

CRSQ

CREATION RESEARCH SOCIETY QUARTERLY



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Celebrating Our 35th Year of Publication

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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

Editor's Comments

As one of the joys of being editor of the *Creation Research Society Quarterly* for the past several years, I have become acquainted with efforts of a numerous and varied nature to present true and accurate scientific results. While I have not particularly enjoyed dealing with evolutionists and frauds who have occasionally attempted to embarrass the journal's publishers, I hope that the peer review process has worked. When a few creationists have unreasonably attacked the views of others, the job of editor has not been particularly pleasant, but I hope that fairness and some measure of accuracy have prevailed. The results of the review process are not always predictable, and one has a difficult time knowing in advance when a paper will appear in the journal. This March issue contains an interesting mixture.

Mark Armitage reports the results of some work begun with the late Dr. Richard Lumsden, who was commemorated in CRSQ 34: 195. The work resulted in the discovery of a new species, which was named in honor of Dr. George Howe, a fellow and long-time board member of the Creation Research Society who has served in many positions over the years. Possibly this work may have some significance for creationists due to relevance for studies of speciation.

Carl Froede has written a series of papers which study the Florida coast and evidence for past shorelines. These relate to evidence for retreat of the waters from the Genesis Flood. The latest paper in this issue treats the Upper Florida Keys.

Using the Van Andel Creation Research Center as home base, Howe, Williams, and Meyer report on a species of grass that grows in circles, spreading outward from a central point. Studies show that the grass occurs only in

certain types of soil and ecosystem. Its occurrence on the Creation Research Society's property may provide an opportunity for further studies of plant succession, Genesis kinds, etc.

In 1889, an Idaho well is reported to have brought a human figurine to the surface from a depth of 320 feet. Whether the evidence for this is credible is a subject examined in considerable detail by Creation Research Society Treasurer Robert Gentet along with Edward Lain. If true, then it may have implications for humans and their origins that contradicts evolutionary scenarios.

Two creationists from Russia have been writing a series of papers about placer mineral deposits on the far northeast coast of the Asian continent. The papers have been developing mathematical models for the deposition of the minerals, and for estimating the time required for such deposits. The results, including those presented in this issue, seem consistent with a young earth viewpoint.

Dr. Jerry Bergman writes about the vast complexity involved in living cells. He summarizes many details of the machinery involved in a cell, which summary the readers are likely to find fascinating. The discussion turns to evolutionism and its failure to explain how these interrelated and complex parts could have originated.

This issue contains more book reviews than has been the norm. I hope the readers will enjoy these along with the Panorama Note by Meyer and Williams reporting on some findings from the Niagara Falls bus trip of last summer. If any readers with some astronomical expertise are interested, please note the Call for Papers in this issue.

Eugene Chaffin
Editor, CRSQ

Of God and His Creatures: That God is Almighty

As creation is the work of God alone, so whatever beings are producible only by creation must be immediately produced by Him. Such are all spirits,* the existence of which for the present let us suppose,* and likewise all bodily matter. These several existences are immediate effects of creative power. Now power is not determined and limited to one effect, when it is productive of several effects immediately, and that not out of any pre-existent material. I say 'immediately,' because if the production

were through intermediate agents, the diversity of effects might be ascribed to those intermediate causes. I say again 'not out of any pre-existent material,' because the same agent by the same action causes different effects according to the difference of material. God's power then is not determined and limited to one effect.

(An Annotated Translation of the *Summa Contra Gentiles* of Thomas Aquinas by Joseph Rickaby. Burns and Oates, London, 1905).

A New Species of Fluke, *Ascocotyle howei*, in the Context of Sibling Speciation

Richard D. Lumsden⁺ and Mark H. Armitage^{*}

Abstract

Ascocotyle (L.) *howei*, n. sp., is described from adults found in the intestines of naturally infected Colombian opossums, *Didelphis marsupialis* L. The new species is characterized by a distinctive flagon-shaped body, and 24-28 scalpel-shaped spines per row, arranged in two complete circumoral rows around a massive oral sucker. This new species most closely resembles *A. (L.) megalcephala* by way of a large oral sucker, a reduced pre-oral lip, a short ceca, and vitellaria

which extend anteriorly to the level of the pharynx and posteriorly to the upper margin of the testes. Some characters, however, would place it in subgenus *Ascocotyle* or even *Phagicola*. In an introduction, the typical life histories and anatomical designations are reviewed for *Ascocotyle* trematodes, commonly referred to as flukes. Remarks concerning sibling speciation and its relevance to creation are summarized in the appendix.

Introduction

Parasitic trematodes such as the worm described in this study are classified as follows:

Kingdom: Animalia
Phylum: Platyhelminthes
Class: Trematoda
Order: Digenea
Family: Heterophyidae Odhner 1914
Subfamily: Centrocestinae Looss 1899
Genus: *Ascocotyle* Looss 1899
Subgenus: *Leighia* Sogandares-Bernal and Lumsden 1963
Species: *howei* Lumsden and Armitage 1998
(this paper)

Typically, parasitic trematodes, or flukes mature as adults in birds, but prior to this they complete part of their life cycle in other organisms, such as snails and fish. There are many differing life cycles for trematodes, and a full discussion of these exceeds the present purpose. The life cycle for *Ascocotyle*, such as described in this study, however, requires a snail within the marsh or estuary as the first intermediate host, and a fish in the marsh as the second intermediate host. Fish eating birds and mammals which come to the marsh to feed, can serve as final

or definitive hosts if they consume infected fish, and if they have the appropriate intestinal environment to harbor the maturing worm. The trematode, if not expelled by peristalsis or other factors in the definitive host, will begin to produce eggs, which then are fertilized by sperm, also produced by the same worm, allowing viable eggs to be passed over time into the rectum of the bird. The life cycle is completed when bird feces containing the fertilized and developing trematode eggs are deposited in the marsh. These then are available to the snail for ingestion.

Anatomical features of these flukes include a so-called ascot (AS), (an ascot is a scarf usually worn around the neck—this worm has a feature resembling an ascot, hence the name *Ascocotyle*), (Figure 7). Other anatomical traits include the size and shape of the oral (OS) and ventral (VS) suckers; the number, shape, and position of spines (SP) around the oral sucker and on the body surface; and the size, position and distribution of certain internal organs (vitellaria (VI), ceca (CE), testes (TE), ovary (OV), excretory bladder (EB), pharynx (PH) and esophagus (ES)). The foregoing anatomical characteristics are typically used by taxonomists to distinguish different species, subgenera, or genera of these microscopic worms from each other. In addition, the location of the estuary, the specific hosts employed, the site of infection, the size and shape of the cyst used to maintain a presence in the intermediate host, and many other factors may be used to compare and contrast the many varieties of these parasites from each other, i.e., to delineate the different species within these groups.

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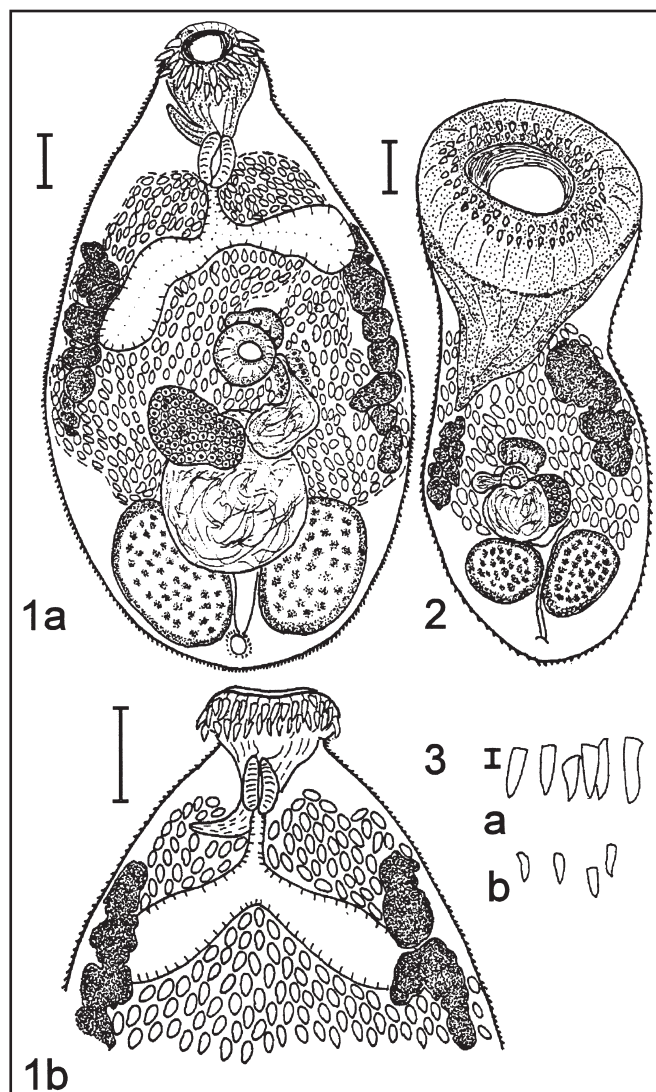


Figure 1. *Ascocotyle howei*, n. sp. a. Ventral view of whole mount (scale is 75 μ m). b. Forebody of a somewhat contracted specimen, with flattened oral sucker (scale is 110 micrometers).

Figure 2. *A. megalcephala*, dorsal view of whole mount (scale is 16 μ m). (Drawn from Paratype #40158, U.S. Natl. Parasite Coll.).

Figure 3. Spines of the circumoral coronet (dorsal and lateral views, scale is 12 μ m). a. *A. howei* b. *A. megalcephala*.

To date, we are not aware of any biochemical studies which can clarify how closely "related" these different species are, although such may be useful in the future. In addition, as will be discussed in the appendix, the "reproductive isolation" test, which often is applied to similar organisms to determine if they are validly distinct species, may be inapplicable. This could be the case since these organisms are true hermaphrodites, bearing both

testes which produce sperm and an ovary which produces eggs within the same individual.

Self-fertilization seems to be the typical reproductive path employed by ascocotylids, although some authors are convinced otherwise with respect to platyhelminths in general (Nollen 1983). Nothing in the ascocotylid literature indicates that cross-fertilization has ever been observed by any worker, so they are, by their very nature, "reproductively isolated." This would preclude their assignment into species designations purely on that basis. Recent observations by the junior author, however, may cast doubt on the long-held belief that ascocotylids are strictly self-fertilizing. For example, worms collected by Price in 1932, and deposited into the U.S. National Parasite Collection as type specimens (#40158, *Ascocotyle megalcephala* Price) now are shown to be joined at the acetabulum, suggesting that genetic exchange (by means of eggs or sperm) may be taking place (Figure 8).

Looss erected the genus *Ascocotyle* with *A. coleostomum* (Looss, 1899) as the genotype. Excluding synonyms, there are at present more than 30 named species comprising the *Ascocotyle* complex as defined per Travassos (1930), Stunkard and Uzmann (1955), Sogandares-Bernal and Bridgman (1960), and Sogandares-Bernal and Lumsden (1963).

According to the taxonomic scheme proposed by Sogandares-Bernal and Lumsden (1963), *Ascocotyle* Looss, 1899 is divisible into three subgenera: *Ascocotyle* Travassos, 1930; *Leighia* Sogandares-Bernal and Lumsden, 1963; and *Phagicola* Faust, 1920. The primary basis at present for this subgeneric organization is cercarial type. Because of the paucity of life history information at the time, most of the assignments to these subgenera were made on the basis of adult and metacercarial morphology (Sogandares-Bernal and Lumsden, 1963).

Specimens of some ascocotylid trematodes collected by Dr. Dale Little from Colombian opossums ca. 1975, and generously provided for the senior author's study, appear to represent a new species, which is designated *A. (L.) howei* and is described herein.

The following species description is based on 11 specimens fixed in 10% formalin, stained with Mallory's triple stain and whole mounted, and five specimens embedded in paraffin and sectioned. Measurements are in micrometers (μ m). Drawings were made with the aid of a camera lucida.

Description

Ascocotyle (Leighia) howei, n. sp. (Figures 1a–1b). Body distinctively flagon-shaped, 740 to 817 long, 490 to 521 in maximum width (at midbody); completely spinose. Short neck terminates in an oral sucker, 108 to 179 in di-

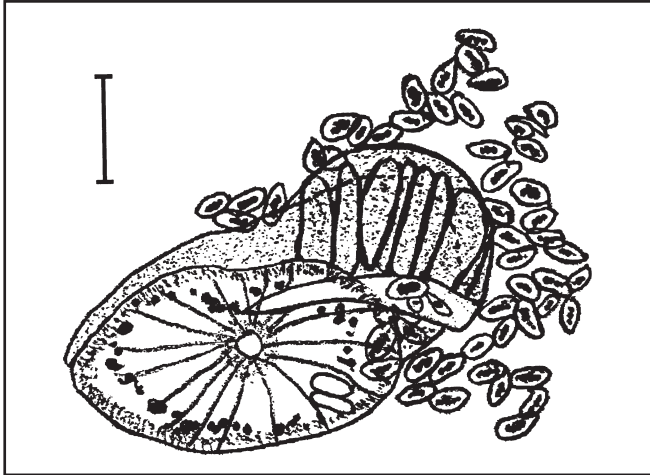


Figure 4. Gonotyl, *A. howei*, (scale is 25 micrometers).

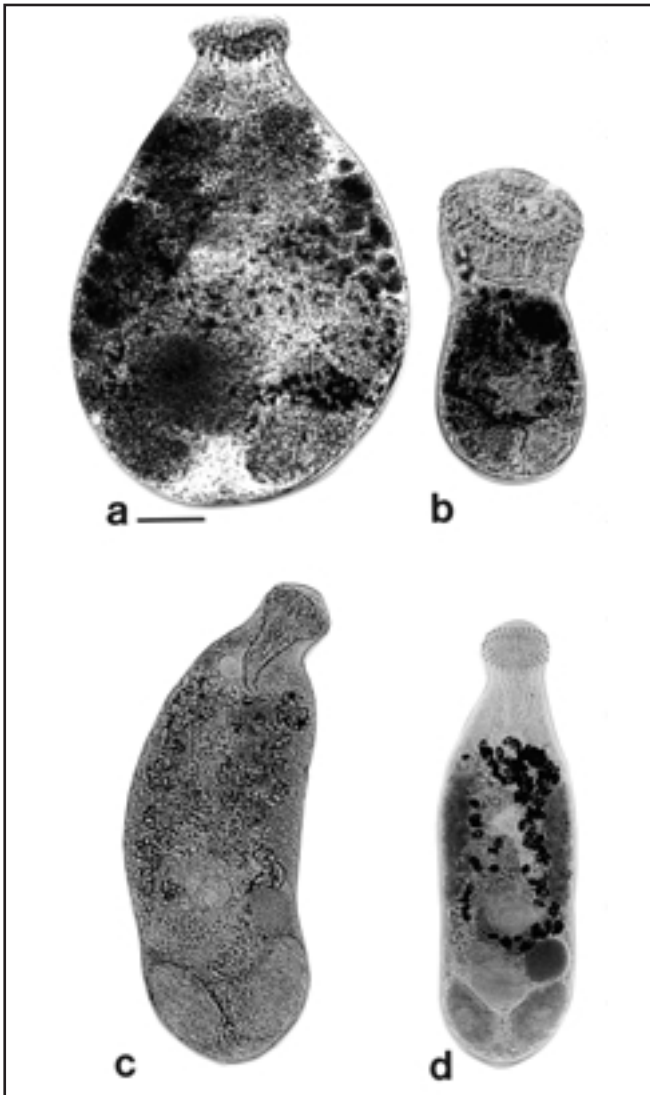


Figure 5. a. *A. howei* (scale is 95 μ m) b. *A. megalcephala*. (USNPC # 40158). c. *A. sexidigita* (Alan Hancock Foundation # AHF691). d. *A. gemina* (AHF # F-1-9-21-81).

ameter, tapering into a caudally directed, conical muscular appendage. Pre-oral lip reduced or absent. Oral sucker with two complete rows of scalpel-shaped spines, 25 to 39 long by 5 to 9 wide at base, 24 - 28 per row. Pre-pharynx present. Pharynx ovoid to nearly cylindrical in shape, 58 to 87 long by 35 to 42 wide. Short esophagus bifurcates into two cecal pouches which do not generally extend past the acetabulum. Acetabulum equatorial, subspherical in shape, 78 to 83 in diameter, enclosed with gonotyl in a genital sac. Genital pore medial, immediately preacetabular. Gonotyl a single pad, immediately anterior to the acetabulum, sinistromedial bearing at least six digitiform pockets or lobes; followed by a more or less sigmoid-shaped seminal vesicle with sperm duct surrounded by prostatic gland cells. Testes broadly ovoid with mostly regular margins, in posterior region of hindbody, 185 to 220 long by 116 to 154 wide. Ovary dextral to body midline, pretesticular, ovoid, 108 to 135 long by 65 to 96 wide. Mehlis gland and Laurer's canal present. Seminal receptacle subspherical, 193 to 251 in diameter, post-ovarian, mediodextral. Gravid uterine coils extending from anterior margin of testes to pharynx, terminating at genital sac; uterus does not penetrate gonotyl. Eggs operculate, embryonated, 17 to 19 long by 7 wide.

Vitellaria generally preacetabular but often extending to pharynx, with 6 to 8 relatively large (50 to 116 by 38 to 85) ovate follicles twisted into a serpentine array on each side of body between ovary and cecal bifurcation. Excretory bladder intertesticular, globlet or tulip-shaped, with smooth margins. Excretory pore terminal with subjacent sphincter.

Taxonomic Summary

Type host: Opossum, *Didelphis marsupialis* L.

Type locality: vicinity of Cali, Colombia, S.A..

Site of infection: intestine.

Etymology: Named in honor of Dr. George F. Howe, in recognition of his contributions to the concept of sibling speciation.

Specimens deposited: Holotype and paratypes: Biosystematic Parasitology Laboratory, U.S.D.A., Bethesda, MD (Holotype USNPC No. 87600, Paratypes 87601).

Remarks

Adult morphology places *A. howei* in the subgenus *Leighia*, where it most closely resembles *A. megalcephala* (Figure 2, USNPC# 40158), in that it bears a large oral sucker, a reduced to absent pre-oral lip, ceca which do not descend past the acetabulum and vitellaria which generally are restricted between the testes and the

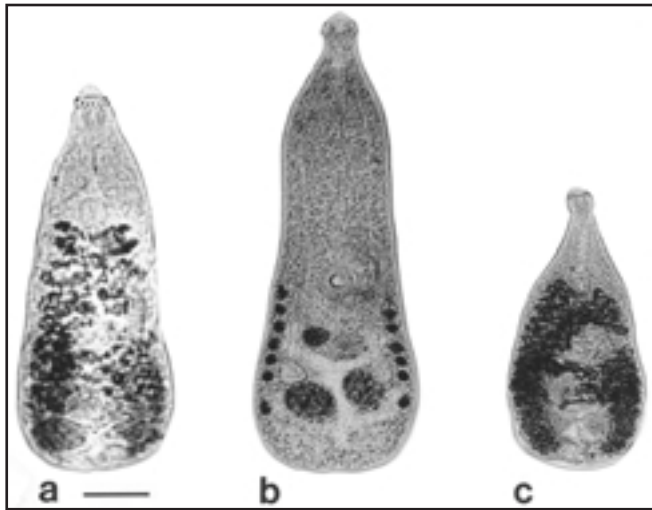


Figure 6. a. *A. (L.) mcintoshi* (scale is 11 microns) (USNPC # 42211) b. *A. (L.) chandleri* (USNPC # 59894) c. *A. (L.) hadra* (USNPC # 84045).

pharynx, although some of these features would place it in *Phagicola* or *Ascocotyle*. Alternately, the subgenus *Phagicola* is characterized by one single complete row of circumoral spines and a second incomplete or accessory row, in addition to an incompletely spinose body, among other traits which do not characterize *A. howei*.

The short ceca, and the vitelline distribution of *A. howei* fit well with the subgenus *Ascocotyle*, as represented by *A. sexigita* and *A. gemina*; yet the number of circumoral spines is generally fewer than expected for *Ascocotyle*. Additionally the vitellaria of *A. howei* extend anteriorly to the level of the pharynx but are disposed as large ovate follicles, versus the smaller and more numerous follicles, otherwise similarly distributed, in *A. sexidigita* and *A. gemina*.

In *A. megaloccephala*, the most posterior extent of the vitellaria is the middle of the acetabulum, versus *A. howei* where it is the ovary; in *A. sexidigita* and *A. gemina*, it is the posterior margin of the acetabulum. The margins of the excretory bladder in *A. howei* and *A. megaloccephala* are evenly contoured (as they are also in *A. gemina* and *A. sexidigita*), versus the robustly lobate, or deeply scalloped configuration of the bladder evidenced by other members of the subgenus *Leighia*. Martin and Steele (1970) described the bladder of *A. sexidigita* as "scalloped," but our examination of the type specimens revealed a smooth margined structure with only a pair of *cul de sacs* extending laterally in the posttesticular region of the hindbody. In *A. howei*, the acetabulum is equatorial, versus subequatorial in *A. megaloccephala* and its postequatorial position in other *Leighia* species. Much like the description of *A. nunezae* (Scholtz, Vargas-Vasquez, Vidal-Martinez, and Aguirre-Macedo, 1997), in which the authors lament, "The morphology of *A. (A.) nunezae*, which shares

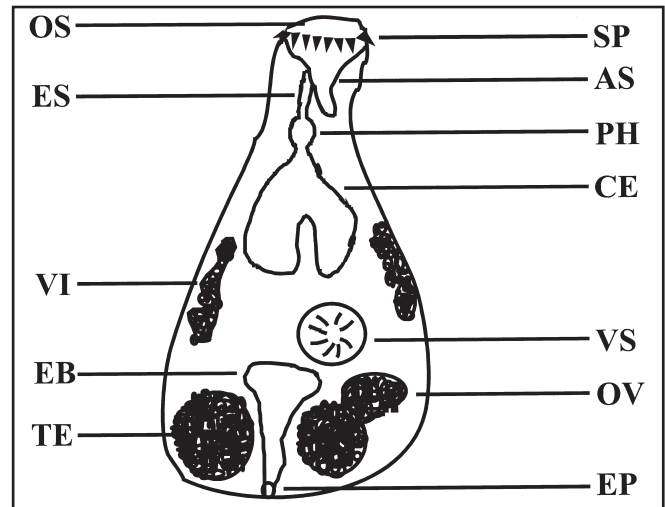


Figure 7. Taxonomic morphology of a typical *Ascocotyle* parasite.

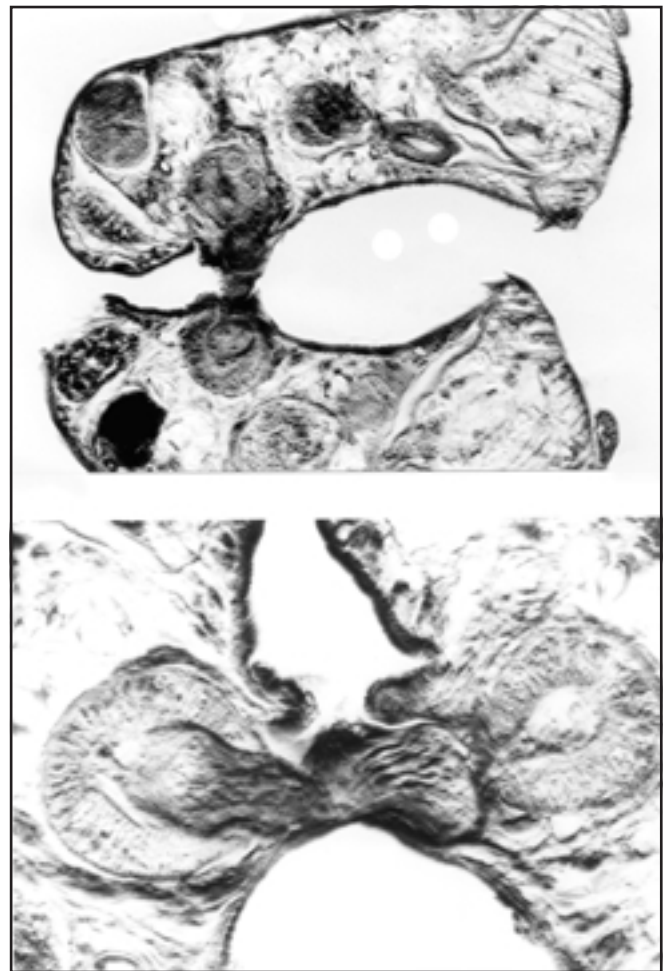


Figure 8. *A. megaloccephala*, serial section (Price 1932), worms joined at the acetabula.

some features for all 3 subgenera of *Ascocotyle*, casts doubts upon the present classification of the subgenera within the genus *Ascocotyle*," the description of *A. (L.)*

howei, likewise muddies the taxonomic waters. We do point out, however, that contrary to the report by Scholtz et al. (1997), *A. megalcephala* does not exhibit "vitelline follicles confined to the post acetabular region," but rather vitellaria which can be found from the level of the testes to the pharynx, as also seen in *A. howei* (Figures 1a, 2 and 5a,b).

Price (1932) differentiated *A. megalcephala* from other ascocotyliids on the basis of body shape. For this species, in particular, the present authors concur that this is a valid characteristic. In its distinctly flagon-shaped body, *A. howei* readily is distinguished from *A. megalcephala*, with its characteristically beaker-shaped form, and from the other species comprising the subgenus where the shape of the body is essentially cylindrical. Realizing that body shape frequently is impacted by the fixation protocol, the senior author believes, on the basis of his experience with the microtechnical preparation of *Ascocotyle* spp., that the comparison of body morphotypes is valid. He also is aware that body shape may vary somewhat for otherwise putatively conspecific forms developing in different hosts (see, e.g., Sogandares-Bernal and Lumsden, 1963, regarding variant morphotypes of *A. (P.) angrense*).

A. howei further differs from *A. megalcephala* in the number of circumoral spines ($2 \times 24-28$ v. 2×36 , respectively), and the oral sucker: acetabulum ratio (ca 2: 1 v. 5: 1, respectively). In other species of the genus *Ascocotyle*, the sucker ratio is ca. 1 - 1.5 : 1. The circumoral spination for *A. sexidigita* and *A. gemina* is $2 \times 28 - 32$. Additionally in *A. howei*, the testes are more widely separated. In our opinion, this does not appear to be a function altogether of an anatomical response to fixation. As is the case for other species of *Leighia*, the gonotyl in *A. howei* and *A. megalcephala* bears digitiform lobes, or pockets, although the exact number of these structures and the presence (or absence) of supportive rodlets noted for some of the other species of this subgenus could not be resolved definitively in the specimens available in the present study. Gonotyl microstructure has been used to distinguish between *A. gemina*, and *A. sexidigita* by Font, Heard and Overstreet (1984) and is probably a valid species criterion, but such features are best discerned in live worms.

The geographic range of *A. megalcephala* is Puerto Rico (Price, 1932) westward to south Florida (Stein, 1968) (cf. the northwestern coast of Colombia, S.A., for *A. howei*); the only known definitive hosts for *A. megalcephala* are herons i.e. *Butorides* (cf. opossums for *A. howei*).

As exemplified by *A. angrense*, there are species of ascocotyliids which infect both birds and mammals with equal facility and have an extensive (intercontinental) geographic range (Sogandares-Bernal and Lumsden,

1963). However, the possibility of at least strain differences within the context of this nominally singular species exists. Indeed, Ostrowski de Nunez (1993) contends that North American populations of "*A. angrense*" are a distinct species, *A. diminuta* (Stunkard and Havi-land, 1924), which Sogandares-Bernal and Lumsden (1963) had reduced to synonymy with the species described by Travassos (1916) from specimens parasitizing *Butorides striata* in Brazil. Another synonym of *A. angrense*, *A. nana* (Ransom, 1920), appears to be a valid species based on life history data obtained by Font, Overstreet and Heard (1984). The broad range of definitive hosts reported for the *angrense* group may be a reflection of the short maturation time (Sogandares-Bernal and Lumsden, 1964) and the relatively non-specific requirements for the excystment of ascocotyliid metacercariae (Stein, 1968).

Acknowledgements

We thank Drs. Dale Little (Tulane University), J. Ralph Lichtenfels (Biosystematics Parasitology Laboratory, USDA), Janet Haig (Allan Hancock Foundation), Margarita Ostrowski de Nunez (Ciudad Universitaria, Buenos Aires) and Robin Overstreet (Gulf Coast Research Laboratory) for providing the specimens essential to this study, and Pam Monson for technical assistance. We also thank Drs. George Howe and Wayne Frair for assistance and suggestions, and for stimulating discussions.

Appendix

Sibling species are morphologically similar or possibly almost identical natural populations of sexually reproducing organisms. They are held to be reproductively isolated, because they have never been observed to mate, even though they may inhabit the same locality. This definition has caused no small stir in taxonomic biology because morphotypes (shape characteristics) are thought to be passed down through generations by parental genes; yet morphologically "related" and almost identical organisms (sibling species) exist without the sharing of genes. Dobzhansky (1955) has stated, "The definition of species as reproductively isolated populations has, however, no meaning where sexuality is lost or where self-fertilization is the usual or exclusive method or begetting progeny." We know that even though there is a distinct possibility that *Ascocotyle* worms share genes (Figure 8), it is more likely that they exclusively self-fertilize. This would mean that the similarities we observe between such groups do not depend upon gene exchange, supporting our claim that they are sibling species.

Sibling species, then, even though sexual organisms, are separated by a barrier which may be characterized as a sterile separation. Because of this so-called 'sterility barrier,' it is assumed that these close morphotypes diverged from a common ancestor in the recent past, and thus must, at the very least, be related on that basis (Dodson and Dodson, 1985). Creationists would be tempted to assert that the origin of sibling species occurred soon after the original Creation events, and such might be the case.

That sibling species exist in nature is hardly in question. As elucidated by Mayr in his description of sibling species (1963), "Many examples will be listed...from the enormous number of such cases in the taxonomic literature. There is hardly a taxonomic monograph or revision that does not give new instances of sibling species." It is a valid exercise, then, to pursue the distinctions of sibling species as we seek a greater understanding of the very origin of new species which appears to be a true function of biology. William Stansfield has noted (1977), "Populations that live in the same locality without interbreeding must be accorded species recognition regardless of the degree of morphological distinctions they exhibit." Yet there was one anonymous reviewer of this paper, after it was presented in a reduced form to a major parasitological journal, who stated, "to call the two species sibling species is absurd...In fact, not only is *A. megalcephala* not a sibling species, it is probably not even the most closely related species." Although it may be true that there exist other more closely related ascocotyliids, the reviewer would have done well to study the very taxonomic literature of this diverse group of parasites because it yields several published examples of sibling speciation in journals from his own field.

Bowers, et al. (1990, 1996) demonstrated that sibling species of *Meiogymnophallus*, (a digenean trematode not unlike the one in this study), collected along the French Mediterranean and British coasts are morphologically almost identical, but that they employ different second intermediate hosts in their life cycle.

Russell-Pinto and Bowers (1998) further elucidated the differences between the sibling species of *Meiogymnophallus*, differences that are observable only under scanning and transmission electron microscopy. Further, Font et al. (1984) described a very closely related member of this ascocotyliid group, *Ascocotyle gemina* (placed within the subgenus *Ascocotyle*, c.f. *Leighia* for the worm in the present study), and stated "We consider *Ascocotyle gemina* to be a sibling species to *A. sexidigita* . . ." even though the two parasites "displayed different specificity for cyprinodontid [host] fishes . . .", and " . . . an explanation of the widely separated geographical distribution of these sibling species is problematical." It is quite clear then that sound justification exists for the consideration

of *A. howei* and *A. megalcephala* as distinct, yet sibling species.

It may be that this area of sibling speciation is troubling for evolutionary systematists because it does not clearly support the theory of descent by means of gradual selection which leads slowly to reproductive isolation. It fits quite well, however, with the creationist position that the basic kinds (baramins) were created at the beginning and that they were plastic enough to yield sibling species in later development (Robinson and Cavanaugh, 1998).

That certain members of the *Ascocotyle* group share distinct phenotypes is not in question. What is problematical is, as in the pairs of *A. sexidigita*/*A. gemina* and *A. megalcephala*/*A. howei*, that such similar phenotypes could be shared when gene pools are not exchanged. These are, after all, hermaphroditic organisms which are widely geographically separated, and this would cause us to puzzle over their similarity on the basis of descent with gradual selection.

Anatomical features in the metacercarial and adult stages of these trematodes (such as the pattern of circumoral spination combined with the anatomical distribution of the ceca, uterus and vitellaria) are believed to be congruent with cercarial type. Within each subgenus, species groups have been differentiated by the arrangement and number of circumoral spines and microstructure of the gonotyl. Among the representatives of the *Ascocotyle* complex are forms which are almost identical in morphology, but exhibit other significant differences in their biology. Host specificity, particularly in the pre-adult stages, is important in the identification of what might be sibling species among the *Ascocotyle* complex (e.g., Font, Heard and Overstreet, 1984, concerning the validity of *A. gemina* Font, Heard and Overstreet 1984, and *A. sexidigita* Martin and Steele, 1970).

Additional features useful for discrimination of sibling species include cercarial behavior and metacercarial cyst structure (Schroeder and Leigh, 1965, and Stein and Lumsden, 1971 a, b, re: *A. leighi* Burton 1956, and *A. pachycystis* Schroeder and Leigh, 1965). For all their subtlety, these characteristics, we believe, are still profound indicators of species diversification. If shared cercarial behavior and cyst structure, along with the overt anatomical disparities we have already discussed do not derive from genetic variation, then the case for sibling speciation as a function of the Creation events is made even more strongly.

Sibling species are identified by the extent to which variants overlap in "morphological space" (as defined and discussed by Remine, 1993) while diverging along other trajectories in the totality of their biology. The sibling species concept would tangibly address the ecological, physiological, and genetic principles underpinning the

differentiation process, perhaps more than the traditional concept of geographic separation of morphologically variant populations. We also note that the sibling species of *Ascocotyle* complex in particular are commonly sympatric (e.g., *A. leighi* and *A. pachycystis*, *A. mcintoshi* Price, 1932 and *A. chandleri* Lumsden, 1963) although this is not the case for *A. howei* and *A. megalcephala*. Such a “test of sympatry” without interbreeding would support calling such pairs “sibling species.”

A. howei and *A. megalcephala* are sibling species, we believe. They overlap in most of their anatomical features but they are distinguishable by body shape (Figures 1a and 2); relative size of the oral sucker; and number, size, and shape of the spines in the oral coronet (Figure 3). (Spine shape may be influenced, however, by the age of the metacercaria at the time of infection - Sogandares-Bernal and Lumsden, 1963 - and fixation - Font, Overstreet and Heard, 1984).

We believe that *A. howei* is a sibling species of *A. megalcephala*: we speculate that *A. howei* has arisen since the time of Creation and we believe that it is a part of the same baramin as *A. megalcephala*.

It is our hope that further study into the area of sibling speciation may provide answers to the question of speciation and baraminology in general.

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Book Review

T. Rex and the Crater of Doom by Walter Alvarez.
 Princeton University Press, Princeton, NJ. 1997. 185 pages. \$24.95.
 Paperback edition from Random House \$13.00
 Reviewed by Eugene F. Chaffin

When the idea was first proposed that a giant impact caused the Cretaceous-Tertiary extinctions, two of the principal investigators were physicist Luis Alvarez and his geologist son. Walter Alvarez, the author of this book, was that son. The book tells the story in very interesting, chronological style. Neither of the pair appears to have been a creationist, but the story is interesting nonetheless. Walter was studying a continuous, apparently complete limestone outcrop in a valley in Italy. Paleontological work using foraminifera placed the boundary between two geological "eras" at a thin clay layer. Happily for the father-son team, Walter obtained a job at the University of California, Berkeley in near proximity to his father. The teamwork between the two was able to identify iridium in the clay boundary layer, and in cooperation with Frank Asaro, to rule out a supernova as the agency of the extinction (due to the absence of Pu-244). The book tells of the formulation of the asteroid or comet impact hypothesis, and how the doctrine of uniformitarianism proved to be a formidable barrier to its acceptance. Many

references are given at the end of the book, documenting the various episodes in this drama, which lasted from the 1970's to the present. Readers wishing to read opposing viewpoints may wish to consult a Web page by Dewey McLean:

http://www.vt.edu:10021/artsci/geology/mclean/oldDinosaur_Volcano_Extinction/.

Recently, the Chicxulub (pronounced Cheek-shoe-lube) crater below the surface in the Yucatan Peninsula of Mexico has been identified as the likely impact site. Supporting evidence includes tsunami deposits in north-east Mexico, Texas, Haiti, and Belize. One wonders whether the submarine deposits which Alvarez mentions can attest to the Flood model. An article by Don DeYoung and Carl Froede appeared in the June, 1996 *Quarterly*, and attempted to answer some of the questions. Many of us have been following news articles and such for more than a decade, and it is interesting to read this book and fill in some of the details with which we might have been unfamiliar.

The Florida Keys: Evidence in Support of Slow Floodwater Retreat Part I: The Upper Keys

Carl R. Froede Jr.*

Abstract

The Florida Keys extend from just south of the city of Miami (Soldier Key) to the Dry Tortugas, a distance of 150 miles. They are composed of two different types of calcium carbonate (i.e., limestone) rock. The upper Keys are exposed sections of former living coral reef (Pleistocene–Key Largo Limestone) and the lower Keys are lithified oolite (Pleistocene–Miami Oolite)

accumulations. The Key Largo Limestone contains coral species similar to the modern-day reef. In places it is greater than 170 feet thick. I propose that the Key Largo Limestone coral reef tract developed during the period of slow Floodwater retreat spanning from 500 to over 1,000 years following the one-year-long global Flood of Genesis.

Introduction

The biblical record documents the Flood as an event which resulted in total global inundation. The Scripture further states that Noah and his family disembarked from the Ark a little more than a year after the beginning of the Flood. Does this require that Floodwater had receded to the various ocean basins at today's sea-level position? No, because: 1) Scripture does not suggest or provide a sea-level position at the time of Noah's disembarking from the Ark, 2) the Bible does not provide a possible rate of Floodwater withdrawal, and 3) many physical evidences exist which indicate that Floodwater remained over sections of the Earth's continents even after the one-year-long Scriptural Flood (see Froede, 1997). One area which supports the likelihood of long-term Floodwater submergence is found in the carbonate rock accumulations of South Florida.

Many of the world's modern carbonate reefs and/or oolitic sand bank accumulations formed when sea-level was at a higher position than at present. With the drop in sea-level these formerly submerged carbonate mounds became exposed. The Florida Keys reflect these sea-level changes and provide an excellent setting in which to study the effects of slow Floodwater withdrawal from the southern peninsula of Florida. Coral reef rock found within the northern portion of the Florida Keys was at one time exposed up to 18 feet above the present sea-level position. I will relate these presently subaerially exposed coral reef rock islands to changing sea-level position within the framework of the Young-Earth Flood Model.

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Carbonate Rocks at the Southern Tip of Florida

The southern tip of the Florida peninsula is composed of thousands of feet of carbonate rock with the vast majority interpreted by uniformitarians as having formed over millions of years during the Cretaceous Period¹. Overlying these massive Cretaceous carbonates are layers of Tertiary clastics and carbonates (Missimer, 1984; Randazzo and Halley, 1997). Many questions remain about this section of Florida since little wide-spread deep sub-surface investigation (i.e., well drilling) has been conducted². Pleistocene age corals (Key Largo Limestone) along with somewhat lateral equivalent age (now lithified) oolitic sands (Miami Oolite) thinly cover this entire area. Present-day exposures of the Pleistocene age coral reef limestone form the individual islands of the upper Florida Keys.

The Upper and Lower Division of the Florida Keys

The Florida Keys extend off the southern peninsula of Florida in a northeast to southwest arc, from the Atlantic

¹Although some of the more deeply buried carbonate rock is believed to date to the earlier Jurassic Period, the majority of the carbonate build-up is viewed as having formed during the Cretaceous Period.

²Neither the deeply buried Cretaceous age limestones nor the overlying Tertiary age limestones and clastics will be addressed in this article. Rather, I will focus on the upper-most coral reef rock (i.e., Pleistocene age - Key Largo Limestone) which thinly overlies these older strata.

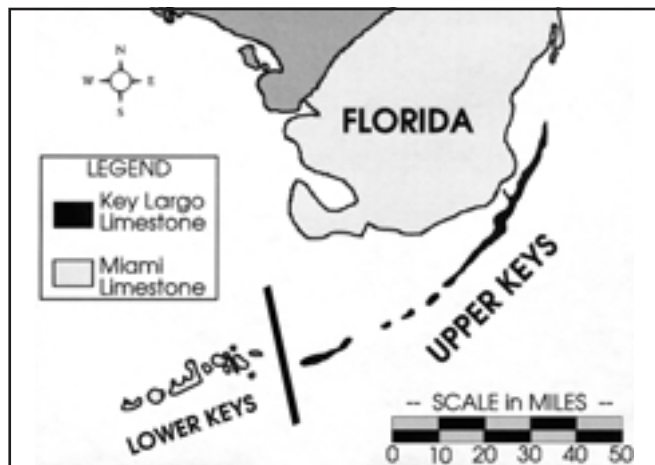


Figure 1. Generalized map showing the Florida Keys extending from Key Largo to Key West. The Dry Tortugas are not shown but lie 70 miles west of Key West. The Key Largo Limestone and Miami Limestone are viewed as chronostratigraphic. Much of the eastern Florida mainland is composed of Miami Limestone. Modified from Hoffmeister (1974, p. 85).

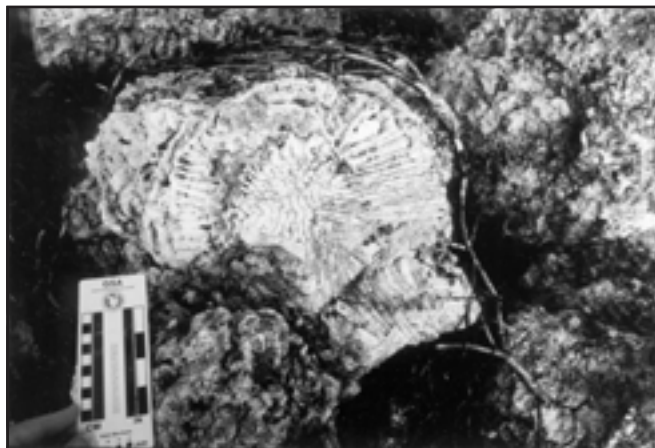


Figure 3. A block of limestone which was once a living head of coral. The upper keys are built on this Pleistocene coral reef rock. It could only have grown in a marine setting and reflects former submergence.

Ocean to the Gulf of Mexico. Geologically, they are divided into upper and lower Keys based on the composition of the limestone rock forming the various islands (Figure 1). The upper Keys are composed of the geologic unit identified as the Key Largo Limestone which was once a living coral reef. The reef was predominantly composed of stony corals³. This former reef is interpreted as having formed within the Pamlico sea-level highstand of the Pleistocene Epoch (Figure 2). The lower Keys also

³Coral is commonly divided into two types: 1) the semi-precious corals, and 2) the stony corals (Hoffmeister, 1974, p. 64).

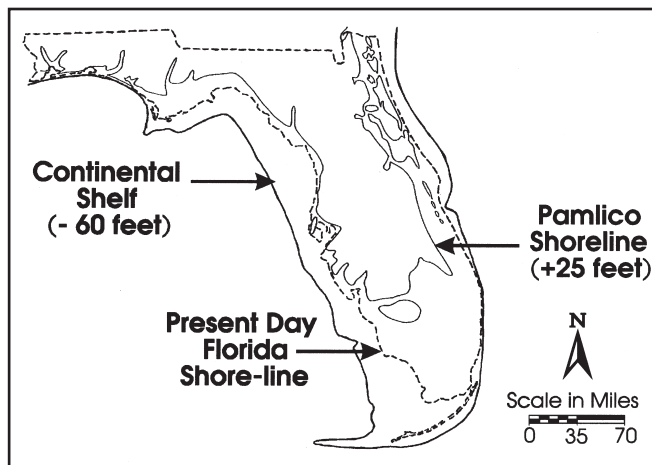


Figure 2. Map of the State of Florida showing the extent of the sea-level highstand associated with the Pamlico period of warming within the Wisconsin (Mid-Wisconsin) glaciation of the Pleistocene Ice Age. Also shown is the continental shelf most of which was exposed during the late Wisconsin glaciation. Modified from Hoffmeister (1974, p. 25).



Figure 4. A block of coral turned on its side revealing the manner in which it once grew. This coral was found several feet above today's sea-level position.

formed during this same period of time and are elevated and lithified mounds of oolitic carbonate sand (Miami Oolite) which overlie the Key Largo Limestone in the lower Keys (Hoffmeister, 1974, p. 86).

The Upper Keys

The upper Keys Pleistocene coral reef rock is actually a collection of many different types of stony corals (Figures 3, 4, and 5). The modern coral reef tract contains many of the same coral species found within the Pleistocene Key Largo Limestone. Today, where the Key Largo Limestone



Figure 5. Another piece of limestone which was at one time part of a submerged coral reef. It is attached to other more massive chunks of limestone all of which suggest a diverse coral reef paleoenvironment.



Figure 6. Looking northward at the northeast wall of the Marvin D. Adams Waterway on Key Largo. This canal connects Florida Bay with the Florida Straits. The limestone is composed of coral reef carbonate rock and rubble and reflects what was at one time a thriving coral reef



Figure 7. A section of the eastern sidewall along the Marvin D. Adams Waterway showing chunks of limestone which was formally a coral reef environment. The wall extends eight feet above the water.

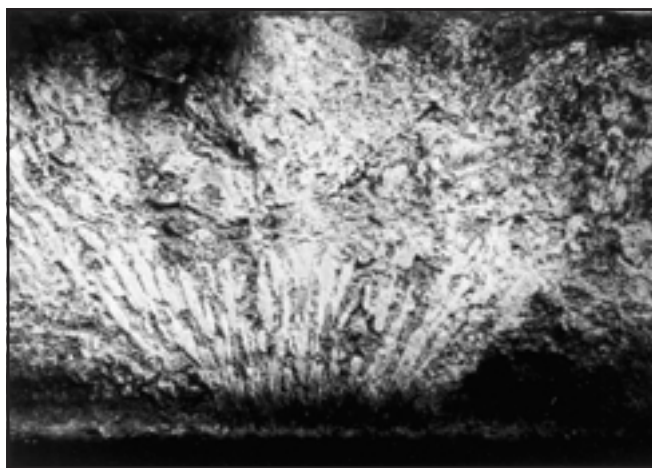


Figure 8. A closeup of the coral in the center of Figure 7. The water is black at the base of the figure and grass can be seen at the top. The section is 10 feet high and clearly visible is the former remains of a star coral (*Montastrea annularis*).

extends above sea-level, it forms the individual islands of the upper Keys (Figures 6, 7, and 8). A few islands within the upper Keys have been quarried for ornamental stone; however, the majority of the coral reef stone was used as construction material associated with the building of the first railroad line to Key West (Figures 9–15).

Uniformitarian Interpretation of the Upper Keys

Uniformitarians interpret the upper Keys as having formed during the Pamlico Stage of the Pleistocene Epoch, approximately 100,000 years ago, when sea-level was

as much as 25 feet higher than present (Hoffmeister, 1974, p. 23). During this period of time approximately 25,000 years was available to form this coral reef environment before the next drop in sea-level (Following the sea-level curve found in Schroeder, Shultz, and Pilkey, 1995, p. 671, Figure 5).

Experiments were conducted on the growth rate of various modern stony corals found within the Florida Keys coral reef tract (Hoffmeister, 1974, pp. 79-81; Hoffmeister and Multer, 1964). It was concluded that the Key Largo Limestone coral reef tract could have formed at its current size under present conditions in as little as 6,000 to 12,000 years (calculated from Hoffmeister, 1974, pp. 86-91). With these experiments



Figure 9. The eastern side of the Windley Key quarry where blocks of limestone were taken for the construction of the railroad which connected Miami to Key West. The sidewalls are from five to seven feet high.

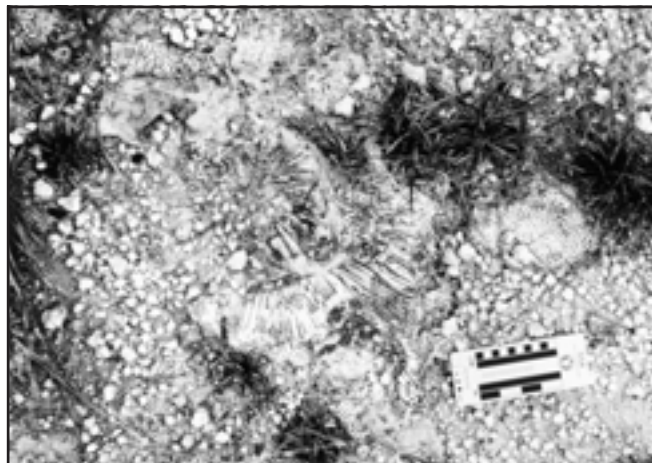


Figure 10. Key Largo Limestone coral reef rock exposed on the Windley Key quarry floor. Scale is in inches and centimeters.



Figure 11. The north quarry sidewall of the Windley Key quarry which exposes approximately seven feet of Key Largo Limestone. Coral reef material is bound together by coral debris and other carbonate materials.



Figure 12. A coral head is exposed along the south wall of the Windley Key quarry. The scale to the left of the coral is in six-inch units.

in mind the entire Key Largo Limestone coral reef tract could have formed approximately two to four times over during the 25,000 years that were available for coral reef growth! However, with all of this time available the coral must have grown much slower than was determined experimentally within the modern coral reef tract.

A Young-Earth Flood Model Approach

The growth rate of stony coral varies both by species and as a function of the environment. The conditions under which the original coral reef formed and developed were much different from those of today. There are several rea-

sons to believe that coral reef growth in the past occurred at a much higher rate than at present. These include the estimated depth of water, distance from silt/clay sedimentary sources, increased water nutrient levels, and the anticipated water temperature at the time that the corals developed, when the Floodwater was at the "Pamlico" water-level position. However, even with higher than present growth rates, the author does not believe that creationists need to explain the entire Pleistocene Florida Keys coral reef tract within the span of only the several hundred years of the single Ice Age (Oard, 1990). We have more time available to grow the coral reef tract if we incorporate the time that Floodwater covered this portion of Florida.

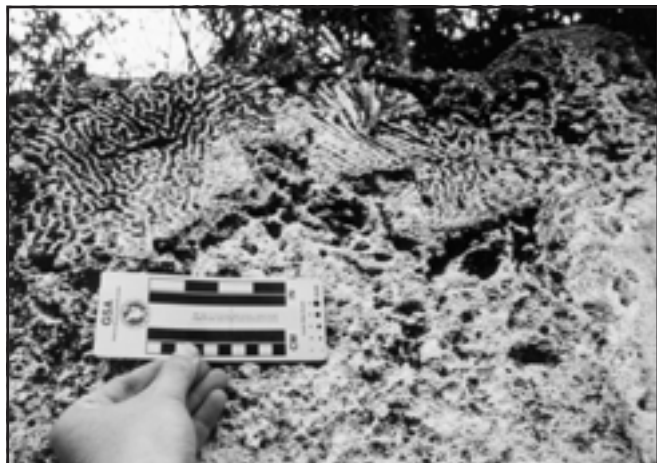


Figure 13. A coral head is exposed along the top of the Windley Key quarry sidewall. Scale is in inches (top) and centimeters (bottom).

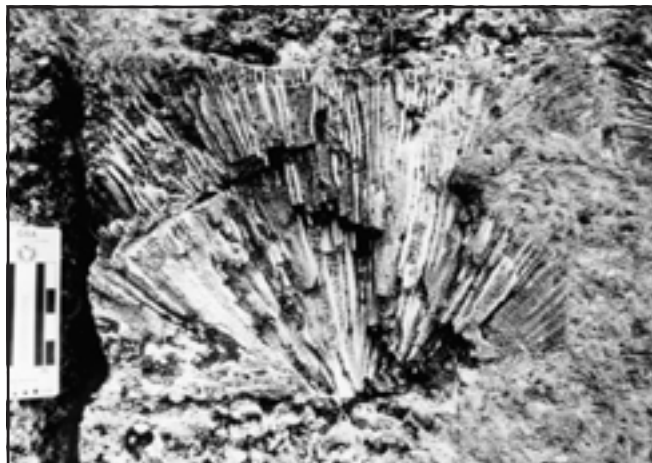


Figure 14. A coral head in growth position exposed along the Windley Key quarry sidewall. Scale in inches.

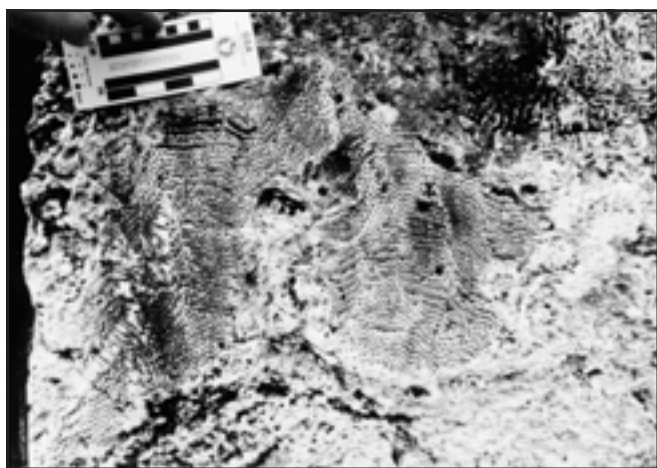


Figure 15. A coral head turned upside down and exposed along the Windley Key quarry sidewall. The coral was probably overturned in a storm (when more coral usually is broken from their base). Scale in inches and centimeters.

Discussion

We have several problems to resolve in order to explain the thickness (i.e., Pleistocene, modern, or both) of the upper Keys coral reef tract within our model. The first issue to address is the thickness of the Pleistocene Key Largo Limestone, measured at more than 170 feet thick in several places within the Florida Keys (Hoffmeister, 1974, p. 86). How can we explain such a thick accumulation of what was once living “modern” coral reef when we start from the position of a global Flood with total inundation and a high sea-level position? Coral reefs grow under very specific conditions. If the water is too deep or too shallow then the stony corals will not grow. Additionally, the water temperature, salinity, and clarity must be

within certain highly-specific parameters to successfully grow a coral reef. Hence, many factors must be evaluated to understand how successful coral reef growth occurred, especially when considering an accumulation up to 170 feet in thickness.

A related issue is the rate of Floodwater withdrawal. The speed in which this occurred directly impacted the manner in which the Pleistocene coral reef tract could have developed. Rapid Floodwater retreat from the southeastern United States within the one-year-long Flood would not have allowed for a reasonable amount of time to form and develop the 220 mile long⁴, 8 to 10 miles wide, by as much as 170 feet deep coral reef tract. Rapid Floodwater withdrawal from the North American continent would probably have been muddy, and not conducive for coral reef growth. Additionally, if the Floodwater retreated in a pulse type manner, then sands, muds, and silts should be found interstratified within the Key Largo Limestone, but none have been described or noted.

Slow Floodwater retreat from this area of south Florida would provide sufficient time for coral reef initiation and development, but only when the submerged surface (i.e., substrate on which the coral grew) achieved an optimum sea-level position. According to Smith (1971, p. 5) coral reef growth is limited by sunlight penetration in seawater (not depth per se):

Because sunlight is rapidly absorbed as it passes through seawater, the requirement of strong sunlight

⁴The Key Largo Limestone has been found to extend in the subsurface from beneath an area northeast of Miami to out beyond the Dry Tortugas—a distance of approximately 220 miles. This buried coral reef (i.e., Key Largo Limestone) was formally much larger than we observe today.

restricts reef building to depths less than 150 feet, and vigorous growth to within 90 feet of the surface.

Hence, water clarity, nutrient load, and the original Tertiary substrate surface were the most important factors in the origin and development of the Pleistocene coral reef tract, with the most important being nutrient-laden current-driven warm clear marine water. This setting requires no clastic input and would support an off-shore environment in which the reef tract could grow, similar to that at present.

The uneven surface of the underlying Tertiary age carbonate and clastic sediments reflect erosion and regional tilting which have influenced the growth and development of the overlying Pleistocene age Key Largo Limestone. It has been proposed that the south Florida area has experienced a decreasing rate of regional subsidence (Missimer, 1984; Winston, 1991), and that regional east-west tilting occurred which directly affected sedimentation in the Keys during the Pliocene and Early Pleistocene (Parker and Cook, 1944; Parker, Hoy, and Schroeder, 1955; Perkins, 1977; Shinn, Lidz, Halley, Hudson, and Kindinger, 1989).

The author proposes that regional subsidence (which occurred with the onset of the Flood) created a basin within the south Florida area which was rapidly filled with carbonate and clastic materials derived from source areas to the north. The rapid in-filling of the south Florida basin resulted in the formation of a submerged surface within close proximity to the elevated marine water surface at the end of the year-long Flood. During this period crustal subsidence within this area was occurring at a slightly higher rate than Floodwater was dropping. Coral reef growth simply "kept-up" with the subsiding crustal block. Eventually, subsidence slowed and reef growth continued while Floodwater slowly retreated from this area. Block rotation caused the western portion of the Keys to drop. This provided accommodation space to allow for greater reef growth and resulted in thicker accumulation of coral within the subsurface. The coral reef continued to grow until the marine water dropped below the reef tract exposing the stony coral to subaerial conditions, this served to kill the coral producing animals.

The decrease in regional subsidence (and tilting) experienced by this area during and following the Flood allowed the Key Largo Limestone coral reef to begin development within the first year of the Flood. As this large area continued to subside, the substrate remained shallow enough for continual coral reef growth. The relationship between crustal subsidence and actual sea-level change remains to be determined. Sea-level changes following the retreat of Floodwater (during the single Ice Age Timeframe) served to add new coral to the reef with each rise, and erode and in-fill the reef with debris and rubble derived from the reef with each fall.

Conclusion

The formation of the upper Keys coral reef tract (i.e., the Pleistocene Key Largo Limestone) required a relative sea-level position at least 25 feet higher than at present. This sea-level position is best correlated to the time when slowly-retreating Floodwater still covered this portion of the south Florida peninsula (see Froede, 1995a, 1995b, 1998). This period of time is defined within the Upper Flood Event Division), rather than during a short-term sea-level highstand event within the single Ice Age Timeframe. Oard (1990, p. 117) proposed that reaching maximum glaciation occurred approximately 500 years after the onset of the Flood. If this period of time is added to the year-long Scriptural Flood, then at minimum 501 years were available to form the majority of the Key Largo Limestone coral reef tract. The point of glacial maximum would correspond to a sea-level lowstand and reef exposure (and death). This would be the lowest point that sea-level dropped before rising to present day levels. Oard's (1990) period of 500 years to reach glacial maximum is viewed by this author as a minimal period. The lowest sea-level position could have been reached even several hundred years later, depending upon the role that subsidence played within this area. The continental-glacier-based drop in sea-level position does not take into account the role that subsidence played in producing the coral reef tract. Any additional time would allow for the continual development of the coral reef tract. Sea-level rise in the remaining years following the lowest drop within the single Ice Age would simply allow additional stony corals to build atop the preexisting coral reef.

The author believes that the Key Largo Limestone coral reef was already well established and thriving as the Floodwater continued to slowly recede from the southern tip of Florida many years after the end of the year-long Flood period reflected within Scripture. The length of time available for the origin and development of the Key Largo Limestone coral reef is viewed by the author as covering potentially a thousand years or more. Additional investigation is necessary to refine the time period available for coral reef (i.e., Key Largo Limestone) growth within the framework of the Young-Earth Flood model.

Acknowledgments

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Book Review

The Creation/Evolution Controversy by James L. Hayward
 Salem Press, Pasadena, CA. 1998. 253 pages, \$37.50
 Reviewed by Don B. DeYoung

James Hayward is a Professor of Biology at Andrews University, Berrien Springs, Michigan. His ongoing research involves the nesting ecology of ancient dinosaurs and diving gulls. This book is Hayward's commendable effort to summarize literature on creation and evolution. Short, helpful summaries are provided for 447 books. The date range extends widely from Copernicus (1543) through 1996 authors. The reviews are concise and go directly to the heart of each book. Resources not included are children's books, videos, and periodical articles. I also noticed the absence of several important creationist books: *The Wonders of Creation* by Alfred Rehwinkel (1974), *Speak to the Earth* edited by George Howe (1975), *The Earth, the Stars, and the Bible* by Paul

Steidl (1979), and *Physics of the Future* by Thomas Barnes (1983).

Hayward remains very objective, letting the authors speak for themselves. Regarding Carl Sagan's book and TV series "Cosmos" (1980), Hayward writes, "...nearly everyone was impressed by Sagan's communicative style ...interpretations of the universe, and superb graphics make "Cosmos" a visual and intellectual feast" (p.48). For another author Hayward writes, "The author's lack of expertise in the subject matter he purports to discuss will be apparent to knowledgeable readers" (p. 164).

This hardback book is expensive, but it is useful as a summary of a full library of Bible-science books. Full author, title, and subject indexes are provided.

Ring Muhly—A Grass That Grows in Circles

Van Andel Creation Research Center Report Number 4

George F. Howe, Emmett L. Williams, and John R. Meyer*

Abstract

There is a grass that grows in ring-like patterns at the Van Andel Creation Research Center (VACRC), Chino Valley, Arizona. We discuss some aspects of the morphology, growth habits, and possible ecological benefits of *Muhlenbergia torreyi* which is also known as the “ring muhly.” A

study of its growth rate and growth pattern is being initiated at VACRC. We recommend ring muhly as a subject of future investigations by other creationists. In this paper we also comment on the origin of grasses and their significance in the creation model.

Muhlenbergia is primarily a New World genus having 160 species (Peterson and Ortiz-Diaz, 1997, p. 222). Studies of genetic affinities in the annual members of this genus are being conducted and the work of Duvall, Peterson, and Christensen (1994) is illustrative of such research. Unfortunately, these studies thus far do not include *M. torreyi*.

Muhlenbergia torreyi is a short grass that starts as one small clump. As years go by, the plant enlarges outward forming a circle with an expanding radius (Figure 1). Such a striking shape is what led people to give it common names like “ring muhly,” “ringgrass,” or “fairy ring.” It can be found growing in every county of Arizona and it thrives best between 4000 and 7000 feet in altitude. It lives on rocky slopes, dry ridges, or sandy plateaus in thin soils like those at VACRC (McDougall, 1973, p. 50-52). It also occurs on deeper soils where it often indicates disturbance or declining site condition because of factors such as overgrazing. Hanson and Smith (1928, p. 142) indicated that in the vicinity of Fort Collins, Colorado, ring muhly was a dominant grass on “...compact soils that contain available moisture during part of the growing season in only the surface 6 to 24 inches.” They also found that ring muhlenbergia “...indicated shallow well-developed hardpan-like structure,” (p. 142). *M. torreyi* thrives over much of the western United States from Kansas and Wyoming to Texas (Hitchcock, 1971, p. 402) and in



Figure 1. This clump of *Muhlenbergia torreyi* has developed into a circular pattern. The wrist watch gives size and perspective.



Figure 2. The pen tip pierces a zone of dead plant organs left behind by the growing fringe at the left.

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Figure 3. Ring muhly plants form fascinating geometric patterns.



Figure 4. *M. torreyi* plants in this view are 8 cm or less in height. The taller plants are other grasses.

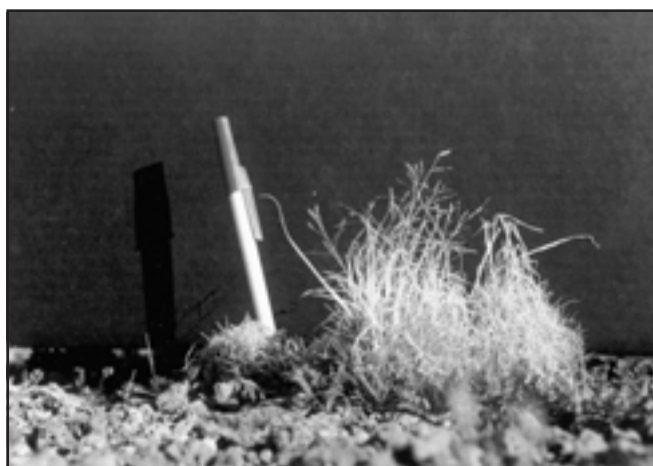


Figure 5. A branching inflorescence or flower cluster of ring muhly seen to the right of the pen, against the black background.



Figure 6. Individual leaves of muhly grass are about one inch long (left of pen).

northwestern Argentina (Peterson and Ortiz-Diaz, 1997; Missouri Botanic Garden, 1996).

Growth of the expanding ring muhly colony occurs on the outer edge of its circumference while dead leaves and stems of previous years accumulate inside that circle (Figure 2). In some cases the original ring apparently changes to yield an arc, when part of the colony dies. Sections of surviving arcs can ultimately assume configurations that are almost linear. A field of ring muhly thus displays such patterns as circles, arcs, and lines forming a pleasant geometric maze across the ground (Figure 3).

M. torreyi was one of the first plants to attract our attention during early visits to the CRS property at Chino Valley. At first we did not know its proper classification (Howe, 1984, p. 13) but Joneen Cockman identified it and has filed specimens of it in the CRS Herbarium.¹ Ring muhly currently grows most extensively on the eastern portion of the CRS property and also flourishes on a

broad grassy belt which separates the front VACRC fence from Highway 89, a strip which is periodically used by power company trucks. This may indicate that *Muhlenbergia torreyi* is a grass that can withstand moderate vehicular traffic.

Ring muhly's hollow stems (culms) range from eight to 40 cm in height (McDougall, 1973, p. 52) but in ours they were generally quite close to the lower end of this height range (see Figure 4). We transplanted some clumps of ring muhly and raised them in an environmental chamber where they were well watered. Under those conditions for a few weeks, new leaves formed and the distance from the soil to the tip of the top leaf was 16 cm.

The flower cluster bears flowers on each of its many branchlets (Figure 5). The individual leaf blades of *M.*

¹This herbarium is an ongoing project and has been the subject of another report (Cockman, 1988, p. 187).



Figure 7. Mat-like disk of dead rhizomes, living arc, and root system are visible here.



Figure 8. Photograph showing some of the root system attached to the plant itself.

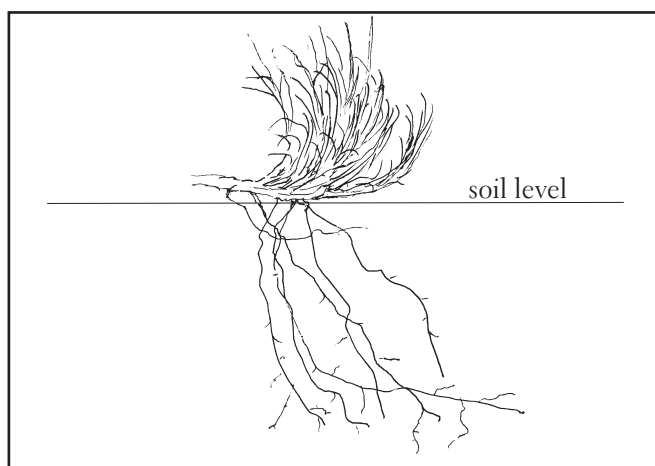


Figure 9. Sketch showing how roots arise for about one inch along rhizome and extend forward ahead of the arc.



Figure 10. The level of the soil inside these rings (right) is slightly higher than the bare ground level near the ruler (left).

torreyi growing in the field were about 3 cm long (Figure 6 and Figure 7) but the leaves forming on well-watered plants in our growth chamber were up to 6.2 cm in length. New leaves form during rainy seasons but this plant carries on with its life in the dry seasons as well because the little green leaves are rolled lengthwise (“involute”) which helps them conserve water.

The leaves maintain a healthy pastel green color even during the midsummer drought and throughout the winter. This means that muhly grass is a plant for all seasons—a perennial that is ready to carry out photosynthesis whenever temperature and other environmental factors permit.

While growing outward, a muhly grass ring leaves a thick mat of dead stem and leaf material (Figure 7)—see Weaver and Albertson, 1956, p. 218. Measuring 10 large colonies, we found the average mat width to be 12 cm.

Vertically, the mat is several centimeters deep, lying directly on the soil.

Growing outward from the edge of the colony are the roots of *M. torreyi* (Figures 7 and 8). In the colony we inspected, these were about four inches long and they extended beyond the edge of the colony, into fresh soil. Functional roots were present for about one inch along the rhizome horizontally (Figures 8 and 9).

We suspect that the expanding ring growth pattern helps these colonies obtain unobstructed space (for continued growth) and fresh supplies of mineral nutrients. Inside each circle or arc the soil level is slightly higher than the level of exposed soil nearby (Figure 10). We inspected several colonies and found that the level of soil inside was often about two cm higher than the soil outside the ring. Perhaps this difference results from the buildup of old leaves and stems, as well as from airborne



Figure 11. Ephemeral grasses and flowering herbs are seen here blooming inside a muhly ring (11a above) and right in the arc itself (11b below).

soil particles that accumulate inside the arc. The colonies may collect wind eroded soil, as happens around the stems of creosote bushes where mounds are formed. Mineral and organic matter inside these expanding *M. torreyi* colonies may foster the growth of various ephemeral plants which are seen to germinate and bloom inside the rings (Figure 11).

Many arc-shaped colonies are arranged at approximately right angles to the direction of water flow down-slope. *M. torreyi* plants may possibly reduce sheet erosion of soil during rain storms by serving as living terraces. Muhly's series of arcs, circles, and linear shapes may very well modify and divert the flow of water across the soil surface. We tried pouring gallons of water into circular colonies and found that they readily absorbed the moisture and prevented it from running directly downhill (Figures 12a and 12b). After a rain storm this inner band of dead tissue serves as a sponge, hoarding water and making it available to the ring of living plants attached.²



Figure 12. Cluster of *M. torreyi* plants before water is added (12a above) and the same cluster of plants after a pail of water has been poured into the center (12b below). Note how the water has been somewhat confined by the grass plant fringe (darker soil within).

We have noticed that these circular or arcuate colonies never reverse themselves by growing inward toward the center from which they arose. Perhaps the growing edge of ring muhly plants deposits some chemical compounds that prevent growth back into the dead mat—a phenomenon known to plant ecologists as “autotoxicity.” The production of fairy rings in sunflower species (*Helianthus seaberrimus* and *H. tuberosus*), for example, has been shown to occur because of a labile chemical substance derived from the underground plant parts—a material that prevents the sunflower from growing backward into the ring (see Muller and Muller, 1956, p. 354). If autotoxicity prevails inside ring muhly colonies, the toxin appears to have no inhibitory effect on certain other herbs which grow right inside its rings (Figure 11). It is

²There is another grass at VACRC that can yield circular and arcuate colonies—the blue grama grass (*Bouteloua gracilis*) (Figure 13).



Figure 13a. *Muhlenbergia torreyi* colony to the left. To the right is a portion of a blue grama ring (*Bouteloua gracilis*). Note the greater height of blue grama plants.

also noteworthy that new muhly colonies can arise inside an old colony ring, just a few inches back from the old colony's growing arc (Figure 14).

M. torreyi is familiar to ranchers and range-management personnel and two of them considered it to be undesirable: "Two undesirable grass species, sixweeks fescue and ring muhly, were present in the pastures in all three periods" (Klippel and Costello, 1960, p. 21). These writers probably classed ring muhly as undesirable because "It was not grazed by the cattle . . ." (p. 21). In two comprehensive studies of grazing on New Mexico rangeland (Donart, Parker, Pieper, and Wallace, 1978; Pieper, Donart, Parker, and Wallace, 1978) there was no mention of any aversion of cattle to the ring muhly.

Even if it were unpalatable to range cattle, ring muhly has other attributes that would easily remove it from the category of pest. It probably plays an important role in soil enrichment and soil conservation. Weaver and



Figure 14. New ring muhly plants can originate inside an old arc, several cm behind the growing front.



Figure 13b. A ring-like colony of blue grama close up. Note the culms and flower stalks which are taller than those of *M. torreyi*.

Albertson (1956, p. 218) found that *M. torreyi* had an extensive root system with a wide lateral spread. Its roots occurred throughout the upper 2.5 feet of soil and some of them went as deep as 4.5 feet. This means that muhly, like other range grasses, brings buried calcium and other mineral nutrients back into circulation from the subsurface zones where they have been deposited.

One of the research reports we found dealing with ring muhly showed that it was unaffected by treatments with the pelleted herbicide tebuthiuron applied to range land in New Mexico to kill sagebrush (McDaniel and Balliet, 1986, p. 276). Peterson and Ortiz-Diaz (1997) found by studying alleles for enzymes that the South American *M. torreyi* populations have recently dispersed from the U.S. and from the Mexican populations both of which have greater genetic variation than the Argentine populations. In a Colorado study, ring muhly was shown to make up 3% of the vegetational cover on short grass prairies (Kinraide, 1984, pp. 279-280). In an earlier paper (Kinraide, 1978), he showed that in El Paso County, CO, *M. torreyi* associates positively with the cholla cactus (*Opuntia imbricata*). Holechek and Pieper (1992) mention *M. torreyi* as one of the grasses in the short grass prairies they studied in New Mexico to determine the number of cattle to put on various rangelands. Also in New Mexico, ring muhly was one of the dominant plants on blue grama uplands studied to determine the effect on nitrogen fertilization (Donart et al., 1978). The nitrogen fertilized plots were significantly more productive than unfertilized control plots. It also figured in another study by these same authors (Pieper et al., 1978) to determine how the grazing pattern would affect livestock production on New Mexico rangelands. While grass production was greatest under a rotation system, livestock production was best under continuous grazing.

We are curious as to how rapidly a growing arc of *M. torreyi* will move across the soil. To that end, nine locations were selected where we have placed rebar pegs at the very front edge of ring muhly colonies (Figure 15). Measurements in future years should demonstrate the rate at which these arcs grow forward in the desert-



Figure 15. Rebar pegs near pen in the center (and at the top) are stationed at the leading edge of ring muhly colonies to permit growth measurements in later years.

grassland conditions of central Arizona. Individual small clumps will be marked to discover how long it takes this grass to change from a clump to a ring shape. We also wish to observe how the clumps get started in the first place and how some of them turn into arcs instead of rings.

Several questions emerge from our study. If ring muhly is tough enough to resist moderate truck traffic, why did it make up only 3% of the cover in a short grass prairie study? When muhly grows under conditions of ample moisture, does it still maintain an expanding circular pattern? Is *M. torreyi* rejected by cattle and if so, why? Is it eaten by sheep? Does ring muhly grow best where it has little competition from other grasses? If so, is it a “pioneer” in ecological succession within grasslands? These and several other questions regarding its possible autotoxicity need to be addressed. We commend ring muhly to researchers as a prime organism for studying the Creator’s handiwork and as an example of a providential piece in the jigsaw puzzle of western ecosystems.

Appendix—Grasses and Creation

One of the locations where grasses are mentioned in the Bible is in Genesis 1:11-12. Here they are listed as having been formed by the Lord on day three. This is an amazing record because grasses are considered by macro-evolutionists to be among the most “highly advanced” flowering plants. Their inclusion on day three of the Creation week, along with all other plants, is at odds with long-age schemes of accommodating day three with the supposed “ages” of plant-fossilization. It is likewise in direct conflict with all evolutionary theories—theistic evolutionism, agnostic evolutionism, deistic evolutionism, or naturalistic evolutionism. Apparently God made grasses and all other flowering plants at the same time that He created the “lower plants” like mosses and algae. The evolutionary series of plant development, as derived from the fossil record, is explained by the creationist as the result of pre-Flood ecological zonation and other factors relating to the dynamics of the deluge. While it is possible that the Creator performed some “microevolution” to yield new species *within* the kinds, it is important to affirm that no biologist has every witnessed the origin of a new kind (baramin) in nature. Perhaps future studies on the genetics and biochemistry of the many *Muhlenbergia* species will suggest where the boundaries of God’s created kinds actually lie in this genus and how much change has occurred since the creation event.

Acknowledgments

We thank the donors to the CRS research fund, interest from which has helped to support portions of this study. We are grateful to the Jay and Betty Van Andel Foundation for contributions which have enabled CRS to build a research center and a greenhouse. We appreciate the assistance of various people including Jeff Englin, Beth Garon, Mary Williams, and Eugene Chaffin in the literature search. We are thankful to Edna Benzol for help in manuscript preparation.

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Book Reviews

Field Studies in Catastrophic Geology by Carl Froede
Creation Research Society Books, St. Joseph, MO. 1998. 120 pages, \$15
Reviewed by John Woodmorappe

The author is a creationist and also a professional geologist who works for the United States Government. This is a book which is loaded with pictures and descriptions of the geology of many places in the US. Naturally the geology of the southeast US is emphasized as that is the home of the author. Particularly impressive are the photographs of dinosaur fossils, shell beds, layered volcanic deposits, lava flows, sandstone dikes, large boulders, ripple marks, and large turbidites. A series of simple diagrams assist the reader in understanding the contents of the book.

The book contains an introduction by Dr. Emmett Williams and an afterword by Dr. Henry M. Morris. Here is how the latter assesses the work:

Thankfully, Carl Froede is one of a growing number of younger geologists (and may their tribe increase!) who are not ashamed of God's Word and are also well trained and experienced in the earth

sciences and are now seeking sacrificially to reinterpret all the geologic data in the context of the literal and divinely inspired record of Scripture (p. 73).

The work of Froede and other creationist geologists stands as an open rebuke to the many compromising evangelical geologists who buy into the uniformitarian long-age system of geology. Froede also deftly shows the errors of the neo-Cuvierist position (that is, those who accept a time-compressed version of the geologic column as reality, and who thereby relegate the Flood to only a small portion of the sedimentary record).

There are separate chapters on such topics as geological time, pseudo-environmental facies, fossiliferous storm deposits, clastic dikes, paleocurrent analyses, turbidites, and other matters relevant to modern geology. The book includes a short glossary for those not acquainted with geologic jargon.

The only real criticism of this work I have is that, owing to its character as an overview-type book, many topics are not covered with sufficient depth. For instance, in Froede's chapter on turbidites, he covers this topic with such brevity that it does not begin to do justice to the explosion of research in this area. In particular it would have been useful for him to have devoted more detail to the colossal variety of turbidites and their ability to lay down many layers of thin beds virtually simultaneously. This would have helped in dispelling the anti-creationist canard which would have us believe that each individual lamina in such deposits as the Green River Formation would have required the existence of a separate turbidity current.

The chapter on paleosols (alleged ancient soils) is one of the first creationist treatments of this matter. In my 1978 paper on cyclic sedimentation, reprinted in my *Studies in Flood Geology*, I had shown that the "seat earths" under coal beds need not be interpreted as soils, even if they have oriented root traces in them (Woodmorappe, 1993). Froede points out how the definition of a soil differs depending upon whether the definition is made by a soil scientists, or by a uniformitarian geologist. There are a wide variety of confusing criteria used to define "ancient soils." I know, from field experience, that some "fossil soils" are named as such solely on the basis of the discovery of scattered root traces! This chapter should be expanded. It would also be helpful if Froede would document more of his claims from the literature.

In the chapter on clastic dikes, Froede does a good job in showing how these dikes indicate that the sediment must have been soft as thick layers of new sediment were being deposited on top of it. This is consonant with the Flood but totally inconsistent with the view that the strata took millions of years to be deposited.

When Froede discusses rounded sedimentary structures in another chapter, he makes it obvious that only

the Flood could have transported large exotic boulders for great distances. One can only imagine the force of the Floodwaters in doing so. Unfortunately, uniformitarians have glossed over these boulder beds, commonly interpreting them as strictly local features, or as products of diagenesis. Froede's chapter on ball-and-pillow structures complements the one on the clastic dikes. Both involve soft sediments, but in different ways.

Does this book appreciate the fact that the Flood deposited vast thicknesses of strata at virtually the same time? Certainly. In the chapter on paleocurrent analysis, Froede makes this very lucid:

Thousands of feet of sediments all showing a consistent ripple mark direction would indicate continuous sedimentation and consistent current movement, not millions of years of epeiric seawater circulation (p. 51).

In still another chapter, Froede discusses the role of volcanoes during the Flood. Helpful tables and diagrams are presented which illustrate the dynamics of different volcanic eruptions as well as the various different types of volcanogenic deposits (bentonites, tonsteins, etc.) which have found their way into the sedimentary geologic record.

No doubt, as more field work is conducted, there will be a new edition to this book. It will be much more comprehensive, and will explore these issues in much more detail. Meanwhile, I heartily recommend the book to anyone who is interested in a field-based approach to Flood Geology. The pictures and descriptions alone are worth the price of the book.

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Woodmorappe, John. 1993. *Studies in Flood Geology*. Institute for Creation Research, El Cajon, CA.

***Darwin's Leap of Faith—Exploring the False Religion of Evolution* by John Ankerberg and John Weldon Harvest House Publishers, Eugene, OR. 1998. 392 pages, \$10.99 Reviewed by Karl Priest**

Authors Ankerberg and Weldon state up front that they do not have science backgrounds. They, also, point out that they frequently use quotations and request being informed of any inaccuracies. In fighting the creation-evolution battle on a local level I am in total agreement with the authors that evolutionists are condescending to Christians by accusing Christians of taking an irrational leap of faith. "We (Ankerberg and Weldon) seek to show evolutionists themselves take an incredible "leap of faith" that far exceeds in credulity anything Chris-

tians ever believed" (pg. 14). There is chance and non-living matter to begin with, ignoring the question of where the matter came from. A prebiotic molecule takes a leap to a larger molecule which takes an even greater leap to a cell. Then there is the extreme leap to the first form of complex life. Finally evolution blindly produces every living thing. The authors say evolution belongs in the realm of *Alice in Wonderland* where the Red Queen said, "Six impossible things can be believed before breakfast" (pg. 309).

I found few things to criticize about this book. The only major shortcoming is a lack of an index. Ankerberg and Weldon also could have included a few more paragraphs about the feasibility of Noah's ark. Also, they left me wondering when they said "...one prominent highly influential evangelical scientist is so enamored with the Big Bang theory he required us to delete a one paragraph criticism of it..." (pg. 269) and then omitted the name of the person. These things said, I gauge the worth of a book by how many passages I mark as valuable. I wore out my marker on this book.

Darwin's Leap of Faith—Exposing the False Religion of Evolution has three sections. The first section is "Evolution and the Modern World." Here the theme is that ideas have consequences. Our view of origins can dramatically affect how we function as a society. Two world-views, scientific materialist and Judeo-Christian, clash on fundamentals. If the universe is meaningless why should not the more powerful manipulate others for what the powerful deem "good"?

The next part, "Evolution and the Politics of Science," is based on the irony that when evolutionists teach silliness in the name of science they demand, and receive, credibility and respect. Even as more damaging evidence accumulates against evolution, it is presented more forcefully as fact. Committed evolutionists will likely not be convinced by persuasive creationist arguments because their philosophical assumptions prevent it. As Romans 1:22 says, Professing themselves to be wise they became fools.

Last, "Evolution and the Scientific Evidence" reveals how Darwinism has become a pseudo-science held by its devotees in spite of overwhelming contrary evidence. This section covers molecules, fossils, mutations and other common categories. It is heavy, from a layman's view, on mathematical probability and logic methods. Ankerberg and Weldon give good advice to evolutionists by stating we must not reject a theory we do not like if the evidence supports it. It is absurd for evolutionists to ridicule creationists for believing God made everything out of nothing while evolutionists maintain that somehow nothing turned itself into something.

The last chapter has a great title, "The Ultimate Con." It homes in on the book's theme that evolution is a religion of blind irrational faith. The spin doctrine, which has been used so effectively in politics, has proven to be a fact of life in our modern society. Therefore creationists need to be aware of this reality that greatly influences the masses. Most people think in sound bites and slogans. For example, the man-on-the-street thinks primarily of an attractive car which has his attention. He begins to think of expenses and safety when something happens to motivate him to think more deeply such as the payments or safety recalls. Then he will expend the effort to get more informed and take action.

Creationists must counter the "advertising spins" of evolutionists and get Joe Average to think of how wonderful our "product" is. Ankerberg and Weldon provide a wealth of material for laymen to use to reach the non-scientists. Once we get them to in the showroom the scientists can provide whatever details Joe wants.

Objections Sustained by Phillip Johnson
Intervarsity Press, Downers Grove, IL. 1998. 188 pages, \$10.00
Reviewed by Don B. DeYoung*

This is Johnson's fourth book dealing with evolutionary philosophy. It consists of 31 essays and book reviews published during the 1990s, mostly in *First Things* and *Books and Culture*. As usual, Johnson graciously yet decisively cuts through scientific and legal jargon to find truth. Two examples: One of the chief dangers of theistic evolution is that it causes the religious community to lower its guard against the invasion of naturalism (p.32). Also, the ongoing debate between classical neo-Darwinists (Richard Dawkins, Daniel Dennett) and revisionists (Stephen Jay Gould, Richard Lewontin) is actually a clash between overgrown egos (p. 81). The only thing holding these groups together is their mutual fear of creation.

The book's second half goes beyond science to challenge several foolish current ideas. Johnson must have tenure because he lampoons everything from militant feminism to environmentalism. Also, political correctness is described as suffocating piety. The essay on Alan Sokol is delightful (p. 150). In 1966 this physicist purposely wrote an article filled with pseudoscientific gibberish. The postmodern journal *Social Text* then unwittingly published the article, thus revealing its intellectual bankruptcy.

It is encouraging to have Phillip Johnson on our side. His pen is a formidable weapon for clarity and truth.

***Ancient Ice Ages or Gigantic Submarine Landslides?* By Michael J. Oard
Creation Research Society Books, St. Joseph, MO. 1997. 130 pages. Softcover \$21.00
Reviewed by Mats Molén**

This book is a must reading for all geologists working with interpretations of earth history, especially those participating in the debate concerning the Flood/Post-Flood boundary. What are considered typical erosional and depositional geological structures indicating long time, in a glacial regime, are shown to be inadequately described in the literature. When diagnostic features are recorded, structures which appear to be glacially or glaciofluvially generated, are simply shown to be mass flows or fluvially deposited. Of course, in a glacial environment, much different erosional and depositional work is present, even such which bear no or very little impact from the glaciers themselves. Therefore it is the more important to pin-point those diagnostic features relevant to the interpretation of a deposit.

Oard describes how the uniformitarian ice age “glasses” have directed the interpretations of many ancient deposits. He documents many unusual (or impossible) “ice age” features rising from such interpretations, and shows how many “typical” ice age features are com-

mon in especially mass flow deposits—e.g. striated and faceted stones, striated bedrock, and dropstone varvites. Oard especially discusses what are considered the main ancient ice ages—the Mid Precambrian Gowganda tillite, the Ordovician Sabaran “ice age,” and the Permian Dwyka glaciation in South Africa.

Even though the book is mainly concerned with so-called ancient ice ages, it is also relevant to many other aspects of geology. It shows how easy it is to overlook a large multitude of geological indicators, and make wrong interpretations, using “glasses”. This also concerns the current creationist debate concerning the Flood/Post-Flood boundary—instead of starting with the uninterpreted data, it is easy to start with different “mega-models” and accept whatever suits these models best.

The book shows how important it is not to only accept uniformitarian interpretations, and speed them up, but to review all data concerning a geological outcrop before explaining its history.

***The Great Alaskan Dinosaur Adventure* by Buddy Davis, Mike Liston, and John Whitmore
Master Books, Green Forest, AR. 1998. 137 pages, \$10.99
Reviewed by Donald D. Ensign**

Several years ago I had the privilege of hearing the late Dr. A.E. Wilder-Smith discuss creation/evolution related topics. During the question/answer session following his lecture he mentioned the discovery of large dinosaur fossil graveyard in Alaska that would prove very significant in the age of the earth debate. Over the years I have heard or read snippets about this discovery, but I had not come across any complete description of these fossil deposits.

Recently *The Great Alaskan Dinosaur Adventure* came to my attention and I eagerly procured a copy to finally get a full report of this great scientific discovery. This book recounts the adventurous journey of the three authors plus Dan Specht and George Detwiler in the northern Alaskan wilderness. These five dedicated Christian creationists braved the harsh sub-arctic elements and fought off hordes of blood thirsty mosquitoes as they made a perilous voyage down the Colville River to the Liscomb Bone Bed.

The main graveyard is composed mostly of disarticulated hadrosaur (duckbilled dinosaur) bones. The thing that makes these bones so special besides their extreme northern location is that some of these bones are petrified and some are unpetrified or unfossilized. Ortho-

dox uniformitarian paleontologists claim these animals died out over 70 million years ago. Since these bones appear to be unfossilized it would be exceedingly difficult to believe that these skeletal fragments could survive in an unpetrified condition for such a vast amount of time.

The writers present two alternate possible explanations. One is that these bones were deposited by the Flood of Genesis. Two, these remains are post flood deposits associated with the Ice Age. Both of these options would present the demise of these creatures in terms of thousands rather than tens of millions of years ago.

If one is looking for a full scientific evaluation of these fossils this slender volume comes up short. Only Chapter 8, “Dinosaur Bones—Frozen in Time” (9 pp.) and a 3-page postscript present any kind of discussion of the dinosaur bones. Even though this discussion is valuable it is superficial and leaves the reader wanting a lot more. While this expedition took place in July 1994 a truly detailed analysis of the fossils is still future (p. 131).

On the other hand if you read this book as an exciting first hand travelog/expedition story written by several of the participants you will not be disappointed. I read it in one sitting and it is a gripping and true life adventure tale.

The Nampa Image—An Ancient Artifact?

Robert E. Gentet and Edward C. Lain*

Abstract

The July 1889 find in Nampa, Idaho, of a small human figure during a well-drilling operation caused intense scientific interest last century. Unmistakably made by human hands, it was found at a depth (320') which would appear to place its age far before the expected arrival of man in this part

of the world, according to accepted evolutionary dating techniques. Although all but forgotten by the general scientific community, the evidence, when viewed without evolutionary bias, still sounds convincing over a century after its discovery.

Introduction

In 1887 James A. Pinney, Nathan Falk, Joseph Perrault, John Bernard, and M. A. Kurtz formed a company to locate artesian water at the new frontier town of Nampa, Idaho. By July of 1889, the artesian well sand-pump had reached a depth of over three hundred feet. Mr. Kurtz was at the sand pump, running its out-coming contents through his hands. In his own words, he "had the clay image in...[his] hand and supposed it was a twig. I dipped it into a barrel of water standing near, washed it off and saw at once what it was" (Wright, 1890, p. 428).

The other persons present when the image was found included Alexander Duffes, a prominent citizen of Nampa, plus the driller and his helper. In a letter dated November 7, 1889, to Kurtz, Duffes certifies that he "was present at the well along with yourself [Kurtz] and saw you pick it out of the sand as it was discharged from the sand pump. There were no others present except two men attending the engine and sand pump. And they could not by any means get it into the place where found, and were just as much

astonished as ourselves at seeing the find. These are the facts of the case, to which I hereby certify, trusting this will thoroughly quiet all doubts." (Wright, 1890, p. 435)

Duffes' statement hardly quieted all doubts. Because of the great depth (320') from which the find reportedly came up, the doubts of evolutionists regarding its authenticity became apparent. In the words of W. H. Holmes:

It [the Nampa Image] is said to have been brought up by an artesian well sand-pump at Nampa, Idaho, in 1889, and derives its archeological interest from the fact that the deposits penetrated are geologically ancient. According to Emmons, the formation in which the pump was operating is of late Tertiary or early Quaternary age; and the apparent improbability of the occurrence of a well-modeled human figure in deposits of such great antiquity has led to grave doubt as to its authenticity" (1919, p. 70).

Because of its fragile condition, the image is now being stored in a small container in the basement of the Idaho State Historical Society in Boise (see accompanying photographs).

More Details of the Find and its Notoriety

At the General Meeting of the Boston Society of Natural History on January 1, 1890, President of the Society F. W. Putnam called upon Prof. G. Frederick Wright to discuss information about the "Nampa Image" (Wright, 1890, pp. 424-450). The entire correspondence in the *Proceedings of the Boston Society of Natural History* (1890, pp. 424-450) regarding the image and the research into its authenticity provides an interesting insight.

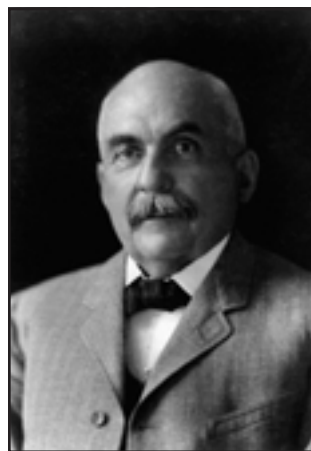


Figure 1. Mark A. Kurtz, finder of the Nampa Image in 1889. Photo from the Idaho State Historical Society (ISHS). Used by permission of ISHS.

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Figure 2. The present-day Idaho Power building in Nampa located over the site of the well where the Nampa Image was found. The well is now capped and is located in one of the storerooms of the Idaho Power building. Earlier Annie Laurie Bird reported (1963, p. 10) that the well “...still serves Nampa since water pumped from its depths is used in the air conditioning system in the Nampa Idaho Power building.”

Charles F. Adams, President of the Union Pacific Railroad, brought the discovery of the image to the attention of the scientific community. President Adams, on a trip to Alaska, had been reading a newly published book by Prof. Wright on the Ice Age. On his return trip in the early part of September 1889, he stopped a few hours at Boise City, Idaho. Mr. Cumming, the general manager for the Union Pacific Railroad in that area, chanced to be in Boise the day after the image’s discovery. Upon being informed of the image, Mr. Adams examined the image still in the possession of its finder, Mr. M. A. Kurtz. In a letter dated Sept. 8, 1889, Mr. Adams informed Prof. Wright of the discovery and also enclosed a short memorandum detailing the find (Wright, 1890, pp. 425–426). Immediately after receiving the letter from Adams, Wright wrote Kurtz a letter with specific questions and requested a photograph of the image.

On September 27, 1889, Kurtz responded to Wright’s request by answering his questions and adds: “We have no means here of having the image photographed so I will send it by express, hoping it will interest you” (Wright, 1890, p. 427).

We can therefore safely assume that on September 27, or very shortly thereafter, the image was no longer in the possession of Kurtz, but made its way by express mail from Idaho to Wright in Oberlin, Ohio. Wright writes, “the image was in my own hands nearly three months in all, so that we had ample opportunity to examine it” (Wright, 1890, p. 439). This bit of information becomes important in evaluating one of the early criticisms of the image.



Figures 3–5. Various views of the Nampa Image as it was seen in August 1996 by the authors while at the Idaho State Historical Society. Notice penny to show scale. Used by permission of ISHS.

Objection I Said To Be An Admitted Hoax

A Mr. McGee attacked the honesty of Messrs. Kurtz and Duffes. Mr. Wright repeats McGee’s assertions in his 1894 second edition of *Man and the Glacial Period*:

'It is a fact,' says Mr. McGee, 'that one of the best known geologists of the world chanced to visit Nampa while the boring was in progress, and the figurine and the pretty fiction were laid before him. He recognized the figurine as a toy such as the neighbouring Indians give their children, and laughed at the story; whereupon the owner of the object enjoined secrecy, pleading: 'Don't give me away; I've fooled a lot of fellows already, and I'd like to fool some more.' (pp. xix-xx).

This well-known geologist turns out to be Major Powell, a famous explorer of the early west, including such areas as the Grand Canyon. Powell later personally wrote of the encounter with the unnamed people with the figurine and clarifies McGee's account by saying:

In the fall of 1889 the writer [Powell] visited Boise City, in Idaho [twenty miles from Nampa where McGee had reported the encounter]. While stopping at a hotel, some gentlemen called on him to show him a figurine which they said they had found in sinking an artesian well in the neighbourhood, at a depth, if I remember rightly, of more than three hundred feet.... (Wright, 1894, p. XX)

This timetable of the "fall of 1889" would throw grave doubts on whether Powell could have even seen the Nampa Image since we know that the image was sent to Wright in Ohio on September 27 or soon thereafter. It may thus be improbable that Powell even saw the Nampa Image. Furthermore, he never names the gentleman who reportedly showed it to him, so we have no sure connection between Powell's account and the discoverer of the Nampa Image.

Powell never says these men claimed to be perpetuating a hoax. He did say that a number of the townspeople had doubts about it:

While stopping at the hotel different persons spoke about it, and it was always passed off as a jest; and various comments were made about it by various people, some of them claiming that it had given them much sport, and that a good many tenderfeet had looked at it, and believed it to be genuine; and they ["different/various persons"] seemed rather pleased that I had detected the hoax. (Wright, 1894, p. xx)

Wright then concludes:

Thus it appears that Major Powell has made no such statement [that the owner of the image said: "Don't give me away; I've fooled a lot of fellows already, and I'd like to fool some more."], at least in public, as Mr. McGee attributes to him (Wright, 1894, p. xx)

Objection II

The Image a Modern-day Indian 'Toy'

It appears that Major Powell felt the image was only a modern-day Indian toy:

He [the writer—Powell] had known the Indians that live in the neighbourhood, had seen their children play with just such figurines, and had no doubt that the little image had lately belonged to some Indian child, and said the same. (Wright, 1894, p. XX)

While one would think that this statement by Powell would constitute one of the most damaging of all objections to the reported find, it actually turns out to be entirely unsubstantiated. W. H. Holmes who wrote about this image years later (1919) makes no mention of this claim and, in fact, acknowledges that such images were not commonly being made by the Indians of that area:

It should be remarked, however, that forms of art closely analogous to this figure are far to seek, neither the Pacific slope on the west nor the Pueblo region on the south furnishing modeled images of the human figure of like character or of equal artistic merit. The nearest region in which work of corresponding culture grade occurs is in the middle Mississippi Valley, the period being recent (Holmes, 1919, p. 70).

A paper in *Creation/Evolution* (Lippare, 1989, p. 31) also seemed to run out of ammunition on this point in attempting to debunk the image when it says:

W. J. McGee (1892) felt that Brinton was too generous to Wright's book and called the Nampa image a transparent fraud—a charge to which Wright did not bother to respond. On the other hand, Wright asked Brinton to provide details in support of his clay toy claim (Wright, 1893a) (sic), but I was unable to find a response.

And no wonder for there appears to be no evidence that Indians in the area of Nampa, or to the west or the south for considerable distances, had made such images. Anyone who has seen the image knows of its fragile existence and to say that children would use such a fragile and small item (1½") as a toy seems pressing it to the extreme.

Objection III

Image Introduced into Sand Pump

In one of the first letters written by G. Frederick Wright to M. A. Kurtz about the image, the question of the sand pump and how it operated was discussed. This obviously was relevant to the possibility of the image being intro-

duced into the pump only to be “re-discovered.” Kurtz’s letter of October 21, 1889, to Wright discusses this question by saying:

The sand pump with the coupling at the top is a little over five inches in the chamber. The sand pump proper is 4 1/2 inches on the outside and the valve is about 3 1/2 inches on the inside. Anything put in from the top would have floated on top of the water and been ground to powder by the action of the sand pump. If there is any way to remove the implied doubt in your letter as to the genuineness of the image please inform me (Wright, 1890, p. 429).

Kurtz further amplifies the workings of the pump in a letter to Wright dated November 30, 1889:

We commenced work at 7 a.m. and the sand pump made a trip every six or eight minutes. Our sand pump is about eight feet in length and is worked very rapidly by steam. The suction valve is attached to two steel rods, attached to a bent rod of steel at the top, the whole forming what is called jars. Now the valve fits and works so nicely on the inside of the pump that if you were to throw a pin in it while at rest, the quick and sudden raising of the jars would throw it out at the top, and if the image had been thrown in as you suggest, it would have bounded out at the top, in good shape. The only other possible way would have been for the helper to have put it in after he had emptied the pump, and the only result would have been that on the descent of the jars, the valve would have knocked the image into pieces (Wright, 1890, p. 437).

Thus, it is clear from the workings of the sand pump, the image could not have been introduced by anyone with the result seen. It would have either been popped out when the pump was started, or broken into pieces if introduced after it had been emptied. In neither case would it have appeared as the contents of the sand pump was being emptied out into Kurtz’s hand.

Objection IV

Carried into the Depths through a Crevice

W. H. Holmes (1919, p. 70) hesitated to accept the ancient age of the image and proposed various alternatives for its discovery. Among the alternatives was the idea that the image may have been introduced to such a depth through a crevice:

While it may have been brought up as reported, there remains the possibility that it was not an original inclusion under the lava. It is not impossible that an object of this character could have descended from the surface through some crevice or

water course penetrating the lava beds and have been carried through deposits of creeping quicksand aided by underground waters to the spot tapped by the drill.

Those of our readers who have followed our previous papers on the artifacts of the gold-bearing gravels of Sierra Nevada Mountains in California (Gentet, 1991) and the famed California Calaveras Skull (Lain and Gentet, 1997) will at once vividly remember the skill of W. H. Holmes to account for many misplaced artifacts by the introduction of mysterious crevices!

To suppose that this fragile, small, baked clay image had such a voyage through hundreds of feet of strata, including a 15’ layer of lava, is indeed an act of faith. It is pure speculation without any factual backing.

There is, however, the question of how the sand pump could have drilled precisely on top of a small item (1 1/2" long) 320’ under the surface of the land. Wright also wondered about this question, and spent a large portion of the summer of 1890 in Idaho to further study the finding of the image the previous summer and to study the geology of the area. Here is Wright’s conclusion:

To many it has seemed in the highest degree improbable that a six-inch hole should chance to hit so small an object at so great a depth. Upon inquiry, however, I found that a very much larger amount of sand and gravel was brought up by the pump from near the bottom than would be required to fill the six-inch hole, and that very likely there was drawn into the pump the material from a good many square feet about the bottom....From this it will be evident that quite a large cavity was made near the bottom, some of them saying that the pile of material thus brought out was as large as a small house. But most of it when I was there had been hauled away to make sidewalks (Wright, 1891, pp. 243-244).

There can be no question that Wright took this matter seriously and did not believe the image was ancient without checking out all the objections. He came away convinced that the image was indeed from the depths and very ancient. He also saw a possible link between the image and the investigations of geologist J. D. Whitney in the California gold-bearing gravels containing artifacts and human remains dating from before the beginning of the Ice Age:

But if we are compelled to ascribe such antiquity to the image, it will go far to relieve the Calaveras skull of the obloquy which has rested upon it on account of its advanced stage of development; for, certainly, the brain that could have modelled so perfect a form as this must have been far removed from that of the ape-like progenitor supposed by

Darwin to be the common ancestor of us all (Wright, 1891, p. 237).

The evidence from California, and now, Idaho, of human artifacts/remains did much to debunk the then current evolutionary timetable for human development. Both Wright and Whitney knew and understood the importance of such finds. Other scientists who held to the accepted evolutionary bias fought any introduction of ancient man. Even today in the latter 1990s—one hundred years later—such ideas of pre-glacial human remains in North America are unacceptable.

Objection V

Strata Too Ancient to Contain Human Artifacts

From the very beginning, the geological setting of the Nampa Image has caused extreme conflict. The memorandum sent to G. Frederick Wright by Charles F. Adams on September 8, 1889, identified the stratum from which the image was believed to have come:

M. A. Kurtz was engaged in boring an artesian well. The image was brought to the surface through the pipe in the usual way among some heavy, coarse sand, from a depth of three hundred and twenty feet from the surface. The different strata that had been bored through were as follows:

Sixty feet of soil.
Twelve to fifteen feet of lava rock.
One hundred feet of quicksand.
Six inches of clay.
Forty feet of quicksand.
Six feet of clay.
Thirty feet of quicksand.
Twelve to fifteen feet of clay.
Then clay balls mixed with sand.
Then coarse sand in which the image came up.
Then vegetable soil.
Then the original sandstone.
(Wright, 1890, p. 425-426).

A U.S. Geological Survey geologic atlas (1904) published a few years later of this same well gives similar geological information:

A well bored at Nampa (elevation, 2490 feet) gave the following section:

At top, hardpan and loam	60 feet
Basalt, below which roots, leaves, and vegetable mold are found	15 feet
Boulders [<i>sic</i>] and sand	100 feet
clay seam	½ feet
sand	40 feet
clay seam	½ feet
sand	30 feet

clay 15 feet
Sand. (From the lower part of this stratum the sand pump brought up a small image similar to a roughly shaped doll, which at the time created much interest, as the statement was made on seemingly good authority that the find was genuine. Further substantiation of this remarkable occurrence has not been forthcoming, and the image may have been dropped into the wellhole by someone wishing to perpetrate a practical joke) 40 feet

Coaly material at the bottom of this stratum. More consolidated sandstone at bottom of section. 19 feet
Total 320 feet

Thus there is in this well, below the 60 feet of Quaternary material, 15 feet of basalt and 220 feet of sands with some clays. The latter probably represent the Idaho formation [Quaternary/Tertiary]. Near the bottom, at an elevation of 2170 feet, was a layer of lignitic material. Finally, below this came a harder sandstone, which may represent the Payette formation [Tertiary].

A later publication (Savage, 1958, p. 20) lists Quaternary basalt flows from Recent, Late and Early Pleistocene in the county where the image was found. While the exact age of the 15' basalt layer is unknown, it would be either "Recent" or "Pleistocene." This area of Idaho was never covered by ice, but it did have a much wetter climate during the time of the glaciers and suffered greatly by large amounts of water during local catastrophes such as the Bonneville Flood.

What is certain is that the Nampa Image is an enigma to evolutionary theories. Man simply could not have been present making clay images of himself at such a remote time. But, such is the dilemma of evolutionary thought when confronted with data that does not fit.

Objection VI

Image Could Be Made to Appear Old

If the Nampa Image were not really old, how could one account for its ancient appearance? After the image was shipped to Ohio to be examined by G. Frederick Wright, it was given to Albert Allen Wright, professor of natural history at Oberlin for careful examination. Also, it was given to F. F. Jewett, professor of chemistry. Wright also recorded their opinions. Over eight full pages of Albert Allen Wright's report are included in Wright's paper (Wright, 1890, pp. 439-447). It is only possible to summarize A. A. Wright's conclusions briefly:

(1) The 1½ " image is that of a female. It is not the work of a child or mere novice. If the short leg was ever of equal length with the other, it was broken and rounded before it came up from the well.

(2) The image was molded out of a plastic, gritty clay, and afterwards burned in a fire.

(3) The unaided eye distinguishes two elements in the material—a powdery material too fine to be called sand and yet not so fine as the elements of porcelain clay, and grains of quartz and possibly of other minerals, scattered at random through the finer substance. The image was so friable that it was not possible to make a thin section.

(4) The source of the material for the image fit the clay balls brought up from the well shortly before the image was found. The clay balls were found to be concretions with interiors nearly white with very fine-grained material displaying concentric rusty rings while the exterior contained the coarse quartz grains.

(5) When the clay was subjected to the heat of a Bunsen gas burner, the oxidizing portion turned red while the remaining portion was gray due to a lack of oxygen at the time of burning. This agreed with the different shades of color observable upon the image's surface.

(6) Albert Allen Wright then tried to duplicate the image using a clay ball that had been brought back from the Idaho well site. After making a similar image and heating it with his Bunsen burner, Wright concluded:

This is the only attempt that was made, and I may say that the success of the imitation was far beyond my anticipations. The general tone and variations of color in the two are exceedingly similar....There is only one point, which seems of any importance, in which the duplicate fails to reproduce the original, and that is a superior tint of redness at one or two points upon the surface of the original, notably upon the back, and at the left hand. This raises the question whether the extreme tint in the original may not be due to a slow deposit or iron rust from external, or even internal sources, and thus furnish evidence of its antiquity. To this it may be replied that the extreme color can be obtained by using a few drops of hydrochloric acid upon the clay, and the reheating. Even deeper tints than are seen in the original can thus be secured (Wright, 1890, pp. 446-447).

In conclusion, Albert Allen Wright said (Wright, 1890, p. 447):

When we find that it is possible in a few hours to produce a duplicate which exhibits all the external and internal characters of the original, there is nothing left in the image itself to sustain the theory of its antiquity. Whoever compares the two [no picture of the duplicate was given] will see that the tool marks are as distinct and fresh in the original as in the duplicate. He will see the same corroded surface on the duplicate [in the grooves?] as on the original. The interior tenacity, composition and color are the same in both. The variations in the ex-

ternal color have been fully set forth. While therefore it would be a great pleasure to be able to confirm the evidence of its antiquity brought forward from other sources by my friend and co-laborer Professor G. F. Wright, I am still compelled to say that I can find no satisfactory marks of the tooth of time upon it.

How did Professor G. F. Wright respond to this negative evaluation of the Nampa Image? In one paragraph he says:

Professor A. A. Wright's examination, it is true, is not of itself conclusive as to age, but there is nothing in it bearing indubitably against its age; while the similarity of the material composing the image and that composing the clay balls, seem to me strongly confirmatory of the genuineness....It seems in the highest degree improbable that anyone should have manufactured such an object on the spot, and have been so successful in meeting all the conditions present (Wright, 1890, p. 448).

One thing seems certain: A. A. Wright succeeded in manufacturing an image very similar to the Nampa Image. In order to do so, sophisticated equipment and chemicals were used. Were such items available on the frontier? If they were, what would be the motive of making such an image? And, how could such a fragile image be planted in the sand pump and survive? And, what about the repeated reports of the integrity of Kurtz and Duffes by many people who knew them? Could the driller, Mr. H. B. Grumbling [misspelled "Grumbley" in one section of Wright's paper], have somehow been responsible for the image? Wright quotes a letter received from Grumbling (Wright, 1890, p. 449):

I was present at the find of the image. Circumstances were such that there could have been no mistake. I don't think there was any chance for the helper to have placed it in the sand, nor do I think he was capable of so doing.

Grumbling only speaks of his helper. He says nothing about anyone else present, including himself. Nor is anything else known about the helper than what was said. The question still remains: "What would be the motive?" A mere prank? If so, why such a sophisticated one?

There is also the point raised by Kurtz: "The similarity of the material composing the image and that composing the clay balls, seem to me strongly confirmatory of the genuineness" (Wright, 1890, p. 448). The image was said to have been located originally in the sand layer *immediately under* the clay ball layer. The clay balls and the image were composed of identical material. This is a strange circumstance. One would normally have expected the image to have been found *higher, not lower*, in the sequence than the material from which it is identical. This would lend credence to the possibility that the clay balls

laying on the surface by the drilling operation would have afforded someone an opportunity to make an image, just as was accomplished by A. A. Wright. The other possibility is that the material from which the clay balls were formed was available to an ancient artisan to use prior to the geologic event that formed the clay balls.

The other professor at Oberlin who examined the image was F. F. Jewett, the chemist. His letter preserved by Wright (1890, p. 448) says:

A careful examination of the Nampa image, and experiments made upon clay taken from the same well, lead me to the conclusion that the image must be of considerable age. I cannot account for the accumulation of the oxide of iron upon the grains of sand, lying between the body of the image and its arms, except by supposing it to have been the result of the slow decomposition of substances containing iron, in its immediate vicinity. Although I have been able to reproduce the color of this oxide tolerably well by heating clay coated with a solution of iron chloride, yet I have not been able to reproduce it by simply heating clay to different degrees of temperature.

Jewett does not provide a detailed account of how he heated the clay "coated with a solution of iron chloride." Did he use a Bunsen burner, as did A. A. Wright? Or, was a more simple mechanism used, one that could have been more easily duplicated in frontier Idaho? And, Jewett makes no mention of A. A. Wright's duplication of the "deeper tints" of redness by using a few drops of hydrochloric acid. The existence of iron oxide on sand grains "lying between the body of the image and its arms" is the sole criteria that leads Jewett "to the conclusion that the image must be of considerable age."

Who Would Profit From a Hoax?

The question of motive or profit enters the picture. The day after the discovery of the image, the general manager of the Union Pacific Railroad chanced to be in Boise City and saw it. As Wright pointed out (1890, p. 448):

There was no sensational publication in the papers, nor has there been any suggestion of mercenary motives. There were no archaeologists or scientific men on the ground to be humbugged. Apparently the image would have disappeared and dropped out of notice but for the fortunate chance which brought it to the attention of Mr. Adams, when his own mind was interested in that class of subjects. The evidence is most direct as to the impossibility of the image's having fallen into the well from the surface, or of its having been put in by design.

It is true that Kurtz, Duffes, and possibly Grumbling were all early and well-known men of the new frontier town of Nampa. As will be seen, they had land in the new town to develop and a little notoriety for the emerging town might be a possible motive for a hoax. Concerning Alexander Duffes, the *History of Idaho*, Volume I (Hawley, 1920, p. 744) records:

The main line of the railroad was built in 1883 as far as Caldwell and a small station was established at Nampa, but the town was not founded until two years later, when Alexander Duffes, passing through on his way to his old home in Canada, saw the possibilities of the place as a location for a town. He obtained 160 acres of Government land near the little railway station and platted part of it in town lots, setting aside a site for a schoolhouse and building the first residence. On November 11, 1885, he and his family moved into their new house, the first to settle in Nampa. Other early settlers and businessmen were: Benjamin Walling, John E. Stearns and B. Grumbling [the engineer at the well site?].

Volume III of *History of Idaho* (Hawley, 1920, pp. 179-180) has a section on Mark A. Kurtz which says, in part:

It was in 1887 that Mr. Kurtz became a resident of Nampa, Idaho, which at that time could boast of a population of but one hundred and fifty, contained a section house and a few other buildings but no churches. Mr. Kurtz purchased a ranch located about three miles north of Nampa and Mrs. Kurtz one on the south side of the railroad tracks, on which a portion of the present city stands....He was keenly interested in everything that had to do with the welfare and progress of Nampa and was largely instrumental in bringing capital into Canyon county for its development and upbuilding. He took a deep interest in the progress of the city and in all that pertained to its welfare....He was a member of the first Chamber of Commerce organized in Nampa.

Some may say that the motive could have been associated with the development of the new frontier town. It certainly put the town on the map of the USA!

But, countering such a thought, all material that we read regarding the character of Duffes and Kurtz spoke against such a theory. The *History of Idaho* (Hawley, 1920, p. 180) also records: "The worth of his [Kurtz's] character was acknowledged by all...." Upon his sudden death by a heart attack on the morning of Tuesday, October 23, 1906, *The Nampa Leader-Herald* (1906) characterized him as follows in a front page obituary: "...religious, and of a high moral character...."

And perhaps most importantly of all, G. F. Wright, after spending a good part of the next summer (1890) in Idaho wrote:

And, first, I would say, that, while upon the ground and in the vicinity, I had repeated interviews with the gentlemen in whose presence the discovery was made, I feel entirely confident that there is no ground to question the fact that this image came up in the sand pump from the depth reported (Wright, 1891, p. 243).

Summary and Conclusions

Unlike the many ancient human artifacts and bone finds in the gold-bearing gravels in the Sierra Nevada Mountains of California last century (Gentet, 1991), the Nampa Image was a sole clue to an ancient landscape now buried deeply under the surface. As such, it is more difficult to claim it as excellent evidence of ancient man in North America.

Nevertheless, the evidences for the genuineness of the Nampa Image seem weighty. The condition of the image would present a very sophisticated challenge for someone on the early frontier. And the workings of the sand pump, which was in operation at the discovery of the image, excludes it being introduced during the on-going operation from on top and surviving. Furthermore, while one might envision a motive for a hoax (though the idea of a hoax to promote the new frontier town was never mentioned by any other writer the authors researched), the people involved were always described as citizens of stature in the community and trusted in their words.

There is, however, always the possibility that all is not as it first seems to be. Perhaps we will never know for sure, but this much we do know: had the find come from a geologic horizon where man's artifacts were expected, there would have been far less controversy involved. The current theories of evolution and the stretched out geologic timetable should not hinder acceptance of human artifacts or bones found in stratum where conventional "wisdom" prohibits.

Acknowledgements

We thank various CRSQ reviewers for making this paper better through their helpful suggestions. We also

thank the Idaho State Historical Society, especially Jody Ochoa, for letting us see and photograph the Nampa Image while we were in Boise during the summer of 1996 and for permission to use photographs in this paper. Tomas Jaehn, archivist, at the Society was also very helpful in locating photographs and historical information in their library. And lastly, the authors are grateful for a Creation Research Society research grant for this project.

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"Everything in life has to do with your world view. You go to the zoo either to rejoice in the Creator or to find some alternative to Him. Your help for the needy is wrapped either in the arrogance that you are godlike and can figure out every detail, or in the modesty and humility that admits even your kindness might be wrong. Your starting point, and your discoveries along the way, determine how you build and manage both your zoos and your governments— if, indeed, these days you can tell the difference." Joel Belz in *World* (5/20/95).

Placer Mineral Deposits on a Young Earth

Alexander V. Lalomov and Serguei E. Tabolitch*

Abstract

We present a mathematical model for stream placer accumulation far from the source. Determination of the model's parameters is discussed, and the model is applied to field data from northeastern Russia. The model calculated the age of these "far transfer" placers in northeastern Russia as not more than 2000 years, hundreds of times less than predicted by uniformitarian geologists.

Field data were used to calculate both average and initial denudation rates during the post-Flood time for northeastern Russia. The model can be applied in similar settings to provide an age estimate for other "far transfer" placer deposits, and should provide considerable economic benefit in prospecting for commercial alluvial placer deposits.

Introduction

Determination of the age of geological features is one of the most difficult problems for modern geology. Although uniformitarian geologists routinely apply radiometric and paleontologic methods, both are based on questionable assumptions (Bliss, Parker and Gish, 1990; Snelling, 1995; Woodmorappe, 1979; etc.). We have developed a different method to determine the age of alluvial stream placers by mathematically modelling the placer deposits' generation. This model was tested with field data from northeastern Russia.

Our opportunity to constrain mathematical models by field observations of alluvial placers was provided by several cassiterite (tin ore, SnO_2) placer mines in Chukotka, northeastern Russia (Figures 1, 2). The primitive ore concentrating equipment in use at the mines is inefficient; we estimate that 30% to 40% of the available cassiterite is lost from the ore-dressing gears (ODG) during the concentration process. The cassiterite grains lost during this process are transported downstream during high flow episodes.

Between 1982 and 1990, we performed sampling of river valleys prospecting for commercial cassiterite deposits. During this work, we sampled processing residue from the ODG up to 13 km downstream, with up to a 500 m drop in elevation. Shallow (less than 20 cm from surface), fine-grained (less than 1 mm) deposits were collected, evaluated in the field, and later analyzed for tin and several other elements.

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Figure 1. Study area.

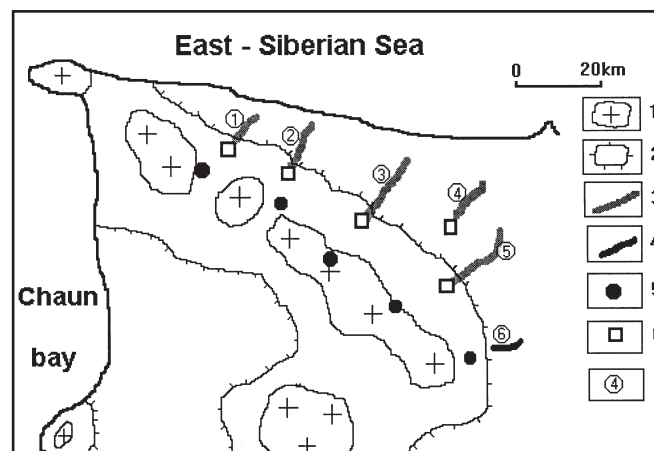


Figure 2. Detail of study area showing locations of placer deposits modeled. Key: 1 = granite intrusives, 2 = mountainous terrain, 3 = artificial tin placers, 4 = natural spit placers, 5 = tin ore sources, 6 = ore-dressing gears (ODG) locations, 7 = placer designator.

A placer is “a surficial mineral deposit formed by mechanical concentration of mineral particles from weathered debris. The common types are *beach* placers and *alluvial* placers. The mineral concentrated is usually a heavy mineral such as gold, cassiterite, or rutile.” (Bates and Jackson, 1987, p. 506). Placers can be sourced by primary deposits, and/or by pre-existing placer deposits. However, all placers are ultimately derived from primary deposits. Placers form where aqueous flow conditions allow the steady separation and concentration of heavy minerals (such as in streams or on coastal shelves). Placer deposits typically result from weathering of heavy minerals from primary lode deposits, and transportation and concentration of heavy minerals, predominantly in gravel, pebble, and boulder-sized sediments of streams (Lalomov and Tabolitch, 1997).

Placer mineral deposits can be subdivided by reference to the distance from their source. In this paper we are interested of two types: “near transfer” placers (NTP) and “far transfer” placers (FTP) of streams (alluvial placers). NTP are located near the source of ore minerals, commonly in the proximal reaches of streams often associated with significant topographic relief. They usually contain coarse grains of heavy minerals—gold, platinum, cassiterite, and wolfram (the metallic element tungsten) among other species. NTP are concentrated primarily by the winnowing of lighter minerals by stream currents. FTP accumulate downstream, far from the primary source of ore minerals. They usually contain heavy minerals of lower specific gravity than NTP minerals, and include rutile (titanium oxide), zircon (zirconium oxide), diamonds, etc., and/or fine grains of gold or cassiterite. FTP accumulate where stream current velocities decrease, allowing the settling of these heavy minerals.

Cassiterite lost from the tin mining operations migrates downstream and accumulates as artificial placer deposits (APD). Distribution of these artificial cassiterite placers is similar to that of FTP, also called “spit placers” (Wells, 1989; Bache, 1987; Yeend, Shawe, and Wier, 1989). Artificial and spit placers share a similar mechanism of formation—the consecutive deposition of minerals by their decreasing specific gravities as flow velocity decreases downstream. This similarity is confirmed by observation of residual cassiterite from the ODG. The fine-grained fraction of cassiterite lost by the ODG occurs, as a rule, in spit placer deposits. The differences between the spit placers and the APD are found in the degree of heavy mineral concentration and the thickness of the placer deposits.

Artificial placers of cassiterite have been observed as a result of 30 to 40 years of processing by the ore dressing plants. High concentrations of cassiterite have appeared in sections of valleys where they were not previously ob-

served. NTP of predominantly coarse cassiterite grains, lost during mineral processing, have formed in proximal stream reaches downstream of the processing plants. Further downstream, the cassiterite ore is diluted by local sedimentation into the streams. In natural conditions, the spit placers would form at significant gradient changes in the streams associated with abrupt topographic elevation changes. The distribution of mineral concentrations in placers has been described mathematically (Polikarpochkin, 1976; Solovov, 1985). Residual cassiterite from the ODG enters the natural system from a defined point source. Artificial cassiterite placers from processing operations have proven to be a potential commercial source because of their high cassiterite concentrations in these secondary placers, and their near-surface location.

This paper presents a mathematical model that describes the formation of both APD and their natural analogues formed in glacial outwash zones. The model includes a method for calculating the ages of spit placers and a post-Flood denudation rate for northeastern Russia.

Mathematical Model

Our model includes the following assumptions:

Alluvial sedimentation is at a steady state during high flow times, and placer formation is evaluated under decreasing flow conditions (high flow to low flow):

- I. All ore minerals entered the streams in their proximal reaches (for natural spit placers) or from the ODG sites (for artificial placers);
- II. Sediment transport distance is simplified to the length of a given stream (X-axis positive downstream);
- III. Source points of the ores were placed at the boundary between high topographic relief and low topographic relief (spit placers), or at the disposal point for ODG residue (APD);
- IV. Time in the model is counted from the initiation of flow velocity decrease when the main phase of deposition commences;
- V. The elementary cell defining the limits of transported sediment has a constant width, equal to the stream width. It has a length of $OX - dX$, and a height of $h(X, t)$, reflecting the vertical capacity of precipitated loads at point $= X$ and at time $= t$.
- VI. The cassiterite used in the calculation (total cassiterite-background cassiterite) is C^* . The transport velocity associated with the cassiterite is V_r , where the subscript “r” designates the ore material. The transport velocity of the other sedimentary material is V .

VII. The rate of deposition of material through the bottom of the cell is related to its total quantity in the cell by the coefficient of proportionality, U .

VIII. Total sediment load contributed down-stream of the source is assumed to be small relative to the up-stream-derived load, and is ignored in the model.

We then use the following equations to define the weight balance for non-ore and ore-bearing sediment loads accordingly:

$$\frac{dh}{dX}V + hU = \frac{dh}{dt} \quad (1)$$

$$\frac{d(C''h)}{dX}V_r + C''hU = \frac{d(C''h)}{dt} \quad (2)$$

These equations are solved by using the exp-function to approximate the decrease in sediment load transported through a cross-sectional plane at point $X = 0$ during a period of decreasing flow (Kamke, 1959):

$$h(0, t) = h_0 \exp(-Gt) \quad (3)$$

$$C''h(0, t) = C_o'' h_0 \exp(-Gt) \quad (4)$$

where:

G = a constant coefficient, defining existing climatic conditions of the valley;

h_0 = the height of the elementary cell at point $(0, 0)$; and

C_o'' = the contents of the ore material (i.e., cassiterite) at point $(0, 0)$.

The solutions for non-ore and ore material are, respectively:

$$h = h_0 \exp(-Gt - (G + U)\frac{X}{V}) \quad (5)$$

$$C''h = C_o'' h_0 \exp(-Gt - (G + U)\frac{X}{V_r}) \quad (6)$$

The total sediment load in the streams is composed of a variety of populations of different size fractions. We assume that transportation of each population is controlled by their average velocity, which decreases with an increase in the size and density of the ore particles (Shilo and Shumilov, 1976). We designate the parameters for each fraction by an index "i" and then apply formulas (1)–(6) separately to each size fraction. Then $C'(X, t)$ —the average quantity of cassiterite minus the background quantity deposited at point X and at time t —is the following:

$$C'(X, t) = \frac{\sum_{i=1}^N (U(C''h)_i)}{\sum_{i=1}^N (Uh_i)} \quad (7)$$

Next, we designate n_i the volume part of i-fraction in the initial transported sediment load through point $X=0$ at time $t=0$:

$$n_i = \frac{h_{oi}}{\sum_{i=1}^N h_{oi}} \quad (8)$$

Then the formula (7) may be restated as:

$$C' = \frac{\sum_{i=1}^N C_{oi}'' n_i \exp(-L_{ri}X)}{\sum_{i=1}^N n_i \exp(-L_iX) + \sum_{i=1}^N C_{oi}'' n_i \exp(-L_{ri}X)} \quad (9)$$

The second item of the denominator in formula (9) is many times less than the first one, therefore we can ignore it for simplification in solving the equation.

$$L_{ri} = \frac{(G + U)}{V_{ri}} \quad (10)$$

There are two ore size fractions common in outlying glacial zone deposits (Shilo, 1981), implying that $N=2$ in formula (9). If we use the subscript "c" for the coarse (sand-size) fraction and subscript "f" for the fine (silt-clay-size) fraction, we can obtain:

$$C' = \frac{C_{oc}'' \exp(BX)}{1 + m \exp(AX)} + \frac{C_{of}'' m \exp(A_r X)}{1 + m \exp(AX)} \quad (12)$$

$$B = L_c - L_{rc} \quad (13)$$

$$A_r = L_c - L_{rf} \quad (14)$$

$$A = L_c - L_f \quad (15)$$

$$m = \frac{n_f}{n_c} \quad (16)$$

Since the velocities of larger sediment particles are more dependent on their relative density than are the velocities of finer-grained ones (Shilo, 1981), we can predict the following relationships between the coefficients in equations (13), (14), and (15): $B < 0$; $A > 0$; A_r may be either > 0 or < 0 . Depending on the particle size of the sediment load, the ore material, and features of stream in the valley; $A_r \leq A$; $B < A_r$.

In equation (12), the first term decreases much faster along the X axis, and its contribution effectively disappears at some point X . The second term reaches its maximum at point $X_{\max}$.

$$X_{\max} = -\left(\frac{1}{A}\right) \ln\left(m\left(\frac{A}{A_r} - 1\right)\right) \quad (17)$$

Thus, the function of concentration in equation (12) may have a comparative maximum sufficiently far from natural or artificial source of ore material related to the ratio of constants for every stream coefficients (13)–(16).

Solutions of the proposed equations (Figure 3) fit diagrams of heavy minerals concentrations relative to different sediment size fractions in a stream flowing from mountainous terrain to a plain described by Russian geologist B. Osovetsky (1986, Figure 51). The distribution of gold in alluvial placers (Polikarpochkin, 1976, Figure 67) is also similar to the diagram of equation (9) (Figure 4) using certain values of coefficients (13)–(16).

We can estimate values for the constants A_r , A , B , C_{of}'' , and C_{oc}'' for any valley whose maximum ore concentration is downstream of the origin. We can approximate the difference $A_r - A$ for the descending slope of the curves for tin concentrations, smoothed with the filter downstream from X_{max} in points X_1 and X_2 , if $X_{max} < X_1 < X_2$.

$$A_r - A = \frac{\ln\left(\frac{C'(X_1)}{C'(X_2)}\right)}{X_2 - X_1} \quad (18)$$

According to equation (12), the estimation error decreases away from point X_{max} . We can determine the values of A_r and A by solving equation (17) for A by iteration (using a method of consecutive approximation). If we take “ m ” value from either field investigation or the literature, then we can determine an approximate value of C_{of}'' .

$$C_{of}'' = C'(X_2) \frac{(1 + m \exp(A X_2))}{m \exp(A_r X_2)} \quad (19)$$

Using the same method, we can determine B and C_{oc}'' for the descending slope of the tin concentration curve nearest to point $X = 0$.

Figures 5a, 6a, 7a, 8a, and 9a show the field measurements of tin concentrations downstream of the placer mines in northeastern Russia (Figure 2). The curves have been smoothed by the filter. Scatter in the field data is attributed to both the small volume of the samples (about 40 cm³) and the uneven distribution of tin in the bottom sediments. Analytical error may also contribute to the field data scatter. Superior mathematical solutions were obtained by using a filter to smooth the peaks in the field data.

Figures 5b, 6b, 7b, 8b, and 9b show the filtered (smoothed) concentrations of tin downstream from the placer mines compared to those concentrations predicted by the model for the same sections of the valleys. Figures 10a and 10b show both field data and modeled concentrations for natural spit placers of the Guravlini River (Crane Creek), (Placer 6 in Figure 2). The correlation coefficient for calculated and field data is 0.652 (Fig-

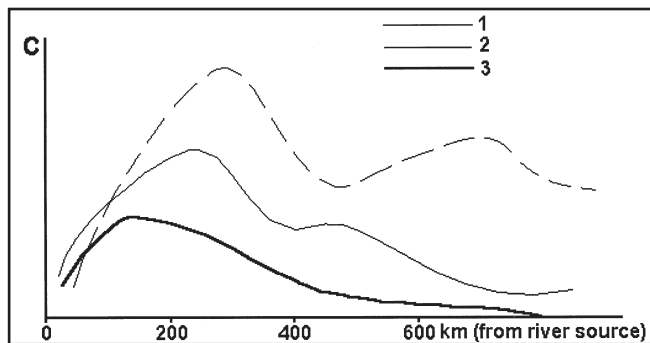


Figure 3. Concentration of heavy minerals by size-fraction in Kuban River alluvial deposits (Caucas, Russia; Osovetsky, 1986).

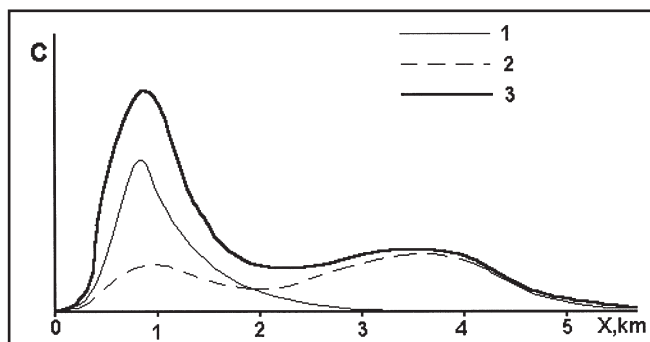


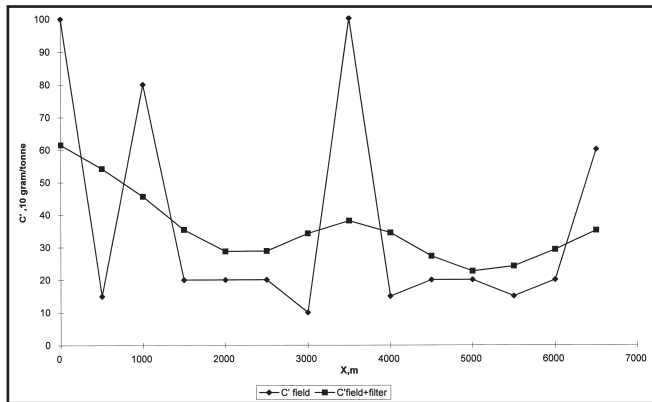
Figure 4. Distribution of gold by size-fraction in Kuobah-Boga placers (northeastern Russia; Polikarpochkin, 1976).

ure 11); for calculated and smoothed field data it is 0.937 (Figure 12), which indicates a genuine correlation between the model and the physical processes. Similar good correlations were also obtained for gold in spit placers (Figures 13a and 13b), but details of these data are not provided in this report.

We conclude that the mathematical model approximates the physical processes of spit placer formation. Therefore, this method is useful for predicting tin concentrations in both natural and artificial placers. This model may be used by the mining industry to predict parameters (shape, location of placer, and concentration of heavy minerals) of economic placer deposits. In addition to the commercial value in our model, we also believe that this method can be used to estimate the age of placer deposits. The following section will discuss this application and show that it is a method that should be of much interest for creation science.

Determination of the Alluvial Placer's Age

Although the development and testing of our model was undertaken in relation to mineral exploration in northeastern Russia, Mr. Guy Berthault helped us continue our investigation and apply the model to the problem of the



Figures 5a. Original field and smoothed (filtered) field concentrations of tin in artificial spit placer 1 from Figure 2.

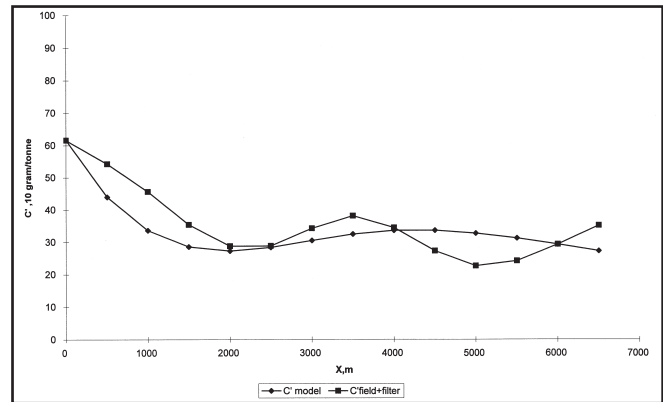
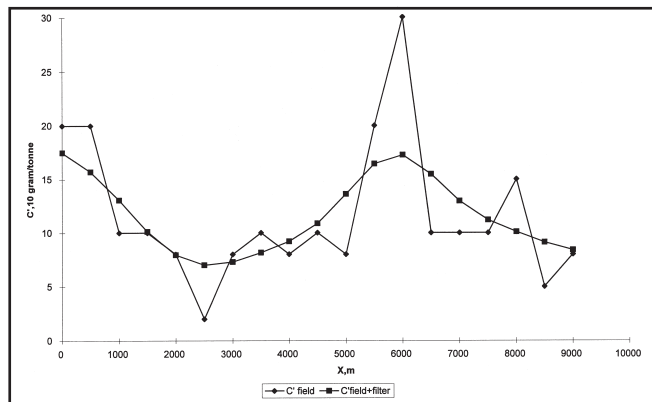


Figure 5b. Smoothed field vs. modeled concentration of tin in artificial spit placer 1 from Figure 2.



Figures 6a. Original field and smoothed (filtered) field concentrations of tin in artificial spit placer 2 from Figure 2.

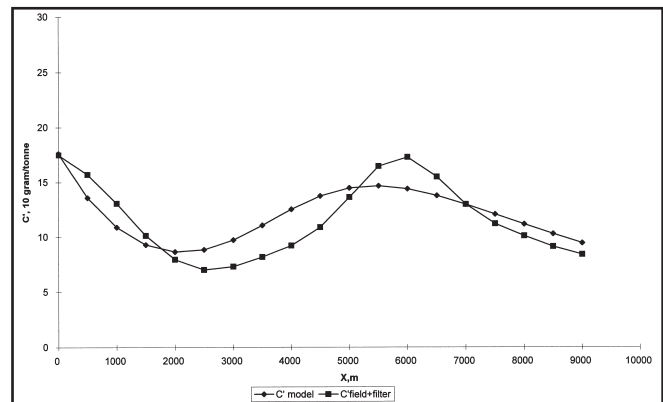
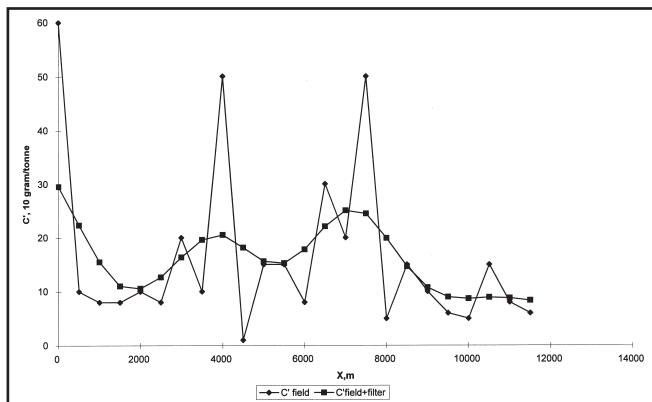


Figure 6b. Smoothed field vs. modeled concentration of tin in artificial spit placer 2 from Figure 2.



Figures 6a. Original field and smoothed (filtered) field concentrations of tin in artificial spit placer 2 from Figure 2.

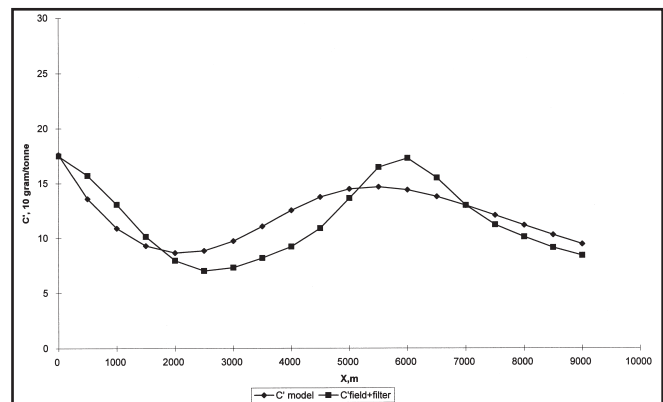
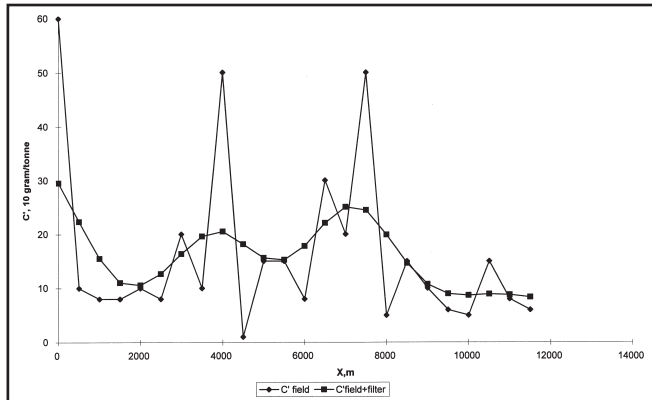


Figure 6b. Smoothed field vs. modeled concentration of tin in artificial spit placer 2 from Figure 2.

age of placer deposits. By using the known age of the APD (30 to 40 years), we were able to apply the model to predict the ages of natural spit placer deposits. Before this calculation can be made, it is necessary to correlate the volumes of tin-bearing sediments generated by ODG to

those generated by natural processes of erosion. We estimated the volume of natural tin-bearing sediment loads for each researched stream as ranging between 1000 and 5000 m³ per year with a present-day denudation rate average of 1 mm/year (Lalomov and Tabolitch, 1996a). The



Figures 7a. Original field and smoothed (filtered) field concentrations of tin in artificial spit placer 3 from Figure 2.

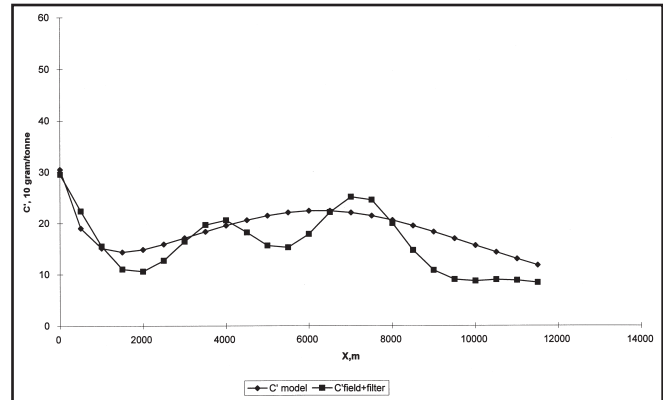
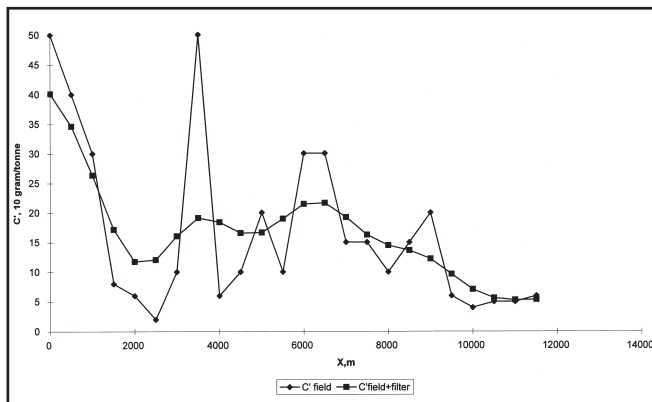


Figure 7b. Smoothed field vs. modeled concentration of tin in artificial spit placer 3 from Figure 2.



Figures 8a. Original field and smoothed (filtered) field concentrations of tin in artificial spit placer 4 from Figure 2.

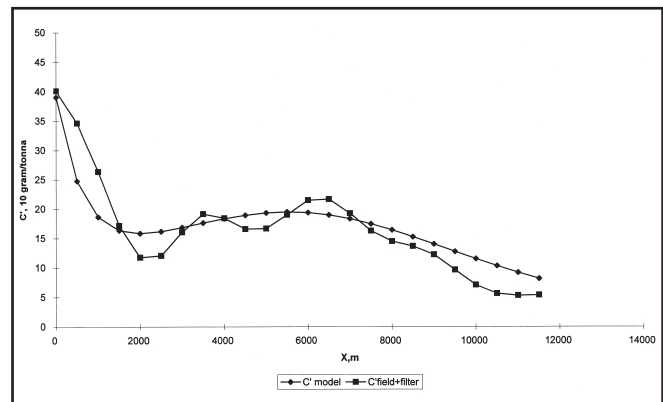
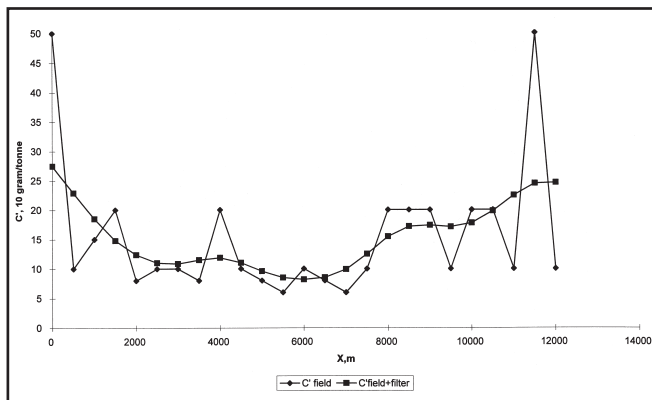


Figure 8b. Smoothed field vs. modeled concentration of tin in artificial spit placer 4 from Figure 2.



Figures 9a. Original field and smoothed (filtered) field concentrations of tin in artificial spit placer 5 from Figure 2.

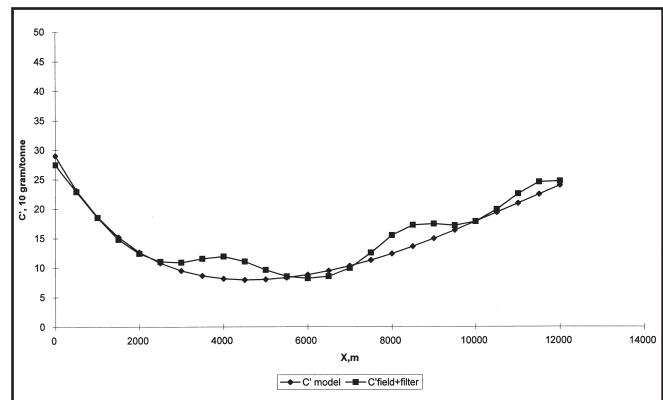


Figure 9b. Smoothed field vs. modeled concentration of tin in artificial spit placer 5 from Figure 2.

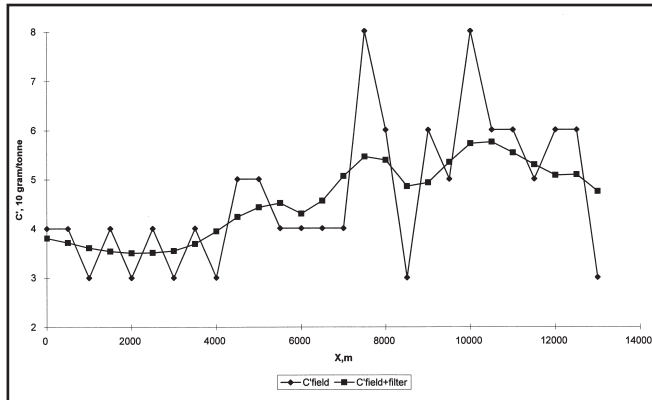
additional volume of the tin-bearing sediment loads derived from ODG wastage was estimated to range between 100,000 and 200,000 m³ per year.

Thus, the volume of artificially-induced tin-bearing sediments introduced into the streams at the ODG sites from mining activity (M_a) is 20–200 times greater than

that volume derived from natural processes (M_n). Hence, we can conclude that:

$$M_a = C_a V_a$$

$$M_n = C_n V_n$$



Figures 10a. Original field and smoothed (filtered) field concentrations of tin in natural spit placer 6 (Guravlini River) from Figure 2.

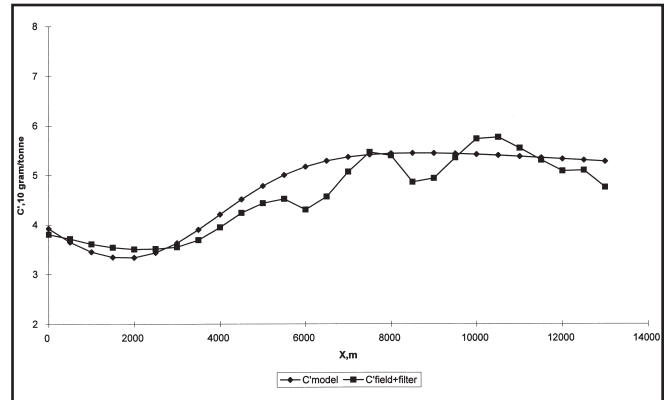


Figure 10b. Smoothed field vs. modeled concentration of tin in natural spit placer 6 (Guravlini River) from Figure 2.

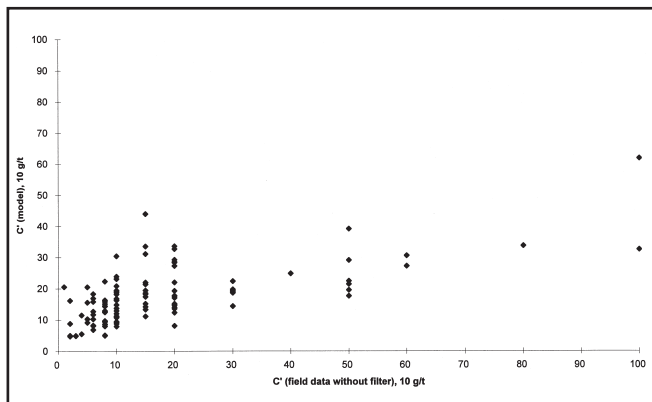


Figure 11. Correlation between original field and model data.

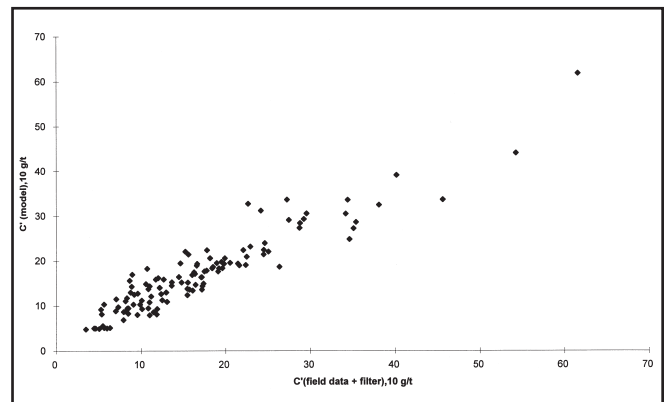


Figure 12. Correlation between smoothed field and model data.

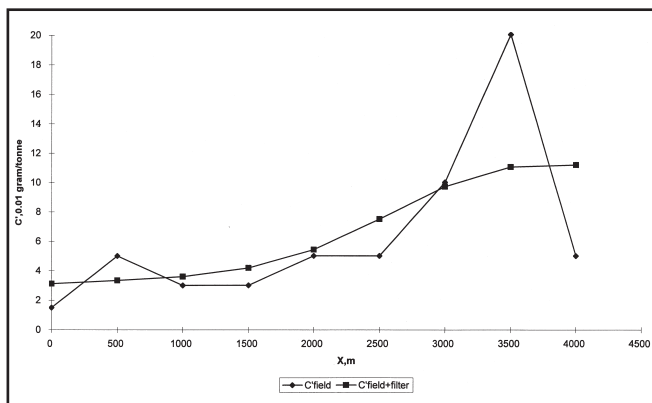


Figure 13a. Original field and smoothed (filtered) field concentrations of gold in the natural spit placer (Placer 6 in Figure 2).

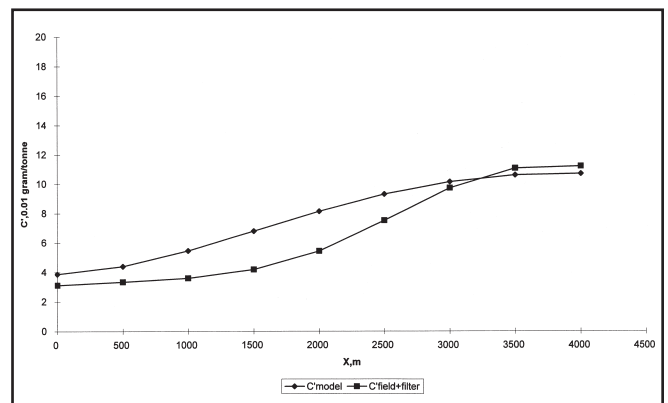


Figure 13b. Smoothed field vs. modeled concentration of gold in the natural spit placer (Placer 6 in Figure 2).

where C_a and C_n are artificial and natural cassiterite concentrations in the sediments, respectively. Therefore, if the concentration of cassiterite in the mines' trains and in the naturally-eroded slope sediments is the same, the difference between the volumes of artificial and natural transport of the cassiterite is:

$$\text{minimum} - \frac{100,000 \text{ m}^3 \text{ per year}}{1,000 \text{ m}^3 \text{ per year}} = 200 \text{ times}$$

$$\text{maximum} - \frac{200,000 \text{ m}^3 \text{ per year}}{1,000 \text{ m}^3 \text{ per year}} = 200 \text{ times}$$

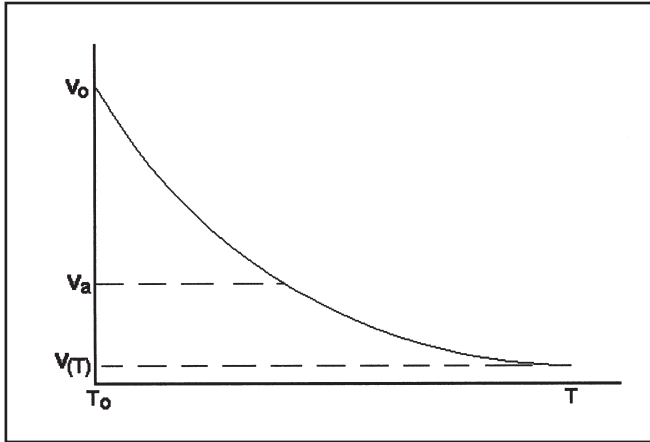


Figure 14. Graph showing method of calculation of post-Flood initial denudation rate.

Hence, the time span for artificial spit placer generation is 20–200 times less than that required for the equivalent formation of natural spit placer deposits. The process of placer generation is the same for both naturally and artificially-induced cassiterite in the stream sediments (since the physical properties of the cassiterite sediments are the same). Since the observed age of APD is 30–40 years; the time span for natural spit placer generation is:

Minimum: 30 years $\times$ 20 = 600 years;

Maximum: 40 years $\times$ 200 = 8000 years.

Therefore, if the rate of sediment loading into the stream is constant (implying a constant rate of landscape erosion), the time span for natural spit placer generation in similar streams (sharp gradient transition from mountainous to plain topography) is between 600 to 8000 years. This approximation is much less than the current uniformitarian estimate of one million years based on biostratigraphic methods.

If the axiom of uniformitarianism is rejected, then we may assume that the rate and intensity of denudation were higher in the past, immediately after the Flood (Nevins, 1974), decreasing from an unknown high magnitude to the present-day lower one (Reed, Froede and Bennett, 1996). Therefore, the real age of the placers may be even less than calculated above.

The model also allows an approximation of both initial and average denudation rates during post-Flood time for the Chaun region in northeastern Russia (Figure 1). A uniform extrapolation of present-day denudation rates produces an estimated age of 40,000 years for the Chaun depression (Lalomov and Tabolitch, 1996b). However, if the axiom of uniformitarianism is rejected, we can use the age of the Flood (4600 to 10,000 years based on the literal addition of the Genesis chronologies (Niessen,

1982) to calculate denudation rates. Thus, we may assume that the average post-Flood denudation rate (v_a) for the Chaun region was from 4 to 9 times greater than the present-day rate of 1 mm/year (Figure 14). Therefore, the real age of natural spit placers has been estimated to range between:

minimum – 600 years / 9 = 66 years; and

maximum – 8000 years / 4 = 2000 years.

To calculate the initial post-Flood denudation rate for northeastern Russia, we assume that the energy of geological processes (a surrogate for denudation rate) was exponentially decreasing after the Flood (Oard, 1996). This allows use of the following equation:

$$v_a = \frac{\int_0^T v_o \exp(-\beta T) dt}{T} \quad (20)$$

where:

v_a = average post-Flood denudation rate;

v_o = initial post-Flood denudation rate;

β = the constant coefficient for the region;

T = age of the Flood (based on literal addition of Genesis chronologies).

We then can solve equation (20) and obtain:

$$v_o = \frac{v_a \beta T}{1 - \exp(-\beta T)} \quad (21)$$

We can define v_o using our assumption of exponential decrease of geological energy:

$$v_o = v_{(T)} \exp(\beta T) \quad (22)$$

where $v_{(T)}$ = present-day rate of denudation (1 mm/year or 1m/1000 years).

From (21) and (22) we obtain:

$$\frac{\beta}{\exp(\beta T) - 1} = \frac{v_{(T)}}{v_a T} \quad (23)$$

Then we solve equation (23) for β numerically, substitute β into equation (22) and solve for v_o for the two given ages of the Flood (Table I):

Table I. Determination of Post-Flood Initial Denudation Rate for the Chaun Region.

T (thousand years)	$v_{(T)}$ (m/1000 years)	v_a (m/1000 years)	$v_o = v_{(T)} \exp(\beta T)$ β (m/1000 years)
4.6	1	9	0.755
10	1	4	0.2335

Our model can thus approximate the post-Flood initial denudation rate for northeastern Russia. We calculated a rate based on present-day denudation $v(T)$, which was estimated for a large region. The difference between the calculated initial rates (up to 32 m/1000 years) and a flat-rate extrapolation (1 m/1000 years), illustrates the difference between uniformitarian and catastrophist assumptions. Of course, local rates may have varied significantly, and our calculation is only a regional approximation. Nevertheless, we believe that the method is valid for estimating the initial rate of post-Flood denudation.

Conclusions

We have presented a mathematical model for the generation of "far transfer" placers that successfully predicts the distribution of heavy minerals in alluvial placer deposits in northeastern Russia. The model implies that spit placer formation can occur in a relatively brief time.

The model shows that the process of natural "far transfer" placer generation is similar to the formation of artificial spit placers downstream from the cassiterite ore processing plants using ore dressing gears. Knowing the time for artificial placer deposit formation allows us to model the time interval for natural placer generation.

"Far transfer" placer deposits in northeastern Russia were modeled as developing in less than 2000 years. This maximum estimate is approximately 500 times less than the age prediction based on the standard geologic timescale. Our model predicts that the true rate of formation of alluvial "far transfer" placer deposits formation is dramatically greater than that assumed by uniformitarian geologists.

Our model also allows a calculation of the initial post-Flood denudation rate for the study area. The average initial rate for the Chaun region is predicted to range between 10 and 32 times greater than the present rate, depending on the associated age of the Flood.

We believe that our model not only is an interesting exercise in the application of the Flood model to geological problems, but that it also has enormous practical importance for predicting the commercial potential and location of natural and artificial spit placer deposits. We intend to continue our investigations of alluvial stream and slope deposits age.

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Book Review

Origins: Linking Science and Scripture by Ariel A. Roth
 Review and Herald Publishing Association. 1998. 384 pages, \$30
 Available from Spring Arbor, 10885 Textile Road, Belleville MI 48111
 Reviewed by Wayne Frair, Ph.D.

Here is a clearly-written comprehensive non-dogmatic work of value for a person in early or advanced stages of learning about important creation/evolution issues. Author Dr. Roth, who is a professional biologist, has had years of experience in science as a professor with graduate students, and as editor of the respected scholarly journal, *Origins*. Roth's book deserves a place in suitable classrooms and on shelves of public and private libraries.

Matters covered include pertinent early and recent history, and "putting it all together" (3 chapters); life—biochemistry through anthropology (5 chapters); geology—fossils, catastrophies (including the Flood), and time (7 chapters); an evaluation of science, truth, and the Bible (4 chapters); some conclusions—condition of science, evaluations of 8 major models relating the Bible and science, and a recapitulation (3 chapters). The 22 chapters are relatively short (average 15 pages including references), and each has a respectable list of references (average of 42 references/chapter). There is a 7-page Glossary and 13-page Index.

This book has been carefully researched, written and proofread. However, I did notice errors with the Latin singular and plural (*lamina*, p. 250; *alga*, p. 314). It is becoming more acceptable with Latin words to anglicize plurals, for example formula to formulas (rather than formulae). *Origins* was published in December 1998, but most references are older than 1996.

It was refreshing to encounter the candor demonstrated by Roth as he wrestled with crucial issues in the ongoing tension between scientific and religious sectors.

Macroevolution came out a loser, but where there are no easy answers he acknowledged this, and there was no rancor toward his opponents. Roth challenges the current geological time scale and stresses his Bible-based view that creation occurred less than 10,000 years ago. He really does not believe that any other position is "creationist", but he deigns to submit that "little in the Bible precludes a very old universe" (p. 233–234). In the extensive geology section he suggests that the Genesis Flood deposits began in the Cambrian and ended in the upper Tertiary. There were, he speculates, rapid plate movements especially during later stages of the Flood, and ice ages were post-Flood. Sedimentary layers probably were deposited rapidly.

Roth realizes that science needs a good revamping. The nature of science: is finding truth and explanations about nature (p. 286). Science often prides itself on being open and objective, but evolution brings into question both attributes. How did science get into the conundrum of defending an idea for which there is little support and for which one finds major scientific problems (p. 333). Science made its greatest error when it rejected God and everything else except mechanistic explanations (p. 334). Science should return more toward the philosophy it had when Western Civilization established sciences's foundations (p. 136).

Roth does not understand that the Bible and science are to be construed in opposition. He has written this book to harmonize them, and he encourages others to do the same.

The Putative Evolution of the Animal Eukaryote Cell Ultrastructure

Jerry Bergman

Abstract

Research in the field of molecular biology and cell ultrastructure has revealed that a vastly greater level of complexity exists in the cell than was envisioned to exist in the entire human body before 1960. Cells are complex machines and, like all machines, their many parts (trillions in the case of cells) must all work in complete harmony yet not interfere with the function of other parts. The cell is not an amorphous bag of water, minerals, grains and food as once thought. Modern research has eloquently revealed it as the most complex machine in the uni-

verse. We now know that the eukaryote cell is vastly more complex than the gross anatomy of the entire human body. This review briefly summarizes the enormous complexity of the eukaryotic cell. Also discussed is the lack of evidence for the evolution of these organelles, revealing a "missing link" much larger and of far greater significance than all others. The gap between organelle containing cells, the eukaryotes, and those cells lacking them, the prokaryotes, is greater than any morphological gap between animal body types.

Introduction

All cells can be divided into two major types, *prokaryotes*, cells without organelles, and *eukaryotes*, cells with them. The organelles and other structures that form the complex machine called the cell are collectively called the cell *ultrastructure*. To study organelles, cell membranes can be broken so as to allow most of their organelles to remain intact, then separated by centrifuging the mixture for several hours in a sucrose solution density gradient. Cell ultrastructure research is so important in the origins of life question that has put the question of macroevolution on trial: "To Darwin ...as to every other scientist of the time, the cell was a black box" (Behe, 1996, p. 9). The cell is so complicated that Trefil asked, could not what the cell does:

...be done more simply? When you look at the complex structure of a cell, Rube Goldberg springs to mind. This leads to the question just posed. Is the complexity of the cell due to the long evolutionary history, or is this really the most efficient structure capable of doing what a cell does? As far as I know, biologists haven't even begun to address this question (1992, p. 104).

Actually research has addressed this question and has found the cell is over-designed and can achieve well be-

yond what evolution would predict. Naturalism must explain the origin of the cell, and so far the extensive century-long search for how cell organelles evolved has produced "an eerie and complete silence." (Behe, 1996, p. 5) A review of the many enormously complex cell structures that Darwinism must explain follows.

The Nucleus

The *nucleus* (Greek: kernel or nut) is the main control center of the cell and also its headquarters. The largest structure in the cell, the nucleus is located appropriately in the approximate physical center of the cell. Some cells are multinucleated: an osteoclast has as many as 15 to 20 nuclei. Many multinucleated cells are formed by the process of syncytium, the fusing of several cells, and other multinucleated cells form by nuclear proliferation. The DNA, the master blueprint that directs the building of the body, is safely stored in this membrane-bound structure. The nuclear membrane itself is a double envelope structure with many pores that extend through both the outer and inner membranes. The pores are not open continuities but are bridged in their centers by a controllable diaphragm that functions as a selective gate (Bozzola and Russell, 1992, p. 43) In between the two membranes is a narrow space called the *perinuclear cisterna* (pl. *cisterna*; singular *cisternae*, a *cistern* is a closed fluid filled sac or vesicle).

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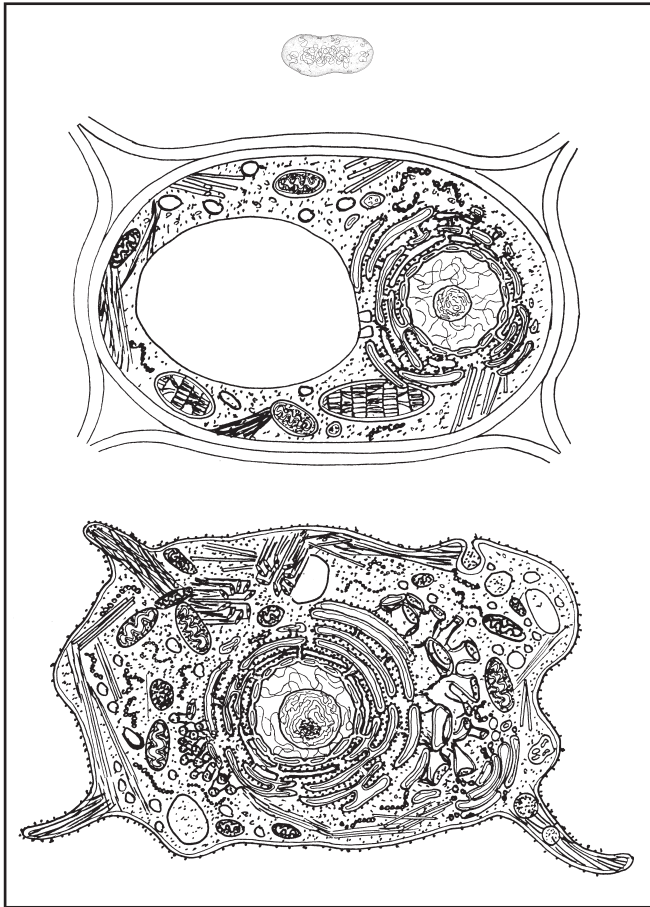


Figure 1. Three types of cells, not drawn to scale. At the top is a generalized prokaryotic cell which shows examples of the major structures, primarily DNA, a cell wall, and various proteins. In the center is a generalized plant eukaryotic cell, and at the bottom is a generalized animal eukaryotic cell. Illustrated in both eukaryotic cells are some of the major structures, which include thousands of organelles. Drawings by Richard Geer.

The nuclear membranes are constructed of phospholipid bilayers in a organization that is similar to the cell membrane. The nuclear pores are about 10 times larger than the cell membrane pores so that large molecules such as mRNA can pass through them. Although much is known about the nucleus, it is still largely a mystery (Gerhart and Kirschner, 1997). The nucleus is filled with *nucleoplasm*, a jellylike substance also called *karyolymph*. The organization of the nucleus is controlled by a completed network of protein strands often called the *nuclear matrix* (Hickman, Roberts, and Larson, 1996, p. 46). The nuclear matrix serves as a “shop supervisor” and organizes the various nuclear components that are necessary for DNA and RNA synthesis.

Humans and most mammals have about two meters of DNA in each cell. The DNA is usually divided up into two classes. The first is *heterochromatin*, which is mostly DNA that is being stored for use later or is not needed for this particular cell. Heterochromatin is usually clustered together into small areas near the cell wall and the nucleolus and appears dark under an electron microscope. The second DNA type is *euchromatin* which is scattered throughout the middle of the nucleus and often appears as a light shade of gray in standard electron microscope photographs. Euchromatin is active DNA that is regularly used for that specific cell, and the DNA a specific cell uses depends on the cell type: nerve cells use different sections of their DNA than muscle cells. The ratio of euchromatin to heterochromatin also varies with the cell’s metabolic activity. Liver cells produce a wide variety of protein types and contain a large amount of euchromatin. Conversely, cells which produce mucus typically have far less euchromatin than most other cell types (Allen, 1991).

The nucleus also contains many complex structures called enzymes such as *polymerase*, the primary enzyme involved in DNA synthesis. Polymerase is also coded by DNA, raising the question which came first, the polymerase which is necessary to transcribe DNA, or the DNA which contains the code to make the polymerase. Obviously they both must exist in order for the system to work and are another example of a complex irreducible unit. The *zygote*, which is a fertilized cell that develops into a new organism, uses polymerase originally manufactured by the mother’s DNA as part of its inheritance from the mother. Both polymerase and DNA plus hundreds of other complex structures are all simultaneously necessary for DNA replication to occur. To assemble DNA as well as RNA, sufficient amounts of *nucleotides*, structures consisting of a base, sugar and phosphate, must first be assembled and transported into the nucleus.

To achieve their purpose in the cell’s cytoplasm, both ribosomal and messenger RNA must travel out of the nucleus through the nuclear membrane *pores*. These pores are discreet units that provide structural support and fit like a hollow rivet on the nuclear double membrane. The nucleus’ outer membrane also is continuous with the “ER” or *endoplasmic reticulum* (from *endo* within; *plasm* to form and *rete* netlike). The ER consists of a convoluted network of membranes that surround minute tubules called *cisternae*. The cisternae are connected to various organelles and also to the nuclear and cell membranes. They contain many kinds of enzymes that control both catabolic and anabolic activities.

Both the ER and the outer nuclear membrane serve as

attachment sites for *ribosomes*, the structures that direct protein synthesis. Other ribosomes are free floating in the cytoplasm, either singly or in sets called *polysomes*. Polysomes can simultaneously make many copies of a protein from one mRNA strand. The free polysomes usually produce protein for use in the cell, and the ribosomes on the ER usually make protein for export. The typical protein is about 300 amino acids long, but some are many times longer than this. Most dehydrated cells consist of about 20% DNA, 20% RNA and 60% protein.

The Nucleolus

Inside the nucleus is usually one non-membranous but structurally discrete region called the *nucleolus* (plural: *nucleoli*) that synthesizes *ribosomal RNA* (rRNA) and packages it with ribosomal proteins to form ribosomes (Alberts et al., 1989). The *nucleolus* organizer coordinates the rapid transcription of rRNA by RNA polymerase I. Many other molecules guide the ribosome assembly process. When completed, both ribosome subunits are moved out into the cytoplasm where they are assembled to make functional ribosomes. Ribosomes are constructed from one large and one small unit. The larger structure consists of 40 different proteins, one four to five thousand nucleotide long rRNA molecule and two smaller RNA's, each about 150 nucleotides long. The smaller subunit consists of another rRNA strand and about 30 different proteins.

The nucleolus also contains concentrated tRNA and processes *messenger RNA* (mRNA), both which are used in making protein for use in the cell and for export. The mRNA processing involves removing the introns and splicing the exons together by a complex process the author has described elsewhere (Bergman, 1999). The organization of the nucleolus differs widely in different cell types, but three major structures are normally found. These include the *nucleolonema* or *pars fibrosa* which is a dense spongy network that surrounds the *fibrillar centers*, a structure that appears in electron microphotographs as a finely granular, rounded mass. The nucleolonema contains RNA in the process of being transcribed, and the fibrillar center area contains DNA that is not being actively transcribed. The last major component is the *pars granulosa* which contain the workshops for the final manufacturing steps of the ribosomal precursor structures. This area in an electron microscope photograph appears as a fine granular material (Bozzola and Russell, 1992, p. 435). This area is small in size in inactive or dormant cells, and much larger in cells making large amounts of proteins. The many functions of these three primary areas are now the subject of much research.

The Storage of DNA

The DNA is wrapped around histone proteins forming a *nucleosome*, each which contains four histone proteins. These are in turn packed together into *chromatin* which are packaged into structures called *chromosomes* in preparation for cell division. Each side of the chromosome pair is called a *chromatid*, and they are connected together by a *centromere* which is located close to the middle area of each chromosome. The centromere produces four arms; each long arm is called the *q arm*, and each short arm the *p arm*.

The packing is so precise that a particular gene (a segment of DNA flanked by start and stop codons) is normally in the same region of a particular chromosome. Further, the packing is such that some areas are more tightly packed, producing color *bands* which help a researcher determine *where* on the chromosome a specific gene is located. The nucleic acid assembly components (such as the phosphorous compounds) are brought inside of the nucleus through the nuclear membrane to enable DNA and RNA synthesis to occur. DNA is packaged into chromosomes only during cell division to help ensure that each new cell has the proper number of chromosomes so it has all of the necessary genes. Normally DNA is stored in chromatin.

The key to understanding DNA is to focus on the fact that it is an information storing molecule. The chemical properties of its often billions of subatomic parts only hold the information units together, as the information which it contains can be stored by many other systems. Some of these information storage systems humans use include ink on paper in the form of writing, or the binary language used by a computer memory. In other words, the meaning of DNA transcends the chemical properties of the medium. Although the DNA structure may not be the only possible way that genetic information can be stored and utilized by biological organisms, it is the only system that humans are aware exists.

The Cytoplasm

Outside of the nucleus in an area called the *cytoplasm* are located four main cell components which are as follows:

1. The *cytoplasmic matrix* called the *cytosol* consists largely of water (75-90%) and soluble proteins, carbohydrates, lipids and inorganic substances that allow the cytoplasm to change from a *sol* (liquid) to a *gel* consistency and back again as necessary for cell function.
2. The *membrane system* includes the endoplasmic reticulum, the Golgi complex, the mitochondria, and the lysosomes.
3. The *transport system* includes vacuoles, vaults and transport proteins.

4. The *fibrillar system* is a complex network of multi-thousands of cords and fibers which hold the cell together, help it move and serve other functions. The above four systems will be reviewed in more depth below.

The Membrane System

The *endoplasmic reticulum* (ER) is a complex network (reticulum means net) of membranes which runs roughly parallel to each other to form a set of channels called *cisternae* (meaning reservoir or cavity). The enormous extent of the convoluted channels is such that one square milliliter of ER alone contains a whopping 11 square meters of surface area. A major function of ER is a site for protein synthesis but it also serves to store newly synthesized molecules and as a site to modify protein such as to add sugars to form glycoproteins. On the surface of some ER called *rough* ER are located *ribosomes*, either singly or in groups. The ribosome groups are often arranged in patterns that resemble whirls. The membrane bound ribosomes produce protein that is usually *exported* from the cell and is secreted as cell products such as hormones (important examples include insulin somatostatin, and serotonin). The *free ribosomes* are often grouped together in units called *polysomes*, and these produce protein for use *within* the cell.

The endoplasmic reticulum lacking ribosomes is appropriately called *smooth ER*. This area is the site of the synthesis of certain lipid compounds such as steroid hormones and phospholipids, and also serves to transport and store certain ions. The smooth ER also stores compounds and minerals including fat and glycogen. In muscle cells the sarcoplasmic reticulum releases calcium to trigger muscle contraction. They can even contain enzymes that inactivate or detoxify carcinogens, pesticides, alcohol and other drugs.

The Golgi Complex

The Golgi complex (named after the Italian histologist, Camillo Golgi) is a saucer shaped stack consisting of flat membrane sacks called *sacculles*. They are generally located near the nucleus and usually consist of less than 10 stacks of sacculles. Two or more sacculles are called *diety-somes*. Inside the sacculles are chemical factories in the spaces also called the *cisternae*. One function of the Golgi complex is to modify protein produced by ribosomes by adding sugars or carbohydrates (and sometimes other materials) to the proteins, a process called *glycosylation*. An example is sugar molecules must be added in the manufacture of gamma globulin. To do this after proteins are manufactured, they are transported to the Golgi

complex and fuse with it on the *cis* or entry cistern.

The Golgi complex also either produces or assists in the production of everything from the *neuropolysaccharides* that the nervous system uses, to the *acromosome* structures used by sperm. The convex surface where the processing begins is called the *forming face*, and the inner concaved surface where the processing ends is called the *maturing face*. The completed products leave at the *trans* or the exit cistern and are carried out in *trans cistern* packages.

Another of its many functions is to sort, store, package and deliver secretory products to the plasma membrane for excretion. To do this it must build individual protective sacks around the chemicals manufactured for export outside the cell. Called *secretory products*, a well known example is insulin and other hormones. Golgi complexes are extensively developed in cells that function to secrete products. These containers are then pinched off of the Golgi complex in areas called *Golgi vesicles*, eventually forming separate structures that surround the secretory products called *vacuoles*.

This package protects the new proteins or other chemicals as they travel from the cytoplasm to the outer cell membrane. The vacuole then fuses with the external membrane and expels its products outside of the cell in a reverse phagocytosis process called *exocytosis*. The secreted hormones then influence other cells, often by causing them to produce proteins. The secretory vesicle membrane then remains as a permanent addition to the cell membrane and also plays an important role in adding surface area to the cell membrane. The Golgi by adding new cell wall material can even gradually transform the cell membrane from one type to another.

Lysosomes

Lysosomes are single membranous spheres that are part of the cell's internal digestive system. We now know they play a critical role in life and an important part in disease (Allison, 1967). These vacuoles contain over 40 kinds of powerful hydrolytic enzymes that function to break down certain foreign molecules including worn, damaged or unneeded cellular materials. *Hydrolytic* (Hydrolytic means *splitting with water*) *enzymes* use water to cleave chemical bonds. The precursor lysosomal enzymes are first synthesized by the ribosomes and processed in the Golgi apparatus to convert them into the active form. The lysosome's membrane is a safe, secure storage system, impermeable to the outward movement of the stored enzymes and resistant to their digestive action. They also have a low pH which denatures globular proteins in order to open them up to the efficient action of proteolytic enzymes that break the latter's peptide

bonds. Their low pH is achieved by active transport pumps in their membrane which pump hydrogen ions inside, lowering the pH to 5, which is about 100 times more acidic than the cytosolic pH of 7 (Tortora and Grabowski, 1997, p. 73).

Material incorporated into the cell by a process called *phagocytosis*, literally *cell eating*, produces a vacuole called a *phagosome*. This method uses the cell membrane to enclose the material to be brought into the cell so that it is completely encapsulated. When the phagosome reaches the cell's interior, a lysosome fuses with it and hydrolytic enzymes flow from the lysosome into the phagosome, digesting its contents.

The cell may also digest its own waste products and recycle the cells organelles by a similar means. The vacuole surrounds the waste material, a lysosome fuses with it, and digestion occurs. This important process is called *autophagy*, and is in turn called *autolysis* if it destroys the whole cell. The catabolized components can be returned to the cytosol for reuse and waste or undigested materials can also be expelled from the cell by *exocytosis*. During this process the phagosome moves back to the outer cell membrane where it fuses with it and expels its contents by a process similar to reverse phagocytosis. Alternatively, undigested material may simply be stored in the cell in a vacuole package called a *residue body*. The lysosome can even destroy the entire cell if the cell is irreparably damaged, cancerous, aged, defective or in need of removal. Lysosomes are called suicide packets for this reason and cell suicide is termed *apoptosis*. An example of "removing cells" by apoptosis is the atrophy of the uterus that occurs after childbirth and the regression of mammary tissue after the mother weans an infant.

Peroxisomes

Another lysosome type which is similar but smaller than lysosomes is the *peroxisome*. This cell body consists of organelles which have spherical membranous vesicles that contain enzymes. These enzymes detoxify harmful substances such as certain fatty acids, phenol, formic acid, formaldehyde and alcohol by oxidizing them, forming hydrogen peroxide (H_2O_2) or other compounds. H_2O_2 is also highly toxic, thus is broken down to water and oxygen by the enzyme *catalase* (deDuve, 1996, p.56). The peroxisome organelle was named only in 1965 by deDuve a decade after the lysosome was discovered (deDuve, 1997). Since then an explosion of knowledge has produced the modern variegated picture of these critically important organelles. They have numerous roles in the cell; many are only now being explored. For example, we now know that peroxisomes are a complex factory involving urate oxidase, D-amino acid oxidase and other enzymes.

Vaults

Vaults are a basic cell component discovered only in the mid 1980's and have only recently received prominence because of their potential role in explaining why chemotherapy often fails (Travis, 1997). They exist by the thousands in many animal cells including humans. Although their role is still largely a mystery, a number of potential uses have been proposed. They were discovered during research using a stain that latches primarily onto fatty acid molecules. Consequently, because they consist primarily of protein, they did not absorb the stain and appeared as white islands in a sea of stained areas. Some negative staining resulted because small amounts of the stain settled into furrows on top of the vaults, revealing certain fine details of their exterior. Specifically revealed were distinct arches that reminded the researchers of Medieval cathedral ceilings—from whence came the name *vaults*.

Structurally vaults consist of 96 copies of a protein called the *major vault protein* (MVP) and 16 short RNA strands integrated inside of the barrel like vault structure. The flaps evidently open up, appearing like unfolded flowers to reveal the inside of the barrel. Each end of the vault consists of eight petal-like structures attached to a center ring by a small hook. These structures indicate their function, and research is now focusing on a carrier role in which the opening and closing of the petals allows the vaults to pick up and drop off their cargo. Evidence now reveals that they shuffle cargo from the nuclear membrane. The short strands of vault RNA may serve as attachments for mRNA and likely the cargo consists of mRNA and other molecules. The vaults then close and carry their cargo to the appropriate location in the cell.

Although currently controversial, experimental evidence indicates that the nuclear pore complexes can be blocked by plugs, and it is now believed that these plugs are vaults. The vault matches almost perfectly with the size and shape of the nuclear pore complexes—the structures which form the doorway of the nuclear membrane channels. The recent interest in vaults is due to evidence that vaults may be used by cancer cells to remove DNA damaging drugs from the nucleus, explaining why many cancer cells are resistant to chemotherapy (Travis, 1997, p. 57).

Mitochondria

The mitochondria are critically important cell structures because they contain the machinery and enzymes necessary to convert food into energy carrying molecules called *adenosine triphosphates* (ATP). They can process fats, sugars, and protein and are found in all cells except mature red blood cells. Called the *powerhouse* of the cell, we

now know that the more active cells such as muscle, liver, and kidney tubule cells contain large numbers of mitochondria, and the less active cells such as the mucous secreting cells contain few of them. Specifically, the enzymatic process by which the mitochondria converts food to ATP is called *oxidative phosphorylation*. The end process involves converting adenosine diphosphate to adenosine triphosphate, a higher energy molecule. Other functions of the mitochondria are regulatory in nature including to help control the calcium level in the cytoplasm. They are also involved in specific kinds of lipid synthesis.

The mitochondria is a unique organelle because it contains its own DNA (mtDNA) in the form of plasmids. The mtDNA is usually located in the mitochondria's matrix compartment, although it is sometimes attached to the inner mitochondrial membrane. The human mtDNA has been completely sequenced and has 16,569 base pairs (Darnell, Lodish and Baltimore, 1986, p. 926). The mitochondria DNA is used exclusively for the organelle's own functions, specifically to enable it to have *some* control, although not complete, over its own replication.

Structurally, the mitochondria has an outer and inner membrane. The inner membrane has numerous plate-like folds called *cristae* (a fold or crest) which possess membranous sacks that contain enzymes. The cristae produce many small rooms inside of this often hot-dog or spherical shaped double membraned structure. Cristae can be either exclusively lamellar or exclusively tubular, and some mitochondria contain both types. The inner membranes contain a large set of enzymes which cause the conversion of food into ATP by a series of reactions called the *Krebs* or *citric acid cycle* which produces oxidative phosphorylation. The inner area called the *matrix* is filled with gel containing scores of different kinds of enzymes. The inner and outer membranes differ in enzymatic activity and also lipid composition. Some of the enzymes such as *ATPase* are permanently fixed in the mitochondrial membrane.

Centrioles

Centrioles are long, thin, complex, straw-shaped structures that are similar to basal bodies except they normally occur in the *centrosphere*, a region of the cytoplasm located near the nucleolus which contains the Golgi complex. They are the only other cell structure besides the nucleus and mitochondria that contain their own DNA, enabling them to control their own replication. In non-dividing cells, centrioles occur in pairs called *diplosomes* which usually lie at right angles to each other. The centriole pair replicates at the beginning of each cell division, producing two new pairs. Centrioles replicate by produc-

ing daughter cells which form long straw shaped structures *perpendicular* to each centriole that they develop from.

The daughter centrioles then increase in length until they reach maturity, and the two diplosomes then separate. One diplosome moves to each pole of the cell and during spindle formation they function as a microtubule organizing center. A *spindle fiber* is a bundle of microtubules which either runs from pole to pole or from a chromosome to a pole. The poles are themselves anchored in the surrounding cytoplasm by radiating microtubules. Centrioles also have a role in the development of cilia or flagellum.

The Fibular System

The cell must have both an internal framework or skeleton system and a means of moving and adjusting to the outside environment. This is achieved by a large complex *fibular system*. The fibrillar system contains three structural families: microtubules, intermediate filaments and microfilaments, each of which are a different size and have somewhat different functions. *Microtubules* are 25 nanometers or less in diameter, *intermediate filaments* are about 10 nanometers, and the *microfilaments* are from five to seven nanometers in diameter.

1. *Microtubules*, elongated, linear hollow phagosome structures, are the largest of the cell's fibers. They are constructed out of a protein appropriately called *tubulin* (Behe, 1996, p. 59). Microtubules employed to construct the cell's skeletal system and are also used to construct the force-generating elements of both *cilia* and *flagella* which allow cells to move. They also function as a conveyor belt to move various substances and organelles around in the cytosol and to assist in the process of phagocytosis. The microtubular skeleton unit termed the *axoneme* contains nine outer doublet microtubules and one central pair. These hollow structures are in turn constructed out of other small hollow tubes made out of *tubulin* protein.

Each microtubule consists of 10 long, thin protofilaments assembled with 13 others to form a structure whose cross section resembles the number eight (thus three protofilaments exist in common with the two tubes). On the side are rows of *dynein arms* which provide a mechanism for the peripheral doublets to slide over each other, causing the flagella to move. Cilia and flagella arise from a complex structure called a *basal body* which consists of nine triplet microtubules located just below the cell membrane. The major center for assembly of microtubules is the organizing region called the *centrosome*, an area near the nucleus that contains the centrioles and other structures.

2. *Intermediate filaments.* We now know that the intermediate filament family plus the microfilaments (actin) and the microtubules (myosin) make up the basic cell cytoskeleton (Ishikawa, Bischoff, and Holtzer, 1996, p. 40-41). The discovery and elucidation of the class of filaments *intermediate* in diameter between actin and myosin was primarily the work of Howard Holtzer (Ishikawa, et al., 1996, p.40) Myosin are the *thickest* filaments, actin the *thinnest*, thus the term intermediate filaments is appropriate to describe them.

This family consists of physically strong and chemically stable fibers that likely serve the role of "high tensile cables" within the cell to help hold organelles in place and give shape to the cell. After the discovery of intermediate filaments in 1968, little attention was given to them until the late 1970s. So far six different types have been distinguished and named according to the cell type in which they occur. Differentiated skin and epithelial cells have many *keratin* filaments called *tonofilaments*, muscle cells have *desmin* filaments, nerve cells contain *neurofilaments* and *nuclear lamins*. The next type *glial filaments* are found in glial cells which underline the nuclear envelope, and *mesenchymal* plus other cell types contain *vimentin* filaments.

3. *Microfilaments*, the thinnest of the three basic types, are the main components of muscle cells and provide their contractile system. They are composed of polymerized *actin* thus are often called actin filaments. They are used in all cell types and are involved in changing the cell's shape and generating force for various functions such as movement. A major function of microfilaments is to move materials in and out of the cell by pinocytosis, exocytosis, and phagocytosis. Actin may appear in highly organized large geometric bundles or scattered throughout the cell. They associate with proteins called *actin-binding proteins* that link them in several ways to form a wide variety of shapes. Actin even forms the contractile ring that produces two daughter cells during telophase.

The Cell Membrane

A critical cell structure is its complex *membrane* system which includes both internal and external membranes. They are constructed primarily out of phospholipids and protein molecules. The cell membrane in plants is much thinner than animals but plant cells contain a strong 7.5-nanometer-thick cellulose cell wall. For muscles, the cell membrane is generally lost as development occurs, forming multinucleated structures called *syncytia*.

The membrane consists of two layers. A major part are the phospholipids which are arranged so that their hydrophilic polar phosphate heads face *outward* and their hydrophobic non-polar fatty acid tails face *inward* toward each other. The membranes are rich in carbohydrates called glycoproteins, some which extend completely through the membrane, others which protrude out of only one or the other side. Since the membrane contains many proteins and is highly fluid, it is described by the term *fluid mosaic model*. The cell membrane also serves as structural support and contains over 200 types of receptors for hormones and other regulatory chemicals which communicate information to the cell nucleus or other cell organelles. The membrane also contains hundreds of cell markers to enable it to enter into immune reactions.

In the majority of tissues, the membrane serves as an effective barrier, preventing entry of some substances and allowing others to move inside the cell. Consequently, the term *semipermeable membrane* accurately describes its role. Permeability is a function of a compound's solubility in lipids, its ionic charge, its size and the presence of specialized carrier molecules. Many ions are small enough that they can pass directly through the membrane, a process labeled *microtransfer*. Larger particles move in and out via phagocytosis or are secreted by granules, a process called *macrotransfer*.

Extending from the outside surface of a bilayer cell membrane are small projections called *microvilli* and on the outer surfaces is often found a layer called the cell coat or *glycocalyx*. This protein-carbohydrate mixture which may extend some distance from the cell surface serves many functions including to help glue cells together. The glycocalyx polysaccharides are also important in cell to cell recognition (Bozzola and Russell, 1992 p. 410). The glycocalyx is negatively charged, thus it also helps to regulate the kinds of charged molecules that can approach the cell surface.

Another means of connecting cells are *tight junctions*, a structural arrangement that prevents fluid leakage and is used in organs such as the bladder. Another major cell junction type is the *desmosomes* which are constructed like spot welds and join cells together by complex *desmin filaments*. The last type is called a *gap junction* which contains what could best be described as rivets that firmly connect the two cells together. In the center of each rivet is a passageway which allows chemical communication between the two cells. Many of the junctions have a special function and some tissues, such as the columnar epithelium which lines the small intestine, utilize all three of these membrane joining structures (Lammerts, 1979, p. 216-218).

Implications for Creationism

In this review, I have only briefly outlined some of the major eukaryote cell structures and some of the many roles they serve in the cell. This review is similar to a tour of a factory involving reading only the titles on each department door and glancing inside. I have said almost nothing about the multi-thousands of different operations that occur continuously inside of each organelle. An estimated 100,000 parts are found in every eukaryotic cell and some of the parts are more complicated than others, but all are exceedingly complex.

The question a Darwinist must answer is, can the “astounding complexity of subcellular organic structures” evolve? (Behe, 1996, p. 15) Darwin based his theory on gross anatomical similarities but the theory must now deal with ultrastructure and biochemistry. Haeckel, a leading popularizer of Darwin, believed the cell was not much more complicated than a “simple little lump of albuminous combination of carbon” (Mayr, 1991, Chap. 9). When Pukinje coined the term *protoplasm* to describe the cell contents, it was believed to be a thick soup gel-like mixture with special but elusive life properties. Now we realize the “cell components” are so highly organized structurally and functionally that describing its contents as ‘protoplasm’ is like describing the contents of an automobile engine as ‘autoplasm’ (Hickman, et al. 1997, p. 14).

Prokaryotic cells also contain many complex structures. For instance the protein machine which transcribes DNA into RNA in bacteria consists of an active pentamer shaped enzyme that contains four separate polypeptide chains. The total molecular weight is a whopping half million, equal to a structure made out of a half million hydrogen atoms. This is only *one* of many proteins which must be perfectly constructed in order for a cell to function properly (Zubay, Parson and Vance, 1995, p. 706). Further, the cell cannot live until all of these parts exist and are functional. For this reason no cell has been found that does not have all of these basic parts. The bacteria *E. coli* has over 4,000 genes and if the “DNA molecules in the single chromosome in *E. coli* were blown up to be the thickness of ordinary clothesline, it would be five moles long.” (Trefil, 1992, p. 105). These instructions coded into the DNA must also be organized so that the genes can be located when needed, no easy task.

Evidence for Organelle Evolution

Orthodox evolution teaches that

...fossils dated at between 3,000 million and 1,000 million years old are mostly 1 or 2 microns in diame-

ter. The size of these so-called “body fossils” is consistent with their being prokaryotic (bacteria-like) forms of life possessing a simple strand of nucleic acid, and with the chemical machinery of the cell either distributed within the cell fluid or attached to the cell membrane. But about 1,000 million years ago larger microfossils begin to appear, 5 to 15 microns in diameter. These fossils, found in chert rocks, look suspiciously like the remains of eukaryotes—that is, the cells seem to have some of their working parts collected in a central nucleus, which can be seen in the fossil as a darker area (Norman, 1994, p. 28-29).

The evidence for this just-so story, when examined carefully, does not support the view that eukaryotes evolved from prokaryotes. Actually the theory of evolution has completely failed to provide an explanation for the origin of the organelles existing in eukaryotic cells:

...the area of greatest ignorance in evolution remains the origin of cells. The key reactions of molecular cell biology—those conferring the coding capacity of the nucleic acids and those involved in the translation of the code into protein and the replication of nucleic acids—must have arisen before the first true cell could exist (Darnell et al. 1986, p. 1126).

For evolution to have occurred, untold millions of transitional forms must have existed between prokaryotes and eukaryotes (Herrmann and Hummell, 1994). This is true for both of the naturalistic theories of organelle origins, endosymbiosis and straight gene mutation plus natural selection evolution. Yet no evidence exists for

...a linear evolutionary connection between a primordial prokaryotic cell (one designed like today’s prokaryotes) and eukaryotic cells, either those existing as unicellular organisms or those comprising multicellular organisms. As we shall see, the sequence data presently available argues against any such direct connection (Darnell et al., 1986, p. 1127).

As a result of this lack of empirical evidence Starr (1996, p. 272) concludes “speculations abound” about the origin of organelles. Although many putative ancient fossils are in very poor condition, multi-thousands of well preserved animals are now known to exist, a few which it is claimed are older than 320 million years (Grimaldi, 1996). Analysis of putative ancient animal cells, such as those embedded in amber so far have not provided *even a hint* of the millions of required transitional forms (Grimaldi, 1996; Poinar and Poinar 1994). One of the oldest known eukaryotes, a poorly preserved protistan claimed to be 1.4 billion years old, shows evidence of clear, well developed, organelles (Starr, 1996, p. 272). A total void of cell structures between eukaryotes and prokaryotes exists and organisms either lack organelles or possess fully functional organelles (Deyer and Obar,

1994). Not even one plausible example of an intermediate organelle has been found to bridge the chasm found between prokaryotes and eukaryotes.

Amber preserved DNA has also been studied and often examples are found to be "very similar to living relatives" (Grimaldi, 1996, p. 128). Termite and bee DNA claimed to be 25 million years old were also remarkably similar to its modern relatives. Evolutionists theorize that eukaryotic cells arose around two billion years ago, thus they claim amber preserved examples do not reach back far enough to shed light on this early history. The amber evidence *does* though show lack of change for the period it documents. The fact that no evidence exists, fossil or otherwise, for the evolution of eukaryotes is a real dilemma for evolution. The popular science writer Trefil (1992, p. 104) called it an "enduring mystery" because:

The differences between prokaryotic and eukaryotic cells are striking, to say the least. But if the latter evolved from the former, why are there no intermediate stages between the two? Why, for example, are there no cells with loose DNA and organelles? If the evolutionary line really went from prokaryotes to eukaryotes, and we have many living samples of each, why did none of the intermediate stages survive?

Even the simplest eukaryote such as yeast cells and the most primitive eukaryotes contain all of the organelles found in "higher" eukaryotes such as humans. Furthermore, usually only minor differences exist in organelles between the simplest and the most advanced eukaryote, humans. Woods concludes that the:

...results of the yeast genome project are surprising, partly because of the similarities between the genetic design of yeast and human cells. Yeast and people are separated by at least one billion years of evolution. Yet both share many of the same genes and function in many similar ways (1996, p. 8).

Research on the ultrastructure of ancient life has found little or no difference between the ultrastructure existing in the so-called ancient life and that existing in modern life, revealing no evidence for evolution. The conclusion of this research is that:

...the ultrastructural remains of fossilized insect tissues in Baltic amber corresponded to what one would expect to find in a routine examination of present-day insects. The character of the tissues in the fossil fly resembled present-day tissues that had been dehydrated with ethylene glycol." (Poinar and Hess, 1982, p. 1242)

Some of the ultrastructures and other features in organisms that have been unearthed are so close to modern forms that widespread concerns exist about contamination. Even those who accept that prokaryotes evolved into eukaryotes admit that no evidence exists for their be-

lief. All organelles, whether in a yeast or in humans, ancient or modern, are remarkably similar and no gradual gradation of apparent complexity can be produced as must have occurred if life evolved. In the words of deDuve "no intermediates of this momentous transition have survived or left fossils to provide direct clues" of the evolution of eukaryotes (1996, p. 50). Simpler animals may have streamlined organelles, but a huge unbridged and unbridgeable gap exists between prokaryotes and eukaryotes. These gaps are not only real, but they *must* exist because all organelles such as mitochondria must have specific structures and a minimum complexity level in order to function (Behe, 1996).

In order for a machine to work, even a simple machine, its complexity can only be reduced so far—below this level the machine will not function. An example Behe explains in detail is a standard mouse trap which has five basic parts, a platform, a holding bar, a hammer, a catch and a spring. It will not function until *every* one of these parts is functional and positioned in its proper place. All the parts must be designed properly to articulate with each other. Likewise organelles will not work unless every part exists and is properly in place. Since organelles are complete complex structures consisting of many thousands of parts, this principle also true of organelles. Without fully functional efficient mitochondria, Golgi complexes, the cells skeletal systems and all other organelles, eukaryote animals cannot survive. Furthermore, the time required for the evolution of organelles is believed to be enormous, and would have left many fossils (Mayr, 1991). Ian Crawford notes:

The fact that it took life on Earth nearly 3 billion years to go from the single-celled to the multi-celled stage implies that this step is very hard. Planets with primitive life may be common but not ones with advanced civilizations. (as quoted in Chown, 1996, p. 6)

Few researchers have even tried to speculate on what these millions of putative "transitional cells" may have been like. The physical evidence for the multi-millions of transitional forms necessary to create a reasonable scenario which could bridge the free living single celled organisms and the many kinds of communal cells found in multicellular organisms is at this point also totally lacking. All too often life forms that are touted as "transitional forms" are just another species, a problem Grimaldi noted with a bacteria find but which also exists with most other life forms:

Widespread skepticism exists in the scientific community, though, as to whether this bacterium is indeed ancient. One problem with trying to determine if the bacteria apparently revived from amber are authentic is that the living flora of bacteria is so poorly known that one may never be sure if a posi-

tive result is simply due to some unknown modern species contaminating the culture. In a teaspoon of forest soil thrive thousands of species of bacteria, most new to science. What assurance is there, given the most sterile and careful conditions of isolation, that a weird bacterium is authentically ancient? Also, all of the DNA extracted thus far from organisms trapped in amber is extremely fragmented. Given this, how is it possible that an entire genome (the DNA chain in an organism) can remain entirely unbroken? A bacterium with a fragmented genome would never be viable (1996, p. 132).

Endosymbiosis

The two current plausible naturalistic models for organelle formation are “progressive differentiation of descendants via mutations of many kinds and their natural selection” and *endosymbiosis* (Margulis, 1971a, p. 230). Endosymbiosis is the conclusion that mitochondria and other organelles were once free living bacteria which successfully invaded other bacteria and then evolved to specialize in, for example, producing ATP as an energy source for its host.

The common endosymbiosis scenario is that animals which were once free-living have “joined together” in cooperative communities which we now call cells that later became part of multicellular organisms. Within these organisms, groups of cells have taken on specialized roles—some becoming muscle, others brain, bone, skin and so on (Hoagland and Dodson, 1996, p.72). This theory was developed in greatest detail by Lynn Margulis, and this paradigm has moved from an obscure, poorly accepted idea to the most widely acknowledged theory of organelle development today partly through her work and influence (Margulis, 1971b).

The endosymbiosis idea is popular not because of the empirical evidence, but for the reason that no other hypothesis is even remotely plausible because of the complete absence of fossil and other evidence. Thus Battley describes the endosymbiosis theory as “tentative at best” (1996, p. 276). A major problem with endosymbiosis is that it is, has been, and still is, untestable (Margulis, 1971a, p. 230). More research and knowledge, has motivated one researcher at the forefront of this field to conclude that:

Data published over the past two or three years, much of them from genome-sequencing projects, have hinted that it is time for a new theory. In particular, it is turning out that eukaryotic nuclear genomes carry many genes of bacterial (sometimes a-proteobacteria) origin which have nothing to do with mitochondrial functions. Moreover, mito-

chondrion-free eukaryotes that we had come to think of as direct descendants of ancient proto-eukaryotes carry mitochondrial genes in their nuclear genomes (Doolittle, 1998, p. 15).

The endosymbiosis theory has come under attack from many other quarters, and no doubt this attack will continue.

Summary

In this short review we have reviewed some of the major cell structures and have briefly discussed what roles they perform in the cell. The more scientists learn about the cell, the more they realize it is a designed, complex marvel which reveals the intelligence of its maker. The evidence for organelle evolution is close to nonexistent and either cells have organelles (all which are eukaryotes) or have none as in the case of prokaryotes (Anderson, 1980). For evolution to have occurred multi-millions of transitional forms must have existed—and no evidence of these has been found in the fossil record in spite of extensive analyzation of thousands of putative ancient cells and years of study of so called primitive animals such as yeast. What is found is either a total absence of organelles or fully functional organelles (Deyer and Obar, 1994).

The gaps between non-life and life and also between prokaryotes and eukaryotes are the largest gaps in the evolution “from chemicals to humans” theory. And all organelles, whether in a yeast or human, are remarkably similar; no gradation of apparent complexity can be produced as has been attempted to explain the evolution of life. Simpler animals such as yeast may have streamlined organelles, but a huge, unbridgeable gap exists between prokaryotes and eukaryotes.

These gaps not only are real, but must occur because a certain minimal level of structural complexity must exist in order for mitochondria and all the other organelles to function. Eukaryotes cannot survive without mitochondria and their other organelles (Zubay et al., 1995). The most plausible scenario that has been developed by evolutionists is endosymbiosis, the idea that the mitochondria, for example, was once a free living archaebacteria which invaded other bacteria and evolved to specialize in producing energy for its host cell. No direct evidence for this theory exists except armchair reasoning, ambiguous evidence such as the fact that mitochondria and centrioles both have DNA which in some ways resembles that in prokaryotes more than eukaryotes. The DNA differences found can be adequately explained by the DNA’s function in mitochondria and centrioles, and many problems remain with the theory (Battley, 1996, p. 275-276).

The common scenario, that cells which were once free living have “joined together in cooperating communities

that we call multicellular organisms, also requires cell evolution. Within these organisms, groups of cells have taken on special roles—becoming muscle, brain, bone, skin, and so on” (Hoagland and Dodson, 1996, p.72). Consequently, millions of transitional forms must exist not only between the non-organelle life system found in prokaryote and the organelle system found in eukaryotes, but also between prokaryotes and all the specialized tissue types such as muscle and nerve cells. Few have even endeavored to speculate on what these transitional forms may have been like, let alone endeavor to present evidence for the multimillions of transitional forms necessary to create any reasonable scenario which could bridge the free living cells and the cells used in multicellular organisms.

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Notes from the Panorama of Science

Niagara Falls: A Uniformitarian Failure

Dr. John R. Meyer, Director of the Van Andel Creation Research Center, recently led a field trip to Niagara Falls (Williams, 1998). The Falls (see Figures 1 and 2) continue to provide a magnificent setting from which to examine the myth of uniformitarianism. Besides being a beautiful and impressive water fall, it has been used to defend steady and long-term rates of erosion within the philosophical framework of uniformitarianism, by its chief evangelist Sir Charles Lyell. Young-earth creationists would explain the Falls as having been recently formed, and still within a “youthful” stage, subject to tremendous rates of headward erosion. Which approach is best supported by the physical data?

Lyell’s Model-Driven Approach

Sir Charles Lyell visited the Falls in October 1841. From this visit he deduced that the Niagara River originally flowed over the escarpment located near the present village of Queenston, Ontario. The southward directed headward erosion of the Falls provided a means of measuring time (or so he thought). Rejecting the local citizenry claims of an erosion rate of three feet per year (and settling on a rate of one foot per year), Lyell thus was able to match *his* perception of distance (approximately seven miles) and time (35,000 years) to his “model” of an ancient earth. An excellent discussion of this entire episode



Figure 1. Niagara Falls—the American falls is to the left and the Canadian falls is seen on the right. Photograph by Tom Wilson.

The Falls History and Setting

This beautiful and impressive waterfall formed due to continental glaciation which occurred during the young-earth Ice Age. Large sheets of ice carved away Flood-deposited strata north of this area, and the headward erosion of the Niagara River resulted in the formation of the Falls. Today, the Niagara River transports water from Lake Erie to Lake Ontario, crossing over the Falls. The Niagara Falls Escarpment is approximately 12 stories high, and carries from 50,000 to 100,000 cubic feet of water over the Falls every second. At maximum flow this represents approximately one half of the water carried by the Niagara River as the rest bypasses the Falls through immense underground tunnels which provide flow for power generation and operation of the Welland Canal.

is presented in Taylor (1991).

Patten (1966) also accurately captured the model-driven aspect of Lyell’s analysis of the erosion at Niagara Falls by stating that Lyell’s theory required oceans of time because he believed that our planet had never experienced a watery global catastrophe like the Flood of Genesis.

A Young-Earth Creationist Approach

Niagara Falls provides the Bible believer with physical evidence of the rapid retreat of the water fall under shorter periods of time than Lyell could have imagined or would have even allowed! The actual data works very well within the short time that has elapsed following the global Flood, the onset of the Ice Age, and the ultimate forma-



Figure 2. Another view of Niagara Falls—the American falls is in the foreground and the small portion of the Canadian falls can be seen on the right. Photograph by Tom Wilson.

tion of the Falls at this specific location. The actual rate of headward erosion does not fit with the immense periods of time that the uniformitarian model requires. Today, the Falls continue to erode in a headward manner (approximated at one foot per year), but not at the same rate as experienced in the past (measured at five feet per year before the hydroelectric diversion tunnels were installed). This setting remains within a youthful state and escarpment erosion will continue to occur at the Falls until they no longer exist.

Uniformitarians must invent “time” in a effort to support their model assumptions. Young-earth Flood geoscientists should continue to check and expose the error of using a non-data-supported model-driven approach. Niagara Falls provides us with a beautiful locale from which to make a case for a young earth.

Acknowledgments

We thank Mr. Ian Taylor for the additional background information that he supplied to us, and to the Creation

Research Society for supporting this field trip immediately following the 1998 International Conference on Creationism.

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Call for Papers

The Second CRS Monograph on Astronomy

Due to the popularity of the first CRS monograph on astronomy, *Design and Origins in Astronomy*, edited by the late George Mulfinger, the CRS has decided to publish a second astronomy monograph. We are interested in original papers, but would consider revisions of papers that have appeared in the *Creation Research Society Quarterly*

in the past 15 years. Submissions on all topics of astronomy are encouraged.

For submissions or additional information, contact Danny R Faulkner, 1402 University Dr., Lancaster, SC 29720. H: 803-286-9781 O: 803-285-7471 e-mail: Faulkner@gwm.sc.edu

Letters to the Editor

Heat Issue in Catastrophic Plate Tectonics

I greatly appreciate Dr. Herrmann's reply (CRSQ 35: 110-111) to my letter concerning the heat generated within the catastrophic plate tectonic model. Would Dr. Herrmann kindly employ his metric with heat transfer and radiation emission equations and provide me a specific solution to the problem discussed? Specifically, I am looking to have the following questions answered.

1) How rapidly (a specific rate) did the heat generated in catastrophic plate tectonics dissipate and where did this occur, in the Mantle, Crust, Floodwater, Atmosphere, or in outer space?

2) What was the maximum temperature attained by the Floodwater covering the earth?

3) What physical processes were involved in this energy transfer and how does this compare with known rates of heat transfer and radiation emission in the real world today?

I eagerly await the solution to these questions as I believe that they hold a key component in explaining the processes involved in Catastrophic Plate Tectonics.

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Robert A. Herrmann's Reply

I assume from these questions that Mr. Froede has not completely read the article mentioned in my letter. I quote one significant portion. "Except as alluded to within the Scriptures, the actual behavior of various natural systems prior to the Flood is unknown... some care is needed in assuming that all natural laws were the same during the antediluvian period as they appear today." Further, as pointed out in the paper under discussion, unless data are continually upgraded, differential equation models are often more suggestive relative to natural system behavior than actual accurate predictors of numerical quantities. For these reason, the model discussed in this article compares but three effects that are known to guide nature system behavior in today's world. The model proposes direct Divine intervention over the Flood period in the form of a metric that has a varying parameter that alters these three effects and only these three effects are considered. As stated in the article, that actual results predicted should only be considered as il-

lustrating tendencies that these rates of change and undoubtedly many others would increase.

Relative to question 1, since there was no one present who actually measured the effects or the parameters, the actual value of the metric parameter di that determined the alterations in the rates of heat transfer and many other parameters are not and probably cannot be known. This paper is not intended to speculate any further relative to these unknowns although others may wish to do so and extend these results. Further, my answer to question 2 is relevant to this question. Question 2 cannot be answered by this model, as presently developed, for many of the same reasons that question 1 has little meaning. But, one additional fact about this model is that it is a substratum model. Hence, depending upon the other parameters desired by this Divine intervention, energy can be absorbed into the substratum.

For question 3, the model makes an exact comparison with laws for the rates of radioactive decay, and heat and energy transfer. As mentioned, this is with respect to those laws we perceive today. But, it uses differentials as measures for such changes. As presently developed, the results stated are directly comparable with the Special Theory "time dilation" concept. The effects can be view as a "time compression" produced by a substratum effect. Within the Special Theory asking for a physical process that has produced an apparent time dilation has little meaning. However, in this model under discussion, the paper does give a physical-like process that relates behavior within the our physical world and a substratum background world. I will not repeat the derivation here. It is in the section "The Derivation, Radioactive Decay and Physical Motion."

I appreciate being allowed to give what are must certainly not very acceptable answers to Mr. Froede's questions. It is unfortunate that, at its present level of development, this model cannot answer such questions directly. But, such models are not designed to give answers to such exacting questions as discussed above without additional speculation which I have purposely not done.

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Design and Construction

In a paper published by the *Bible-Science Newsletter* (Honeyman, 1989) entitled "The essentials of manufacturing," I compared the requirements for the manufacturing of any useful article with the widely propagated rules of evolution.

It is an amazing fact that the basic requirements for manufacturing a highly complex computer or a communications satellite are exactly the same as those for cooking or writing a letter. They are: *information, skill, and work*. Furthermore, as far as the human mind is able to determine, those requirements are absolute.

However, friendly criticism has shown that the foregoing statement is not complete; it should also include *design* and *material*. Taken together, these five factors appear to represent the requirements for both the creation of the universe, and the production of any useful article by human beings.

Is it possible that Creation was similar to what humans are able to do? Hebrews 11:3 states: "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." To put this in modern terms, the material of the universe can be seen, but it was made of something which can not be seen. Nearly two thousand years after this was written, scientists have discovered that atoms are one form of energy, which, of course, cannot be seen.

So it appears that God created energy, probably in the form of atoms, which were at the same time assembled in various structures such as stars and the solar system. If this statement is not entirely correct, the writer begs indulgence, because Creation is difficult to describe in human terms. However, these statements are provided to show that God created the *material* for the universe. People, of course, may only use materials that are already available.

Creationists have used the argument from design for many years, and certainly it is a powerful argument for creation. However, there is the equally important argument that after design is developed, it must be constructed, or manufactured, or put together in some way in order to be useful. The design of an automobile is fantastically complicated but you cannot drive the design to work. Somehow it must be carefully constructed of suitable materials. But when you have the *design* and the *materials*, then the requirement is *information, skill, and work*. Is that the way God created the universe? Scripture at least tells us that "he rested on the seventh day from all his work which he had made."

There are at least two important lessons which may be drawn from these facts. Evolutionists propose that the material of the universe came from a singular event, sup-

posedly in the form of hydrogen and helium. No pre-design is permitted. But they also claim that the factors which generated a complex universe are *uncontrolled chance, natural forces, and vast periods of time*. It appears that in order to convert hydrogen and helium into the many forms of matter in the universe, processes very much like manufacturing would be required. Again, as far as human intelligence can determine, these processes would require information, skill and work. Do these facts indicate that the rules of evolution are only imaginary and totally unable to produce a universe?

The second implication of this information is that teachers may be able to teach the highly scientific factors which must be used to construct a useful article. What we can *know* is scientific, is it not? Surely no judge would claim that manufacturing is "religious." Of course, there may be many judges who would complain if they found that teachers were not teaching students to "believe" in evolution.

There are some very real advantages to be gained if creationists will emphasize the importance of the many processes which convert raw materials into useful finished products. Relatively few people produce designs, but almost every person in the world will use information, skill and work in their daily activities. These basics are even involved in as simple a task as writing a letter. Most people would insist that they use intelligence to accomplish their work. Therefore, we have a powerful proof that intelligence was inherently necessary in the creation of the world, and the logic of our argument may be convincing to some who are looking for the truth.

It is also very important to note that the identical rules apply to the processes in a living cell. Some of the really significant advances in science in recent years have revealed the extremely complex systems necessary to life and reproduction. We find that the DNA contains information but the cell also has the skill necessary to do the work required for its existence. All of these processes have precise controls which allow for very limited deviations from the norm. It is amazing that evolutionists argue that completely loose and unbound forces could generate living cells with highly precise controls.

The knowledge which we now have about the information contained in the DNA has generated a very severe additional problem for evolutionists. The proposition that lifeless chemicals could somehow change into a living cell has never been demonstrated. No matter how difficult it might be to evolve the first living cell, how would that cell go about gathering information for the DNA? Moreover, the ability to use information is called intelligence, is it not? Secular scientists deny any role for intelligence in evolution, but the use of information in a cell is

evidence of intelligence. Computers use information in the same way but only if it is programmed by the builder. Then if evolution cannot provide intelligence, we have powerful evidence that it was provided by a Creator. The skill in a cell is a specialized ability to use information to control both life processes and reproduction. Could this be called intelligent programming?

Probably never before in human history has there been such a concentration of effort to obtain, store, recover and use information. Computers have vastly promoted this effort so that information has become extremely important in many lives. This may be an opportunity for

creationists to emphasize the relation between design, construction and information, and publicize the facts by every possible means.

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The Upheaval Dome Impact Site: Flood Model Implications

In 1995, a consortium of geoscience research institutions sponsored a seismographic study of the Upheaval Dome impact site, Southwest of Moab, Utah in the Canyonlands National Park (Louie, Kanbur, Perez, and Plank, 1995). This study was conducted to resolve a long-standing debate on whether the crater structure was the result of salt dome uplift or extraterrestrial impact. The late Eugene Shoemaker investigated the Upheaval Dome site and discovered shock-deformed rock and shatter cones, all diagnostic of impact origin.

In an attempt to understand the subsurface structure of the impact crater, Louie et al. (1995) generated seismic waves (using a 700 pound hammer drop). The seismic energy was recorded from a string of geophones placed in a radial pattern extending 5 km from the center of the Dome structure. The study confirmed the impact hypothesis and provided significant detail of the geological deformations beneath. On the basis of the geometry and size of the deformation of the local strata, it was determined that a bolide 0.3 to 1.2 km across impacted the site leaving a deformed area 5 to 10 km in diameter of which Upheaval Dome is only a remnant (Louie et al., 1995). The relict crater is about 3 km across from rim to rim with a "rebound peak" in the center.

Upheaval Dome (Figure 1) is now considered the largest impact site on the Colorado Plateau (Louie et al., 1995). Erosion of the crater structure following uplift of the Plateau is presumed to have removed about 1 km of overlying strata leaving the present day structure known as Upheaval Dome. The dome provides some variety in the impact models. For example, Upheaval Dome rests above a more deformable salt layer instead of the hard rock basement models found elsewhere in the world. The deep-seated salt layer (Paradox Formation 1.2 km below the surface) reflects deformation from the impact. Presently, the Upheaval Dome has been dated between 5 and



Figure 1. View, looking north, across Upheaval Dome near visitor parking area. "Rebound Peak" in the foreground with deformation folds visible at base of Wingate Sandstone cliff (right of center).

100 m.y. within the uniformitarian time frame.

Does any of this have relevance to catastrophists? I believe so. A geological map of Utah (Hintze, 1988) shows the relict rim of the crater to be in Jurassic Navajo sandstone with the nearest persistent Cretaceous surface, the Dakota sandstone, to be 25 to 30 miles away to the northeast. Reference to a geologic column chart for the Canyonlands area (Hintze, 1988, p. 183) indicates that for the Upheaval Dome region, about 1200 feet of sediments once rested above the Navajo Formation before subsequent erosion of the area around the Canyonlands took place. Sometime following this period of erosion the Grand Canyon was formed with the drainage of ancient Grand or Canyonlands lake (Austin, 1994; Oard, 1993; Williams, Meyer, and Wolfrom, 1991, 1992a,b).

Louie et al. (1995) indicate 1 km of sediment has been eroded from the dome, (including missing Tertiary sedi-

ments not shown on the chart, Hintze, p. 183), associated with the uplift and erosion of the Colorado Plateau. The relationship of the Colorado Plateau uplift to the formation of Grand Canyon deserves further study.

I propose that Upheaval Dome was formed by extra-terrestrial impact in the latter part of the Flood or during the post-Deluge time, but before the carving of the Canyonlands. It is conceivable that the Upheaval Dome impact might have triggered the breaching of the dam ponding the Canyonlands Lake with the subsequent formation of the Grand Canyon (see Austin, 1994).

[Editor's note: Readers may be interested in some recent articles in the *Quarterly* concerned with catastrophic meteoritic impacts on the Earth. DeYoung, D. B. 1994. Age of Arizona Meteor Crater. *CRSQ* 31:153-158; Froede, Jr., C. R. and D. B. DeYoung. 1996. Impact events within the young-earth Flood model. *CRSQ* 33: 23-34; Froede, Jr., C. R. and E. L. Williams. In press. The Wetumpka Impact Crater, Elmore County, Alabama: An interpretation within the young-earth Flood model.]

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The Holy Bible as Two Separate Books

Typically, evolutionists take the “scientific” high ground when debating creationists about Earth history. They claim that we follow a “religion” while they conduct science in the manner in which it is suppose to be conducted, free of any binding religious beliefs. Of course this ignores their own presumptions and inherent philosophical beliefs (e.g., atheism, naturalism, humanism, etc.) that they follow when conducting research. Unfortunately, we commonly fail to confront the evolutionists with another aspect of the Scriptures—its historical accuracy!

The Bible As History

While the Bible is used as a means of learning about the love of God, and mankind's relationship with Him, it also provides the history of the earth as God wishes to convey that information to His chosen people—the Israelites. The historic nature of the Bible in its accuracy and detail is clearly impressive. While many archaeologists have attempted to disprove it—the history recorded within the

Bible has consistently been shown to be accurate and true time and time again. If the Bible was the work of “man” we would expect it to contain errors and inaccuracies—especially as it has been translated and copied over the thousands of years that it has existed. However, as God's inspired word it has been proven to be a completely accurate record of the history of the nation of Israel—it has never been shown to be otherwise! This is a “proof” to the Divine nature of this most important book.

Uniformitarian and evolutionist geoscientists appeal to man's discovery of Earth history based strictly on fossils extracted from sediments and strata found across the crust of this planet. Typically historical written records are used to provide “recent” information (e.g., Chinese astronomical observations, earthquakes, tsunamis, etc.) which is then integrated into the uniformitarian framework. Religious texts are not used because of their inherently spiritual nature, which is mythicized and then used to discount the books in having any significance for “science.” This is where we need to challenge the uniformitarian assumptions about the Bible.

Conclusion

We can argue the existence of “GOD” and debate the evolution of life on this planet—issues which cannot be proven and which have their central basis in one’s own personal belief system. But, we commonly fail to point to the source of our belief—the Holy Bible! Some of the shortest discussions that we can have with uniformitarians is over the fact of the accuracy of Bible history. The Holy Bible provides a very real and accurate account of Earth’s short history. If uniformitarians and evolutionists want to discuss why believing in a young-earth is wrong then they *must* present evidence that the Bible (as a historical document) is incorrect! This changes the whole argument.

Evolutionists “believe” that life has evolved and they offer up fossils taken from various rock layers as their best evidence in support of their worldview. Associated with those fossils are plenty of pretty figures and drawings to prove it—but is that proof? Their story will change with each new discovery. However, the Scriptures remain

completely accurate and unchanged. Which of these two competing groups offers the best reasons to believe in their worldview—the answer should be obvious!

The historical accuracy of the Holy Bible should be brought into any debate in dealing with those willing to argue the “religion versus science” worldviews. Hundreds of years of archaeology within the Middle East have never proven the Scriptures to be in error. However, this fact is commonly overlook or ignored by the Christians and Jews alike. This is another reason we can defend our belief system, and from which we can conduct creation science. Evolutionists must prove the Bible to be false if we are to believe in their stories explaining fossils and Earth’s past. Until this happens (and it never will), we can have complete confidence in what the Holy Bible records as the history of the Earth. Now it is time we get out and investigate it for His glory.

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Book Review

True Science Agrees with the Bible by Malcolm Bowden
Sovereign Publications, Bromley, Kent, UK. 1998. 559 pages, £9.95.
Reviewed by Lambert T. Dolphin

Malcolm Bowden is a prolific writer, eclectic in his interests; he is also a pillar of creation science research in the U.K. defending biblical Christian faith with vigor and thoroughness. His latest book is wonderful compendium, practically a small encyclopedia, covering many areas of interest to educators, students, and Christians studying science. Bowden begins by shining light on the first 11 chapters of Genesis. He then moves to consider the Gap and Day-Age theories, the meaning of *yom*, views of the early church fathers, astronomical anomalies, vapor-canopy theories, frozen mammoths and the dispersal from Babel. He concludes the third section by discussing early Christianity in England, followed by a review of archaeological confirmations of the Bible from Egypt and Israel, a chronology of the Old Testament, and a discussion of dinosaurs.

Sections 4 and 5 are devoted to a very helpful treatment of the age of the universe and the earth, with replies to critics. (Bowden believes in a recent origin for the universe based on Biblical and scientific evidences). Section 6 is compendium related to the Christian basis of science and a number of anecdotal accounts relevant to the dis-

cussion of creation with non-creationists and educators. In his very full Appendix Bowden discusses the history and relevance of the debate on the constancy of the speed of light and the anthropic cosmological principle. He has some fine material on geology, sections on the Gospel in the Stars, the use of numbers in the Bible, and a stimulating section “Is Science True.” He includes in the Appendix very good reviews of geocentricity and relativity theory, easy to understand and follow.

I agree with Duane Gish, who in writing the Foreword said, “...I found it hard to put down since it discusses so many fascinating and important subjects... many of which are not discussed in other works.” In my own opinion this book is a very valuable “must-read” reference work on science and the Bible. One does not have to agree with the author on every point since his thoroughness of treatment allows the reader to understand the arguments and the data and to make up his own mind on controversial topics. The book is free from clichés and in-group language, it is well suited for classroom use, as a gift to non-Christian friends, and as very readable and authoritative reference work.