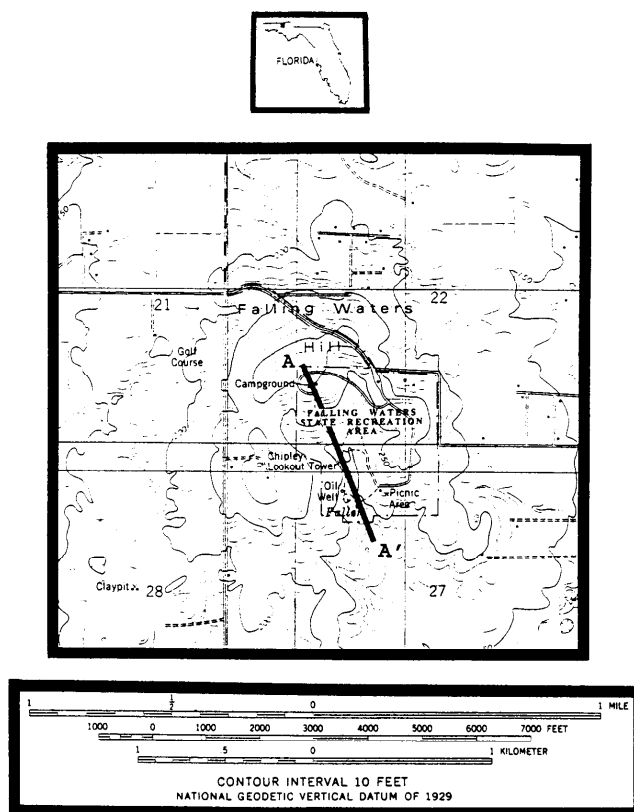


Figure 1. U.S. Geological Survey map showing the general area surrounding Falling Waters State Recreation Area. Note the arcuate shape of the Falling Waters Hill surrounding the sinkhole area. The topography serves to funnel surface waters and associated groundwater into this limited area and probably has served to accelerate the formation of the solutional features found in the limestone. The cross-sectional line is presented in Figure 2.

have formed as a result of uplift associated with the Chattahoochee Anticline, located to the northeast of FWSRA (Chen, 1965, pp. 1-3; Scott, 1991, p. 5; 1992, p. 8). However, Patterson and Herrick (1971) have sug-

gested that the Chattahoochee Anticline is much more localized and is more properly identified as the Gordon Anticline (Figure 8). Even more recently the Chattahoochee Anticline has been projected as a NE-SW trend, splitting the middle between the previously identified N-S and E-W trends (Maddox, 1993, p. 6; Rupert, 1994, p. 4; Schmidt, 1984). Hence, the subsurface structure of this anticlinal feature beneath this area of the Tri-States remains somewhat unresolved in terms of its exact size and direction. However, there is sufficient evidence to suggest that some uplift has occurred within the area and has resulted in the formation and development of the Marianna Lowlands Province.

The former erosion and removal of the clastic strata within this general area has served to expose carbonate rock at earth's surface. The timing of this interplay of geologic forces remains unclear, but it appears to correlate to the middle/late Eocene. Following the removal of clastic overburden, broad areas of limestone rock exposed within the Marianna Lowlands appear to have undergone extensive erosion. The weathering of the limestone surface along with the solutional enlargement of joints and fractures resulted in the development of a karst topography. Today surface precipitation continues to enter the limestones of the Marianna Lowlands via joints and fractures, it then migrates south and southwestward following the dip of the limestone formations

and the hydrologic pressure gradient (Schmidt and Coe, 1978, p. 4).

Several limestone outliers and ridges exist within the Marianna Lowlands Province which attain several hundred feet difference in elevation from the surrounding limestone plain (Schmidt and Coe, 1978, p. 1; Vernon, 1942, p. 37). It is in these higher areas that there is the most pronounced development of solutional pits and caves. According to Maddox (1993, p. 3), Falling Waters Hill is one of these erosional outliers in eastern Washington County, within the Holmes Creek watershed. He further states:

Elevated carbonates of the Miocene Chattahoochee Formation and underlying Oligocene Suwannee Limestone provide the host rock, where solution has progressed downward along major vertical joints and fractures. These resulting vadose cave passages are deep for Florida, due to the thickness of limestone existing above the relatively low potentiometric surface of the upper Floridan aquifer system.

The dip of the limestone layers within the Marianna Lowlands Province reflects the effect of the uplift from the northeast. This uplift created fractures and joint sets which directly contribute to the development of karst within this province (Kastning, 1984). Within

FALLING WATERS RECREATION AREA

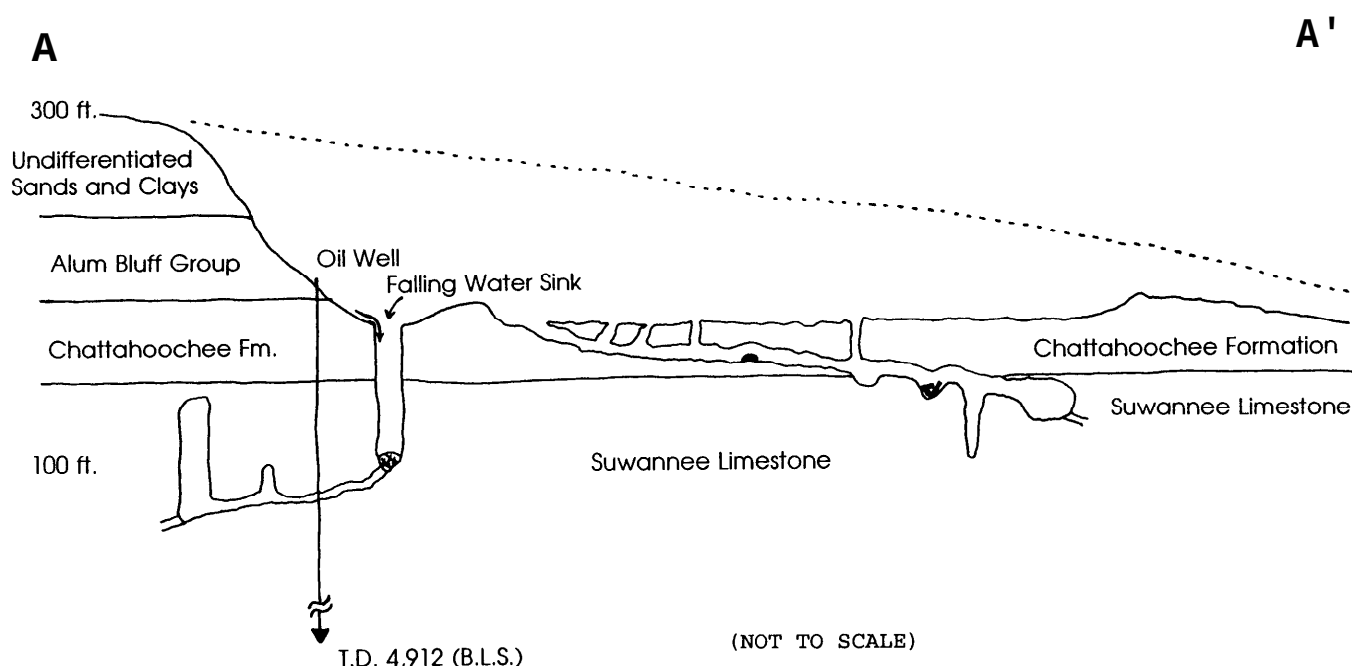


Figure 2. Generalized cross-section (not to scale) showing the Falling Waters Sink and adjacent cave network. Both of the cave systems end where waters flow beneath limestone ledges. The dotted line represents the general slope of the Falling Waters Hill surrounding the sinkhole area. Trees and associated debris wash from the surrounding area into the sinkhole and cave systems and are displayed as the black elongated features in the pits and depressions. All but the uppermost sections of the stratigraphy for the Falling Waters area probably represent Floodwater deposits. See text for additional explanation.

the FWSRA the limestone layers are only exposed in certain places due to the elimination of the overlying undifferentiated sands and clays, and the Alum Bluff Group sediments (Figure 2). This concept and its interplay on the formation of karst at FWSRA will be developed later within this paper.

Area Archaeology

Archaeological and paleontological evidence indicates an interesting history for the Florida Panhandle. Excavation sites across this area suggest that early Indians hunted mammoths in the area as late as 7500 years ago* (Boxrud, 1995). Such archaeological associations are rather typical for exposed karst formations in Florida. This same information can also help young-earth creationists in placing the geologic formation of Falling Waters and similar karstic sites in Florida within the context of the Flood Event/Ice Age time frames (Froede, 1995a). Archaeologists and paleontologists have for years been studying the human and animal remains found in such Florida karst formations (Bense, 1994; Clausen et al., 1979; Purdum, 1992; Rosenau, Faulkner, Hendry, and Hull, 1977; Rucker, 1996, p. 219; Rupert, 1988; Stamm, 1994, p. 70). Recent work along the Aucilla River (east of FWSRA) and other sites in Florida has unearthed early Indian artifacts with mammoth, mastodon, bison, and other megafauna fossils from the Pleistocene (Faught, 1988; "The Tusk . . .," 1995). Even the remains of possible prehistoric butchering sites have been discovered (Dunbar, 1995; Hoffman, 1983; Neill, 1964; Richardson, 1988; Serbousek, 1983). Some of the spear points found in association with these sites suggest that the early American Indians may have migrated from Asia to lower latitudes through an Eastern North American passage rather than through the Far West as traditionally viewed (Wilford, 1994).

Florida's paleontologists have long realized that the presence of fossil animal remains in the present-day river environment is the result of drastic sea-level changes in the past, particularly during the ice age, when sea-level in Florida was much lower. In fact, a number of inundated sinkholes with paleontological and archaeological features have been located off the coast of Florida on the continental shelf. These submarine sites hold potentially valuable artifacts (Anuskiewicz, 1988; Dunbar, 1988a, 1988b; Faught, 1988; Lazarus, 1965; Serbousek, 1988; "Underwater site. . .," 1995). Attempts have been made by paleontologists to reconstruct the late Pleistocene and early Holocene environments of Florida, and the results suggest a diverse paleoclimate, with wet and dry environments

*Note—The authors accept neither the philosophical assumptions nor the vast time frames of the uniformitarian worldview. Later we will suggest an interpretation following the Young-Earth Flood Model using the creationist geological timescale previously suggested by Froede (1995a).



Figure 3. Small surface stream discharges into the Falling Water Sink. Note person in lower left for scale. This stream is the result of both overland flow and groundwater discharge.

coexisting in close proximity. Sea-level also changed rapidly during this time due to the waxing and waning of the continental glaciers. Paleo-Indian hunters tracked animal herds across many areas of Florida. Today, several of these "kill" or "butchering" sites have been located in places that are now underwater (Carbone, 1983).

Several items pertinent to creationist research can be drawn from these developments alone. The ice age, at least in the Southeastern United States, is believed to have promoted diverse fauna on a relatively grassy landscape. In the stages of regrowth following the Flood, along with the climate changes of the single ice age (Oard, 1990, pp. 78-91, 127-128; Vardiman, 1993, 1994; Whitcomb and Morris, 1961, pp. 288-326), these extensive grasslands would seem very plausible. This environmental setting could also explain the prevalence of so many large grazers—mammoths, mastodons, bison, horses, camels, giant land tortoises, glyptodonts, and ground sloths. Evidences suggest that Indians were already utilizing many sinkholes and karst formations as freshwater supplies as they hunted game across the area; thus, it appears that some of these karst

features were already in existence, or in the late stages of development due to hydrological changes brought on by the ice age.

American Indians remained near the Falling Waters site until the 1800s. Early American settlers reported that the Indians utilized the colorful rocks found in the vicinity of the sinks. These rocks were also collected by the early settlers. According to Carswell (1991, pp. 433-434), a historian of the region:

Early settlers came from miles around to pick rocks with desirable color characteristics for use in making dyes. The rocks provided the pioneer housewife with a dazzling selection of color shades and blends. . . . A few (rocks) resemble the coconut somewhat in color, shape and size. The outer shell may be broken to reveal a fine-grained, reddish, dry, heavily pigmented substance inside. That is the substance early settlers used as dye. The fine-grained substance is powdery-dry and will burn, but not with explosive force. (parenthesis ours)

In the mid 19th century a local resident harnessed the waters of the stream to power a grist mill for grinding corn. These waters were also utilized for a legal whiskey distillery established in the late 1800s. Between 1919-1921, a wildcat oil well was drilled at the site, going to a depth of 4,912 feet below the land surface (Figure 9). The accounts of the "burning rocks" apparently prompted the wildcatters to drill in what they believed to be oil bearing sands. While not striking oil, the drilling project did net a wealth of information about the geologic nature of the Falling Waters site (Carswell, 1991, pp. 433-437, 443; Rupert and Lane, 1992, p. 3; Vernon, 1942, p. 33).

In the 1950s local efforts were made to turn the waterfall and adjoining sinks into a park, which was finally accomplished in the early 1960s (Carswell, 1991, pp. 437-442). A series of caves and passageways through the limestone connect the sinks in the park (Figure 2). Spelunkers have explored many of these passages. Before 1906 a large underground lake (approximately 1-3 acres) was located somewhere below the falls, but modern spelunkers have observed no trace of it. The underground stream at the base of the falls, however, has apparently changed course in fairly recent times. Rock falls and debris may have blocked the former route to the underground lake. Spelunkers have also reported the absence of stalactites and stalagmites in the caves, evidence which suggests these passageways have recently formed (Carswell, 1991, p. 436; Rupert and Lane, 1992, pp. 7-9). Additionally, the small sizes reported for the cave passageways suggests that surface abrasion by sediments prevents the development of speleothem features (Maddox, 1993).



Figure 4. Surface stream waters pour into the Falling Water Sink. Note the horizontal jointing in the side walls of the Suwannee Limestone.

Karstic Development

According to Uniformitarians, the development of karstic terrain is usually viewed as taking tens to hundreds of thousands of years based on the extrapolation of today's weathering processes and limestone dissolution rates back in time (Beck, Ceryak, Jenkins, Scott, and Spangler, 1984, pp. 18; Ford and Williams, 1989, p. 420; Goudie, 1995, p. 64; Palmer, 1990, p. 189, 1991, pp. 4-5; White, 1990, pp. 162-164). Even though it is recognized that limestone dissolution is dependent on many variable factors only a few factors are actually considered relevant to the process. Within the uniformitarian model it is suggested that mildly acidic water (carbonic and/or sulfuric), marine (ionic) waters, and biogenic factors are the primary factors in carbonate dissolution (Goudie, 1995, p. 61; James and Choquette, 1984, p. 165; White, 1988, p. 297-301; Wright and Smart, 1994, p. 477). Joints and fractures within the lithified limestone layers serve as zones of weakness and allow for greater rates of dissolution as compared to the whole rock surface. However, changes in precipitation levels and in the water chemistry (e.g., carbon dioxide,

water temperature, ionic species, hydrogen sulfide, etc.) can drastically increase the rate that calcium carbonate is dissolved in the subsurface. Hence, the formation of karst can be accelerated based on these changes and therefore decrease the amount of time necessary to form these limestone dissolution features.

Presently, there are three models* used to explain the formation and development of caves and conduits within limestone layers (Ford, Palmer, and White, 1988, p. 408; Ford and Williams, 1989, pp. 261-265; White, 1988, pp. 264-271). However, Ford and Ewers (1978) caution that these three models are oversimplifications of an extremely complex process in the formation and development of karst and the processes involved in karst formation remain poorly understood. All of the karst developmental models suggest the dissolution of the calcium carbonate by water (both groundwater and surface precipitation). Changes in the regional groundwater base level is viewed as providing the greatest role in the development of karst features (Ford and Ewers, 1978, pp. 1792-1793; Ford, Palmer, and White, 1988, p. 408; Ford and Williams, 1989, p. 496-504; Mylroie, 1984; Palmer, 1984, 1990; White, 1988, p. 294-295; Worthington, 1991, p. 127). We believe that this is one of the most important aspects within our interpretation of how these features form. A creationist model for cavern and subsequent speleothem formation in relation to the Flood can be found in Williams, E. L. and R. J. Herdktlotz, 1977, *Solution and Deposition of Calcium Carbonate in a Laboratory Situation II*. CRSQ 13:197-199.

The development of speleothems (i.e., stalactites and stalagmites) within limestone solution conduits depends upon the regional position of the groundwater table. The limestone opening must be above the water-table (i.e., not underwater) in order to allow for the formation and development of these features. In that no speleothems are reported at the FWSRA they will not be expanded on here further.

FWSRA within the Young-Earth Flood Model

We suggest that the majority of the sediments which compose the FWSRA stratigraphic section were deposited in marine conditions when Floodwaters still covered this area (Froede, 1995b; Froede, in review). This interpretation is based on the presence of marine fossils which occur throughout the stratigraphic column for this area. Hence, the marine fossils require a marine setting and the only time in earth's past when we view these conditions as present was when Floodwaters once covered this area (based on this elevation). Only the

*The three places where caves and conduits are suggested as forming are: 1) in the carbonate rocks above the groundwater table (i.e., vadose zone), 2) in the shallow groundwater zone (i.e., shallow phreatic zone), and 3) in the very deep groundwater zone (i.e., deep phreatic zone).

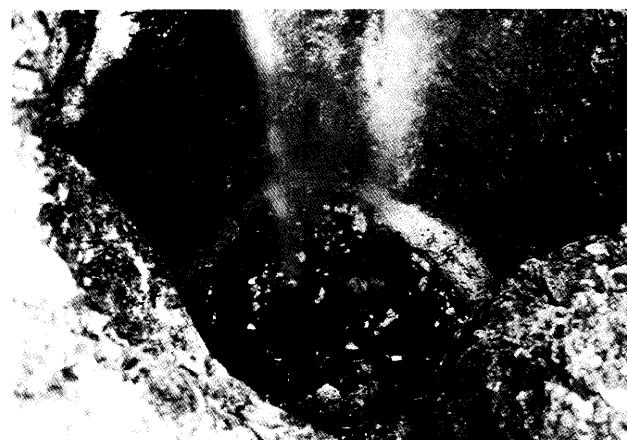


Figure 5. A closeup of the bottom of Falling Water Sink. The water falls on wooden debris derived from the former grist mill and dead trees washed into the sink. This wooden material now serves to block the passage.

uppermost clastic strata around the FWSRA suggest a freshwater environment. This freshwater environment was only initiated following the withdrawal of the marine Floodwaters from this area. Hence, we would suggest that the boundary marking the Upper Flood Event from the Lower Ice Age Timeframe, for this particular locale, would occur where marine strata end and freshwater strata begin (based on lithology, paleontology, sedimentary structure, mapping, etc.—see Froede, in review). The lowering of the regional base-level of groundwater (concomitant with Floodwater withdrawal) also served to enhance the formation of karstic features in the limestone rock in the subsurface.

Precipitation associated with much of the Ice Age created erosional conditions in which the overlying un lithified clastic sediments were subject to large-scale erosion. Additionally, the erosion was not limited to only the clastic overburden, but included much of the limestone exposed at the surface as well as in the subsurface within sections of the Marianna Lowlands. This is displayed in the highly dissected karstic plain which covers the Marianna Lowlands Province today and also by the relief expressed by the surrounding upland areas (Figure 8).

Within our interpretive framework we view the original limestones (i.e., Suwannee and lower portions of the Chattahoochee) as forming from calcium carbonate rich muds derived mainly from algae and microfossils. This flora and fauna lived in the relatively shallow Floodwaters while they covered this section of the North American continent (see Puri and Collier, 1967, p. 359) during the Upper Flood Event Timeframe. Water currents operating during this period of time served to occasionally mix these algal/microfossil derived carbonate muds with various isolated invertebrate communities in this shallow marine environment (e.g., Chen, 1965, pp. 88-91; Huddleston, 1993, pp. 108-114).

Nearby fluvial sources occasionally contributed clastic sediments forming thin layers between the carbonate rich muds as the Floodwaters continued to slowly recede toward the Gulf of Mexico Basin. This shift from a shallow marine carbonate mud to a freshwater clastic environment, with the slow withdrawal of the marine Floodwaters, is reflected in the vertical stratigraphic section exposed at the Falling Waters site. In support of our interpretation we will now review the stratigraphic section found at FWSRA.

The Suwannee Limestone is the lowest exposed stratigraphic unit at the FWSRA. However, as it is exposed specifically at Falling Waters it is not exactly the same limestone, either in composition or paleontology, as the type section farther to the southeast. Vernon (1942, p. 56) stated that the identification of several marine molluscan fauna led to the identification of the carbonate rock layers in Washington County as Suwannee Limestone; he adds:

It was impossible to establish mappable units within the Suwannee in Washington and Holmes Counties.

It may be that the unit mapped as Suwannee Limestone in Holmes and Washington Counties is not the precise equivalent of the Suwannee in its type area. The writer, however, feels that the identification of Suwannee mollusks from some of the localities in Holmes and Washington Counties justifies the correlation.

Additionally, Vernon (1942, p. 59) describes the Suwannee Limestone as:

... characterized by solution topography with numerous sinks and irregularities which pre-empt or capture surface drainage.

The Suwannee is a light-gray to buff, porous, extremely fossiliferous limestone. Locally the bed is a mass of large and small foraminifers. Partial weathering produces crystallization and a pink tint due to the incorporation of iron oxide. The limestone contains many silicified masses which remain in the residual clays (following the weathering of the limestone mass) and some have been included as boulders in alluvial deposits. Some of these Suwannee boulders ... were originally calcareous, highly fossiliferous sandstones. (parenthesis ours)

According to Yon and Hendry (1969, p. 12) the Suwannee is additionally described as: "... a light yellowish orange, abundantly microfossiliferous, partially recrystallized, soft to hard, granular limestone (calcarenite)."

At the Falling Water Sink, Vernon (1942, p. 61) reported the Suwannee Limestone as composing the lower 73 feet of exposed section. Overlying the Suwannee Limestone and also exposed along the sidewalls of the Falling Water Sink is the Chattahoochee Formation (Tampa Limestone equivalent) which has been describ-



Figure 6. An opening to the underlying cave system immediately adjacent to Falling Water Sink. Note how easily that vegetation can be washed into the cave system.

ed by Reves (1961, p. 67) as: "... 11.5 feet of light gray, indurated massive chalky, sandy, silty, argillaceous, fossiliferous limestone ... containing lenses and seams of blue-green clay."

In the early to mid 1960's an extensive limestone resource drilling program was conducted in Washington County, with several wells drilled near the FWSRA. The testing of the composition of the various limestone layers revealed that the Chattahoochee Limestone was almost pure calcium carbonate (95%), with the remaining 5% being magnesium carbonate (Shirley and Sweeney, 1965, p. 132). Drilling records revealed a porous and vuggy upper surface of the Chattahoochee Limestone immediately beneath the clastic overburden. This type of highly weathered zone (i.e., subcutaneous or epikarstic zone) serves to enhance the dissolution of the limestone. According to Ford and Williams (1989, p. 120) drainage into the subsurface within this zone is initially diffuse but then moves along preferred paths as it drains into the subsurface. Additionally they state: "Therefore it is probable that corrosion within the epikarst is greatest where flow paths converge above the more efficient percolation routes."

Hence, the Chattahoochee Limestone serves to funnel water down into the underlying Suwannee Limestone in a manner which directly enhances the formation of subsurface conduits.

The reader will note that the previous descriptions of the Suwannee and Chattahoochee Limestones do not suggest an original coral reef environmental setting. Rather, these limestone units better support a Bahamian shallow-water-carbonate bank-margin type of depositional environment (Halley, Harris, and Hine, 1983; Hine and Neumann, 1977; Lasemi and Sandberg, 1984; Milliman, Freile, Steinen, and Wilber, 1993; Purdy, 1963a, 1963b; Strasser and Davaud, 1986). This depositional setting has a direct bearing on the time and manner in which these limestones would develop, with the shallow-water-carbonate bank-margin environment developing much more rapidly than a true coral reef environment. We note that not every limestone deposit reflects a former coral reef environment and this fact has great implications as we reinterpret carbonates in the stratigraphic record within the framework of the Young-Earth Flood model (Dunham, 1970; Nevins, 1972; Whitcomb and Morris, 1961; Woodmorappe, 1980, 1982). The Bahamian shallow-water-carbonate bank-margin type of depositional environment is typical for most of the Cenozoic carbonates found in the Western Florida Panhandle.

The Alum Bluff Group which immediately overlies the Chattahoochee Limestone marks a major change in sedimentation. Carbonate sedimentation ended as near-by terrigenous sources deposited elastic sediments in the marine environment. Schmidt and Coe (1978, p. 12) reported the Alum Bluff Group deposits as:

They tend to include sandy clays and clayey sands with abundant mollusk shells (marine varieties) being preserved. . . there is a thin veneer of sands which exists as a blanket deposit covering all lithologies. These sands can be found at various elevations, **traceable to ancient sea level fluctuations.** (parenthesis and emphasis ours)

Immediately above the Alum Bluff Group are undifferentiated clastics which reflect a freshwater setting. These sediments were deposited after the marine waters withdrew from this area. This layer is probably derived from reworked Alum Bluff Group sediments as well as sediments derived from upland areas.

Following the deposition of the various stratigraphic layers within the area around the FWSRA, precipitation then served to begin the erosion of these elastic sediments and the underlying strata. Additional erosion and removal of the undifferentiated sands and clays, the Alum Bluff Group, and portions of the underlying limestone layers would follow the drop in the regional groundwater base-level. This drop in the groundwater level would directly correlate with the drop in sea-level conditions associated with the waxing and waning of the continental glaciers during the single ice age and possibly include some tectonic input. The dropping of the regional groundwater base-level is the same sort of phenomenon that was suggested as contributing to the formation of caves and solution conduits in the



Figure 7. Another series of openings separated by a small limestone ridge. In many places these openings follow the joint set of the Chattahoochee and underlying Suwannee Limestones.

Clayton Limestone along the Chattahoochee River in Georgia (Froede, 1994). Additional carbonate dissolution would occur due to the production of volcanic aerosols during the single ice age (Oard, 1990, p. 67). These volcanic products would have served to increase the acidic strength of precipitation and groundwater and therefore increase the dissolution rate of the limestones. Organic materials decomposing in the subsurface would also contribute to the dissolution of carbonate rock by leaching organic acids into the groundwater and thus enhance the dissolution rate of the calcium carbonate (James and Choquette, 1984). Hence, there are many factors which affect the dissolution of carbonate rock and they all would serve to accelerate (at varying degrees) the process of karst formation. This then suggests that karst features can develop more rapidly than the uniformitarian model currently recognizes and at a rate that works well within our short time frame.

The greatest rates of carbonate dissolution would occur where freshwater and saltwater would mix in the subsurface. This mixing of these waters within the subsurface would have occurred as the Floodwaters slowly withdrew from this area. Additionally, any transgression/regression events during this time (associated with continued but lessening tectonism and repeated glaciation-see Reed, Froede, and Bennett, 1996) would have served to repeat this corrosive environment.

Within the mixing zone the limestone dissolution features would have rapidly developed as the marine Floodwaters mixed in the subsurface with freshwater flowing southward along limestone joints and fractures (see Back, Hanshaw, and Van Driel, 1984; Beck, Ceryak, Jenkins, Scott, and Spangler, 1984, pp. 17; Ford, Palmer, and White, 1988, p. 411; Land, Paull, and Hobson, 1995; Mylroie and Carew, 1988; Plummer, 1975; Runnels, 1969; Steinen and Matthews, 1973; White, 1990; Wicks, Herman, Randazzo, and Jee, 1995). According to Back, Hanshaw, and Van Driel (1994, p. 286) this subsurface mixing of marine and freshwater should be viewed as more common than currently realized; they state:

Geologic significance of subsaturation can be emphasized by remembering that every marine limestone now containing freshwater has been subjected to dissolution and diagenesis caused by the mixing zone phenomenon at least once. Most have probably undergone the effects of this pro-

cess repeatedly. For example, at any stand of sea level, the zone of dispersion (mixing zone) will occupy a certain position within the limestone aquifer. As sea level drops, the zone of dispersion will follow the lowering sea level, thereby subjecting additional carbonate rocks to these processes. Subsequent rise of sea level will permit the zone of dispersion to migrate back up through the aquifer and cause the limestone to undergo additional diagenesis and differential dissolution. (parenthesis ours)

This repeated intermixing of freshwater and marine waters within the limestones would have enhanced and accelerated the formation of solutional features. The enlargement of these features would have increased the rate of overlying clastic sediment removal, which could have culminated in the collapse of the clastics into the solutional cavities. These sediments would then wash through the solutional conduits and enlarge

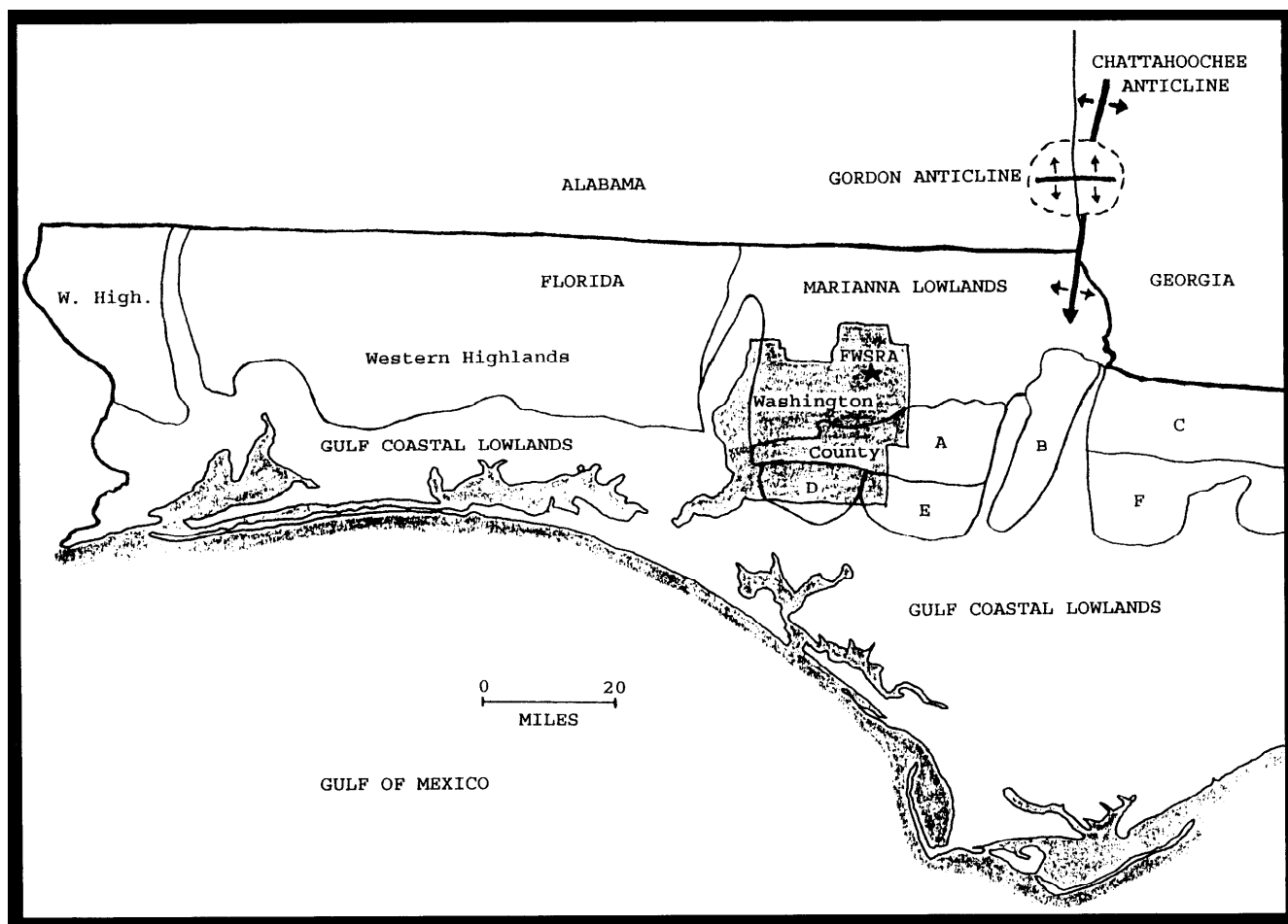


Figure 8. Geomorphic features of the western Florida Panhandle. The Falling Waters State Recreation Area lies toward the northern end of Washington County within the Marianna Lowlands Province. Also note the Marianna Lowlands in relationship to the other higher geomorphic provinces. The uplifted area most commonly identified as the Chattahoochee Anticline lies to the northeast of Falling Waters. The areas represented by letters show adjacent but separate geomorphic areas: A) New Hope Ridge, B) Grand Ridge, C) Tallahassee Hills, D) Greenhead Slope, E) Fountain Slope, F) Beacon Slope. This figure is compiled from Chen, 1965; Fernald and Purdum, 1992, p. 22; Patterson and Herrick, 1971; Rupert, 1994; Scott, 1991, 1992; Scott, Lloyd, and Maddox, 1991.

the passageways through abrasion. Ultimately these clastics would discharge at downgradient seeps and springs.

The development of vegetation (specifically trees) in the soils which directly overlie the limestones would have also contributed to the further development of sinkholes during the Ice Age Timeframe. Following the death and rotting of the tree, the former root system could provide a preferential drainage conduit from the surface directly to the top of the underlying limestone. Waters would then rapidly drain into the subsurface and flow toward any solutional features already existing within the limestone. Eventually, and as a function of the rate of water influx through the root conduit, the limestone sinkhole would erode away overlying sediments until it became exposed directly to the surface (Newton, 1987, pp. 24-25). The authors observed this root conduit phenomenon first-hand at FWSRA.

The complete lack of speleothems within any of the caves of FWSRA suggests that these caves and sinks probably formed in subaqueous conditions (i.e., within the Phreatic Zone). This would require the regional groundwater table to have existed at a higher level than present, which directly correlates to a higher-than-present sea-level position. We would suggest that the FWSRA limestone solutional conduits were probably initiated at an early stage perhaps starting under phreatic conditions with the withdrawal of the Floodwaters and the influx of freshwater. The uplift of the area in and around the Marianna Lowlands coupled with the drop in sea-level would have served to contribute to the rapid erosion of the overlying clastic sediments and upper sections of the limestones. Groundwater during this time would have served to drain through rapidly developing solution channels within the limestone at depth. Eventually, the clastic overburden would have been removed from many areas within the Marianna Lowlands by both overburden collapse and from erosion via overland flow. The constant influx of plant and clastic materials through the solutional passageways probably served to prevent the formation and development of speleothems within the various cave systems once the area existed above the groundwater table.

The circular shape of the area immediately surrounding FWSRA suggests that sinkhole collapse was a primary cause in the removal of the clastic overburden. A drop in the regional groundwater level probably initiated the final stages of removal of the limestone and clastic materials overlying these sinkhole features. The occurrence of a thin layer of sedimentary clastic cover which still remains over the present sinkhole/cave network serves to reinforce our interpretation of the "from the bottom up" development of this karstic landscape (i.e., sinkhole collapse) [see Sinclair and Stewart, 1985]. Rupert and Lane (1992) also proposed this same manner



Figure 9. All that remains of the original oil well drilling project is this surface casing which is filled with cement.

of formation for the Falling Water Sink. While overland flow served to wash away some of the clastic sediments covering this area of the Marianna Lowlands, it probably was not a major factor in forming these sinkholes and cave systems. Today, surface water run-off from the area immediately surrounding these sinkholes continues to channel water into the subsurface and wash both clastics and plant debris into the sinkholes and caves. The mapping of the FWSRA cave systems has revealed a complicated drainage pattern following fractures and joints within the limestone (Lane, 1986, pp. 53-57; Maddox, 1993, pp. 15-17; O'Hara, 1984). The poor development of the cave network, the narrow passageways, and the lack of any speleothems within the caves suggest that the FWSRA cave system formed within the past few thousand years. Our interpretation is counter to the uniformitarian model of the development of these features over the course of a much greater time span.

Waters entering these sinkholes follow the regional dip of the limestone layers. The waters would ultimately discharge where openings (i.e., seeps and springs) formed and developed (usually near coastal areas). When sea-level would drop the groundwater would continue to move in the subsurface following the regional dip of the limestone layers and again create springs farther downgradient. With a drop in sea-level and the corresponding drop in the regional groundwater base level, areas once containing springs would turn into sinks as groundwater by-passed these areas for lower areas to discharge. It is these springs and sinkhole areas which served the paleo-Indian cultures as they moved across the Southeastern United States. A drop in the sea-level and regional groundwater table, during a stade within the single ice age, might have forced these early cultures to move ever southward seeking reliable sources of water at seeps and springs. The subsequent rise in sea-level, associated with an interstade within the single ice age, would restore the former seeps and springs at their higher elevations.

Due to the relief surrounding the sinkholes and cave network around the FWSRA, we would suggest that

this area was never a site for a spring (Figure 2). The topography of the site does not suggest that a spring or river ever flowed from this site. While there probably was some overland flow across this area in the past, there is no evidence of any stream which emanated from this collection of caves or sinkholes. Additionally, the FWSRA cave system has not been reported to contain any megafauna typical of historical water source sites. Rather, only wood and clastic sediments are reported as found within the cave systems (Maddox, 1993, p. 15). If in the future there is discovered the remains of some Pleistocene creature within one of the caves, further investigation could then be initiated to determine how it may have come to be within the cave.

Conclusions

The karstic features displayed within the Marianna Lowlands Province provide interesting testimony to the dissolution of limestone rock. It has been suggested that following the uplift of this area clastic sediments and underlying limestone layers were subject to erosion. According to uniformitarian estimates, the limestone layers dissolved away over the course of many thousands of years leaving sinkholes and caves.

The use of many of these karst features by paleo-Indian cultures suggests that they were already formed. Various relics found at many of these karst sites indicate that the paleo-Indian cultures used them. Megafossils and other archaeological evidence suggest that many of these areas were also used by animals.

In following the time frames of the Young-Earth Flood Model, we would suggest that by changing the precipitation rates along with a few groundwater parameters the solution of the limestone rock could have occurred in a much more rapid fashion. Probably the most important factor in the dissolution of the limestone was the mixing of fresh and salt water as the Floodwaters slowly receded from the area. Changes in sea-level (as a result of tectonics and glaciation) directly impacted regional groundwater levels. The drop in sea-level and corresponding drop in groundwater base level would enhance the further development of the existing sinkholes and subsurface conduits (i.e., caves) from which surface waters would drain. Sediments overlying these sinkhole features would eventually collapse (a process identified as soil arch failure), exposing the underlying limestone sinkholes. This same phenomenon is reported today where groundwater pumping rates in karst aquifers lower the water table to the point where the surrounding soil arches, vugs, and solution features can no longer support the weight of the overlying sediments, resulting in catastrophic collapse (Beck, 1986; Bonacci, 1987, pp. 168; Newton, 1987; Rosenshein and Back, 1988).

The description of the narrow cave passages which follow the joint and fracture sets within the FWSRA limestones reflects a poorly developed cave system.

We would suggest that the cave systems at FWSRA reflect relatively recent development (i.e., within the past few thousand years as opposed to one which has been developing over the course of tens to hundreds of thousands of years). We interpret the solutional conduits within the FWSRA limestones as initiating with the mixing of marine and freshwater with the draining of the Floodwaters. Enlargement of these solutional features likely occurred due to abrasion from the clastic sediments which washed through these features with the drop in groundwater base level. The continued flushing of the conduits by water-driven plant and clastic materials has prevented the formation of any speleothems. The FWSRA was never the location of a spring simply because it only became exposed as the regional groundwater table dropped (following the drop in sea-level). Hence, we suggest that it has always been a sinkhole site.

Migrating paleo-Indian cultures which lived within this area used the flora and fauna to support their existence. Evidence to support this interpretation has been gathered and studied by uniformitarian archaeologists. We agree with their findings but reject the uniformitarian time frames. We view the paleo-Indian cultures as also providing us with additional information about the timing of sea-level rise and fall during stades and interstades of the single Ice Age. This subject will be addressed in a later article (Rucker and Froede, in review).

Found within the Marianna Lowlands Province, FWSRA represents an outlier of carbonate rock and overlying clastic sediments where changes in sea-level and groundwater have resulted in the formation of a number of karstic features. The small-scale development of the caves within this area suggest to us that they have only been in existence for three to four thousand years, since the withdrawal of the Floodwaters. Further development of these karst features has occurred in association with the wet weather conditions of the ice age. Minor development has continued since then. Today, we believe that FWSRA provides testimony to earth's short history and global Flood.

Glossary

Interstade — A warmer substage of a glacial stage, marked by a temporary retreat of the ice (Bates and Jackson, 1987, p. 341). Our definition of this term would suggest that we only experienced one ice age with many warm periods (i.e., interstades). This period would result in a sea-level rise.

Karst — A type of topography that is formed on limestone by dissolution, and that is characterized by sinkholes, caves, and underground drainage (Bates and Jackson, 1987, p. 356).

Phreatic Zone — Also known as the zone of total water saturation; this subsurface zone is where all the pores spaces are filled with water under pressure greater

than one atmosphere (Bates and Jackson, 1987, pp. 500, 749).

Stade — A substage of a glacial stage marked by a glacial readvance (Bates and Jackson, 1987, p. 639). Our definition of this term would suggest that we only experienced one ice age with many glacial readvances (i.e., stades). This period would result in a sea-level fall.

Vadose Zone — The zone of aeration or area above the groundwater surface (Bates and Jackson, 1987, p. 717).

Vug — A small cavity in a vein or in rock (Bates and Jackson, 1987, p. 728).

Acknowledgements

We wish to thank our families for allowing us the time and opportunity to visit and research the interesting karst features and site history found at the Falling Waters State Recreational Area. Glory to God in the Highest.

Trust in the Lord with all your
heart
and lean not to your own
understanding;
In all your ways acknowledge him,
and he will make your paths
straight.

Proverbs 3:5-6 HOLY BIBLE, NEW INTERNATIONAL VERSION
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A BIBLICAL CHRISTIAN FRAMEWORK FOR EARTH HISTORY RESEARCH PART III—CONSTRAINING GEOLOGIC MODELS

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Abstract

Previous parts of this series have demonstrated the superiority of the biblical Christian system to the naturalist-uniformitarian system in providing metaphysical and epistemological frameworks for Earth history research. Following a logical progression towards deriving geologic models, the next step is the use of information from sources other than geology to constrain and direct model formulation. To begin the process, special revelation will be applied as a primary constraint. As the most reliable source of historical information, the Bible provides both general and specific constraints. General constraints include: Limited time; catastrophic process; an event-oriented perspective; and the possibility of a more complete geologic record than is recognized by uniformitarians. Specific constraints include the outline of historical events presented in the biblical text. Although many constraints from other disciplines (e.g., history, archeology) could be explored, a rigorous examination of these areas is beyond the scope of this paper.

Introduction

This series is presented as a logical progression aimed at the development of geologic models of Earth history within the context of biblical Christianity. Understanding that science is not an independent venture, but rather a facet of human intellectual endeavor, the progression began at an axiomatic level instead of an evidentiary one. Part I demonstrated by formal tests that the naturalist-uniformitarian system is invalid because of axiomatic contradictions between its basic assumptions and conclusions, and therefore cannot be the basis for successful geologic models of Earth history. Part II demonstrated, in contrast, that the biblical Christian system passes the same formal tests, and is a system within which successful geologic models of Earth history can be developed and tested. Part II also introduced a method for Earth history research. Biblical Christianity affirms the ultimate unity of truth in God, and therefore applies the “university” paradigm to human knowledge, and its derivative mixed question approach. The “university” paradigm is the belief that all truth is connected, coherent, and consistent, even if human knowledge has not yet progressed to the point of understanding all the connections. The mixed question approach recognizes the connectivity of truth and subsequently accepts the concept of multidisciplinary problems and solutions. In the context of investigating Earth history, this type of approach would recognize that ‘facts’ outside of geology must be evaluated for completeness of any conclusion.

Developing geologic models of Earth history is analogous to moving inward through the ever-narrowing concentric circles of a target. Each outer circle adds

increasing constraints to the final geologic model, and only within the inner circle is geologic data considered. In the outer circles, we have shown that the biblical Christian system is logically superior to the currently-accepted naturalist-uniformitarian system by virtue of its axiomatic consistency. Moving inward, a transition is made into the area of developing positive programs of investigation into Earth history, restricted by the outer circle of the logical consistency of the biblical Christian system. Since the biblical Christian worldview accepts the mixed question approach, the next circle in the target is the further constraint of potential geologic models with factual information from other disciplines outside of geology.

Each of the previous steps is required because the rock record is not a prepackaged presentation of Earth history, since multiple conflicting interpretations are possible. The benefit of the rock record is rather that it offers the basis for comparing competing geologic models. In concentrically narrowing spheres of validity, conclusions from these models are first constrained by the metaphysical and epistemological framework, and then by data from other relevant disciplines. It is already clear from Parts I and II that any interpretation of the rock record must be directed away from the naturalist-uniformitarian framework and into the biblical Christian framework because the latter passes formal tests of axiomatic consistency that the former does not. The challenge to scientists operating within the biblical Christian system is to develop empirical models, consistent with the entire system, that stand or fall on their ability to interpret field data. If a particular model fails empirical tests only, then the model must be revised, but only within defined limits. If a particular model fails axiomatic tests within its parent system, it must be more drastically revised or abandoned. Geo-

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logic models must include criteria by which the model can be judged, revised, and /or rejected with respect to both categories.

Following this logical progression through the target simultaneously restricts the scope of any potential model and increases the level of detail demanded, thus increasing the potential for variety in each model. Every model developed within the biblical Christian system will share certain features in common, but will also have the potential for significant variety. This progression will proceed as follows:

- (1) All geologic models of Earth history should be identically constrained by the metaphysical and epistemological frameworks of the parent (biblical Christian) system;
- (2) All such models will be similarly constrained by data external to the scientific model under the mixed question approach. Differences between models at this level will result from differences in the interpretation of external data (e.g., the inferred geologic significance of a particular historical event recorded in the Bible such as the breakup of the "fountains of the great deep" (Genesis 7:11));
- (3) Each geologic model will attempt to explain field data sets. At this level models may vary dramatically, depending on the selection of the data set, and the interpreter.

The explanation and application of the second step is the subject of this paper. Its scope precludes a comprehensive development of that step, and for that reason, and in keeping with the concept of the dimensional hierarchy in knowledge described in Part II of this series, factual constraints discussed below will be derived only from the Bible.

Biblical Constraints on Earth History Models

Factual constraints on geologic models coming from disciplines other than geology are recognized because of the multidisciplinary (mixed question) approach to historical analysis that emphasizes contributions from areas of knowledge outside of science. The challenge for creationists lies in the paradox that the most reliable (based on God's trustworthiness) information about Earth history lacks significant detail. This aspect of biblical revelation simultaneously increases the opportunity for human creative thought and the level of uncertainty in investigations into Earth history. In other words, the Bible broadly defines an outline of Earth history, but is insufficient in historical detail for formulating detailed geologic historical models. It does describe certain events in Earth history that are geologically significant, but does not say very much about them from the point of view of modern geosciences professions. Previous authors (e.g., Whitcomb and Morris, 1961; Oard, 1990) have discussed these events and their geologic significance, but with a large degree of uncertainty at the level of interpretation. Thus the

tradeoff for creationists is between the axiomatic inconsistency of uniformitarianism and the interpretational uncertainties of biblical Christian historical analysis to date. When placed in these terms, the superiority of the biblical Christian approach becomes clear, however, most scientists do not choose to think in those terms.

Biblical input can be divided into two areas, general and specific. General information consists of broad principles explicitly presented, or reasonably inferred from clear passages that are of significance to scientific models. Specific information is found in the record of specific events that individually may be of significance to geologic models. There are a number of general principles derived from the biblical historical record that are significant to any geologic model. Four of the most important are presented below, and include: (1) a relatively limited timeframe; (2) importance of catastrophic process; (3) an event-oriented perspective; and (4) the relative completeness of the rock record. These principles are interrelated, and these relationships provide additional internal evidence of the consistency of the biblical record.

Time

Time is the feature most commonly associated with the uniformitarian geologic column, but paradoxically, uniformitarian interpretation is relatively unconstrained temporally, since time necessary for most hypothesized events is presumed to be available. This reservoir of time allows more freedom of interpretation by dismissing limits potentially imposed by adjacent strata. This is done through the use of projected intervals of missing section; i.e., a given sedimentary section can be designated as a deep-marine deposit even if a vertically adjacent section is considered continental fluvial, since intervening deposits predicted by Walther's Law (regarding the lateral and vertical associations of facies) could have been removed by erosion over a depositional hiatus over millions of years potentially represented by the boundary between the two units. However, the biblical record does not provide an extended time framework. Therefore, historical geologic models in the biblical system must accommodate relatively limited time intervals for geologic events, and emphasis is shifted to understanding geologic processes that would generate observed strata in that limited timeframe.

It is ironic that in spite of the more stringent limits placed on interpretation in the biblical Christian system; philosophically, time is much less significant for the theist than for the non-theist. This is because time and historical progression assume metaphysical significance for the naturalist, since time is a major cause of change. Time and history lose this almost mystical significance in the biblical Christian system, since time and history are created and directed by God. This results in two

important distinctions in the theist system: (1) the assumption of "pre-history" is not made, since records of all natural history are included in revelation; and (2) the biblical system supports the significance of discontinuous events rather than the mere passage of time in a particular sequence (Cullmann, 1964; p. 20) by emphasizing God's interactions with man and nature through time. Since information outside science (appropriate in a mixed question analysis) describes significant discontinuous and novel events (i.e., creation, curse, flood, etc.), a derivative geologic model must also embrace discontinuity. Time, which integrates the observed physical discontinuity in nature into a historical progression, itself had a beginning point, and will likewise have an endpoint. Thus time is not the ultimate integrating factor of physical reality as supposed by the uniformitarian, but instead points to God as the provider of continuity.

Another distinction addresses the issue of the application of science to historical analysis. Since these events are outside of human experience in the sense of repeatable scientific investigation, the scientific method is not directly applicable, and the principle of causality must be employed to indirectly derive modern analogies to historical events by discovering an event-process relationship. Please note that this is another important distinction between the uniformitarian and the biblical method. The uniformitarian approach to interpretation of the rock record is univocal; it demands a direct relationship between observable modern process and unobservable historical geological process (e.g., sedimentation, volcanism, fossilization, etc.). Therefore, field data should be almost identical in all geologic ages and open to interpretation based on observed modern processes (see any discussion of the derivation of facies models). Obvious failures have been explained away superficially without addressing the failure of the methodology and the implied failure of the parent naturalist system (see Ager 1993a; 1993b). In contrast, the biblical Christian system includes potential differences in past geological processes, although the underlying physical-chemical processes are probably constant.

This clear demarcation between models from the two systems on the basis of time opens three additional areas in which biblical Christian models can be clearly distinguished from those of the naturalist system. These areas include: Catastrophism, the extent of missing section in the rock record, and the contrasting significance of discrete events as a paradigm for interpretation, as opposed to that of a continuous chronology.

Catastrophic Process

The biblical record of time combined with the observed magnitude of the rock record demands catastrophic (i.e., at least greater in rate and magnitude) conditions during certain periods of Earth history. An open question for further investigation is the nature of qualitative change in geologic process brought on by

a quantitative increase in rate and magnitude. While it is likely that a process-product interpretive approach to field data may demand processes not presently observed, it is also possible that these processes can be modeled by investigations of the underlying quantitative variations in the rate and magnitude of constant physical/chemical processes. This concept is currently being approximated by uniformitarian researchers under the label of "Event Stratigraphy." Additionally, it is being developed and used within the framework of Sequence Stratigraphy (Sloss, 1988; Frazier and Schwimmer, 1987). For a discussion of Sequence Stratigraphy from a young-earth perspective, see Froede (1994).

Although it is not commonly noted as such, the explicit biblical record of catastrophic process in the Genesis Flood demonstrates internal consistency with the biblical record of limited time, which implies catastrophic processes by reference to the massive volume of the existing rock record. Any theological position that incorporates both an old earth (4596 Ma) and the Genesis Flood is not demanded by the rock record, and is thus less consistent because of the principle of parsimony (Occam's Razor). Geologic field data, especially when analyzed on a global scale, also appear to require catastrophism. Individual sections imply processes different from those observed at present, and geologic preservation of large-scale sections (e.g., Cretaceous chalk deposits) is itself extraordinary in modern terms, since preservation depends on the rapid deposition and burial of the constituent strata in episodic, high-energy events (see Ager, 1993a; 1993b; Einsele, Ricken, and Seilacher, 1991; Seilacher, 1984; Dott, 1983).

Accounts in historical texts of past events of geologic significance do not describe geologic processes with the same detail and from the same perspective as would geologic models. Therefore, field evidence is required to best describe in detail the extent and nature of particular geologic events. Sections of the rock record may provide evidence of physical processes similar in nature and scale to those operating at the present, as well as those unexplainable by modern example. An advantage of any biblical model is that it can accommodate either conclusion prior to the examination of the field data, since in addition to recorded catastrophic processes, the majority of recorded time in the biblical historical record does not demand a catastrophic interpretation of a given stratigraphic unit (i.e., the Flood was a worldwide event of tremendous geologic import, but was also short-lived).

Event vs. Continuum

The length of historical time is important for estimating the rate and associated energy levels of past processes, but as mentioned above, there is another aspect of time that generates significant distinctions between biblical and naturalist models. That aspect is the issue of continuity versus discontinuity in-history and in nature (for more discussion, see Adler, 1967). The natu-

GEOLOGIC TIME SCALE			
ERATHM	SYSTEMS	SERIES	AGE (Ma)
CENOZOIC	QUATERNARY	HOLOCENE	0.01
		PLEISTOCENE	2.0
	TERTIARY	PLIOCENE	5.1
		MIOCENE	24.6
		OLIGOCENE	38.0
	PALEOGENE	EOCENE	54.2
		PALEOCENE	55
			55
MESOZOIC	CRETACEOUS		144
	JURASSIC		213
	TRIASSIC		242
PALEOZOIC	PERMIAN		286
	CARBONIFEROUS		360
	DEVONIAN		408
	SILURIAN		438
	ORDOVICIAN		505
	CAMBRIAN		570
	PRECAMBRIAN		

Figure 1. Geologic Time Scale after Lemon (1990).

ralist system must embrace physical continuity to maintain a rational approach to nature because there is no transcendent reality (i.e., God) to provide rational connection and meaning to observed discontinuity. Blurring of this philosophical distinction has caused confusion in past attempts to correlate biblical events with the uniformitarian timescale (Figure 1). But there can be no symmetry between the biblical Christian models and those of the naturalist-uniformitarian system, because the uniformitarian geologic column is biased towards history as a continuum, expressed by its dependence on evolution. Evolution operates as a continuum, producing products that would clearly show continuity if all the data were available. Thus, for the evolutionist, the ability to classify modern and ancient biota is the result of observational gaps, not actual ones. Uniformitarianism shares this assumption by presenting a continuum into the past of all geologic processes. Frequent modern revision to uniformitarian interpretation is a result of the disagreement of observed

data with the concept, and uniformitarianism has not embraced the philosophical rejection of continuity.

The utilization of the continuum paradigm has not survived empirical observation in either evolutionary biology or uniformitarian geology. The ability to separate and classify taxa in biology is mirrored by a twofold similarity in geology: (1) the ability to separate and classify the fossil contents of strata, and (2) the ability to separate and classify the strata themselves. Recognition of observed discontinuity in nature has led to revisions that attempt to accommodate both sides; however resolution on a metaphysical level is not likely within the naturalist system, since its proponents deny metaphysical reality. For example, punctuationist constructs of evolutionary progress are only superficially different from gradualist constructs, since quantitative discontinuities in rate do not fundamentally alter the underlying continuity of process and product.

A similar tension between observation and paradigm has been present in the Earth sciences for a number of years. Interpretation of the rock record has historically existed in a tension between a chronological and an environmental focus. Chronological interpretation is exemplified in the traditional practice of biostratigraphy, and environmental interpretation has received increasing emphasis recently in studies of depositional environments by use of the facies concept (Blatt, Middleton, and Murray, 1980; p. 618), and more recently by sequence stratigraphy (Wilgus, Hastings, Kendall, Posamentier, Ross, and Van Wagoner, 1988). This shift in research emphasis may be the result of a belief among professional geologists that the chronological task of stratigraphy is almost complete, and that the remaining interpretive challenges involve environmental reconstruction. However, it could also be that field data from a variety of global settings drives event-oriented interpretation rather than chronological interpretation.

Therefore, there has arisen a philosophical internal tension in the naturalist uniformitarian system between the underlying philosophical concept of history as a continuum and empirical observations that do not support this view. This philosophical tension is being addressed on a scientific level by the advent of neo-catastrophism; however, it must also be resolved on a philosophical level. Philosophic resolution can be accomplished within the biblical Christian system, but it is difficult to see how such resolution can occur within the naturalist-uniformitarian system.

The biblical Christian system resolves that tension because it allows a catastrophic and discontinuous event-driven approach within geology by removing the philosophical issue from geology to philosophy and theology. Geologic units are distinct because they represent discrete historical events with physical processes that may not have any "modern" observable analog. Similarity in geologic units (e.g., worldwide red-beds, chalk deposits, etc.) is based on the more fundamental consistency of physical/chemical pro-

cesses through time (Ager, 1993a). This distinction is important, and must be seen in contrast to the traditional uniformitarian concept of modern processes operating in repeatable patterns throughout history. In the former case, the geologic challenge is to infer unobserved processes based on physical-chemical laws, while in the latter it is to recognize the ancient effects of familiar geologic processes within the context of an extremely sparse data set. Thus, the underlying continuity in catastrophism is one step removed from uniformitarianism, being based on adherence to physical-chemical laws that govern all physical processes.

A biblical model might predict geologic processes different from any modern examples, but linked by analogy to modern physical/chemical process, which are assumed to be constant. The continuity of physical principles of flow dynamics, sedimentation, chemical reactions, etc. is granted based on the presupposition of an orderly cosmos, justified by the theological understanding of divine Providence. However, there is no limit placed on the combination and magnitude of these processes by the parent philosophical framework (as is done by the naturalist-uniformitarian system). Continuity of physical-chemical processes does not ensure the same rigid continuity of geologic processes. It only provides the basis for geologic interpretation via analogy.

Missing Section

Another clear distinction between uniformitarian and biblical models resides in the issue of missing section in the rock record. The uniformitarian approach demands present physical processes acting over long periods of time. Since non-preservational (erosion, non-deposition) processes dominate preservational processes in most observed settings, the assumption that large portions of the rock record have been destroyed by erosion is forced by the uniformitarian system (see Ager, 1993a; pp. 43-54; Dott, 1983). This assumption is ubiquitous to all uniformitarian geologic models, and is believed to be supported by the fossil evidence of large gaps, based on the assumption of organic evolution. For additional information on the nature of the rock record see Woodmorappe (1980).

However, the biblical system requires an history of discontinuous catastrophic events. On a global scale, regional depositional processes during these events would probably have exceeded non-preservational processes, and regional depocenters would then contain a relatively complete record of strata deposited during the event interval (event intervals would also contain a record of synchronous erosion and non-deposition, but these could only be delineated based on the assumption that most of the strata deposited were preserved). Thus a biblical Christian geologic model could predict that much of the originally preserved rock record emplaced during the Flood event remains relatively intact. It is likely that the transition from the global event environment of the Flood to a

more localized event environment represented by present geologic processes would reflect a decrease in the preservational potential of the geologic record. A major test of any biblical geologic model would be its ability to supply a reasonable interpretation of discrete geologic events that follow the historical outline supplied by the Bible without major interpretational discontinuity in field data. These same strata may or may not have been determined to contain major gaps within the uniformitarian framework.

Specific Constraints in the Historical Outline of Events

In addition to general constraints on biblical geologic models, the nature of the biblical record as a collection of historical narrative, provides specific constraints to interpretation by providing the "answer" prior to the exercise of more indirect scientific or forensic methods. The key to constraining geologic models by the specific narrative of biblical tests lies in the ability to impute geologic significance to a historical record that does not provide geologic detail. For example, the narrative of Abraham's journey to Canaan has intense social, cultural, religious, and theological significance, but cannot be considered a geologically significant event. In contrast, the account of the creation of the earth is tremendously significant to geologists, and strongly constrains historical interpretation.

A detailed discussion of all of the events recorded in the biblical texts that are potentially of geologic significance is beyond the scope of this paper, and such discussion is common throughout creationist literature. From the geological perspective, the two most important recorded historical events are Creation and the Genesis Flood. A variety of distinct processes can be inferred from both of these narratives, and applied to geologic interpretation. For example, geologic processes associated with the Flood event have been described by numerous authors, and include: Tectonic events at the onset of the Flood; catastrophic marine transgression; physical and chemical phenomena associated with maximum Flood levels; major tectonic readjustment in the late Flood stages and the resulting global regression; decreasing energy levels in deposition; post-Flood re-equilibration; and the resumption of lower energy geologic processes. Because the purpose of the biblical record is not to supply geologic models, the authors recognize that "geologically significant" events have occurred which are reflected by their products in the rock record absent of any explicit biblical (or other) historical reference. These include widespread glaciation (an "ice age") [see Oard, 1986; 1990], meteorite impacts (Froede and DeYoung, 1996), volcanic eruptions, etc. Extrascientific factual constraints (such as historical narrative from the Bible) are unidirectional, but are limited. They are unidirectional in the sense that they constrain interpretation of the rock record, but they themselves are not changed by the rock record. They are limited because the

complete interpretation of the rock record will not be contained in those constraints.

Assessing the Uniformitarian Geologic Column

In addition to the positive factual input from revelation, history, philosophy, etc., biblical Christian geologic models can be constrained by the results of an assessment of uniformitarian geology. The university concept presupposes a mixture of truth and error in a wide range of knowledge, and the resulting potential for additive truth being developed through the efforts of many people. Aristotle (in McKeon, 1941; p. 712; 993a30) recognized this fundamental potential of human intellect when he stated that:

The investigation of the truth is in one way hard, in another easy. An indication of this is found in the fact that no one is able to attain the truth adequately, while, on the other hand, we do not collectively fail, but everyone says something true about the nature of things . . .

Thus, any attempt to reformulate geologic models in the biblical Christian framework will be significantly enhanced by an investigative, rather than a polemic approach to the uniformitarian geologic column.

Formal tests demonstrate that the naturalist-uniformitarian system is invalid on a metaphysical level (see Part I of this series). However, many years of heavily funded research by legions of intelligent and highly trained workers have contributed vast quantities of geologic data interpreted within the framework of uniformitarianism. It is worthwhile to assess the success and failure of those efforts to facilitate the development of models within alternative systems, and creationists should be willing to utilize factual truth and proven methodology that is present in current geologic literature.

Any assessment of the naturalist-uniformitarian contribution must recognize both positive and negative features. Positive features include:

- Skills in organizing and directing research;
- Quantity and quality of data;
- Field and laboratory research experience;
- Highly-developed and sophisticated methods for research, and the ability to apply new technologies to existing problems.

Negative features include:

- The over-emphasis on chronology as the basis for historical analysis resulting in a potential under-investigation of field data as phenomena are “pigeonholed” to fit models;
- Dependence on the process of organic evolution to provide the pivots around which the column is fashioned;
- Paleoenvironmental reconstruction predicated upon observable geologic processes acting over long periods of time, even when field data do not appear to support that premise.

The positive features can be summarized under the umbrella of professionalism by most geologists. Large quantities of high-quality geologic data are available today. These data include large areas of the surface and subsurface of the earth that have been mapped based on field observations, well logs, seismic profiles, paleontologic (including micropaleontologic and palynologic) studies, petrographic studies, and numerous other types of information, integrated within the naturalist-uniformitarian system. Recent application of plate tectonic and depositional sequence concepts have not yet fundamentally altered the basic structure and methodology of classical uniformitarianism. Frequently geologic work is performed under the pressure to achieve economic success in the oil or mining industry; and thus, concepts are tested by additional data acquisition (although this work often remains confidential for a period of time).

The quality and quantity of existing interpretations and their supporting data are such that no creationist should dismiss them out of hand. Any attempt to minimize the contribution of Earth scientists is shortsighted and counterproductive. There is a narrow path for any worker desiring to revamp geologic interpretations. On one side is the danger of arrogance and ignorance in a cheap dismissal of the vast work of the geologic profession over the last century and a half. On the other side is the inability to distinguish adequately between data and interpretation, follow constraints imposed by a consistent metaphysical and epistemological framework, and therefore integrate that data into models fully consistent with the biblical Christian system. Only by understanding the necessary links between theology, philosophy, history, and science (as partially presented in Parts I and II of this series) can the latter danger be avoided.

Although existing work should be respected, a major pitfall is the inseparability of the uniformitarian timescale and evolution, and the resulting emphasis in interpretation based on chronology, rather than physical process and significant events. The intricate arrangement of stratigraphic units is based firmly on the flora and fauna contained in it at a “type locale.” This biostratigraphic dependence of the rock record is illustrated by the rigidity of the model prior to absolute radiometric dating applications with a relatively limited dataset. Each unit is available for study at a type locale. Correlations of the type section are based on its chronological compatibility in reference to the geologic column, since lithologic changes (due to facies changes) and superposition ambiguity (due to limited preservation) render more traditional methods inapplicable on a regional or global scale. Questionable correlations are supported by stratigraphically adjacent formations with unambiguous ages derived from their evolutionary position. However, application of the uniformitarian timescale is commonly sophisticated, with a variety of

stratigraphic methods integrated into the interpretation of a given group of strata, based on many physical properties of a given unit (lithology, fossil contents, petrography, geometry, relative position to adjacent strata, etc.).

Close examination of all knowable parameters of a given rock unit is necessary for interpretation, especially in a biblical Christian model. Uniformitarian emphasis on chronological relationships provides a measure of built-in interpretation even when the details of a given rock unit are ambiguous, or difficult to observe. However, the biblical Christian emphasis on events/process-product relationships demands more careful interpretation of all units, and should force researchers to suspend judgment and interpretation until sufficient data are available to support such conclusions in their own right.

The collection of large amounts of detailed geologic information, the development of sophisticated research methods, and the integration of large datasets are applauded as aspects of the uniformitarian system which should be emulated by catastrophists. The accompanying metaphysical framework is not acceptable and must not be used. Great care is needed in distinguishing between the data and the interpretations, since that distinction is not always clearly made in most current literature.

Fashioning a Creationist Geologic Column

Since biblical Christian geologic models will differ from the uniformitarian geologic column in respects other than just the length of time involved, we propose that a "condensed" version of the standard timescale is not adequate as a basis for future creationist field studies (Figure 1). We propose that young earth creationists construct and apply distinct models (e.g., Austin, 1994; Froede, 1995). Each of these models must be constrained methodologically and factually for reasons presented in the first part of this paper. Although the tenets of uniformitarianism are rejected, the excellent datasets compiled by geologists over many years should not be ignored. Valuable information resides in geologic literature regardless of the model applied, and it should be used by creationists as appropriate.

Many Christians have wrestled with the correlation of the uniformitarian geologic timescale within the framework of a young earth model. Many ideas have been proposed in an effort to unite the two scales (Whitcomb and Morris, 1961, p. 276; Hedtke, 1971; Woodmorappe, 1980; Coffin and Brown, 1983 p. 74; Scheven, 1990; Rugg, 1990; Northrup, 1986, 1990a, 1990b). However, none have proved satisfactory for broad based use, possibly because of confusion between the process of formulating models and defining the system within which the models would be formulated. A general timescale has been presented by Froede (1995), and the authors commend the open-ended nature of this scale as a basis for its initial acceptance.

Conclusions

1. Geologic models of Earth history can be constructed within the biblical Christian system. These models are first constrained by the metaphysical and epistemological conclusions drawn from that system. Such models are also constrained by the introduction of complementary factual data from extrascientific sources. Although the Bible is the most reliable source of information, it was not intended to supply detailed geological information for this type of research. Therefore, it limits, but does not fully define geological models of Earth history.
2. Biblical limits are imposed by general information regarding time, catastrophic deposition, discontinuity in historical process, and the inferred extent of missing section in the rock record. Specific information in the form of historical narrative that may contain information of geological significance is another source of limits to any models defined.
3. An investigative, rather than polemic approach to the work of uniformitarian geologists benefits any worker desiring to construct historical models. Benefits are derived from the vast quantity and superior quality of datasets, the professional approach to research problems by many uniformitarian researchers, and their utilization of a variety of field and laboratory methods to solve problems.

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LETTER TO THE EDITOR

Zuiyo-maru Carcass Revisited: Plesiosaur or Basking Shark?

In a recent review of LeBlond and Blousfield's *Cadborosaurus—Survivor from the Deep*, Scoggan refers to a carcass recovered by the crew of the Japanese fishing trawler, *Zuiyo-maru*. He writes: "No mention is made of the plesiosaur carcass snagged off the coast of New Zealand in 1977" (Scoggan, 1996). The reason LeBlond and Blousfield do not mention that particular carcass is simple: LeBlond does not believe it is a plesiosaur (LeBlond, 1992). He was kind enough to provide this author with a copy of a series of papers written by Japanese scientists concerning the identification of this carcass. Scoggan's review is certainly not the first time this carcass has been identified as a plesiosaur by hopeful creationists and cryptozoologists alike (Niermann, 1994; Taylor, 1987); unfortunately, a close examination of available evidence summarized in the Japanese papers does not favor that identification.

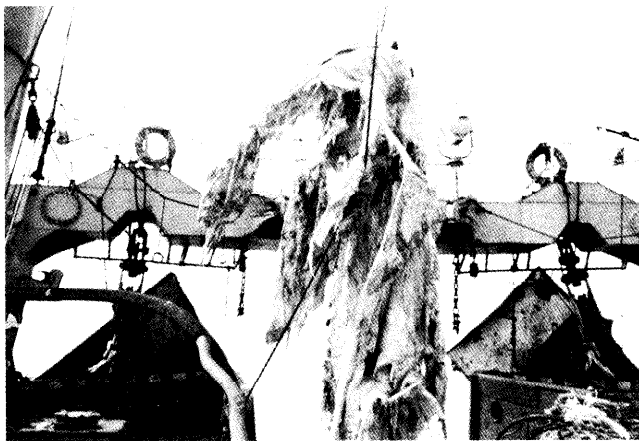
In the spring of 1977, the *Zuiyo-maru*, captained by Akira Tanaka, was trawling for fish in the southern Pacific, east of New Zealand. On the morning of April 25, the *Zuiyo-maru* was at the Chatham Rise, about 30 miles east of Christchurch (43°57'S, 173°48'E). While the vessel was trawling at 300 m, the carcass became entangled in the net. It was drawn near the boat and was assumed to be a dead whale. Following standard procedure, Captain Tanaka ordered the men to pull in the carcass for release outside of the net area. A rope was bound around the trunk, and the carcass was lifted over the deck. At this point, the rope tightened and the body slipped. While the body was suspended in this position, Michihiko Yano borrowed a camera to photograph the carcass (Figures 1 and 2). Michihiko Yano was 39 years old at the time and was employed by the Taiyo Fishery Company as an Assistant Production

Manager. He was a graduate of the Yamaguchi Oceanological High School and an amateur photographer. As Acting Section Chief aboard the *Zuiyo-maru*, he made most of the observations that later would dominate the Japanese newspapers (Koster, 1977).

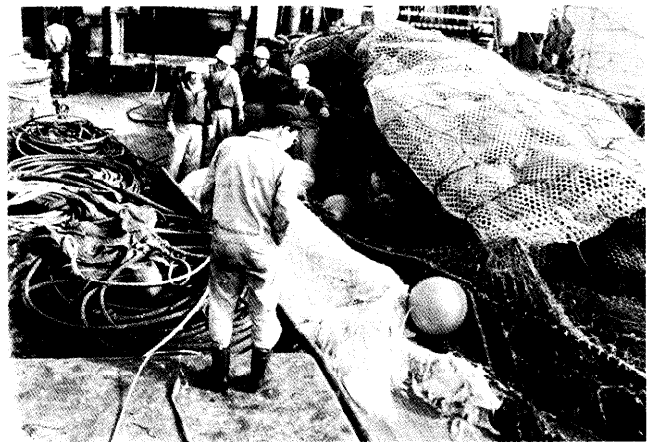
The carcass was laid on the deck, and Yano took a set of measurements. He also removed 42 pieces of "horny fiber" from an anterior fin. These were washed with water, soaked for about 12 hours in a solution of approximately 0.04% sodium hypochlorite, and air dried (Kimura, Fujii, Sato, Seta, and Kubota, 1978). After about one hour, the carcass was thrown overboard. A total of 18 different men observed the carcass and five different photographs were taken. It was only after the carcass was disposed of that Yano made his sketch (Obata and Tomoda, 1978; Figure 3).

From the start, this find was a mystery. The captain originally thought it was a whale; the crew thought that it might have been a turtle with its shell stripped off; Yano could not identify it. He took the pictures with the hope that someone else might. Two of the pictures show something very similar in appearance to a plesiosaur-like animal (Figure 1a and 1b). The scientific opinion was that the carcass was that of a species of shark known as the basking shark in an advanced state of decay.

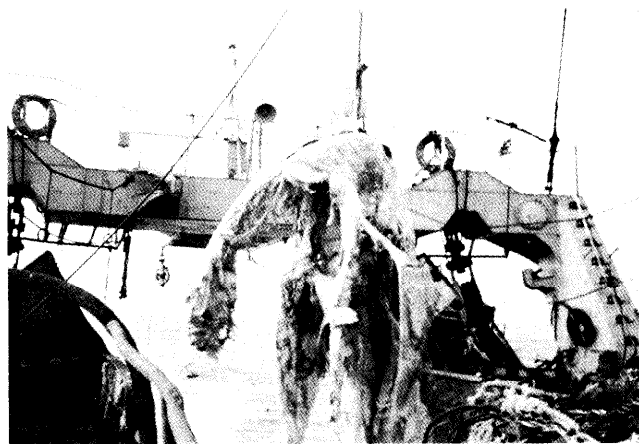
After Yano returned to Japan, he had the film developed, and prints were given to Dr. Fujio Yasuda, professor of ichthyology at Tokyo University of Fisheries, for identification. Taiyo Fishery Company (today known as the Maruha Corporation) held a press conference on July 20, 1977, announcing the discovery to the world. This was before any identification had been made. Needless to say, several Japanese newspapers published sensational stories about living plesiosaurs, and the carcass quickly became a "hot" news item in



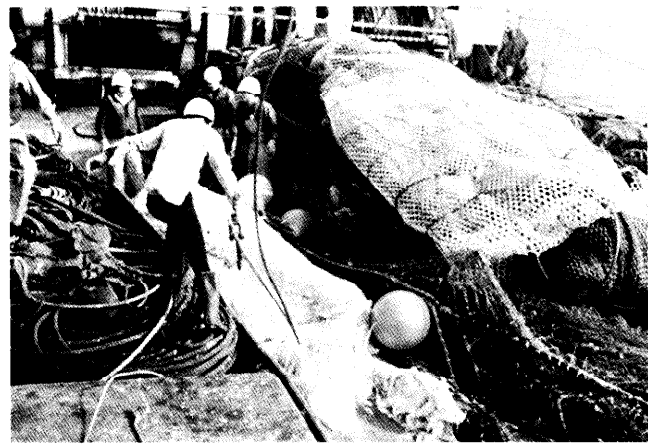
a



c



b



d

Figure 1. Four of the photographs taken by Michihiko Yano on April 25, 1977. a, b. Two views of the front. These two photographs did the most to inspire the plesiosaur identification. c, d. Two views of the carcass on the deck.

Japan. On July 25, Taiyo fishery Company issued a preliminary biochemical analysis of horny fibers from the anterior fin. The report did not, however, make a clear identification of the carcass, and the press remained confused regarding what to publish about the identity of the find.

At this time, Dr. Tadayoshi Sasaki, president of Tokyo University of Fisheries, proposed a meeting of scientists to study the evidence regarding the find. The initial meeting was held on September 1, 1977, with 12 scientists present. The second meeting was held on September 19, 1977, and 15 scientists attended. All in attendance agreed to study the evidence and prepare papers to be published in a collection by the Societe Franco-Japonaise d'Océanographie. They also agreed to refrain from publicizing their opinions until the collection was complete. The final report again echoed the scientists' disagreement about the identity of the carcass. The majority opinion, however, was that the body was a badly-decayed basking shark, *Cetorhinus maximus* (Sasaki, 1978).

Evidence that is Consistent with the Shark Identification

1. The anterior fin is articulated at a right angle to the shoulder, as in sharks (Obata and Tomoda, 1978).
2. The ribs, as measured by the crew, were 40 cm long. This is only consistent with some kind of shark (Obata and Tomoda, 1978; Hasegawa and Uyeno, 1978).
3. The bones shown in the limbs of Yano's diagram were not observed directly. A hard object was felt in the limb when it was stepped on, but the bones Yano depicts are his own interpretation (Obata and Tomoda, 1978; Omura, Mochizuki, and Kamiya, 1978).
4. In one of the photographs, what may have been the dorsal fin is visible (Omura et al., 1978; Hasegawa and Uyeno, 1978; Figure 4).
5. The photograph showing the back of the animal reveals what appear to be myocommata (Omura et al., 1978).
6. In both the photographs and eye-witness descriptions, the fins have fin rays (Omura et al., 1978).

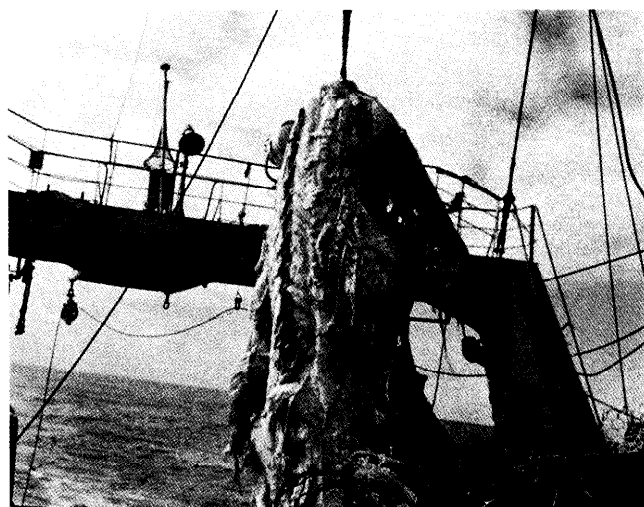


Figure 2. The only clear photograph of the back of the carcass. Taken by Michihiko Yano, April 25, 1977. What appears to be the dorsal fin is visible, along with prominent myocommata (see Figure 4).

7. Rotting sharks typically lose their jaws and gill arches, thus giving the false impression of a small head (Omura et al., 1978).

8. A positively-identified basking shark carcass was stranded at Nemuro, Hokkaido in September, 1977. It was very similar in overall morphology to the carcass discovered by the *Zuiyo-maru* (Omura et al., 1978).

9. The length of the carcass was 10 meters. This is consistent with a large specimen of basking shark (Yasuda and Taki, 1978; Hasegawa and Uyeno, 1978).

10. The reported large pelvic fins were not photographed. Yano's sketch shows them as interpreted by him. What may be the pelvic fins in one photograph could also be claspers, the enlarged pelvic fins of male sharks. In an advanced state of decay, these may appear to be of comparable size with the pectoral fins (Hasegawa and Uyeno, 1978).

11. The horny fibers taken from the anterior fin clearly shrank at 63°C. Fibers of elastoidin from a basking shark shrink at 65°C. Both shrink to approximately one-third their natural length (Kimura et al., 1978).

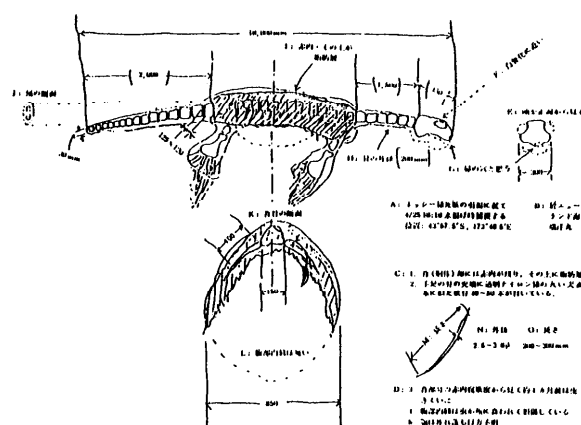
12. Transmission electron micrographs revealed striations on the horny fibers. The striations were 45-50 nm long, too short to be collagen. This indicates that the animal was not a quadruped (Kimura et al., 1978).

13. Gross amino acid analysis showed a high similarity between the horny fibers and basking shark elastoidin soaked in sodium hypochlorite (Kimura et al., 1978; Table 1).

14. Japanese shark-fin processors, accustomed to dealing with shark carcasses, identified the carcass as a shark (Abe, 1978).

Evidence that is Inconsistent with the Shark Identification

1. Eye-witnesses were adamant about the presence of posterior fins that were comparable in size to the



矢野道彦氏による本標本動物死体のスケッチ。見やすくするため、寸法の数字で寸法を括弧に代えてある。A-Oは英語の説明のためとから付け加えたもの。

Figure 3. The sketch and measurements of the carcass made by Michihiko Yano, April 25, 1977. This sketch was only made after the carcass had been thrown overboard, approximately 1 hr after its capture. This sketch and translations are taken from *Collected Papers on the Carcass of an Unidentified Animal Trawled off New Zealand by the Zuiyo-maru*, 1978.

Translations:

- A. Capture of a Nessie-like carcass. Trawled on April 25, 10:00 at 43°57.5'S, 173°48.5'E [sic].
- B. At the sea off New Zealand; *Zuiyo-maru*.
- C. 1. Red muscles remaining on the back of the trunk, overlaid by fat tissues.
2. There are 40-50 pieces of transparent, nylon-like cartilages, roundish in cross section, around the tips of the limbs.
- D. 3. Judging from the state of putrefaction, the animal may have been alive until about one month before acquisition.
4. Internal organs in the abdomen are damaged, eaten by worms or fish.
5. The lower jaw has been lost.
- E. Front view of the head.
- F. Well skeletonized.
- G. Probably nostrils.
- H. Diameter of the bone.
- I. Red muscles; fat layers on them.
- J. Cross section of the tail.
- K. Cross section of the back bone.
- L. No internal organs in the abdomen.
- M. Length.
- N. Diameter.
- O. Length.

anterior fins. This would indicate that the creature may have been a tetrapod (Obata and Tomoda, 1978).

2. The odor of the carcass was mammalian, not chondrosteian or teleostean. Particularly, the absence of the strong odor of ammonia would argue against the shark identification (Obata and Tomoda, 1978; Hasegawa and Uyeno, 1978).

3. The photographs show the presence of red muscle in a limited area (Obata and Tomoda, 1978).

4. Eye-witnesses denied the presence of a dorsal fin (Omura et al., 1978).

5. The waxy substance that covers the carcass both in the photographs and eye-witness descriptions is called adipocere. Adipocere is formed from the saponification of fatty acids. The presence of this much adipocere would seem to indicate that in life, the animal possessed a layer of blubber. Blubber is clearly inconsistent with a shark identification (Seta, 1978; Weigelt, 1927).

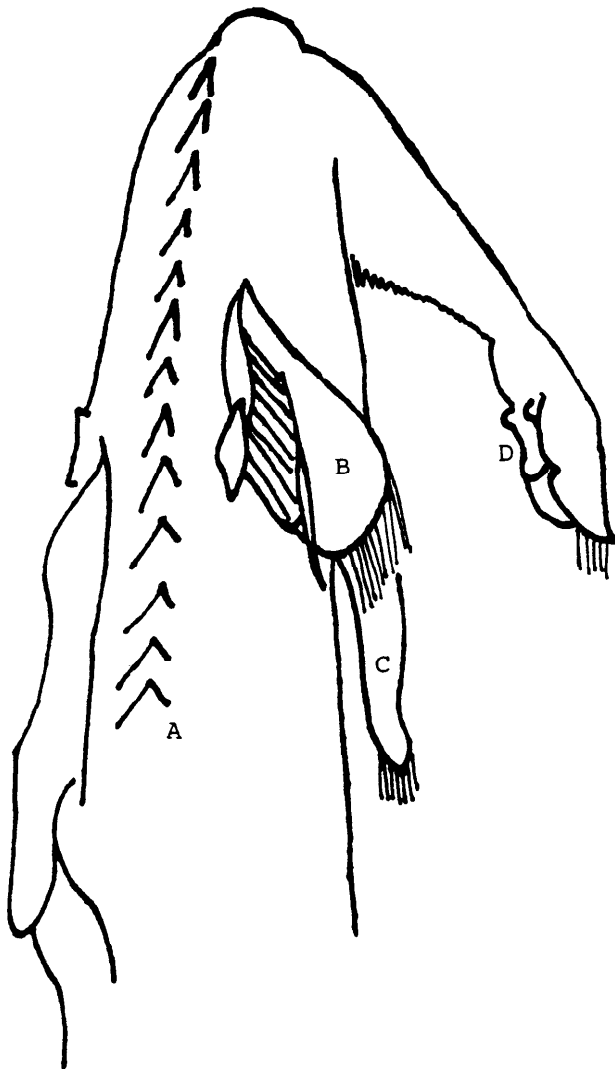


Figure 4. Interpretive sketch of the photograph in Figure 2. A. Myocommata. B. Dorsal fin. C. Right fore-limb. D. A structure in the neurocranium that may be the remains of an orbit.

Discussion

Despite the inconsistencies, the weight of evidence strongly favors the shark identification. It is therefore recommended that creationists employ caution in their use of this find as evidence for recently-living plesiosaurs.

Acknowledgements

I would like to thank Paul LeBlond, Ben S. Roesch, and especially Paul Humber, who was kind enough to provide me with the original photographs and a copy of his personal file on the find.

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Table I. Results of gross amino acid analysis conducted on the horny fiber and elastoidin of basking shark (residues/ 1000 residues). Composition was determined by JLC-3BC liquid chromatograph (JEOL Co. Ltd.). NaClO treatment was 0.607% NaClO for 24 hr at room temperature. The high tyrosine content (43 residues/1009 residues) is characteristic of elastoidin. Other collagens have only five or fewer residues of tyrosine per 1000 residues. From Kimura et al., 1978.

Amino acid	Horny fiber	Elastoidin	
		Native	NaClO-treated
4-hydroxyproline	45	45	45
Aspartate / Asparagine	54	56	55
Threonine	25	25	25
Serine	39	40	40
Glutamate / Glutamine	80	80	80
Proline	130	125	125
Glycine	291	282	290
Alanine	109	106	110
Cysteine	7	8	6
Valine	25	24	24
Methionine	10	10	10
Isoleucine	20	20	20
Leucine	19	19	19
Tyrosine	43	48	41
Phenylalanine	12	12	12
Hydroxylysine	5	6	6
Lysine	25	26	26
Histidine	11	15	13
Arginine	51	53	53

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BOOK REVIEWS

The Age of the Universe: What are the Biblical Limits? by Gorman Gray. 1996. Morningstar Publications, 931 15th St., Washougal, WA 98671-1209. 128 pp. \$8.00, softcover.

Reviewed by R. H. Brown*

This thought-provoking book is primarily directed to Biblical creationists. It is also targeted to scientifically-literate individuals who have reacted unfavorably to creationist literature. It will be warmly welcomed by a large portion of creationists who adhere to a historical-grammatical exegesis of the Bible. And there are categories of readers within which it will elicit an antagonistic reaction.

Any treatment related to creationism deals with the nature of basic reality, whether the universe is basically the product of matter, or of mind. If the basic reality is matter, there has been evolution; if the physical universe is the product of mind, there has been creation. Amalgamations of these basic options need not be considered in this brief review. In the Western World consideration of mind as the basic reality has led to secular creationism (purely intellectual concepts), and to Biblical creationism. Biblical creationism has two subcategories: 1) treatment of the first chapters of Genesis as legend or a symbolic vehicle, and 2) modeling based on a historical-grammatical exegesis of Scripture.

Gray's book is in the historical-grammatical exegesis (HGE) category of Biblical creationism. HGE creationist literature has been highly successful in establishing the scientific evidence as indicative of the origin of life by fiat creation, rather than a spontaneous expression of the innate capabilities of elementary matter (non-theistic evolution). It has been moderately successful in relating Earth's geologic features to the world wide Flood described in Genesis 6-8. But HGE creationists have had severe difficulty in dealing with the scientific evidence related to the age of the universe. Gray's thesis is that there is a bridge between historical-grammatical Biblical creationism and the scientific evidence regarding the age of the universe, a bridge that does not compromise either source of information. His development of specifications concerning this bridge is a major contribution to apologetics.

The book begins with a Foreword by David Eckman, Associate Professor of Hebrew at Western Seminary. An adequate review can best be given in Eckman's words:

This is an encouraging little book for a Bible teacher and trained Hebrew teacher to review! It consistently shows how a careful English reader

with access to biblical language tools can come to thoughtful and insightful conclusions. . . .

Over the years I have been trained in biblical and ancient languages in almost every imaginable type of school, from fiercely conservative to flaming liberal. . . . My first lessons in Hebrew were from Bernard Northrup, an arch conservative and a creationist, and my last lessons were from James Barr, an arch-opponent to Fundamentalism. . . . through that training and my own studies of the Hebrew text, I came to certain conclusions about the text in Genesis one. Those conclusions were based not upon any great interest in science or creationism. They were based upon what I believed careful literary technique and a close reading . . . of the Genesis one account would bring. . . .

My conclusions were based upon years of academic study in the biblical languages, and lo and behold Mr. Gorman Gray has noted the same things through the careful study of English texts of the Bible and the use of Hebrew-English tools.

Not only did I enjoy the care that is exercised in this book by Mr. Gray, I also found it interesting that some of his observations are supported by those who have no interest in his concerns. Significant scholars who have no interest in the internecine battles of Fundamentalists have noted some of the same things. . . .

In effect what one has with this book by Mr. Gray is a meeting of two separate streams of thought coming into an unwitting confluence. These streams are the scientific discoveries of the past and some literary and linguistic studies of the same period.

Although I do not favor interpreting the Hebrew terms *'eret* and *shamayim* as used in Genesis 1:1 differently than as specified in Genesis 1:8-10, as is done by Mr. Gray, the translators of the NIV, and many prestigious commentators, I consider his book essential reading and deserving critical analysis by individuals in all subcategories of both creationism and anti-creationism.

According to the exegesis on which Gray's treatment is based, the first chapter of Genesis reports two epochs of creation: a primeval epoch in which the basic features of the physical universe were established (verse one), and a recent epoch in which planet Earth was equipped with organic life (verses 3-31). Verse two is a transition statement that specifies conditions on the surface of planet Earth at the beginning of the recent epoch.

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Reason in the Balance: The Case Against Naturalism in Science, Law and Education by Phillip E. Johnson. 1995. Intervarsity Press. Downers Grove, IL. 245 pages. \$19.99.

Reviewed by Wes Harrison*

With the publication of *Darwin on Trial* (1991) and its subsequent acclaim, Phillip Johnson has become a prominent voice among those challenging both the scientific and philosophical validity of evolution. Contributing no doubt to his popularity and especially his access to academe is his status of professor of Law at the University of California, Berkeley—unusual credentials for a spokesman on behalf of divinity in the realms of science. Particularly within evangelical circles, he has become a sought after speaker for conferences and a solicited contributor to various religious periodicals. These factors no doubt cultivated a ready audience for his second book, *Reason in the Balance*, which was later awarded fourth place among the 25 most significant books with a Christian perspective in *Christianity Today's* 1996 Book Awards.

In many ways *Reason* is an extension of the latter chapters of the author's earlier book where he went beyond the scientific factors (biology, genetics, fossils, chemistry) to deal with the philosophical assumptions that underlay the theory(s) of Darwinianism. This shift of emphasis was also the result of rapid and extensive confrontations occasioned by the popularity of the earlier work and the author's own interest in developing channels of dialogue with evolutionists, especially in the academic setting.

Although scientific factors remain critical areas of concern in regard to the questions of the origin of existence, life, and life processes, Johnson contends that the real battle is ultimately and unavoidably a philosophical one. The central question becomes, does God exist? If He does, then the origin and continuing purpose of life reflects design as expressed in the power, will and intent of the Creator. The elements and processes of chemical, astrophysical and biological actions would, therefore, in decipherable ways indicate design (divine activity), thus making such a conclusion at least plausible if not conclusive. On the other hand, if God is an imaginative creation of mankind's ingenuity, then it would not be reasonable that such a divinity would have anything to do with existence in a causal way; therefore the only reasonable conclusion to be drawn is to search for such causes in nature itself. What is "reasonable" is not as much determined by the searching itself as it is the preconceived notions of what is "reasonable." Design cannot be allowed as explanatory if one accepts only natural causes for all existence.

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The author easily demonstrates that modern science has largely chosen to define "true science" as a self-creating and self-sustaining "natural process"; scientists need only to apply their mental capacity to trace out the properties of the natural processes. Religious explanations are *ipso facto* eliminated; they are "unreasonable" when applied to "science."

Johnson contends that such a perspective is an unjustified *a priori* assumption that has come to be accepted without reservation by the wider community of scientists. Rather than defining science on the basis of methodological naturalism—defining, clarifying, rejecting or accepting hypotheses through observable, repeatable, demonstrable processes—they expand the meaning to include as well a metaphysical Naturalism under which they understand that the only causes in all existence must be natural, physical. Thus, any non-physical explanation is completely unreasonable and unacceptable in the field of science. Religious explanations simply cannot be considered in any way scientific. Religion is relegated to a cultural nicety, having no scientific explanatory validity.

Johnson persuasively points out that a naturalistic methodology (naturalism with a small "n") does not rule out an ultimately non-physical explanation of existence, but simply demonstrates that certain physical causes have certain physical effects. Why this even exists or for what purpose the physical cause-effect relationship operates is not revealed in the process itself. It only demonstrates that it happens. Explanations of ultimate purpose and origin are metaphysical questions that are answered through philosophical avenues. Both Naturalism (that existence is self-creating and eternally self-sustaining) "this is all there is or ever will be:(" and Design (divine fiat) are reasonable possibilities. Both accept the natural physical processes but differ on where they came from and why they operate the way they do. A religious hypothesis is potentially as acceptable and reasonable as a Naturalistic one. Johnson emphasizes lower case *naturalism* as simply a natural process, while upper case *Naturalism* is a philosophical statement. It is his formulation of naturalism = Naturalism, showing that many scientists combine the two into a philosophical world view.

The author chides his fellow believers, theistic evolutionists, who buy into a "scientific Naturalism" by conceding that science must be done on the basis of an "atheistic methodology" though they continue personally to hold to a theistic metaphysics. According to Johnson, this is theistic schizophrenia.

He receives substantial support for his viewpoint from an unlikely source, the agnostic philosopher William Provine. At Provine's invitation, Johnson has been able to present the theistic position in some of Provine's courses, together offering students adept pre-

sentations of the two ultimate conclusions to existence: purpose by divine design or meaningless, accidental, happenstance. Both gentlemen agree it cannot be a mix; that it is either Naturalism or Theism; and metaphysically speaking, neither proposal is necessarily precluded by methodological naturalism. Both follow valid reasoning processes, though the conclusions may be more or less persuasive.

Culturally, the naturalism = Naturalism equation has had almost as mesmerizing and negative an effect as it has had in the world of "science." As noted in the subtitle, in addition to science, the author chose law and education as case studies. Two contrasting Supreme Court decisions demonstrate how religion has been marginalized in contemporary American society, thus invalidating it as a viable, scientific way of thinking. *Lamb's Chapel* (a religious group requesting use of a public school building after hours) won their case against the school board which did not want a religious group to use a public building for religious purposes (separation of church and state). But the court decision was based on group discrimination, that is, all groups must be treated equally and since other groups used the building, so could religious groups. According to Johnson such a decision tends to marginalize the validity of religion in our society—it puts it on the same level as a garden club when in reality it should be considered in regard to the significance it has for the very foundations of social ethics.

The other case was *Edwards vs Aguillard*, Louisiana's law of equal time for the theories of origin, creation and evolution. The court decision simply made a distinction between scientific thinking, evolution, and religious thinking, creation; the latter was clearly not an acceptable avenue of thought in the realm of science. The court, according to Johnson, unwittingly accepted evolution as scientific on the basis of the naturalism =

Naturalism equation. In both cases the marginalization if not antagonistic view of religion as a valid and culturally significant way of thinking expressed by the courts has the effect of undermining the value and influence of religion on American society.

In regard to education, one gets the distinct feeling that the author is joining the current culture wars. Here Naturalism takes on the guise of socio-ethical relativism. Based on the classical materialistic/social relativists (Marx, Nietzsche, Freud, Darwin), modern disciples (Dewey, Searle, Rorty) hammer out a social/cultural ethic that is founded on human reason, again relegating religion to secondary if not tertiary importance. Human not religious reasoning is the only valid basis for rational social decisions. The effect of such reasoning is seen, for example, in sex education which treats teen sex as just another contact sport that requires appropriate equipment to reduce injury. Sex education that emphasizes preparation for healthy monogamous family life or sex within ethical restraints would smack too much of religious thinking to receive much validity. The overall effect of this social ethic is the values crisis currently experienced, especially in the American education system.

Johnson is superb in analyzing the naturalism = Naturalism equation which pervades the modern world, especially in academe from which it is diffused throughout American society through the courts and lower educational system. He skillfully draws from classical works as well as from prominent contemporary thinkers to effectively illustrate his basic thesis. As *Christianity Today* recognized, it was one of the most significant books of 1995 and will remain so for quite some time.

Reference

Johnson, Phillip E. 1991. *Darwin on trial*. Intervarsity Press. Downers Grove, IL.

Book Announcement

Designs in the Living World

Lane P. Lester, Dennis L. Englin, and George F. Howe

This is a new 200-page creationist biology textbook that is being used this year at two Christian colleges. It is written at the introductory level and is suitable for high school use as well. To reduce costs, it has line drawings, and is looseleaf, 3-hole-punched, and shrink-wrapped.

Here is your opportunity to get one of the few remaining copies at the same price being charged to bookstores, only \$15 postpaid. Send your check payable to...

Lane P. Lester, Route 1, Box 205, Hull, GA 30646

RESEARCH PROJECTS AT THE VAN ANDEL CREATION RESEARCH CENTER LAB DIRECTOR'S REPORT

JOHN R. MEYER: Director of the CRS Van Andel Creation Research Center

The Van Andel Creation Research Center has been established by the Creation Research Society to pursue advanced origins research within a creationist perspective. This facility, built by a generous grant from the Jay and Betty Van Andel Foundation, is now operational and well equipped for a number of research projects. The goal of this research is to support the development of a comprehensive creationist model through the pages of the *Creation Research Society Quarterly*.

In addition to our current research projects, we welcome participation by other experienced scientists who share our goals and objectives. Thus, the facilities of the Van Andel Research Center are being made available to experienced scientists and their advanced students who are working closely with them. Our Visiting Scientists' Quarters are experiencing increased use and provide lodging for two scientists for extended periods of time. Parking spaces for at least two recreational vehicles can be provided.

Scientists who are on sabbatical, summer leave, or have short periods of free time for research in Northern Arizona will find our facilities ideal for a wide variety of research projects. Laboratory equipment includes many standard items such as centrifuges, slide making equipment, pH meters, gas chromatograph, precision balance, lab oven and furnace, binocular microscopes and electrophoresis equipment. We have available a wide variety of field research equipment such as weather instrumentation, pocket transit, altimeter, motor driven psychrometer, and a rock core drill.

*Van Andel Creation Research Center, 6801 N. Highway 89, Chino Valley, AZ 86323.

In addition, we can provide a rather complete electronics shop and several research computers. One computer is equipped with an analog to digital converter operating under virtual instrumentation software. Standard hand tools are available.

The research facilities include two general laboratories and two wet labs. The operation is supported by a small, dedicated research library and a three-quarter ton, high-clearance pickup truck suitable for back country use.

Geologically, the Van Andel Creation Research Center is located in the Transition Zone, but is very close to the Colorado Plateau and only a two-hour drive to the Basin and Range Province. This places the investigator within reasonable driving distance of many important research areas. This includes such outstanding geological features as the Grand Canyon, the Petrified Forest National Park, the Meteor Crater, and the Falls of the Little Colorado River.

Biologically, the Research Center is located in the desert grasslands of Northern Arizona. Thus, we have reasonable access to a wide variety of biological communities. This includes the alpine community on San Francisco Peaks at 12,600 feet and the Sonoran Desert at 1,000 feet near Phoenix. Our area is rich in Pronghorn antelope, deer, elk, and javelinas.

If you are interested in pursuing advanced origins research projects with the Van Andel Creation Research Center, please write for our bulletin entitled, *Research Projects at the Van Andel Research Center*.

Errata

CRSQ Vol. 33, September 1996, p. 107, the sentence at the bottom of the first column beginning "In this situation . . ." should have been finished as follows: "In this situation another error is introduced. A regression program that is sensitive to Pearson's correlation coefficient . . ."

CRSQ Vol. 33, September 1996, p. 106, in the sentence in column one reading "Austin (1994, pp. 111-131) does not address the division at all; he simply uses the Sr-87/Sr-86 and Sr-87/Sr-86 ratios . . ." the first Sr-87/Sr-86 ratio should have a "t" subscript denoting the ratio at the present time t, and the second Sr-87/Sr-86 ratio should have a "o" subscript, denoting the ratio at the original time when the rock crystallized.

CRSQ Vol. 33, September 1996, p. 106, Figure 2, the label for the y-axis should read 87Sr Gmol*E-7 instead of 86Sr Gmol*E-7. The data are given correctly in the Table of Appendix I.

Quote

If thou couldst understand a single grain of wheat, thou wouldst die for wonder (p. 168).

Quote from Martin Luther. Bainton, Roland. 1978. *Here I Stand*. Abingdon Press. Nashville.

