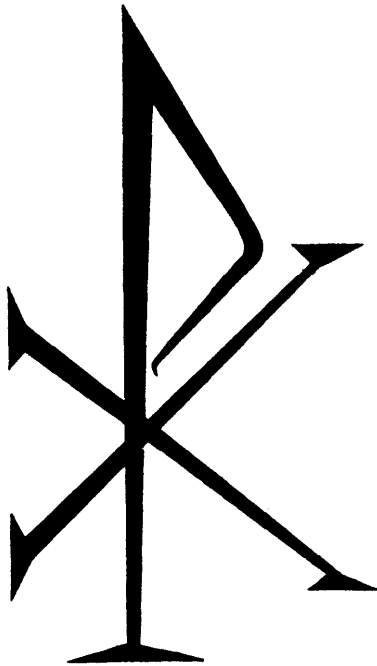


CREATION RESEARCH SOCIETY

1966 ANNUAL



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**

CREATION RESEARCH SOCIETY

1966 ANNUAL

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EDITORIAL COMMENT

As a group of scientists we are heartily in accord with the words of St. Paul,

For the invisible things of him from the creation of the world are clearly seen, being understood by the things that are made, *even* his eternal power and Godhead; so that they are without excuse: Because that, when they knew God, they glorified him not as God, neither were they thankful; but became vain in their imaginations and their foolish hearts were darkened. Professing themselves to be wise they became fools, and changed the glory of the incorruptible God into an image made like to corruptible man, and to birds, and four-footed beasts, and creeping things. (Romans 1:20-24)

Our articles have shown a few evidences of design in nature, of which so many abound. We believe that the marvels of even the most humble plant demand a teleological explanation,

But we also believe what St. Peter says,

There shall come in the last days scoffers, walking after their own lusts, and saying, Where is the promise of his coming? For since the fathers fell asleep all things continue as *they were* from the beginning of creation. For this they willingly are ignorant of, that by the word of God the heavens were of old, and the earth standing out of the water and in the water: Whereby the world that then was, being overflowed with water, perished: But the heavens and the earth which are now, by the same word are kept in store, reserved unto fire against the day of judgment and perdition of ungodly men. (2 Peter 3:3-7)

I feel it therefore timely to dedicate the 1966 Annual mostly to articles dealing with the Flood.

Our treasurer Wilbert Rusch, Sr., points out clearly why we do not believe "that all things continue as they were since the beginning of creation." His effective review of the work of Abelson and associates indicating that the organic matter found in chondrites and meteors is of inorganic origin is very timely. (My own review of this important work can now await publication in some later quarterly.) There is much in Rusch's comprehensive paper which can be effectively used both by our regular and sustaining members in their speaking engagements and teaching.

When N. A. Rupke, who recently completed his degree in geology at the University of Grönigen in Holland, offered to write an article, I had temporarily forgotten the detailed way in which European scholars go about their work. Anyone reading his paper who still doubts the sudden and world-wide destructive effects of

the Flood has my sincere admiration. As Rupke so aptly says, "Potest, nam est." Or to put it another way, we may not be able to explain it, but there it is for all the world to see. And furthermore anyone who has taken or studied structural geology realizes that uniformitarian concepts certainly leave much to be explained also.

Henry M. Morris with his usual clarity presents a fine introduction to an analysis of the destructive and sorting effects of water in various kinds of motion. This is a subject which he, as a hydrologist, is eminently qualified to discuss. We are looking forward to the second part of his article which lack of space has delayed for publication until one of our later quarterlies,

Both my own paper and that of Harold Slusher are merely introductions to the study of thrust faults and other structures for which there is no really adequate explanation in terms of orthodox geological theory. From the Flood geology viewpoint, many of these formations are not faults at all, but are the result of regular recurrent deposition, accompanied in places by subsequent movement, when both the overlying and basic formations were relatively soft and unconsolidated. Here is a field where much research needs to be done since thousands of these wrong-order formations and related structures occur.

Clifford Burdick's preliminary report is truly revolutionary. Though Leclercq has reported spores of vascular plants from the Cambrian, such a detailed presentation of evidence for not only Gymnosperms, but Angiosperms or flowering plants as well has not been published. Certainly any concept of plant evolution is relegated to theorizing as to *what might have happened* before the pre-Cambrian!

For several years I have been following closely Burdick's painstaking work, and more than anyone else realize how difficult it has been for him to consent to the publication of these data so totally at variance with the usual ideas of plant evolution. It is our hope that first priority may be given to the financing of more of this research. So far Burdick has done all of it on his own time and at his own expense. He certainly deserves the sincere thanks of all of us for sharing with us this original and fundamental research discovery.

For many years, Donald W. Patten has been assembling data showing the pattern of catastrophism which resulted not only in the sedimentary rock formations, but mountain ranges,

volcanoes and glaciers as well. I was asked to review certain chapters of a book he will soon publish presenting this data. His chapter on the various features of the polar ice caps and former and existing glaciers as well was new to me, and I am sure it will be new for most of our members. Frankly, I never knew there was so much ice and the explanation of its occurrence poses a real problem, not only to orthodox geologists, but Flood geologists as well.

His satellite capture theory is indeed fascinating and merits careful study. Not being much interested in astronomy, I had not realized how much evidence there really is for various kinds of ices in outer space. Planets such as Saturn truly are strangely made. The facts that Patten presents certainly do not fit into the pattern of uniformitarianism, but indicate a catastrophe of world wide proportions. He will welcome discussion of his theory, the details of which he presents in his forthcoming book.

My own study of the Darwin finches is mostly of interest because it led me to realize how much we need to critically reevaluate the taxonomy of vertebrate forms of land breathing animals. It is becoming more and more evident that our point of view calls for a complete new look at many sciences, both as to theory and the facts

which have been presented. For certainly we as scientists look for and write about that which we wish to see. And we must always remember that much of what is seen in nature exists only in the mind of the observer.

So let us not accept so easily the so called "objectivity" of science. Let us have a fresh look. Let us see more clearly how the remains of a once perfect world still shows so clearly the handiwork of our God, who daily is concerned over even the most humble sparrow that falls by the wayside, and who each spring causes the flowers (lilies) of the field to burst forth with such splendor that Solomon in all his glory was not arrayed like one of these.

Walter E. Lammerts,
Editor

P.S. I wish to add a note to explain recent delays in publication. To make the Quarterlies and Annual worthwhile, careful checks and cross-checks have been made on references, illustrations, etc. Also, please note that all publication and mailing work must be accomplished in addition to full-time employment responsibilities.

John N. Moore,
Managing Editor

REPORT ON THE HIGH SCHOOL BIOLOGY TEXTBOOK

The Textbook Committee of the Creation Research Society is now working on the manuscript of *Foundations and Applications of Biology*, a high School textbook. Individual members have been assigned various sections for the first draft in accordance with their own experience and judgment. Most of those first drafts have come in, except for illustrations. Illustrations will require a little more time.

Those committee members who were not given initial writing assignments will assist in editing the text and checking on its scientific accuracy. This first draft will be worked over extensively to achieve continuity and unity of the subject, consistency of style, adjustment to the high school level, and to include more exercises and other teaching aids.

Then the second draft will be prepared in large enough quantities for pilot "runs," as supplementary material, in a few high schools. Two high schools, one public and one private, are already scheduled to begin pilot forms in September, 1966.

It is believed that this textbook will be a creditable book of science, suitable for the best of high schools. Being released from the dogmatism of the theory of evolution, these writers are able to concentrate more time on the basic laws of science.

The textbook committee consists of the following: Dr. Russell C. Artist, Dr. Thomas G. Barnes, Dr. Bolton Davidheiser, Dr. Douglas Dean, Dr. Duane T. Gish, Dr. George F. Howe, Dr. John W. Koltz, Dr. Walter E. Lammerts, Dr. Frank L. Marsh, Dr. John N. Moore, Dr. R. Clyde McCone, Dr. Jack Wood Sears, Dr. William J. Tinkle, Francis Urton, Rita Rhodes Ward, and Dr. Paul A. Zimmerman.

Dr. Thomas G. Barnes,
Committee Chairman

(Editor's note: Dr. Barnes is doing a superb job in getting the cooperation of these men, and also in arranging for trial "runs" of text material in two schools this Fall.)

CONSTITUTION OF CREATION RESEARCH SOCIETY

(All members should be informed that Articles of Incorporation of the Creation Research Society were duly filed with the Department of Commerce of the State of Michigan on 27 February, 1966. Action is still pending with the United States Internal Revenue Service on approval for tax-exempt basis for receipt of contributions to a non-profit corporation.)

Article I. Name and Purpose

Section 1. The name of this organization shall be the Creation Research Society.

Section 2. The purpose of this organization shall be to publish research evidence supporting the thesis that the material universe, including plants, animals, and man, are the results of direct creative acts by a personal God.

Section 3. In order to correlate this truth with facts learned in science, thus removing obstacles to faith, the Society shall publish research and interpretation of scientific data.

Section 4. The Society shall be a non-profit organization within the meaning of the law.

Article II. Statement of Belief

Section 1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.

Section 2. All basic types of living things, including man, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.

Section 3. The great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historical event, worldwide in its extent and effect.

Section 4. We are an organization of Christian men of science who accept Jesus Christ as our Lord and Savior. The account of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Savior for all mankind. Therefore, salvation can come only through accepting Jesus Christ as our Savior.

Article III. Membership

Section 1. There shall be two classes of membership in the Society. All members of both of these classes shall subscribe to the Statement of Belief when becoming members.

(a) Voting Members shall hold an earned degree in science of Ph.D., M.D., M.A., M.S., or the equivalent in education or experience, as determined by the officers of the Society.

(b) Sustaining Members do not necessarily hold degrees but are interested in the program of the Society. They shall receive the literature of the Society and have all the rights and privileges of members except voting and holding office.

(c) Sustaining Members who are students shall receive their memberships at a reduced fee.

Section 2. If a Member should change his belief, so that he no longer can accept Article II, he shall resign.

Article IV. Organization

Section 1. The officers of the Society shall consist of President, Vice-president, Secretary, Corresponding Secretary, and Treasurer, and they shall constitute the Executive Board.

The Board of Directors shall consist of 18 members representing the various scientific disciplines. The Board of Directors shall be elected by mail ballot of the Voting Members every three years beginning in February 1966.

The Board of Directors shall elect an Executive Board from their own membership.

Section 2. The President, advised by the Secretary, shall appoint such boards and committees as shall be found necessary.

Section 3. It shall be the policy of the Society to keep the organization as simple as is consistent with efficient functioning.

Article V. Meetings

Meetings may be called by a majority of the Executive Board or by a majority of the Board of Directors.

Article VI. Amendments

This Constitution, except as regards the statement of belief, may be amended at any regular meeting if the Voting Members have been informed of the proposed change at least two months previously.

ANALYSIS OF SO-CALLED EVIDENCES OF EVOLUTION

WILBERT RUSCH, SR., M.S.

Concordia Junior College, Ann Arbor, Michigan

Introductory Observations

Before one begins to write in this semantic age of ours, it has become necessary to define terms, for instance, the term creation. So I submit that in my opinion the theory of creation asserts that:

a) organisms now living have descended from organisms of the same created kind, as referred to in Genesis;

b) within such created kinds, processes of change may have occurred and do occur to such an extent as to produce individuals differing in various degrees from their parents, yet never sufficiently different to constitute a new "kind"; (for example, the various breeds of dogs, and the several races of men);

c) such physical changes which are demonstrated to have appeared in organisms since their creation, have arisen through degeneration due to the Fall of Man or through natural causes which now continue to be in operation and which therefore can be studied experimentally.

I also should define the term evolution. I am well aware of the fact that there are in both Standen and Kerkut references to two theories of evolution. However, in the majority of our present day science books, certainly those in the elementary, secondary and undergraduate levels, the word evolution usually means what Kerkut and Standen both call the "general theory of evolution," that is, the theory that all the living forms in the world have arisen from a single source which itself came from an inorganic form. This is 'amoeba to man' evolution and is the meaning of the word evolution as I am using the term in this presentation.

Now if it happens that more persons hold to one particular philosophy than another, that does not make the first philosophy true. It could actually be that the minority view may express the truth, with the majority view being false. So it is with evolution; the number who believe in it is no guarantee of its truth.

An honest person will accept items which have actual existence as facts. On this there should be no disagreement. But the hypotheses that are built on such facts, as well as the reconstruction of past events are all legitimate grist for differences. As Dr. George once wrote,¹ "Facts remain but theories crumble." I might also point out that Dr. James Conant has said, "Statements about the past, predictions about the future, generalizations about what event will follow

another, are all grist for the mill of the thorough-going sceptic."²

We find ourselves in a dilemma because those who subscribe to evolution take a body of facts and interpret them one way, while those who subscribe to creation take the same body of facts and interpret them another way. It is my contention that actually neither can be proven, both must be taken on faith.

And let me underline this last clause, *both* must be taken on faith. Evolution is not a fact, it is a theory. Recently the French biologist, Prof. Louis Bounoure, quoted Yves Delage, a late Sorbonne professor of zoology as saying:

I readily admit that no species has ever been known to engender another, and that there is no absolutely definite evidence that such a thing has ever taken place. Nonetheless, I *believe* evolution to be just as certain as if it had been objectively proved.³

Incidentally, Bounoure comments: "In short what science asks of us here is an act of faith, and it is in fact under the guise of a sort of revealed truth that the idea of evolution is generally put forward."

Dr. Bounoure, formerly president of the Biological Society of Strasburg, as well as Director of the Zoological Museum and still director of research at the National Center of Scientific Research in France also wrote—"Evolutionism is a fairy tale for grown-ups. This theory has helped nothing in the progress of science. It is useless." In a later article on the same subject, Bounoure quoted from a present day Sorbonne professor of paleontology, Jean Pivateau, the admission that the science of facts as regards evolution "cannot accept any of the different theories which seek to explain evolution. It even finds itself in opposition with each one of these theories. There is something here which is both disappointing and disquieting." "More on this aspect will appear later.

At this point I must digress on the subject of quotes. The plaintive cry is often raised that a creationist may not use an evolutionist's statement as a support for a creationist's point of view, I submit that this complaint is invalid. For one thing, no reputable creationist attempts to portray an evolutionist as supporting the case of creation. This is not the intent of the quote. But if the evolutionist mentions a point in his writing that the creationist can use to his advantage, then by all the rules of evidence, he is free to do so.

Certainly any piece of favorable evidence an attorney can pry out of a hostile witness, is choice evidence indeed, and the attorney would be a fool not to make the most of it. Further, the dilemmas of evolution are often best presented by its proponents. They certainly can be trusted to minimize their difficulties, so I can scarcely be charged with exaggerating them. So, for the record, assume I quote from those of evolutionist persuasion, unless I identify the man's position as being otherwise. In this connection I would like to draw your attention to some words that W. R. Thompson wrote in 1956:

As we know, there is a great divergence of opinion among biologists, not only about the causes of evolution but even about the actual process. This divergence exists because the evidence is unsatisfactory and does not permit any certain conclusions. It is therefore right and proper to draw the attention of the non-scientific public to the disagreements about evolution. But some recent remarks of evolutionists show that they think this unreasonable. The situation where scientific men rally to the defense of a doctrine they are unable to define scientifically, much less demonstrate with scientific rigor, attempting to maintain its credit with the public by the suppression of criticism and the elimination of difficulties, is abnormal and undesirable in science.⁵

May I say that for my part, I intend to continue to draw the attention of the non-scientific public to the weaknesses and disagreements about evolution as long as the Lord gives me strength so to do.

The statement that "everyone working in science accepts evolution as a fact" is often used as an argument for compelling the acceptance of evolution over against creation. I submit that this statement is not true, and I think that can be indicated by the known position of the following individuals:

Dr. Frank L. Marsh, professor of biology at Andrews University; Dr. Henry Morris, Professor of hydrolic engineering and head of the civil engineering department, Virginia Polytechnic Institute; Dr. Walter E. Lammerts, in the past on the faculty of the University of California and for many years research director of Germain's, in addition to being the leading rose authority on the west coast; Dr. Thomas Barnes, director of the Schellenger Research Laboratory, also on the faculty of Texas Western University; Dr. W. R. Thompson, former director of the Commonwealth Institute of Biological Control, Ottawa, Canada; Dr. J. J. Duyvenné de Wit, late head of the zoology department, Orange Free

State University; Dr. John Moore, professor of science education, Michigan State University; Dr. Louis Wolfanger, professor of soil science, Michigan State University; Dr. Duane Gish, biochemist of the Upjohn Laboratories, Kalamazoo, Michigan; Dr. George Howe, professor of biology, Westmont College, California; and Dr. C.E.A. Turner, professor of chemistry, Surrey, England.

I am personally acquainted with all of these men and have been in correspondence with them many times. In each case I am positive that each one in turn could name an equally larger and possibly more impressive circle of men with whom they are acquainted and who also do not accept evolution as a fact. For example, Dr. Lammerts has told me that there are five friends of his who are all Ph.D.'s in nuclear physics on the staff of the Lawrence Radiation Laboratories, who are involved in the government operation "plowshare." All five of these men are creationists, although they are nuclear physicists.

To mention an additional few, I could add to this list the late Dr. L. Merson-Davies, gold medalist in geology, of England; the late Dr. Paul Lemoine, curator of the Natural History Museum, Paris, France; as well as Dr. Martin Lings, currently of the British Museum; and Professor Louis Bounoure of the National Center of Scientific Research, France.

Finally, I am in the unique position to know, as treasurer of the organization, that the Creation Research Society has over 150 members who have earned Ph.D. or M.D. degrees in science and have signed a statement of belief in creation as opposed to evolution as voting members. Now I am willing to grant that this number may be in the minority, but that there is nobody working in the field of science of reputation who does not accept evolution as a fact is a statement I simply will not accept.

I think another valid question to be raised is, Could books and articles on creation be scarce because the creationist view cannot get a fair hearing? I ask the reader to judge from the following three examples. I feel that the situation is a little less biased in England, since I know that the *Journals of the Transactions of the Victoria Institute* are open to both creationists' as well as evolutionists' viewpoints. Some recent studying I have been doing indicates that on the continent, particularly in France and Germany, the question of evolution is even more open. Actually, the only two possibilities regarding the origin of the living world are development by transformisms (evolution) or creation by God.

The position of the science of today over against creation may best be demonstrated as follows:

(a) Dr. S. Zucherman once wrote:

Either evolutionary change or miraculous divine intervention lies at the back of human intelligence. The second of these possibilities does not lend itself to scientific examination. It may be the correct explanation, but, from a scientific point of view, it cannot be legitimately resorted to in answer to the problem of man's dominantly successful behavior until all possibilities of more objective explanation thru morphological, physiological and psychological observation and experiment are exhausted.⁶

(b) Dr. W. R. Thompson recently wrote me that the chapter on evolution in his recently reissued work, *Science and Common Sense*, (Magi Books, Inc., Albany, N.Y. 12208) would be much stronger against evolution were he to write it today. As he put it, at the time he wrote it, the book had to be passed by a reader, who had strong evolutionistic views, and therefore Thompson was forced to compromise to get the book published.

(c) The noted columnist, George Sokolsky, touched on another example when he wrote,

So it appears from what can be learned about it that certain scientists, including leading astronomers, threatened Macmillan with a boycott of their textbooks if they did not rid themselves of Professor Velikovsky's book. Of course, what the learned and liberal professors wanted really was a total suppression of a book which opposes their dogma.⁷

Macmillan yielded to the threats since they were an extensive publisher of textbooks, and transferred the publishing operations to Doubleday and Company, which does not publish science texts and therefore was immune to such a threat. Actually Doubleday published all five of Velikovsky's works.

As a continuation of this story, I also refer the reader to John Larrabee's article in the August 1963 issue of *Harper's Magazine*, entitled "Was Velikovsky Right?" I think this article ought to be required reading for all who maintain that scientists are completely objective, never biased, and thus not like the average human being. In this article Larrabee points out that as early as 1950, Velikovsky predicted the high temperature of Venus, the radio emissions from Jupiter, as well as the phenomenon we know as the Van Allen radiation belts. For none of this has Velikovsky been given any credit on the basis of priority, nor have his predictions even been acknowledged in any of

the descriptive writings on these matters. To avoid misunderstanding, I should mention that Velikovsky is not a creationist, although considered a scientific heretic of the first magnitude.

In this country, almost all books dealing with creation that I know of have been published by religious book houses.

Evolution and Classification

The theory of evolution is based on a number of fundamental considerations. The first one I would like to briefly consider is classification or taxonomy. This argument runs along these lines: Since it is possible to classify organisms, it is held that all true classification should be genealogical. And so we have taxonomists reshuffling classifications of plants and animals in an effort to find new natural systems of classification. Then any current system of classification is held to be natural, and thus a proof of evolution.

Frankly, the fact that we can group living and fossil forms of life into some thirty animal phyla and some twenty-five plant divisions would be the last thing one should expect from an evolutionary development. While these major phyla and divisions aren't as clear cut as we might like them to be, nevertheless they are stable and recognizable entities. But a random evolutionary development should call for an enormous hodge-podge, rather than such a small number of recognizable entities compared to total species number.

Furthermore, that we can arrange animals and plants into groups on the basis of resemblances should be no more significant for developmental history than that we can arrange the elements into families. I have yet to hear a chemist propose that the halogen series evolved from fluorine to iodine, because it is possible to arrange them in this series.

We may also ask the question, Why should the type form insect or cephalopod continue to be inherited in the face of random variations, if transformism be true? Even in a lower hierarchical level, despite all repeated mutations, the majority of species and all genera are real entities. This was recognized by C. E. Davenport who wrote,

When I study thrips and wish to secure a species described fifty or more years ago as living in a certain composite plant in eastern Russia, then if I go to the designated locality and look in the designated species of flower, I will find the species with all the characters described fifty or 100 thrip generations ago. How is such an experience to be harmonized with universal mutations?⁸

Davenport says this is the heart of the problem of evolution.

The evolutionist says that, when we find animals and nature grading in complexity of structure from a protozoan to a mammal at the other extreme, this proves that evolution from a one cell to a multicellular form has taken place. The creationist says that a multiplicity of forms was part of the design of the creator. Both these statements are logical. Which one is correct? Since this is subjective evidence (animals and plants don't carry classification labels) an argument could be endless on this subject with no progress possible. I might quote the late Dr. Austin H. Clark, once curator of the U. S. National Museum, who wrote,

It is almost invariably assumed that animals with bodies composed of a single cell represent the primitive animals from which all others are derived. They are commonly supposed to have preceded all other animal types in their appearance. There is not the slightest basis for this assumption beyond the circumstance that in arithmetic—which is not zoology—the number one precedes the other numbers.⁹

Evolution and Comparative Anatomy

Much has been made of comparative anatomy as an argument for evolution. And again we reach an impasse. If a creationist and an evolutionist strolled through a museum, the latter would look at the specimens displayed and hold that structural similarity in mammals, for example, suggests that all forms have evolved from a common ancestor. Of course the former, seeing the same displays, would believe that the structural similarities suggest a common general design to meet a common environment created by God. Again there is no correct conclusion possible since the evidence is subjective, to be bent depending on the belief of the individual using it.

However, a word of caution has to be injected here. To think of animals in terms of bones and dead bodies alone is not enough. Certainly, for example, the difference between cat and dog transcend the anatomical and physiological, the temperaments of the two animals are different and this also represents part of the innate difference between these two animals.

I would also like to point out the following fallacy. A scientist looks at an animal, names a certain bone, then looks at another animal and uses the same name for a corresponding part. He then postulates the bone is the same. Therefore the similarity is supposed to have phylogenetic significance, and he now uses this as evidence for evolution. Obviously the postulate of homology is a subjective one created by his own mind which may or may not be correct.

Particularly in the case of the fossils are these two cautions necessary. Animal fossils are classified on the basis of skeletal parts solely, ignoring, of necessity, since they are absent, such characteristics as warmbloodedness, the number of heart chambers, red blood cell structure, presence or absence of a diaphragm and the like.

Evolution and Vestigial Organs

A third proposed proof of evolution is vestigial organs. These are structures that are found in some animal or human organism, that are considered to have no use in the present form, but have had a use in previous forms and therefore represent a sort of "memory" of an evolutionary ancestor. Truly the fate of vestigial organs has been rather sad.

In the human being, there was once a long list of such organs that were considered as useless remnants of man's evolutionary past. Although this list once ran to well over a hundred, today most of this list has gone the way of all flesh. It seems odd to us today to find that such structures as tonsils, the parathyroids, the thymus, the pineal gland, the appendix, and the coccyx were all on this list. I might mention incidentally that certainly anyone who has suffered a broken coccyx is painfully aware of the fact that it serves as an anchorage for rectal muscles. Obviously if it is serving a useful function in the body it cannot be a vestigial remnant.

The appendix has now been admitted to play a part in the control of the intestinal flora, and again, since it has proven to have use, particularly in the light of recent observations made in connection with the growth of germ free organisms, the appendix must be taken off the vestigial list. True we can get along without our tonsils and we can get along without our appendix, but we can also get along without one arm and one leg, and certainly nobody in his right mind would thereby class them as being vestigial.

In other animals, the claws on either side of the vent in certain boas and pythons as well as some other snakes have often been pointed to as useless relics of the hind legs of snake ancestors. But Dewar refers to A. K. Martin who wrote "The Ways of Man and Beast in India" and who therein reports observing that these protuberances are of assistance in the movement of these snakes. Others have also referred to the fact that the spurs projecting from the python serve as a means of helping the animal anchor itself in movement through trees.

Two more examples should be mentioned. namely whales with transitory teeth and the semilunarfold in man. In man, the latter's main use is to collect foreign material that gets into

the eyeball and collect this material into a sticky mass in the corner of the eye, where it can easily be removed and does no damage. This has been reported by E. P. Stibbe.¹⁰

With respect to the whales that have embryological teeth which never grow into teeth, Vialleton says,

certain of these supposed vestigial organs deserve special examination, because they play a part that was unknown to Darwin. When he cited as truly vestigial organs the germs of teeth in the fetuses of whales devoid of teeth in the adult state, and those of the upper incisors in certain ruminants, the gums of which they never pierce, he forgot that these germs in mammals, where they are very large relative to the parts enclosing them, play a very important part in the formation of the bones of the jaws, to which they furnish a point on which these mold themselves. Thus these germs do have a function."

Furthermore, Dr. John Cameron reports that he studied a microcephalic idiot of whom the jaws receded due to poor teeth development. He says, "In many of these individuals the teeth never develop at all. The cause of poorly developed jaws are due to a deficiency or actual failure of development of the dental germs."¹²

In his *Transformist Illusion*, Dewar insistently raises a rather pertinent question—namely, where are the nascent organs, those that are about to evolve into useful organs? No one other than Darwin has ever broached this subject. Logically, if new organs are in the process of being developed, then in some animal form we should find some incompletely developed organs which are on the way to develop into fully useful structures later, but at present have no function. Yet I have read absolutely nothing on this subject.

Evolution and Embryology

A fourth point is the evidence from embryology. Haeckel enunciated the Law of Recapitulation or Biogenetic Law in 1866. This is stated succinctly, "Ontogeny recapitulates phylogeny," or the development of the individual repeats the development of his race. Probably one of the main reasons for the lack of effectiveness of this law is that it does not apply to the plant world. This would then mean that since plants and animals are postulated as evolving from a common ancestor, this common ancestor gave rise to two lines of descendants—one following the Law of Recapitulation, the other not! De Beer and Swinton refer to the Law of Recapitulation as "a theory that in spite of its exposure, its effects continue to linger in the nooks and crannies of zoology."¹³

With respect to Sinnott and Wilson's position that some leaves would seem to recapitulate an ancestral trait, De Beer and Swinton say that the Biogenetic Law cannot be true in view of the frequency with which young foliage leaves are found to be more specialized than those formed at later stages. The embryologist Huettner gave a fairly accurate picture of the light in which it is viewed today when he said, "as a law, this principle has been questioned, it has been subjected to careful scrutiny and has been found wanting. There are too many exceptions to it. However, there is no doubt that it contains some truth and that it is of value to the student of embryology."¹⁴

Huettner proceeds further to point out some other difficulties. It became necessary to divide the characteristics developed in an embryo into primitive (palingenetic) and specialized (cenogenetic) characteristics. Then it developed that there was a problem in differentiating between the two. It is complained that the palingenetic traits are obscured and sometimes eliminated at the expense of the cenogenetic.

For example, there is never a true blastula or gastrula in the mammals. Also organs do not develop in the proper order. In the earliest fishes found, there are teeth, but no tongue. But in the mammalian embryos, the tongue develops before the teeth. Huettner says that there are numerous cases of this type. It is known that environmental conditions will change the orderly sequence of differentiation in the embryo, which drives one to the conclusion that recapitulation is subject to change. All this leads Huettner to refuse to accept the recapitulation theory as a 'law.' It is also of interest to note that most crabs hatch out of a larval form known as Zoeas, which differ greatly from the adult form. Yet other crabs hatch out as miniature crabs. Where is the operation of the Biogenetic Law?

Along these same lines, embryologists who make phylogenies sometimes work at embarrassing cross purposes with paleontologists. In human development, it is noted that we find that most of the bones develop from embryonic cartilaginous foundations; for instance, those that develop into the ethmoid, sphenoid, occipitals, as well as the vertebra and the long bones of the fore limbs. This would seem to imply that cartilage is primitive and bone is more advanced. As one grows older, more and more cartilage is replaced by bone. Applied to phylogenies, this would mean that sharks, as cartilaginous fish, would be the precursors of the bony fish. Unfortunately, if you take the paleontological record on its face value, we find there to our surprise, that the cartilaginous fish have developed apparently from the bony fish, since they occur later in the geological record.

In embryological development, simpler parts must be formed before more complicated ones. In small embryos, shape will be determined by physical forces, which play less and less a part in determining shape as size increases. Many apparent recapitulations may only be expressions of the fact that all animals are built out of the same kind of materials such as carbohydrates, fats, proteins, etc. Often recapitulation is absurdly irrelevant. For instance, the respiratory surface develops late in an embryo, yet how could earlier forms have survived without it? The head size in the mammalian embryos is relatively enormous but very small in their ancestors.

Long ago, when I worked in embryology, it was pointed out at the time that the embryo has two types of organs: a) Those that do not function until after the child is born, of which the lungs are a good example. Hence we develop only one lung system. b) Organs which have a function during embryonic life as well as later, and hence change form, sometimes several times, to meet changing needs. I would consider the heart and the kidneys in this category. It might be said also that the embryo would seem to follow Maupertuis' postulate of least action.

Origin of Life Discussed

The question is often raised, What about the ability of scientists to create life? In these days we so often find a headline proclaiming "Scientists Create Life," only to discover that the progress towards this goal has been a crawl rather than an achievement. What is the true picture?

A theory that deals with the origin of life, should start with the inorganic and wind up with at least a functioning cell. Intermediate steps of necessity would be proteins and deoxyribo nucleic acids (DNA), as well as the ribo nucleic acids (RNA). These are all molecules of tremendous size, but still organic molecules. They are not living, although associated with the growth and reproduction of living things.

Viruses are debatable organisms. F. Bawdin of England, noted virologist, holds that they are degenerate forms of life. Viruses are essentially a protein membrane enclosing a core of DNA. They multiply by invading the cells of an organism and using its cell constituents to produce additional viral units. One virus form that is useful to man invades bacteria and destroys them. These are known as bacteriophages or simply phages.

Stanley Miller first performed the experiment where H_2O , NH_3 and CH_4 , when an electric

spark was passed through the mixture, produced a soup of simple amino acids. More recently an electron beam has been passed through such a mixture and produced the simple ringed base adenine. This base, classed as a purine, occurs in RNA along with another purine, guanine, as well as pyrimidines such as cytosine, and uracil. Chemists then have also irradiated with ultra-violet light a mixture of H_2O , NH_3 , and CH_4 to form $HCHO$ which has then been polymerized by further radiation to form ribose and deoxyribose. These sugars occur in a typical nucleotide molecule.

An inorganic phosphate has been heated with a mixture of uracil and ribose to link these two compounds together to form diuridilic acid, which is a double linked nucleotide molecule. However, doing this sort of thing in the laboratory under carefully controlled conditions, and having the same thing occur by chance in an open environment are two different things. Furthermore, these results are still a far cry from creating something living. These compounds are still organic chemicals, complex, yes; and this has been a beautiful job of synthesis, but not yet creating life.

Dr. Sol Spiegelman of the University of Illinois recently received a bacteriophage from Japan and isolated an RNA molecule from it. Then from another bacteriophage he also isolated a specific enzyme, replicase. When the two were placed in a nutrient material, other RNA's were produced. In this case the enzyme can generate identical copies of added viral RNA. This new RNA can infect, by serving as the template for more virus. Each enzyme recognizes the genome for its own RNA and requires it as template for synthesis. However, the presence of more than one nuclease will break the whole procedure down. So this process is simply duplicating some cell chemistry. When Dr. Spiegelman was asked if he had created life in a test tube, he replied, "Only God can create life."¹⁵ Another biochemist at the same time commented "if we knew the chemical composition of each different molecule in the living cell and if we knew how they reacted, it would take us about 10 years to do what the living cell can do in 10 minutes."

But let's go back to the beginning of this discourse on the origin of life. Since the Urey-Miller experiment, it is practically stated as fact that the earth had a beginning atmosphere of H_2O , CH_4 and NH_3 . But an interesting article in *Science*¹⁶ would seem to negate this primordial atmosphere. Three investigators, Studier, Hayatsu and Anders, examined meteorites that showed hydrocarbon traces. These meteorites were assumed to have come from either comets

or asteroids, and so they set about examining the trapped gases within the bodies of these meteorites, on the assumption that these trapped gases might indicate the gases present when the hydrocarbons were formed. The results were not at all comforting to devotees of the Urey-Miller conditions. Examination indicated that rather than the presence of the required NH_3 , which was totally lacking, N_2 was present.

Another surprising discovery was the overwhelming preponderance of aromatic rather than aliphatic hydrocarbons present. The carbohydrates and amino acids that were referred to before as being theoretical intermediates in the process of creating life, are all basically aliphatic compounds, or derived from them. None of these can be derived from aromatic compounds, so the presence of these latter would also seem to mitigate against a Urey-Miller atmosphere. There also was an absence of the heavier members of the methane series. To the authors, this evidence seemed to exclude a process such as the Urey-Miller, as representing a solution to the origin of life in the past by natural processes.

I might add another piece of evidence against the Urey-Miller scheme, and that is the total absence of any evidence in the stratigraphic record of conditions other than those now pertaining. No matter how old the rocks are supposed to be, the pre-Cambrian sedimentaries and metamorphic are composed of fragments of older rocks which seem to be the same as those now present.

W. W. Rubey¹⁷ in a discussion of Stanley Miller's paper on "Formation of Organic Compounds on Primitive Earth" was quoted as concluding that the ocean and the air were formed as products of degassing of the interior of the earth. Evidence for volcanic activity is found in the earliest rocks. Gases associated with present-day eruptions are H_2O , CO_2 , N_2 , CO , H_2 and S . Condensation of such a mixture would lead to an atmosphere of CO , N_2 , H_2 and small amount of H_2O and CO_2 . Where is Miller's NH_3 which is vital to his scheme?

So all this speculation becomes good clean honest fun, and the chemistry becomes examples of beautiful, clever synthesis of organic compounds with no life or near life yet having been created. Even if a system, classifiable as living, ever is synthesized, man will not have proved that this is the way that the first synthesis was executed. He will only be mimicing the processes of nature, that is, he will be walking in the footsteps of the Creator.

Evolution and Paleontology

The question in many minds at the moment is probably. What about geology and the fossil

evidence? I think that at the beginning of this phase of my analysis I would submit that the question of the age of the earth is independent of the question of creation versus evolution, and I will so consider it. I know a number of individuals who will take the geological calendar as commonly presented today, but who nevertheless do not accept any part of the theory of evolution. One of the best examples was Douglas Dewar, recognized as one of the most effective proponents of creation.

In his *Transformist Illusion* he takes the geological calendar as read, but throughout the book he will obviously have no part of evolution. What is remarkable is that Dewar originally in his college years and for a while thereafter, was an evolutionist, but as he became more knowledgeable in the morphology and physiology of birds in India, he more and more was convinced of the fallacy of the theory of evolution. So by the time he returned to England he became a prominent voice of the protest against evolution.

Fossils are facts of life. The shells and bony structures that have been uncovered are real, as are such things as tracks, imprints, casts and molds. So they must be dealt with as actualities and not as figments of the imagination. However, the reader will bear in mind, that how they got to their resting place, under what circumstances they lived, as well as when they lived, are all subject to interpretation and difference of opinion.

A beautiful and complete series of fossil shells, may by some be considered to provide an excellent evolutionary series in which one form grades into another. However, such a change in shell structure may be simply an indication of a change in environment, a more or less acid condition of the water. Dr. C. Emiliani, has observed that temperature changes in the ocean, will affect the coiling of a shell from right to left. I was present in a group in which Dr. Fagerstrom, of the University of Nebraska, reported that certain foraminiferan forms altered their shells in response to pH changes in the water they were living in.

So the very real question can be raised, Are these really evolutionary changes, or are they simply responses to environmental changes? What I wish to emphasize here is that the evidence from paleontology is not absolutely conclusive, and can never be so in itself, because it must always be incomplete, not only because it may be geologically imperfect at any given time, but because the picture it gives us of the organisms concerned is necessarily only a partial one.

Among the plants, the order of appearance of the fossils is anything but an order of progression from simplicity to complexity. In fact, in recent years due to the development of palynology, the study of microfossils in the form of spores in the rocks, this picture has become even more complex. According to the evolutionary theory, we would expect to find liverworts and mosses following the algae as among the most primitive of plant forms, since they are the simplest of all plants that are considered to be archegoniate.

But unfortunately it has been observed that there is no geological evidence whatsoever that can make the delineation of the origin of bryophytes anything other than a hopeless one. This is probably the reason why in the various botany courses I have taken, the subject of evolution usually hasn't even been mentioned.

A new field of study in paleontology is called palynology. This involves the study of fossil pollen grains or spores of plants. Often this is the only part of the plant remaining as a fossil. Spores are sculptured uniquely, so that they can be compared and identified as to genus in many cases.

Recent findings in this new field have thoroughly confused the evolutionary picture with respect to the plant world, in my opinion. Pollen grains have been found in Lower Devonian, Silurian and Cambrian rocks which would indicate the presence of vascular plants at the time of deposition of these rocks.

In addition to the presence of pollen grains, other difficulties have arisen. S. Leclercq of the University of Liege, Belgium, reports, "a marked discrepancy observed between two floras so close in geological time as the Middle and Lower Devonian is difficult to reconcile. The absence in Lower Devonian of plant impressions positively related to any of the very differentiated plants of the Middle Devonian is astonishing." ("Evidence of Vascular Plants in the Cambrian," *Evolution*, Vol. 10, June, 1956, pp. 109-113.)

Daniel I. Axelrod also reports that the oldest land plants now known are from the early Cambrian of the Baltic region, ("Evolution of the Psilophy tales," *Evolution*, Vol. 13, June, 1959, p. 264.) Pointing out that the bulk of the unmetamorphosed Paleozoic and pre-Cambrian rocks are not continental but marine, Axelrod holds that few records of land plants would be expected in that period, at least as far as structures other than pollen grains would be concerned.

However, I would like to draw attention to the fact that the statements made by Axelrod relative to the distribution of the fossil plant

forms and their environment apply with equal justice to the animal fauna. He points out the possibility that there were all sorts of land plants that were in existence that are not known as fossils due to the fact that the sedimentary terrestrial deposits are not available.

This then would imply that any missing terrestrial deposits, which might contain the structural fossils of plants, may also contain the fossils of land animals that once lived at the same time as such plant environments. Yet, said animals, according to all current paleontological theories, would not have been evolved at that time. The only problem is that animals do not leave pollen grains, whereas plants do. (Readers will be interested in the article by Clifford Burdick, "Microflora of the Grand Canyon," which appears elsewhere in this Annual-Editors.)

It should be pointed out that nowhere do we find a complete record of deposition through all the geological ages. The complete geological record is made up by plugging in various segments of the record from various parts of the world so as to make up a whole geological column. But there is no locality where you can dig down and uncover a complete geological column from end to beginning. Actually there is no locality where you can even dig down and uncover a complete series such as the horse from *Equus* at the top to *Eohippus* or *Hyracotherium* at the bottom. Such a series must be made by drawing together fossils from different states, yes, even from other continents.

While one committed to the theory of evolution might refuse to question a phylogenetic tree developed in this way, I submit it still is open to debate. May not many of these forms have lived contemporaneously at different localities, or must the only acceptable explanation be that they succeeded one another? The answer is not carried on labels engraved on the fossils.

Fossil Record Very Incomplete

If you look at the complete picture of life in the rocks, you find some rather peculiar things. Probably one of the most important is the sharp break that occurs between the oldest rocks known as the pre-Cambrian and the Cambrian rocks. Incidentally, all these fossils are aquatic. The first plants were algae on the basis of the remains. All the animals were invertebrates spread over all of the most important phyla, such as sponges, jellyfish, sea cucumbers, starfish, brachiopods, mollusks, and crustaceans, as well as some worms.

Thus, of the great divisions of the animal kingdom, we find that all have been formed by the Cambrian period except the vertebrates, and these appeared in the next or Ordovician

period. One very noticeable and important fact bearing on the theory of evolution is made evident. Amongst these earliest fossils, we find that all the phyla appear in the rocks fully formed: i.e., possessing the complete bodily plan of construction typical of their phyla. For example, the earliest crustacea are undoubtedly crustacea, the earliest mollusks are undoubtedly mollusks, etc. As has been noted by any number of paleontologists, the phyla appeared separately, as it were, in most cases, giving among their fossils no indications of their origins from other phyla.

If evolution were true, then these phyla should have evolved one from the other in an increasing scheme of complexity and diversity. We should find them grading into one another, at least to a much greater degree than they do at present. We should find fossils which connect the phyla unmistakably, but to date none have been found in the early rocks. Even when we deal with the vertebrates which supposedly appeared last among the animals, we can find no true connecting link with previous phyla. As a result there is no agreement regarding their origin.

A search of the literature in the last fifty years will show that the vertebrates have been derived from nearly every one of the invertebrate groups, except possibly the protozoa. I think this sudden appearance of all the phyla without any transitional forms is a most powerful reason negating a theory of evolution from amoeba or unicellular form to all the various representative present forms, Arnold Lunn once wrote, "Faith is the substance of fossils hoped for, the evidence of links unseen"¹⁸

Simpson has said,

the paleontological evidence for discontinuity consists of the frequent sudden appearance of new groups in the fossil record, a suddenness common to all taxonomic levels and nearly universal at high levels. Since the record is, and must always remain, incomplete, such evidence can never prove the discontinuity to be original.¹⁹

But this is certainly strongly suggested, if we are limiting ourselves to facts and not one theory. Actually, I would think that if the type of origin of new forms suggested by the known fossil record were to be named, it would of necessity be called origin by creation.

D. D. Davis, in 1949, commented on the gaps in the geological record. He held that the sudden emergence of new types, for example, families in order, has given real trouble of late. Davis mentions that many German morphologists question the validity of evolution, and both he and Simpson have mentioned such paleontologists as Schindewolf and Kuhn who have felt this way.

Davis also said, the facts of paleontology conform equally well with other interpretations that have been discredited by neobiological work, for example, divine creation, innate developmental processes, Lamarckism, etc., and paleontology by itself can neither prove nor refute such ideas.²⁰ I agree, but let it be said that Davis still has faith in evolution.

Further, Oswald Spengler noted the following regarding the fossil record:

There is no more conclusive refutation of Darwinism than that furnished by paleontology. Simple probability indicates that fossil hoards can only be test samples. Each sample, then, should represent a different stage of evolution, and there ought to be merely 'transitional' types, no definition and no species. Instead of this, we find perfectly stable and unaltered forms persevering thru long ages, forms that have not developed themselves on the fitness principle, but appear suddenly and at once in their definitive shape; that do not thereafter evolve towards better adaptation, but become rarer and finally disappear, while different forms crop up again. What unfolds itself in ever-increasing richness of form is the great classes and kinds of living beings which exist aboriginally and exist still, without transition types, in the grouping of today.²¹

Another difficulty of the fossil record is what might be termed 'skipping.' It was Dana who mentioned land snails of the Carboniferous period, which disappeared from the record, not to reappear till the Cretaceous period, after which they persisted into present times. Dana also mentioned scorpions of the Upper Silurian, which then disappeared until the Carboniferous. At this time they return in the fossil record, along with spiders, which both disappear after the Cretaceous, not to reappear until the Tertiary period.

In 1911, Smith mentioned the shrimp, *Anaspides*, which has not been found as a fossil in any rocks since the Carboniferous, but appeared in his day in mountain streams in remote Tasmania.

Finally, you may recall the coelacanth or lobe-finned fish, *Latimeria*, which belongs to a group that was thought to have become extinct in the Devonian period. From the Devonian to the present day, not a single fossil of this form has been found in any rock. But by the end of 1958, nine had been found in the ocean off the island of Madagascar. Incidentally, its present apparent deep-water habitat ought to cause some rethinking of the formation of rocks that contain lobe-finned fossils.

Of the early Paleozoic, 90 per cent of the rocks are depositions in shallow seas, with the remaining 5 per cent those of coastal plains and deltas. We might well ask where is the record of the land? What plants and what animals lived on the land at that time? In view of the findings of palynology regarding spores of vascular plants in the Cambrian, these become even more legitimate questions. But all the paleontological reconstructions seem to be confined to marine environments. Through the late Paleozoic, the percentage distribution isn't much different.

In the Mesozoic we find plenty of reptiles; and in these rocks we find a greater percentage of terrestrial deposits, which represent the environment of the reptiles. But does this necessarily mean that there were no reptile forms living through much of the Paleozoic on the same land that was supporting the growth of the plants that produced the spores? I am fully aware that this is paleontological heresy.

Specific Points of Concern

I am bothered by the insistence on the principle "the present is the key to the past," and the principle of either uniformity or uniformitarianism. When I look at deposits such as the bone beds in western Nebraska which consist of a remarkable number of various mammals whose bones have become completely disjointed and are one big jumbled up mess that reaches a layer five to six feet thick, I ask myself, How could this have come about? I could add the islands of almost sheer bones that are described as existing in the sea north of Siberia. Include also the quick and sudden burial of lions and mammoths in Alaska, that are now being uncovered by gold mining operations.

I am bothered by densely packed layers of shells alternating with almost completely fossil free layers that are found in the Greenhorn limestone in Kansas and Nebraska. Above all I am disturbed by the cyclothen explanations that I read in all the geology books to explain the coal beds, and then I find innumerable cases of tree trunks fossilized or coalified, which pierce through successive layers in terms of tens of feet. And I could give many more instances. Despite the fact that catastrophism is ignored by most geologists, I am afraid that for me these instances and others that I could add spell catastrophe rather than slow even deposition.

I am bothered when I read glib descriptions of equable paleo-climates over the whole world in terms of our present day solar relationships. I know that when you have a spherical body interposed in the path of parallel energy rays, you can't escape a climatic zonation due to the sphericity. There is some factor here that is not taken into account.

I am disturbed when paleomagnetism is referred to airily, and complete reversals of the earth's magnetic field are postulated, which seem to be supported by sound evidence. But I ask myself what kind of circumstances brought this about, and above all what kind of associated phenomena have been completely left out of consideration? What force could have conceivably reversed the whole magnetic field of the earth? Now that we know that the radiation belts are involved in such a field, what kind of storms would have accompanied such a reversal?

Questions such as these and the failure to find reasonable answers drive me to suspend judgment on the picture that is painted in texts dealing with past conditions. I have no quarrel with the various rock layers as they are diagrammed in texts. If there has been drilling of wells along a line, then the cores would present factual evidence as to how this part of the earth's upper crust is composed. But I may be pardoned, if I express considerable skepticism when a set of quiet unnoticed activities is postulated as the means whereby these various layers were formed and laid down.

What About Human Evolution?

A final question in the minds of many is probably, What about human evolution? From the evolutionist's point of view, man has evolved from an ape form known as *Ramapithecus*. This has been found in India in the Siwalik Hills. Current opinion would seem to hold that this form is dated as Miocene. All the material that is available currently seems to be jaw and tooth material. From this point on to that rock level known as the Pleistocene, there is absolutely nothing to go on as far as fossil evidence is concerned.

In explanation, it is held that the habits of anthropoids do not favor fossilization. In this connection Ernest Mayr²² has some interesting things to say. For one, "Logically it is possible to conceive of a situation in which we would be certain that man has evolved (from the primates) but (we) would know nothing about the actual history of this evolution" (p 163).

From a standpoint of faith in evolution, Mayr says, "Our not very remote ancestors were animals, not men" (p 287). On the other hand, speaking from the scientific standpoint, Mayr also says, "Man's recent history is shot through with uncertainties" (p 168). And on another page "there is not merely one missing link" but a "whole series of grades of missing links in hominid history" (p 637).

Be that as it may, there has been a profound change in outlook on the subject of sequence of human fossils. All human fossils today are

put into one genus, namely the genus *Homo*. This is correcting a rather unfortunate habit in the past that resulted in far more name forms than were justified. Dobzhansky²³ says on this matter,

A minor but rather annoying difficulty for a biologist, is the habit human paleontologists have of flattering their egos by naming each find a new species, if not a new genus. This causes not only a needless cluttering of the nomenclature but it is seriously misleading because treating as a species what is not a species beclouds some important issues.

The result of the compression is that a common current classification groups all hominid fossils into the following three categories: (1) The first is *Homo transvaalensis*. This group is also sometimes referred to as *Australopithecus* species, either *africanus* or *robustus*. (2) The second form is known as *Homo erectus*. This form has two varieties, one being *erectus* and the other *pekinensis*. (3) The final form is *Homo sapiens*. This form also has two varieties, one being *neanderthalensis* and the other *sapiens*.

Today these forms are all placed in the same genus-Homo and referred to as hominids because they all show upright carriage, bi-pedal locomotion, and essentially human tooth and jaw structure. This question of what is a human being, particularly when you are just dealing with the skeletal parts, is somewhat of a problem. It should never be forgotten that paleontologists are dealing with a very incomplete organism.

Arbitrarily it is generally assumed that if there is evidence of controlled use of fire and the use of tools accompanying the remains, then such remains ought to be classed as human. There are always the interesting questions, Were these tools and fire used by the fossil forms present, or Were these used by another form which existed with the fossil form, but of whom there are no fossils as yet found? Behavior cannot be discerned in man's ancestry, for behavior leaves no bones.

Also, I think anthropologists are wary today of equating size of brain and quality. The brain size varies among all mammals. It certainly varies in human beings. The average capacity of the modern American man is held to be about 1400 cubic centimeters. And yet Anatole France had a brain capacity of 1,000-1,200 cubic centimeters depending on whom you are reading, while Jonathan Swith had a brain capacity twice as great. It is generally agreed today that the variation of *Homo sapiens* will run from somewhere close to 1200 to about 1500 cubic centimeters whereas Neanderthal man ran as an average

in excess of this, generally having a larger brain than modern man. His range, however, was from 1300-1425 cubic centimeters. *Homo erectus pekinensis* specimens range in brain capacity from 900-1200 cubic centimeters, and *Homo erectus* runs from 770 - 1000 cubic centimeters.

The brain case is considered to be a very human looking feature of the *Australopithecus* forms. The brow ridges are heavy, but no more so than in some human fossils and even a few modern skulls. The mastoid process is present, and it is conical as in man. This is considered to assist in anchoring the muscles that hold the skull erect and therefore it is assumed that the *Australopithecines* had a human rather than an ape-like neck. However, the brain size seems to have run about 450 to a speculative 600 cubic centimeters. If you take the 550 maximum which is the average estimate of most anthropologists, then you have what Vallois, the noted French anthropologist, calls a Rubicon. This 200 cubic centimeter gap has not been crossed by any fossils to date.

Not too long ago it was rather firmly held that there was a direct line of human evolution running from some unknown anthropoid precursor to the *Australopithecines* to Java and Peking man to Neanderthal to Cro-Magnon to modern man. This beautiful phylogenetic line has fallen by the wayside. Several factors have contributed to its demise. It has recently been admitted by Robinson, Leakey, and others, that the *Australopithecines* can no longer be viewed as the oldest known relatives of *Homo sapiens* because more human (less brutalized) forms have been discovered who lived simultaneously with them. It was in 1963 that Dr. Leakey reported the find of a human pre-Zinjanthropus form which he named *Homo habilis*. At that time he suggested that all works on anthropology would have to be rewritten, including his own, since *Homo habilis* for practical purposes was very similar to modern man.

Brown and Robinson discovered in 1949 some human remains in Swartkraus. These consisted of two mandibles. Dr. J. T. Robinson, of the Transvaal Museum at Pretoria, South Africa, has written an opinion of this discovery of *Telanthropus*, which claims them as a superior race, definitely human, which, after invading the sites where the more inferior South African *Australopithecines* lived, led to their extinction by more intelligent manufacture and use of weapons. Dr. R. J. Mason,²⁴ who is a research officer of the Archaeological Survey of the Republic of South Africa, is of a similar opinion. Carleton Coon also refers to them as human.

One of the most fascinating developments also has been the finds of Neanderthals in the caves

of Skhul and Tabun at Mt. Carmel. In Tabun you find more modern forms apparently pre-dating the classical Neanderthal type. While the Tabun population was being specialized in a Neanderthal direction, the Skhul population was becoming less specialized. This has led the French paleontologist John Piveteau²⁵ to state, "being torn from the same layer as *Homo sapiens*, he (Neanderthal man) suffered, in his body, a veritable regression; but one recovers in the psychism of this physically degraded man the mark of his human origin." (Italics added.)

In this same work, Piveteau makes a statement on page 50 which is being held by a number of other individuals, and has previously been referred to, namely that the dimensions of the brain cannot furnish any indication whatsoever as to its functioning. It should also be mentioned that the possibility exists that deleterious gene mutations and recombination could bring about a decrease in brain size, even tending towards microcephaly. These would also bring about facial feature changes. Certainly these possibilities ought to be considered.

What are we then to do with this material on human evolution, of which I have given just the bare sketch? To deny the existence of the fossils, is wrong. They do exist. However, we can look at these now, in the light of the evidence from the Neanderthal situation, at Skhul and Tabun, and ask ourselves are these animals on the way to being men? Or are these men who have been excessively brutalized and degenerated, actually a sort of a devolution, that resulted finally in extinction? This is the considered opinion of the late Dr. de Wit, formerly head of the department of zoology at the University of the Orange Free State in the Republic of South Africa. (See J. J. Duyvené de Wit, "Reflections on the Architecture of the Organic World and the Origin of Man—A Critical Evaluation of the Transformist Principle," *Philosophic Reformata*, 29e Jaargang, 1964. This may be obtained from J. H. Kok N. V., Kampen, The Netherlands.)

It is true that this overall application of the Neanderthal proposition is not subscribed to by the vast majority of the paleontologists. However, it might be pointed out that prior to the discoveries of Skhul and Tabun, any supposition that Neanderthal was a degenerate form of more modern human types would have been laughed out of existence. So we are faced again with the situation—here is the evidence. Which way shall it be interpreted?

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PROLEGOMENA TO A STUDY OF CATACLYSMAL SEDIMENTATION

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“when we see the thing done, it is vain to dispute
against it from the unlikelihood of the doing it.”

John Ray

(Letter to Tancred Robinson/22 Okt./1684)

Sedimentation as it takes place today is a calm and slow process acting on a small scale—Holocene sediment is accumulating little by little in various sedimentary environments. If the greater part of the earth's sedimentary rock was deposited at this modern rate it would have required vast periods of time.

However, an abundance of phenomena which appear in most pre-Quaternary rock testify to a complete uncommon mode of sedimentation which might be called “cataclysmal”; i.e. sequences of considerable thicknesses were rapidly formed during a large-scale deposition. Likely, this cataclysmal event, as evidenced by the Work of God (Nature), fell together with the Noachian deluge, as narrated by the Word of God (Scripture).

In the present article the historical development of the concept of cataclysmal deposition is traced ever since the birth of geology as a science. Further, the lines of evidence in regard to this concept are partly viewed. Finally, some results of field-work are presented.

Referential procedures are changed according to the nature of subject-matters. In regard to terminology the Geological Nomenclature (English, Dutch, French, German) of the Royal Geological and Mining Society of the Netherlands is followed.

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I: Short History of Relevant Ideas

1) Nicolaus Steno (1631 -1687)

In the 17th century the true method of interpreting nature was proposed by Francis Bacon (1561-1626) in his *Novum Organum Scientiarum* (1620). He defended the value of methodically executed experiments against Aristotle (384-322 B.C.) and his mediaeval votaries. Generally speaking Bacon raised up the shield of empiricism as the means by which the physical world could be disclosed¹

The first investigator who applied the empirical method to geological questions was Nicolaus

Steno (Figure 1). His “Prodrome” on a dissertation entitled *De Solido intra Solidum naturaliter Contento* (1669) marked the birth of geology as a science, and especially of stratigraphy.

In this “Prodrome,” to which the proper dissertation was never added, Steno expressed the then uncommon view that the strata of the earth are due to the deposits of a fluid². Furthermore he conceived the principle of superposition in writing: “At the time when any given stratum was being formed, all the matter resting upon it was fluid, and, therefore, at the time when the lowest stratum was being formed, none of the upper strata existed”³



Figure 1. Nicolaus Steno. (After a portrait in the Pitti Palace).

Steno also grasped some causes of stratification. Strata lacking heterogeneous bodies, he argued, were of primeval origin, whereas fossiliferous strata were formed during the ante-

diluvian period and during or since the Noachian deluge by inundations caused by violent winds or downpours. Among other things he wrote: "Different kinds of layers in the same place can be caused either by a difference of the particles which withdraw from the fluid one after the other, as this same fluid is gradually disintegrated more and more, or from different fluids carried thither at different times."⁴

Besides, Steno made a stand against Aristotle and his disciples, who upheld the view that fossil remains of buried organism were produced *in situ* by a certain "Vis Formativa," "Vis Plastica," or "Quid Vis." He maintained the real organic character of fossils, and gave it as his view "that the formation of many mollusks which we find to-day must be referred to times coincident with the universal deluge"⁵.

The main effect of this universal and recent catastrophe Steno confined to the earth's geomorphogenical characteristics. In this context it is noteworthy that he concluded his "Prodrome" by showing that the biblical data of primeval creation and subsequent devastation constitute a framework wherein all results of geological observations could successfully be contained, arranged, and distinctly conceived.⁶ Consequently the "Prodrome" was not only a landmark in the development of geology in general; it also made its author the founding father of deluge geology. Curiously this historical truth has not been stressed up till now as far as I know.

By reason of his scientific ability, uniformitarian geologists have tried to claim Steno-making him, in subscribing to the Noachian flood, a victim of church dogma and theological authority.⁷ But on the contrary, a careful reading of Steno's "Prodrome" leads to the inference that his knowledge of biblical history stimulated his discovery that the earth's crust contains the record of a sequence of historical events, and made it a matter of course that fossils were the remains of mainly marine creatures thrown out on the continents by the running flood waters.⁸

2) John Ray (1627-1705)

Though Steno's "Prodrome" became widely known among his contemporaries, John Ray took the lead up to a point in geology. The latter's ideas in this case were couched in the celebrated *Three Physico-Theological Discourses, Concerning 1) The Primitive Chaos and Creation of the World, 2) The General Deluge, its Causes and Effects, 3) The Dissolution of the World and Future Conflagration* (1629).

The "Discourses" went through several editions until well into the 18th century. In those Ray brought up much of novelty and impor-

tance; e.g. his observations on the hydrological cycle.⁹ However, as regards stratigraphy his "Discourses" did not represent an improvement upon Steno's "Prodrome," because Ray also attributed the earth's layers to local though tempestuous inundations, mainly occurring during antediluvian times.

He held the view that at first the earth was covered with water; that the land was raised up by subterranean fires; and that as a result the waters were driven back. He continued in writing: "Afterwards when the greatest part of the earth was thus raised, the skirts were alternated by the sediments of rivers and floods, whence and from the several inundations of the sea came the several beds or layers of earth."¹⁰

Yet Ray did not go beyond the framework of biblical history and in consequence he in fact was a deluge geologist. The outcome of the Noachian flood he mainly restricted to tectonical catastrophes. Amidst these he supposed the tearing apart of the continents where he guessed that the Old and the New World formerly were linked together.¹¹ This primitive pangea concept, also conceived by Adriaan Buurt (1711-1781) and other 18th century scientists, foreshadowed Alfred Wegener's continental drift theory.

Further, Ray adopted Steno's idea of fossils as organic remains, and disputed the opposite view of many of his contemporaries. He himself viewed the scattered fossil remains as a result of the universal deluge waters. To Edward Lhwyd (1660-1709) he expressed relating to his "Discourses": "I have inserted something concerning formed stones as an effect of the deluge, I mean their dispersion all over the earth. Therefore you will find all I have to say in opposition to their opinion who hold them to be primitive productions of nature in imitation of shells."¹²

In the presence of these data it is somewhat surprising to read in Byron C. Nelson's *The Deluge Story in Stone* (1931): "Of those in England who opposed the Flood theory because they did not believe that fossils were the remains of former living things, the most prominent was John Ray";¹³ by mischance this incorrect information entered into the otherwise excellent *The Genesis Flood* (1961) of John C. Whitcomb and Henry M. Morris.¹⁴ As Nelson does cite the "Discourses," he seems to have read them; but unfortunately he did not read them well, ascribing to Ray opinions which, indeed, he expounded, but only in order to argue against these.

3) John Woodward (1667-1727)

Up to now a clear notion of the formation of stratified rock of considerable thickness was not

presented. The first to take the right road in this case was John Woodward of Gresham College. This keen-witted scientist, being intimately acquainted with most of England's stratified formations, wrote in elucidation of these *An Essay towards a Natural History of the Earth, and Terrestrial Bodies, especially Minerals; as also of the Sea, Rivers and Springs. With an account of the Universal Deluge, and of the Effects it had upon the Earth* (1695). In it he proposed his theory of a Universal Solvent.

Woodward launched into speculations concerning the Noachian flood, assuming that the upper part of the earth's crust was wholly dissolved in the all covering waters, constituting a muddled mass. From this the solid constituents would have settled down according to specific gravities, thus bringing about stratum super stratum, in which the organic bodies and parts thereof would have sealed up after gravity sorting.

It is noteworthy that the main argument for the rapid formation of subsequent strata consisted in the phenomenon of stratification itself. The same phenomenon is taken up by modern catastrophists to make out a good case for their convictions. Specifically, Woodward stated in his "Essay" with regard to the mentioned muddle:

That at length all the Mass that was thus born up in the Water, was again precipitated, and subsided towards the bottom. That this Subsidence happened generally, and as near as possibly could be expected in so great a Confusion, according to the Laws of Gravity; that Matter, Body or Bodies, which had the greatest quantity or degree of Gravity, subsiding first in order, and falling lowest: that which had the next, or a still lesser degree of Gravity, subsiding next after, and settling upon the precedent: and so on in their several courses; that which had the least Gravity sinking not down till last of all, settling at the Surface of the Sediment, and covering all the rest. That the Matter, subsiding thus, formed the Strata of Stone, of Marble, of Cole, of Earth, and the rest; of which Strata, lying one upon another, the terrestrial Globe, or at least as much of it as is ever displayed to view, cloth mainly consist.

Woodward continued with treating of gravity sorting and he went on to say:

That for this reason the Shells of those Cockles, Escalops, Perewinckles, and the rest, which have a greater degree of Gravity, were enclosed and lodged in the Strata of Stone, Marble, and the heavier kinds of Terrestrial Matter; the lighter Shells not sinking down

till afterwards, and so falling among the lighter Matter, such as Chalk, and the like, in all such parts of the Mass where there happened to be any considerable quantity of Chalk, or other Matter lighter than Stone; but where there was none, the said Shells fell upon, or near unto, the Surface.¹⁵

It stands beyond all argument that Woodward's theory of a Universal Solvent was an inadequate theory. Nevertheless it contained some constructive notions; e.g. that of gravity sorting which foreshadowed Henry M. Morris' concept of hydrodynamical selectivity.¹⁶ Such, in some measure modern ideas, went beyond the grasp of several of Woodward's contemporaries who cried down his "Essay." Even Ray turned against him, though they basically took the same position, as Karl A. von Zittel rightly stated.¹⁷

Aside from stratigraphy, Woodward's writings were of lasting value for paleontology. He took pains to demonstrate that the fossils were organic remains laid down in the deluge. Consequently he scorned the ideas of Edward Lhwyd on the one hand and Martin Lister (1638-1712) and Robert Plot (1640-1696) on the other that fossils were but "*Lapides sui generis*" or resulted from an "*Aura seminalis*." Woodward wrote in this case:

"that they are so far from being formed in the Earth, or in the Places where they are now found, that even the Belemnites, Selenites, Marchasits, Flints, and other natural Minerals, which are lodged in the Earth, together with these Shells were not formed there, but had Being before ever they came thither: and were fully formed and finished before they were reposed in that manner."¹⁸

Thus Woodward swept away forever the wrong opinion concerning fossils; and he showed together with his adherent Johann Jacob Scheuchzer (1672-1733), [who translated the "Essay" into Latin (1704) and also wrote the *Herbarium Diluvianum* (1709) and other excellent writings], the way for a better understanding of the fossiliferous strata.¹⁹

In this context it is worth noting that Johann Jacob's brother Johann Scheuchzer (1684-1738) used a half water filled bowl in showing that the Noachian flood could have been caused by a sudden stopping of the earth's rotation and a consequent gushing forth of violent tidal waves. An account of this experiment was given in a dissertation on *Lapides Figurati* read in the year 1710 before l'Academie Royale des Sciences. Irrespective of the adequacy of this elucidation to the historical events two conclusions are at hand; viz. that, to my knowledge, it was Johann Scheuchzer who was the first to execute a geological experiment and not Horace-Benedict de

Saussure (1740-1799), as claimed by Ph. H. Kuenen,²⁰ and that with this experiment the cataclysmic character of the Genesis Flood was distinctly conceived.²¹

4) **George-Louis Leclerc, Comte de Buffon (1707-1788)**

During the second half of the 18th century, geology was retarded in its auspicious development by the impact of the writings of George-Louis Leclerc, Comte de Buffon; viz. by his *Theorie de la Terre* (1749) and *Des Epoques de la Nature* (1778), constituting the initial parts of his voluminous *Histoire Naturelle* (1749-1782).

In this matter Buffon was preceded actually by his compatriot Benoit de Maillet (1656-1738), who drew up a cosmic system after Cartesian fashion, published posthumously in 1748 under the title of *Telliamed, ou Entretiens d'un philosophe indien avec un missionnaire françois sur la diminution de la mer, la formation de la terre, l'origine de l'homme, etc.*, in which "Telliamed" represented the anagram of "de Maillet."

De Maillet maintained that the strata of the earth and even the mountains were built up beneath the level of the sea by the ocean currents and by the flux and reflux of the tides. Consequently the earth's stratified rock could not have been deposited in a short space of time but only gradually during several millennia. De Maillet wrote about certain strata: "Undoubtedly they were formed in that place by a current coming from north-west, and from the sea-side, which manufactured them there successively one after another in a period of many thousands of years" (Translated from the French).²²

In an article, "Sur la Production des Couches ou Lits de Terre," Buffon lined up with de Maillet's assertions in this case.²³ Moreover, on the subject of time he did not mere guess-work but introduced a time-dimension, based on an alleged refrigeration of the globe which he had brought into being as a glowing mass torn from the sun by a striking comet.²⁴

Thus a dating method was introduced within the framework of evolutionary cosmogony. Yet Buffon's maximum estimate of the earth's age remained in the order of 75,000 years.²⁵ None the less it was plain that his system was contradicted by the biblical cosmogony. As a result Buffon tried to explain away all physical implications of the Noachian deluge, substituting the cataclysm concept by his tranquil theory, in which any geological effect of the deluge was denied. The passage in question in Buffon's *Preuves de la Theorie de la Terre* ran as follows:

After all, it is easy to convince oneself that it is neither in one and the same time, nor by the effect of the deluge, that the sea left uncovered the continents which we inhabit; because it is certain, by the testimony of the sacred books, that the earthly paradise was in Asia, and that Asia was a continent inhabited before the deluge; in consequence, it is not in that time that the seas covered that considerable part of the globe. So the earth was, before the deluge, broadly the same as she is today; and that enormous quantity of water, which the divine justice brought down on the earth to punish the culpable men, caused in fact the death to all creatures; but it produced not a single alteration on the surface of the earth; it destroyed not even the plants, because the pigeon brought back an olive-branch (Translated from the French).²⁶

So Buffon introduced the concept of an earth history passed off quietly in the course of periods of long duration; and although Buffon took a lot of geological data from Woodward's "Essay," he frequently made a stand against him and thus Woodward's influence was eclipsed by Buffon on account of the latter's eloquent diction.²⁷

5) **Jean-Andre Deluc (1727-1817)**

Still a new champion of biblical catastrophism appeared on the scene in the person of Jean-Andre Deluc (de Luc) who became an adversary of the Buffonian cosmogony. This Swiss naturalist made himself a name by his meteorological observations and experiments and by his travels through many parts of the European continent. His name was attended by authority for most of his contemporaries and he wielded great influence in his day.

In one of his early writings, viz. *Lettres Physiques et Morales, sur l'Histoire de la Terre et de l'Homme. Adressees a la Reine de la Grande Bretagne* (1778-1780), Deluc introduced the term "geology" instead of the until then usual designation "cosmology."²⁸ Next to these "Lettres" are to be named his *Lettres sur l'Histoire Physique de la Terre, adressees au Professeur Blumenbach* (1798) and his *Abrege de Principes et de Faits concernant la Cosmologie et la Geologie* (1802).

In these Deluc set himself to bear out Moses' account of cosmogony by natural history. Unfortunately he took his stratigraphical data from Horace-Benedict de Saussure, being the contemporary leading mineralogist, who held the view that granitic rock took shape as a layered deposit, being precipitated by a process of crystallisation in a primordial fluid.²⁹ In consequence this chemical process must have been a gradual one and would have taken up much space of time.

In order to fall in with Saussure's view in this case, Deluc conceived of the days of creation as of periods of indeterminate length.³⁰ In elucidation of the Noachian flood he conjectured that the mainland of before, hanging over huge cavities, collapsed by which an enormous basin came into being, taking in all ocean waters. As a result the ocean-floor of old became the mainland which we inhabit today.³¹ Thus he rendered an account of fossils and of a lot of other geological data.

Deluc's idea's were enunciated by one of his intimates, namely the Dutch poet Willem Bilderdijk (1756-1831), in a treatise on *Geologie, of Verhandeling over de Vorming en Vervorming der Aarde* (1813), which constituted the first original Dutch dissertation on geology. Bilderdijk turned against the Buffonian doctrine of a geomorphogenical history of long duration. He wrote:

It was, since Buffon, a cherished idea, that awe-inspiring space of time in which he led us about. The hugeness thereof startled and interested. But, actually, he who accounts for an effect by a force which must have acted infinitely to produce the effect to be accounted for does not make clear anything. Everything in the corporeal world takes place in a time-dimension (Translated from the Dutch).³²

Bilderdijk referred to the physical chronology, drawn up by Deluc, for the period since the universal flood.

In doing this Deluc had made use of some dating methods based on natural processes; e.g. the formation of vegetable mould; the reduction of tongues by marine abrasion; or stream erosion.³³ He proved to be aware of the fact that the last mentioned process could not have worked uniformly. He wrote: "at first the rivers carried away to the ocean a quantity of materials incomparably larger than that which they carry away today" (Translated from the French).³⁴ From these Deluc inferred "that our continents are not old; and that not any other phenomenon contradicts that inference" (Translated from the French).³⁵

Unfortunately Deluc's influence was largely eclipsed by the "Discours sur les Revolutions de la Surface du Globe" (introductory part of the *Recherches sur les Ossements fossiles* (1812) and published separately in 1826) of George Cuvier (1769-1832) who got the theory accepted that the present-day condition of the earth's crust resulted from a sequence of cataclysms in the course of lengthened periods.³⁶

6) James Hutton (1726-1797). .

The philosophy of uniformitarianism in the earth's science, advanced in the "Telliamed" and advocated by Buffon, was brought into

vogue by the writings of James Hutton and his countryman Sir Charles Lyell (1797-1875). Hutton made his doctrine public before the Royal Society of Edinburgh in a paper entitled "Theory of the Earth; or an Investigation of the Laws observable in the Composition, Dissolution, and Restoration of Land upon the Globe" (read 1785), which paper was afterwards developed into his renowned *Theory of the Earth, with Proofs and Illustrations* (1795).

In these works Hutton upheld the view that the laws of nature had acted uniformly throughout history. Thus the phenomena of the earth's crust were to be made clear by means of changes still in progress today. In consequence these changes would have taken up vast periods of time in order to account for the earth's characteristics. As a result Hutton scorned the idea of catastrophism, and he wrote in his paper of 1785:

But though, in generalizing the operations of nature, we have arrived at those great events, which, at first sight, may fill the mind with wonder and with doubt, we are not to suppose, that there is any violent exertion of power, such as is required in order to produce a great event in little time; in nature, we find no deficiency in respect of time, nor any limitation with regard to power.³⁷

In pursuance to this time-philosophy Hutton maintained that the strata now exposed on our continents were deposited little by little in the course of geological time; treating of limestone he stated:

We are led, in this manner, to conclude, that all the strata of the earth, not only those consisting of such calcareous masses, but others superincumbent upon these, have had their origin at the bottom of the sea, by the collection of sand and gravel, of shells, of coralling and crustaceous bodies, and of earths and clays, variously mixed, or separated and accumulated.³⁸

These assertions led to a vigorous controversy in which Deluc took action as an adversary of stature against the uniformitarian doctrine.

Nevertheless the Huttonian modernism gained grounds—mainly because John Playfair (1748-1819) interfered in the controversy in support of Hutton's "Theory of the Earth," of which that English mathematician prepared an exposition, easy of access, under the title of *Illustrations of the Huttonian Theory of the Earth* (1802). How important a place was awarded to time in uniformitarianism was put into words by Playfair as follows; alluding at a vast progression of daily operations, he wrote: "TIME performs the office of *integrating* the infinitesimal parts of which this progression is made up; it collects them into

one sum, and produces from them an amount greater than any that can be assigned.”³⁹

Yet the Huttonian “Theory” did not win a wide acceptance among geologists until it was championed by Sir Charles Lyell. He brought the matter up in his *Principles of Geology: Being an Attempt to Explain the Former Changes of the Earth’s Surface, by Reference to Causes now in Operation* (first vol. 1830 and completed in 1834)—the title constituted the summary of Lyell’s work. In this he stated that his method “endeavors to estimate the aggregate result of ordinary operations multiplied by time”; and further on he wrote: “For this reason all theories are rejected which involve the assumption of sudden and violent catastrophes and revolutions of the whole earth, and its inhabitants.”⁴⁰ Lyell frequently challenged the catastrophic school of geologists, primarily in the person of Woodward, and as a result he completely expelled all deluge geology from the professorial chair.⁴¹

7) George Fairholme (dates unknown)

Up to now hardly any examination of the earth’s strata was carried out in order to decide in the time-energy dilemma. In his *Geologie Bilderdijk* wrote in view of the uniformitarian systems: “Fortuitous observations, suggested by mining, and partly ill-noticed or -imagined, being always insufficient, defective, and only local, produced false and rash conclusions, upon which the imaginations, which passed for demonstrations or real inferences, were built” (Translated from the Dutch).⁴² Even Lyell in his celebrated *Principles of Geology* did nothing but lining out the probability of slow deposition of sedimentary rock and by no means did he establish the actuality of it.

The search for the testimony of stratified rock itself with regard to the rate of its formation was initiated by some 19th century deluge geologists. Among these the sharp-witted George Fairholme took the lead in writing the *New and Conclusive Physical Demonstrations, Both of the Fact and Period of the Mozaic Deluge, and of its having been the only Event of the Kind that has ever occurred upon the Earth* (1837 and 2nd edit. 1840). These “Demonstrations” constituted a landmark in the development of deluge geology. In it Fairholme exposed sedimentary structures, bespeaking a rapid deposition of successive strata to a very great thickness, and he conjectured that the earth’s stratified rock was built up by an abnormal tidal action—afterwards called the tidal theory.⁴³

Fairholme’s work was elaborated by some 19th century votaries. Yet a deluge geologist of stature did not appear on the scene until the 20th century when George McCready Price

(1870-1963) published his epoch-making *The New Geology* (1923). The main merit of Price has been his having taken hold of the crystallized time-table of geological ages, Price’s arguments in this case are for the most part couched in his *Evolutionary Geology and the New Catastrophism* (1926). Unfortunately, in dealing with the order of the earth’s strata little attention was given to the rate of formation of stratified rock.

Now then, even after one got well posted as to the earth’s crust, Huttonian geology was not scorned—primarily in consequence of its being connected with a non-biblical philosophy of life. Francis C. Haber observes: “Hutton’s thought was a development of natural theology and the timeless world-machine view.”⁴⁴ Today this philosophical heritage is playing a trick with the greater number of the world’s geologists.

Though it is attempted to justify uniformitarianism on account of the great number of adherents of this philosophy it should be born in mind that the “majority” cannot be an argument in science and its problems; for as noted by German poet and scientist Johann Wolfgang von Goethe (1749-1832): “Nothing is more repulsive than the majority: for it consists of not many forceful leaders, of scapegraces who accommodate themselves, of weaklings who assimilate themselves, and the crowd who trundles behind, without any acquaintance of its own mind” (Translated from the German).⁴⁵

Next following I have dealt with some conclusive data on the rapid formation of much of the earth’s stratified rock.

II: Main Arguments to Rapid Deposition

1) Polystrate Fossils

In spite of the prevailing hypotheses of graduality and, along with this extreme length of the earth’s history, the conditions in which most fossils all over the world are unearthed bear testimony to an extraordinary, rapid and often cataclysmal process of sedimentation. One of those conditions is displayed by a group of fossils in what I propose to call a “polystrate position.” By this concept is meant the fossil remains of huge animals and petrified tree-trunks, extending through a thick bed or, properly speaking, through two or more strata of sedimentary rock.

Such—so to be termed—“polystrate fossils” are found in many parts of the world; their height may be tens of meters and, despite this, their *topmost parts are as well preserved as the basal ones*. These facts indicate that the petrified remains were sealed up before decay and, in consequence, were buried in their polystrate position by rapidly deposited layers of sediment shortly after or even when they died or were torn up by the roots.

It is not as common to come across polystrate animal remains as those of upright tree-trunks; yet they are found. Van der Vlerk and Kuenen (1962) report: "In the United States a thick, apparently uninterrupted deposition of sands and clays is found, in which the entire bodies with the skin-impression of huge pre-historic reptiles are met with" (p. 63) (Translated from the Dutch). In case the sedimentation had been uniform the giant carrions would not be covered within 5000 years; therefore, van der Vlerk and Kuenen conclude: "The only possibility is that immediately after the death the dead body was covered and as it were ensiled by a thick bed of sediment" (p. 64) (Translated from the Dutch).

Other polystrate fossils are mainly restricted to truncated tree-trunks. These are found chiefly in the Carboniferous series; though they are found as well in exposures of Mesozoic and Cenozoic formations (Fairholme, 1837, p. 392; Shrock, 1948, p. 293; Nilsson, 1953, p. 718). Geikie (1903) writes: "It is not uncommon in certain Carboniferous sandstones to find huge sigillarioid and coniferous trunks imbedded in up-right or inclined positions" (p. 654).

Further he states: "It occasionally happens that an erect trunk has kept its position even during the accumulation of a series of strata around it" (p. 654). Geikie concludes: "We can hardly believe that in such cases any considerable number of years could have elapsed between the death of the tree and its final entombment" (p. 654).

This inference is the more conclusive when the tree-trunks are 6 to 9 meters high. It is noteworthy that such dimensions are not exceptional. About a decenniad ago in the neighbourhood of Essen-Kupferdreh in Germany over the seam Angelika, a series of *Lepidophyta* was unearthed at interspaces of 3 to 5 meters. Klusemann and Teichmüller (1954) report: "The stumps are 7.5 m. in height and must have been still higher before they were cut down by the Rurh in the Riss glacial epoch" (pp. 374-375) (Translated from the German) (Figure 2).

Afterwards, when in the same area the deposits over the seam Sonnenschein were exposed, again upright tree-trunks standing over 7 meters came to light, which likewise must have been still higher before the glacial age. The mentioned authors remark: "Because the *Sigillaria* properly speaking constituted only bark-tubes when their insignificant wood-body had become putrefied they may have been more transitory than for instance the solid oak or Sequoia trunks of today" (p. 379) (Translated from the German). As a result the enclosure of the truncated tree-trunks cannot have taken up much space of time. Klusemann and Teichmüller conclude:



Figure 2. Polystrate tree-trunk near Essen-Kupferdreh (Germany). (Photo by Klusemann).

"Perhaps it were some months, perhaps some years, but certainly not much longer" (p. 379) (Translated from the German); and this estimate is even the maximum one.

These polystrate trunks were found over a wide area. It also occurs that such fossils display a remarkable vertical dispersion; e.g. at The Joggins on Nova Scotia. Dunbar (1960)

writes: "Here erect trunks are recorded at 20 horizons distributed at intervals through about 2,500 feet of beds" (p. 227). Only a wholly uncommon process of sedimentation can account for conditions like these.

The fossilized tree-stems are not only found erect, They also occur in positions, forming an angle with the lie of the strata, varying from nothing up to 90°. A striking example of this was reported by Tayler (1857; and Nelson, 1931, p. 111) who made reference to a lofty trunk, exposed in a sandstone quarry near Edinburgh, which measured no less than over 25 meters and, intersecting 10 or 12 different strata, leaned at an angle of about 40° (Compare with Figure 3).

Similar examples are mentioned by Geikie (1903, p. 655). In addition he states that the internal microscopic structure of the relevant trees was well preserved. Further Geikie conjectures: "In such examples, the drifted trees seem to have sunk with their heavier or root end touching the bottom, and their upper end pointing upward in the direction of the current" (p. 655). Moreover, as stated by Arber (1912, p. 114), in some districts the prone stems far exceed those still upright.

Now then, as already noted by Fairholme (1837, pp. 393-394), an inclined stem constitutes a stronger testimony to rapidity in deposition than even an upright one;

for while the latter might be supposed to have been capable of retaining an upright position, in a semi-fluid mass, for a long time, by the mere laws of gravity, the other must, by the very same laws, have fallen, from its inclined to a horizontal position, had it not been retained in its inclined position, by the rapid accumulation of its present stony matrix (p. 394) (Emphasis added).

A special class of polystrate stems is constituted by stumps which extend up through a coal seam, together with some layers of sandstone and sandy slate, or even through two or more of these coal seams and all interbedded strata. Curiously few references are made to this and, if any, for the most part by earlier authors (Bolsche, 1918, p. 34; Price, 1923, p. 462). Even so examples are unusually abundant; consequently, the coal beds were rapidly deposited just as well as the above mentioned inorganic sequences.

Sometimes the upright position of the erect stumps is claimed to prove their having grown where they now stand – *in situ* (Brongniart, 1828, pp. 183-184; Schuchert, 1924, p. 401; Dunbar, 1960, p. 227). However, there are several facts which invalidate the hypothesis that they were of an autochthonous origin. More often than



Figure 3. Polystrate tree-trunk near Edinburgh (England). (After Witham).

not they are devoid of both branches and roots; and, as a result, they cannot have grown where they now stand. They also are found at various heights. Whereas, had they grown *in situ*, their basal parts must be rooted in one particular stratum.

In view of these facts Arber (1912) writes: "It is not certain that these trunks, despite their upright position, are *in situ*. They are much more probably drifted material, like the sandstones which enclose them" (p. 101). And, what's more, examples are found which appeared to be *upside down*, or, in other words, which have their root end uppermost. On account of these facts, there is no question but that the relevant stems were of an allochthonous origin (Compare with Figure 4).

Besides, it must be remembered that a drifted tree-stem will often float upright, for its centre of gravity is situated at the lower end of that stem, which constitutes the heavier one. In this context Fairholme (1837) wrote: "the stem of a heavy tree, especially if it be long, and have consequently a great disproportion between the weight of its two extremities, would naturally sink in a fluid, and perhaps still more, in a semi-fluid, with its root end downwards" (p. 393). This actually is observed along the banks of the great rivers; Arber (1912) writes: "in the deltas of large rivers to-day, the bases of trees of large size, sometimes with fragments of roots still attached, may be deposited in a more or less upright position, though they have been transported for a considerable distance" (p. 106).



Figure 4. Polystrate tree-trunks near Saint-Etienne (France). (After Brongniart).

Moreover, as pointed out by Grand'Eury (1890, p. 244, compare with pl. XIII, fig. 7) the petrified tree-stems more often than not display a thickened trunk-base. Now Horbiger (Fauth, 1913, p. 443) conjectured that the relevant trunks functioned like the spindle of a natural hydrometer (Senkwaage) by which the massive rhizome constituted the bulb (Senkgewicht); as a result they tended to float upright and were deposited in that position as soon as the current quieted. Accordingly Nilsson (1953) states: "The anatomical structure of a plant-part determines its position in a measure" (p. 716) (Translated from the German).

Curiously the upright stems usually are cut off according to a shear plane which coincides with a bedding plane. They are not fractured obliquely, as often occurs today when a tree has broken off above the roots. It is asserted by Potonie (1910, p. 120) that the shear planes were brought about by a water level of old. However, this contention cannot be supported by any modern analogy whatsoever.

On the contrary a comparison between the mentioned features and recent analogs brings to light an unequivocal discrepancy. An examination of Stump Lake in North Dakota by Aronow (1957) showed considerable level fluctuations within a few centennia: "The lake levels seem to respond in a very sensitive manner to slight climatic changes" (p. 410). Among the many stumps once rooting *in situ* only one specimen was left. It was found in an advanced state of decomposition and all similarity with fossil examples was lacking.

In addition, something else excludes that a water level came into play here; viz. that there are fossil tree-stems which are sheared off at various heights (compare with Grand'Eury, 1890, pl. XIII, fig. 7). In order to elucidate this enigma, Horbiger (Fauth, 1913, p. 445) conjectured that the relevant trunks were embedded by a huge tidal wave, bringing about stratum super stratum, during a furious cold. As a result the upper parts of the soaked trunks, standing above the frozen level of the last bed,

became as hard as nails and were sheared off on a level with the bedding plane by the next tidal wave; to this Nilsson (1953, p. 718) adds that on account of certain causes some tree-stems were not snapped off until a fresh bed was deposited and their parts, still standing out, were struck by a next impetus.

Personally, I am of the opinion that the polystrate fossils constitute a crucial phenomenon both to the actuality and the mechanism of cataclysmal deposition. Curiously a paper on polystrate fossils appears to be a “black swan” in geological literature. Antecedent to this synopsis a systematic discussion of the relevant phenomena was never published. However, geologists must have been informed about these fossils. In view of this it seems unintelligible that uniformitarianism has kept its dominant position.

In order to make this clear, as best I can, I present a historical analogue: in his *Tabulae Anatomicae Sex* (1538), the anatomist Vesalius (1514-1564) pictured the human liver with five lobes; three of these he never could have observed. Nevertheless, Vesalius pictured them—apparently in imitation of Galenus (131-200) whose conceptions were true dogmas until well into the 16th century. Nowadays most geologists uphold a uniform process of sedimentation during the earth’s history; but their views are contradicted by plain facts. Nevertheless uniformitarianists insist on their point—obviously they line up with Huttonian philosophy. A case like this is no more a matter of geological argument; I can but present it as a curious example to those who intend to trace the psychology of scientific dogmas.

2) Ephemeral Markings

A classification of sedimentary structures may be executed on the basis of several criteria; e.g. according to the time and site of formation (Nagtegaal, 1965, p. 347-352). In that manner the structures are divided into non-organic and organic types; the latter being produced by all sorts of organisms. The former are divided into “syndepositional structures” (produced by the mode and site of deposition of the settling material) and “non-syndepositional structures” (produced by the disturbance of the deposited particles).

If the disturbance of the boundary plane between sediment and water, i.e. of the depositional interface, is produced from above then the structures are called “metadepositional,” and if from below “postdepositional.” The meta- and postdepositional structures are not distinguished in regard to time. Among the non-organic, as well as the organic structures, a profusion of specimens are very transient—primarily

those located on surfaces. When the depositional interface moves upwards as sedimentation continues they easily are obliterated.

Sedimentary structures, characterized by pronounced transiency, I propose to classify as “ephemeral markings.” As a rule they are not preserved in the sedimentary complexes of the Quaternary—in which system also bedding is scarce. On the other hand the ephemeral markings are frequently recorded in all earlier systems. Their preservation more often than not requires quite a rapid deposition of covering sediment; and their astounding abundance suggests that the sedimentation was cataclysmal both to rapidity and extent. Dozens or even—when subdivided—hundreds of types of ephemeral markings are known at present and their number is still swelling. In this paper only certain types can be treated; e.g. ripple marks, rain prints, trails and tracks,

Ripple Marks

As early as the middle of the previous century two basic types of ripple marks were clearly discerned; viz. the symmetrical or oscillation ripple marks, and the asymmetrical or water-current ones. The former are produced by wave action in stagnant water, the latter by water currents not exceeding certain critical current velocities. Gradually an amplified division was proposed; e.g. by Bucher (1919, p. 208), by Kindle and Bucher (1932, p. 654), and by van Straaten (1953, pp. 1-2). However, it only applies to recent ripple marks. Concerning fossilized structures obviously identical with ripple marks the binary division may be still useful.

The conditions producing the structures at issue have been thoroughly studied for a long time; int. al. by Darwin (1883, pp. 18-43) or recently by Kirchmayer (1960, pp. 446-452) and Tanner (1963, pp. 307-311). Curiously the factors which favour or prevent the preservation of ripple marks are barely given attention. An attempted systematic discussion is contained in Bucher’s paper of 1919. In this context it is worthy of mention that ripple marks are extremely transitory. As a rule they are wiped out soon after they are produced. Geikie (1903) states: “On an ordinary beach, each tide usually effaces the ripple-marks made by its predecessor, and leaves a new series to be obliterated by the next tide” (p. 643).

However, ripple marks—chiefly mud ripples—become preserved in recent deposits—as reported by Trusheim (1929, p. 76, Abb. 6) or by van Straaten (1951, p. 54). Nevertheless examples are extremely exceptional—especially with regard to sand ripples. Accordingly Kemper (1965, p. 79) remarks that only endogenous structures stand a good chance of becoming pre-

served. As a rule surface markings are destroyed by the currents and the sustained reworking of the sea-bottom material ("ständige Materialumlagerung am Meeresboden").

For all that, Kemper came across well preserved current ripples in the Bentheimer Sandstein. He writes: "The more startling is a slab with current ripple marks . . ." (p. 79) (Translated from the German). The preserved ripple marks constitute a serious problem—especially in regard to the symmetrical type. Kindle and Bucher (1932) write:

The preservation of typical oscillation ripples under a thick layer of coarse sand, as is frequently seen in many sandstone formations, offers a more difficult problem than the preservation of current ripples, as the very existence of oscillation ripples excludes the possibility of any current erosion in the vicinity of the sedimentary surface (pp. 652-653).

However, fossilized ripple marks constitute one of the most common sedimentary structures in pre-Quaternary sequences. They are found in most exposures of any group all over the world; and, as a rule, they are markedly well preserved. Relating to sand ripples, Inman (1958) states: "they are one of the sedimentary structures frequently preserved in the geologic record" (p. 522). For obvious reasons the ripple marks must have been rapidly covered with sediment shortly after they were formed. Bucher's (1919) words are: "They must all, soon after their formation, be sufficiently covered with sediment settling on them from above" (p. 242).

As a rule the ripple marks occur only at the bedding planes of the layers—curiously not within these. This absence of ripples within the layers itself suggests that the latter were formed by an uninterrupted sedimentation. Often the ripple marks are seen from bedding plane to bedding plane in a series of layers of which each more often than not stands several feet. Practically invariably the layers succeed each other with an astounding regularity. These conditions suggest a periodical deposition, as of ebb and flow, though it must have been of an uncommon rapidity and on a large scale i.e. cataclysmal.

Presumably the sediment conveyors were huge tidal waves as assumed in the tidal theory (Nilsen, 1953, *passim*)—which waves must have been generated abundantly during the Noachian deluge (Whitcomb and Morris, 1961, *passim*). However, it cannot be clear at first sight why the sediment conveyors did not obliterate the ripple marks. Some possibilities are proposed here—though it does not concern the actuality but only the mechanism of cataclysmal sedimentation.

Perhaps some ripples were of the firm type not seldom found on sandy beaches. Kindle and

Bucher (1932) write: "Such ripple marks would survive the passage of sand-bearing currents, and speedy burial might result without damage to their form" (p. 653). Perhaps the sediment conveyors were inter- or overflows in a large body of water and did not scrape along the bottom. Perhaps the ripple marks were frozen during deposition intervals—as supposed by Nilsen (1953, p. 689). As a matter of fact fossil ice crystal marks are found on sandstone surfaces (Twenhofel, 1932, p. 677).

Rain Prints

From the metadepositional structures the rain-prints are found. A rain-drop falling on a surface of soft sand or wet mud produces a pit margined by a ragged rim. When the wind drives aslant the rain-drop, the imprint is ridged up to one side. The raised margin indicates the direction toward which the wind blew.

Obviously these structures are extremely ephemeral. As a rule they are washed out within a few hours. Despite this rain-prints are often found in the fossil record. Geikie (1903) writes: "The familiar effects of a heavy shower upon a surface of moist sand or mud may be witnessed among rocks even as old as the Cambrian period" (p. 644). However, as remarked by Twenhofel (1932, pp. 677-680), it is doubtful if they really have so frequent an occurrence as suggested in the literature.

Perhaps the supposed rain-prints were produced by agents similar to rain-drops though not identical with them. The imprints may be hail-, drip-, or spray, and splash-prints. The tendency for these imprints is to have a greater width and depth than the rain-prints. Nevertheless there cannot have been a difference in regard to transiency worth the name. Consequently, all mentioned types require a rapid deposition of the layers covering them. Add to this the fact that the imprints are often found at successive bedding planes. As a result a large-scale deposition seems to have built up the relevant sequences in a short space of time.

Trace Fossils

The occurrence of some types of trace fossils leads to identical conclusions. A variety of animal trails and tracks is produced in unconsolidated sand and mud. Generally—by reason of the softness of the sediment—the markings are quickly wiped out by wind- or water-action. Especially this holds good in regard to sand; for, as stated by Shrock (1948), "the nature of this material is such that markings made on its surface have relatively little chance of being preserved" (p. 174). Lately the same is stressed by Whitcomb and Morris (1961, pp. 166-168). For all that, trails and tracks may become fossil

(compare Shrock, *ubi sup.*). However, this does not alter the fact that examples of preserved trails and tracks in recent deposits are singular to a high degree.

Now then, despite this, they are found in the fossil record in countless numbers and sometimes over vast areas. Moreover, they may be classified among the phenomena to be observed in all systems and even in all series. The types are diverse. Twenhofel (1932) writes:

They consist of worm trails from the rocks of all ages since the Proterozoic; tracks of crustaceans, as perhaps *Climatichnites* from the Cambrian of Wisconsin, which resembles the trail of a small automobile and may be an algal impression, and double rows of pits, as in the Richmond of Anticosti, where they have been followed over a 6-inch bed of limestone for 75 miles; tracks of amphibians from the Kansas Coal Measures; and the famed reptile tracks of the Newark sandstone (p. 675).

Frequently the interpretation of trails and tracks is still doubtful. A relevant structure consists of parallel, concentric furrows, about 2 mm. in width, which is classified as "Helminthoida" and, usually, is described as "guided meander" or "spiral track" (Seilacher, 1954, *passim*; Moore, 1962, p. 200; Schafer, 1962, p. 334). It is known through thousands of examples from the Cambrian system till the Tertiary. Schafer (1965, pp. 83-90) connects it with analogues produced on a recent mud flat. About the recent traces, he states that they cannot become fossils—even with favorable sedimentation circumstances. Thus from the outset the preserved specimens must have been much more deepened. However, even then their preservation can only be brought about by the covering with sediment soon after they were produced.

Bird Tracks

Also bird-tracks are reported; e.g. by de Raaf, Beets and Kortenbout van der Sluijs (1965, p. 146-148) in the Lower Oligocene of Navarra and Zaragoza in Northern Spain. The basal part of the formation is made up by calcareous shales intercalated with siltstones. Upwards the sequence grades into a much more arenaceous succession with scores of beds with bird-tracks. de Raaf *et al.* write: "Bird-tracks, both on sandstones or siltstones (occasionally on ripple-marked surfaces or associated with salt pseudomorphs) and on shales (evidenced as natural casts on the sole of overlying arenaceous beds), occur in the entire arenaceous succession, although more frequently in its lower parts." These numerous and well preserved bird-tracks require a rapid deposition of the capping layers.

In the conclusion of their report de Raaf *et al.* remark:

It finally remains to consider the extraordinary, and often beautiful, preservation of a truly amazing abundance of bird-tracks in an area of the order indicated. It is hard to see how tracks abounding in all directions so repeatedly could be preserved at all with such regularity without invoking eolian action. Only thus can we envisage the much-repeated mechanism of quick burial and most successful preservation of the tracks after their imprint in exposed wet arenaceous to clayey sediments, first with wind-blown silt and sand derived from drying flats and only later by more sediment transported by water," p. 147.

The mechanism of preservation here postulated may have played a part—but the mentioned conditions imply a wholly uncommon process of sediment-conveying and -settling.

More often than not various ephemeral markings are found on one and the same bedding plane, i.e., ripple marks, rain prints, mud cracks, and trails or tracks occurring together and mutually strengthening the testimony of each to cataclysmal sedimentation. It should be noted that together with the mentioned bird-tracks observed by de Raaf *et al.*, ripple marks, rain prints and mud cracks were also perceived.

The rapidness by which these markings must have been covered is emphasized by very recent observations on flysch and graded graywackes. The term "flysch" refers to sedimentary complexes made up of shaly-marly sediments and medium-thick sandstones. The hard, dark rock, denominated as "graywacke," often occurs in flysch-like sequences and it resembles the flysch sandstones. Whenever cropping out, the lutite layers easily crumble away, exposing the undersides or "soles" of the sandstones. Mostly the soles are sharply defined and show a variety of surface markings, which as a rule were designated as "hieroglyphs"—a term applied to any markings found on bedding planes. Today the term "sole markings" is generally accepted.

These markings are the casts of structures in the underlying shales or marls produced there by organisms, currents, or other agents. The diverse types are described by Kuenen (1957), Pettijohn and Potter (1964), Dzulinsky and Walton (1965), *et al.* There are tracks, burrows, rill marks, flute casts, etc. Now then, the typical features of flysch and graded graywackes are interpreted by Kuenen and Migliorini (1950) in terms of a certain type of density current, viz. the "turbidity current" ("troebelingsstroom").

The relevant deposits are considered according to the turbidity current hypothesis, as "resedimented rock" or, usually, as "turbidites." Kuenen

(1957) summarizes the now widely accepted hypothesis:

Briefly, the hypothesis of resedimentation assumes that the detrital sediment is first deposited near the coast, e.g., on a delta. At intervals a mass of this material starts to slide down the slope and changes to a turbulent current, propelled by its excess weight over that of the clear surrounding water. On reaching a decrease in slope, the current is retarded, becomes overloaded, and starts to loose sediment (p. 232).

So the pre-existing structures on the superface were preserved and casts of these formed upon the bases of the capping layers. Concerning the preservation of these structures it is stated by Kuenen (1957): "The fact that such delicate markings as grazing tracks and trails, if that is what they are, have been imprinted on the graywackes of resedimented series apparently demonstrates that some turbidity current caused no erosion but started deposition at once and thus conserved pre-existing bottom markings" (p. 233). This deposition came about "very suddenly and swiftly" (Kuenen, 1957, p. 232).

More often than not the material involved must have been really immense and the velocity of the currents may have come to some 100 km an hour (compare Kuenen, 1958, p. 3). Besides, the amazing rhythmic bedding of flysch deposits, which is without modern analogue, suggests that the entire sequences were built up by a periodical and—as it were—pulsating succession of turbidity currents. If the turbidity current hypothesis is right, then the turbidites were, strictly speaking, deposited in a cataclysmal way.

None the less, Kuenen (1953, p. 7; 1957, p. 232 and compare with 1964, *passim*.) claims that the lutites were formed slowly by pelagic sedimentation and, as a result, the intervals between the deposition of successive sandy beds tended to be long. However, evidence is growing that the lutite layers were rapidly formed. Dzulinsky and Walton (1965) write: "Although emphasis has been laid on the operation of turbidity currents in the formation of sands, the hypothesis may also be applied to fine-grained beds. There is little doubt that the lower parts of most shaly layers associated with flysch sandstones commonly belong to the same sedimentary episode as the underlying arenite" (p. 11).

And further they remark: "Even in seemingly homogeneous shales, close examination frequently reveals a number of graded units. True pelagic deposits are probably very insignificant in flysch sediments and this contention finds some support in the evidence that thick shaly-flysch units have accumulated in short time intervals" (p. 11).

However, if the original material was "first deposited near the coast, e.g., on a delta" (Kuenen, 1957, p. 232), accumulating there gradually, then a succession of turbidity currents, rapidly generated after each other, cannot be accounted for. A succession of turbidity currents can be accounted for if the sediments of entire coastal regions and marine slopes were loosely packed and easily to disturb; and if agents, generating the turbidity currents, were abundant and intensive.

Typically, these conditions are existing within the framework of deluge geology. As regards the period when the deluge waters fell, Whitcomb and Morris (1961) write:

The newly-deposited sediments were still relatively soft and unconsolidated, and the imposition of new gradients and currents over them when the lands began to rise would have immediately induced scouring action on a large scale. The mixture of water and mud thus formed would, in flowing downslope, itself cause tremendous submarine erosion and ultimate redeposition (p. 269).

During this period, eustatic movements, earthquake; and volcanic activity, competent to generate turbidity currents, must have been very numerous.

Lack of space prevents continued enunciation of the arguments for cataclysmal deposition—though a profusion of arguments might be brought to the front, e.g. (1) the thanatocoenoses or "fossil graveyards," (2) the excellent preservation of even soft parts of single or packed up organisms, or (3) the phenomenon of stratification as an indication of some recurrent tidal wave phenomena of abnormal character (compare MacFarlane, 1923; Price, 1923, 1926; Nilsson, 1953; Velikovsky, 1956; Whitcomb and Morris, 1961; *et al.*). These lines of evidence are commonplace since Buckland (1836-1837) and Miller (1840).

On the other hand, the facts classified here as "polystrate fossils" and "ephemeral markings" are barely referred to in the literature on catastrophic geology—though the former phenomena are most conclusive and the latter are much more common in sedimentary complexes than any of the other facts. Without question they constitute strong arguments in favor of cataclysmal deposition, and, generally, support catastrophism as a scientific principle to interpret the earth's history. It would be gratifying if competent scientists were alive to collect and publish examples of the mentioned fossils and markings. In conclusion of this article I present some results of field work in The Netherlands (Winterswijk) and in Belgium (The Ardennes).

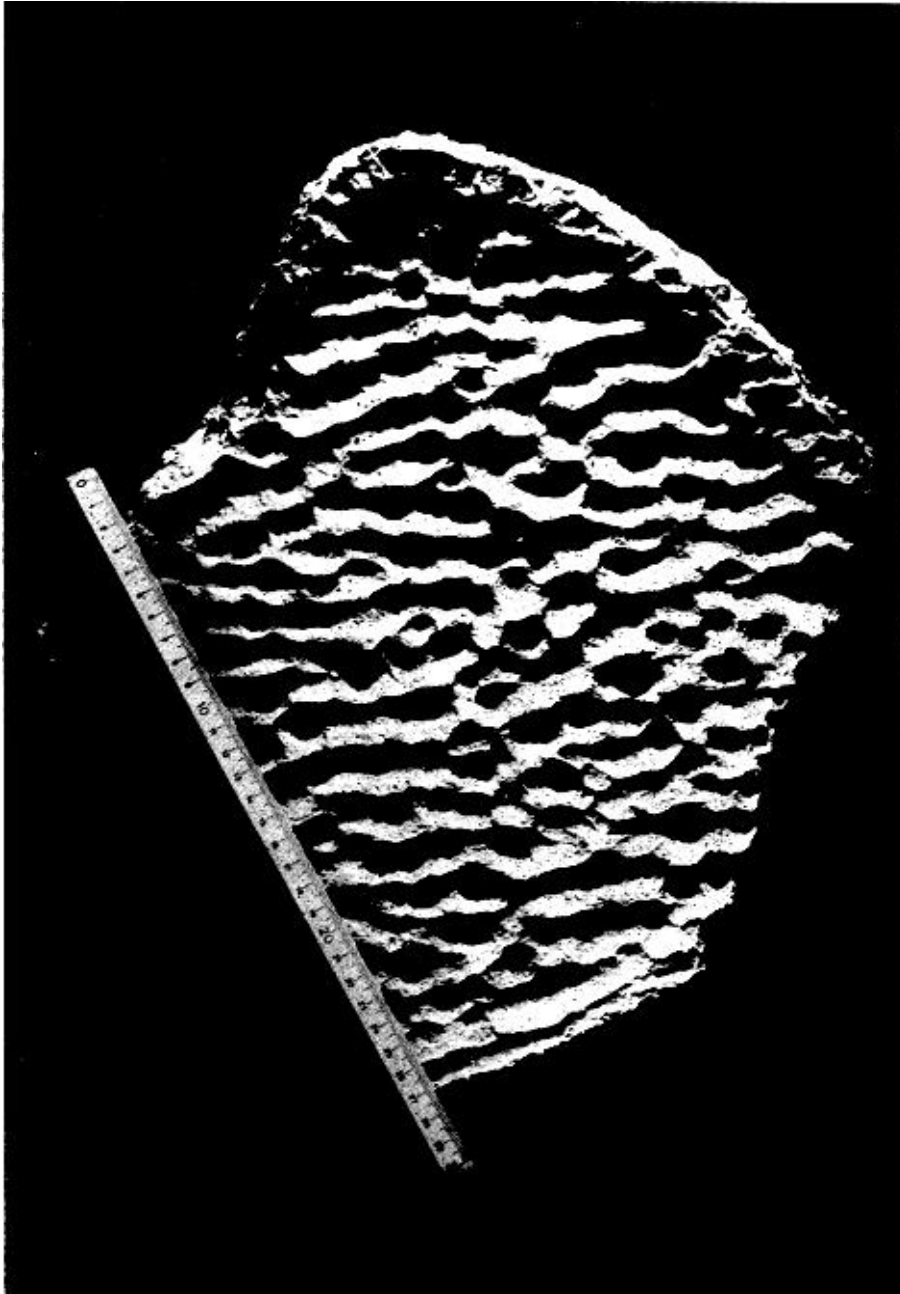


Figure 5. Ripple marks in the Winterswijk Muschelkalk (The Netherlands). (Specimen from the author's collection).

III: Some Results of Field-work

1) Winterswijk

In the Netherlands the Mesozoic is covered practically everywhere with complexes of Tertiary and Quaternary sediments. Only in some areas they crop out; e.g., in the Geldersche Achterhoek where int. al. Triassic limestones are only covered with thin beds of Pleistocene till or niveo-eolian cover-sands. The limestones contain *Myophoria* species and consequently are classified as Muschelkalk; generally, it is assumed that the deposits belong to the Lower Muschelkalk. In the vicinity of Winterswijk on the Vossenveld the limestone is being exploited by the N. V. Winterswijkse Steen- en Kalkgroeve. In that area the Muschelkalk has a formation thickness of 40-50 meters and is excavated in two quarries; viz. the Old Quarry and about 1 kilometer eastward, the New Quarry. Both I have visited several times.

In the Old Quarry the limestone displays a layered structure; it is built up of thin beds or even of laminae. On the surfaces of most beds ripple marks occur. They are of various sizes and types—though for the most part they consist of interference wave ripple marks. On an aver-



Figure 6. Rain print in the Winterswijk Muschelkalk (The Netherlands). (Specimen from the author's collection).

age the wave length is 1.5 cm. and ranges from 1 to about 2.5 cm. As a rule the crests are sharply defined and the specimens show no indication of levelling of the ripple ridges (Figure 5). The Old Quarry abounds with ripple marks; they are found at various horizons and I traced them over an area of some 20-30,000 square meters. It is a riddle to me how Faber (1959, p. 25) can say that ripple marks are rarely seen in this exposure.

In this same quarry many pits occur which look like imprints made by rain-drops; they do not extend in the limestone underneath and consequently are not crossed burrows. The average diameter is 4.5 mm., whereas imprints of 2 and 7 mm. are also found. For the most part the imprints are but few or not rimmed-though I recorded also rain prints with extremely well preserved rims. Now and then the impressions are elliptical and margined but to one side; the elevated side indicates the direction in which the rain-drop came down (Figure 6). In places the prints abound and they are found at various horizons. Frequently they are found on slabs with fossilized mud cracks; the cracks are restricted to thin beds or laminae being only some few mm. thick. For instance, on a surface, enclosed by superficial mud cracks and being about 10 cm.², some 10 to 15 rain prints occurred.

In the New Quarry also thin beds and laminae are extant; in addition thick layering is observable. On the relevant surfaces ripple marks are relatively infrequent—whereas rain prints are very abundant and often occur on laminae criss-crossed by mud cracks.

Frequently surface markings of puzzling character appear which were not described or determined until now; Faber (1959, p. 31) seems to make reference to it when he writes that he came across some patterns which he could not place. In figure 7 a specimen is pictured. Kuenen suggests, by personal communication, that the structure was produced during consolidation—though he does not vouch for the truth of his guess. Personally, I incline to the opinion that the structure was produced by streamlets of flowing water which eroded minute channels—called rill marks. I observed a recent ephemeral structure identical to Figure 7 on the beach of the Dutch isle Schiermonnikoog.

On beaches the back washing wave is followed by a film of water which finally divides into streamlets. Sometimes the streamlets flow back in zigzag line and produce tiny channels round about rhomboid patches which are not eroded away; the extremities of some diamonds may run out into tongues of sediment. The same was observed by Twenhofel (1932) who states:

On beaches composed of fine sands, the returning waters of waves may be succeeded by a

net-work of anastomosing rills or small currents whose minute erosion produces a sculpturing of the beach surface resembling the surface of a *Lepidodendron* tree, the uneroded surface or polygons between the minute currents being diamond-shaped, with the long axes of the diamonds normal to the water's edge (p. 671).

Now then, the mentioned features are displayed by the pictured surface; viz. the uneroded diamonds and the tongues of sediment (e.g. middle left)—though on a small scale as compared with rill marks on sandy beaches. Little joints which are of secondary character confuse the original structure as does also the clearly visible trial.

Trails and tracks are not abundant though they are found (compare with Figure 7); a trackway is recorded of *Chirotherium* (sic!) *peabodyi* (Faber, 1958, pp. 317-321; p. 448; van Regteren Altena, 1958, pp. 447-448),

Evidently both the Old and the New Quarry hold a profusion of ephemeral markings; viz. ripple marks, rain prints, mud cracks, rill marks, and, incidentally, trails and tracks. Without question the delicate structures here determined as rill marks are very transient. Consequently, all recorded markings must have been rapidly covered with sediment.

Within the framework of Huttonian geology, it is assumed that the limestone sequences were deposited by the settling of calcareous skeletons of marine micro- and macro-organisms. On account of rain prints, mud cracks, etc. it is assumed that the Winterswijk Muschelkalk originated in shallow water, e.g. a lagoon. Van Straaten (1963, pp. 12-13) supposes that in the north half of the Adriatic some 20 grams of lime per square meter per annum, i.e. 0.00008 cm. per annum, is deposited.

In regard to the Winterswijk limestone, the rate of lime deposit could not have been much more—for the distinct bedding and lamination and other phenomena are thought to prove that conditions of life were unfavorable. It is beyond dispute that in sedimentary environments like this no ephemeral markings could have been rapidly covered and preserved; in other words, uniformitarianism cannot account for the Winterswijk Muschelkalk.

In order to account for the excellent preserved conditions of countless ephemeral markings which occur through the entire deposit it is necessary to assume that lime beds were rapidly deposited after each other. This implies that the calcareous materials were not auto- but allochthonous, and were transported from elsewhere. Moreover, the regular bedding suggests that the sediment transport was governed by

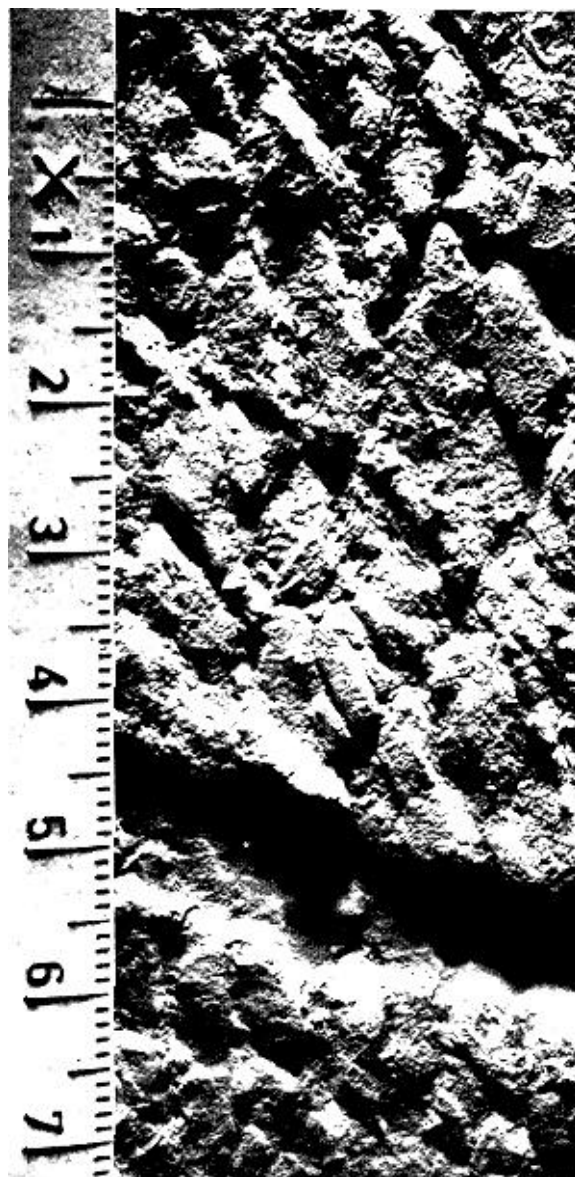


Figure 7. Rill marks (?) in the Winterswijk Muschelkalk (The Netherlands). (Specimen from the author's collection).

rhythmic and—as it were—pulsation depositional patterns.

2) The Ardennes

The relief of eastern Belgium is dominated by an orogen called the Ardennes; in the folding process only Paleozoic sequences were implicated; they are intersected by the Meuse and her tributaries-e.g. the Ambleve or the Bocq. In their valleys, often Devonian and Carboniferous sand- and limestones are exposed. The Famennien—a stage of the Upper Devonian—consists for the most part of psammities. They are excavated on a large scale for the purpose

of paving and building; as a result the Famennien is largely exposed and most data are obtained from the relevant quarries.

On entering a psammite exposure the regular bedding is striking; beds of psammite succeed each other with astounding regularity—more often than not *thin beds of shale* constitute the partings of the arenaceous units.

Almost invariably on the bedding planes, ripple marks occur which are of various types. Both symmetrical and asymmetrical ripple marks are found—though the former more frequently than the latter. Often it is possible to trace these marks over the entire surface of an exposed bed. When ripple marks are first exposed they appear to be—for the most part—extremely well preserved. In this connection, I offer two examples:

In Figure 8A, symmetrical wave ripple marks are pictured which occurred in a quarry near Aywaille sur Ambleve; on an average the wave length is 4-6 cm.; the crests are still sharp.

In Figure 9A, asymmetrical current ripple marks are pictured—though the pattern was altered by wave action. This specimen occurred in a quarry near Yvoir in the valley of the Bocq. The wave length is about 3.5 cm.; there is no sign of levelling of the ripple ridges. In this context it is worthy of mention that these ripple marks occurred on sandy slabs.

Rain prints are not abundant in the psammites; van Straaten (1954) even reports that “he did not find one single unambiguous example” (p. 36). However, they in fact are found, since I came across an example in the quarry near

Aywaille sur Ambleve (Figure 10). The surface shows two imprints being slightly rimmed on the right, toward which the water-drops must have been directed. Otherwise, the imprints may—properly speaking—present spray- or splash prints. The imprints occur isolated, being about 1.5 cm. in width while one is clearly elliptic. In the splash zone of a beach I observed two nearby splash prints of identical feature; both the fossil and the recent imprints were without great depth.

In regard to trails there is no shortage; on the contrary, they are typical of the Famennien. In Figure 11, a trail is depicted which I found in the quarry near Yvoir in the valley of the Bocq. It occurred on a rippled surface, and lengthwise to a trough; the surface marking is rimmed on both sides and the little ridges are amazingly well preserved. Perhaps the trail was produced by a worm though it is difficult to determine the true nature of the agent.

It is believed by van Straaten (1954) that the Psammites du Condroz—the arenaceous facies of the Upper Famennien in the Ardennes—were formed in “a tidal lagoon, bordered by tidal flats and receiving a more or less periodical supply of fluvial material” (p. 25); the supply must have been limited by a minimum of 0.03 mm. per annum and a maximum of 0.6 mm. per annum (compare with van Straaten, (1954) p. 45).

However, these uniformitarian suppositions cannot be brought into agreement with the mentioned phenomena. It is true that an alternation of sandy and shaly laminae may be brought



Figure 8A. Ripple marks in the Aywaille psammite (Belgium). (Photo by Rupke).

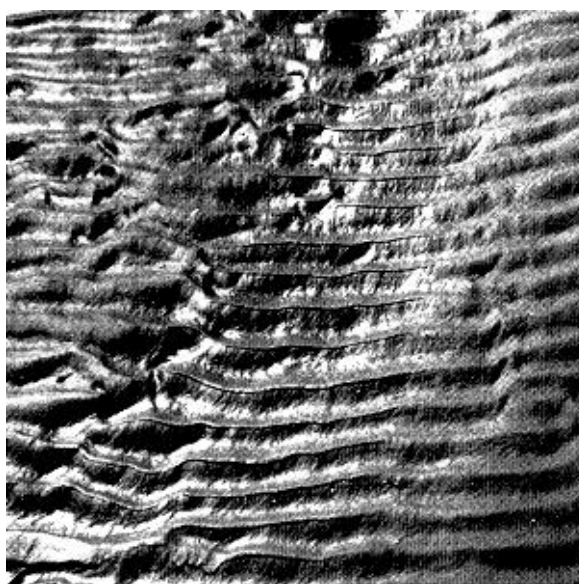


Figure 8B. Ripple marks on the beach of Schiermonnikoog (The Netherlands). (Photo by Rupke).



Figure 9A. Ripple marks in the Yvoir psammite (Belgium). (Photo by Rupke).

about in recent deposits; viz. as tidal- or storm-surge lamination on tidal-flats or marshes (Richter, 1926, p. 306; 1929, pp. 25-26). However, such laminae are only some few mm. or, at most, some cm. thick. But the sandstone- and limestone beds, parted by shaly units, as observed in exposures of the Famennien and—just as well—of various other sequences in the Ardennes, more often than not measure several decimeters in thickness and occasionally even much more. In fact, the distinct alternation of sandstone or limestone beds with shales suggests a tidal action and a consequent periodical deposition. But from the outset these tides must have acted much more intensively and extensively than the known tides of today in order to bring about beds of the mentioned thickness. Perhaps a periodical succession of tidal waves of great sedimentary competency came into play here.

In Holocene deposits ripple marks are preserved, but it applies mainly—maybe exclusively—to ripple marks in mud. Ripple marks in sands are extremely transient. In Figures 8B and 9B, ripple marks are depicted as observed on the sandy beach of Schiermonnikoog. Figure 8B represents symmetrical wave ripple marks which are somewhat modified by erosion. Figure 9B shows asymmetrical current ripple marks—downstream slope on the left, so current from the right—and crosswise symmetrical wave ripple marks which likewise are modified by erosion.

These patterns were photographed shortly after



Figure 9B. Ripple marks on the beach of Schiermonnikoog (The Netherlands). (Photo by Rupke).

they were laid bare; nevertheless, the ripples became already blurred on account of sun- and wind action (Figure 8B on the right and Figure 9B on the left). For that in the mentioned Ardennes exposures, many specimens are extant of amazingly well preserved ripple marks occurring on sandy bedding planes covered by shale- or sandstone beds. These conditions, bespeaking rapid deposition of successive beds, are absolutely unequalled in Holocene sediment. This statement is even more valid in regard to splash marks and worm (?) trails—being extraordinary ephemeral, but nevertheless preserved in the Famennien. As a result uniformitarianism is deficient in accounting for the sedimentary phenomena of the Famennien, and of analogous sequences in the Ardennes.

Undoubtedly the actuality of cataclysmal deposition is apparent from a profusion of sedimentary phenomena. Yet the mechanism of rapid formation of sedimentary complexes is somewhat difficult to conceive—though enlightening elucidations are already given (Price, 1923, pp. 679-692 to be compared with Twisden, 1877, pp. 35-48; Nilsson, 1953, *passim*).

Perhaps—as to limestone—ooze from antediluvian deep-seas was stirred up and transported by tidal waves, generated during the Noachian deluge. Then due to current-sorting, the finer materials (e.g. lime- and clay particles) were deposited in one locality, and the coarser (sands etc.) in another—though frequently not per-

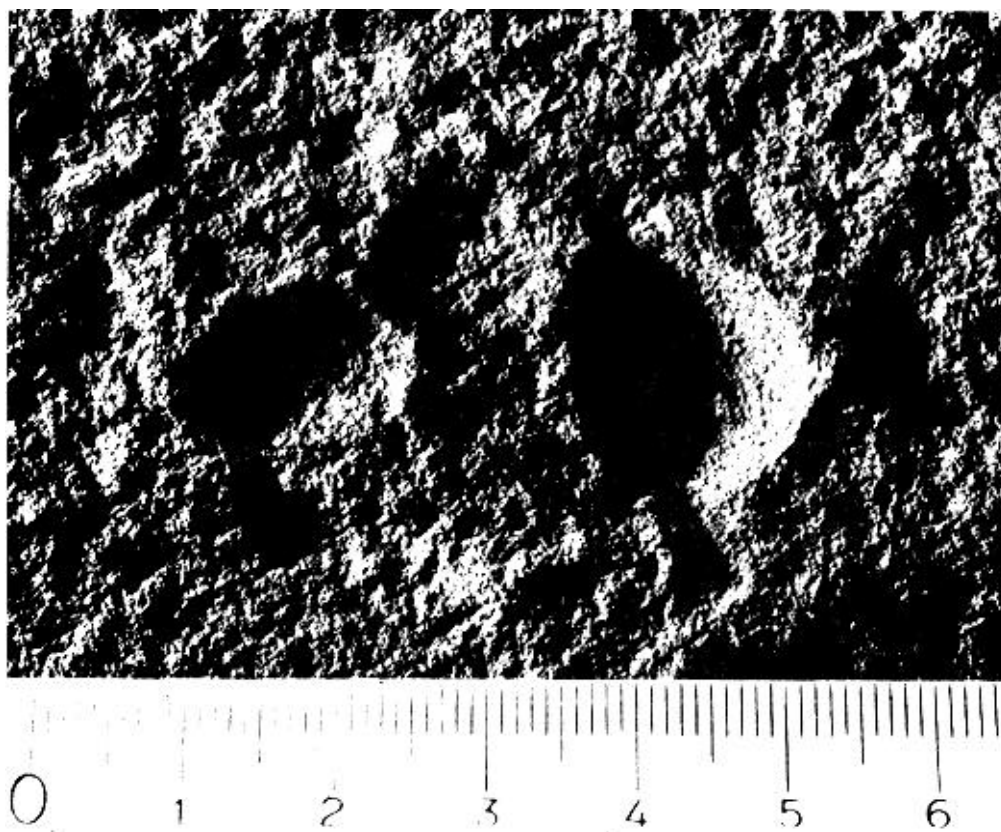


Figure 10. Splash (?) prints in the Aywaille psammite (Belgium). (Specimen from the author's collection).



Figure 11. Worm (?) trail in the Yvoir psammite (Belgium). (Specimen from the author's collection).

fectly sorted, Indeed, the Winterswijk Muschelkalk is composed of limestone, and also of marl, shaly marl, marly shale, and even of some calcareous sandstones.

However, and most importantly, the reader should bear in mind that the conceivability of cataclysmal sedimentation cannot constitute a criterion as to the actuality of it. It is unsound to argue: "Non est, nam non potest," as is frequently done by Huttonian geologists. In this connection, the words of John Ray, cited at the beginning of the present article, are worth laying to heart, and accordingly I claim with all authority of empiricism: "Potest, nam est."

December 1965.
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Notes and References

- ¹Francis Bacon, *Novum Organum Scientiarum*, Lib. I, Cap. LXXXII, Lib. II, Cap. X et passim.
- ²Nicolaus Steno, *De Solido intra Solidum naturaliter Contento*, pp. 26-32; Facsimile-Edition, ed. W. Junk, no. 5, 1904. An English translation entitled *The Prodromus of Nicolaus Steno's Dissertation concerning a Solid Body enclosed by Process of Nature within a Solid* with an introduction and explanatory notes by John G. Winter appeared in 1916, University of Michigan Studies, Humanistic Series, Vol. XI, Part II.
- ³John G. Winter, *Ubi sup.*, p. 230.
- ⁴*Ibid.*, p. 227.
- ⁵*Ibid.*, p. 258.
- ⁶Compare, pp. 67-76; original edition.
- ⁷Sir Andrew Geikie, *The Founders of Geology*, 1897; Dover Republication 1962, p. 60.
- ⁸G. W. von Leibnitz wrote concerning Steno: "saepe ipsum nobis narrantem audire memini, ac gratulantem sibi, quod sacrae historiae and generalis diluvii fidem naturalibus argumentis, non sine pietatis fructu, asrueretur"; *Protogea*, Par. 6; *Summi Polyhistoris Godefridi Gvilielmi Leibnitii Protogea*, pp. 12-13; 1749.
- ⁹John Ray, *De Wereld cvn haar Begin tot haar Einde. In drie Natuurkundige Godgeleerde Redeneringen, II: Den algemeenen Zuudvloed, desselfs Oorzaken en Uitwerkingen*, pp. 62-98; 1765 (being the Dutch translation of his "Discourses").
- ¹⁰Because I only had the disposal of a Dutch edition of Ray's work I cite from Charles E. Raven, *John Ray, Naturalist, His life and Works*, 1950, p. 438.
- ¹¹John Ray, *Ubi sup.*, p. 148.
- ¹²Charles E. Raven, *Ubi sup.*, p. 431.
- ¹³Byron C. Nelson, *The Deluge Story in Stone*, 1931. p. 37.
- ¹⁴John C. Whitcomb and Henry M. Morris, *The Genesis Flood*, 1961, p. 90.
- ¹⁵John Woodward, *An Essay toward a History of the Earth*, p. 73-76; 1702. Extracts are given by Melvin E. Jahn and Daniel J. Woolf (See "The lying stones of Dr. Johann Bartholomew Adam Beringcr being his Lithographiae Wirceburgensis," Notes, pp. 176-178; 1963.)
- ¹⁶John C. Whitcomb and Henry M. Morris, *The Genesis Flood*, pp. 273-274.
- ¹⁷Karl Alfred von Zittel, "Geschichte der Geologie und Paleontologie," p. 41; *Geschichte der Wissenschaften in Deutschland, Neuere Zeit*, Band 23, 1899.
- ¹⁸John Woodward, *Ubi sup.*, p. 19.
- ¹⁹In almost every publication dealing with Woodward, he is put on a level with Thomas Burnet (Compare *Telluris Theoria Sacra: orbis nostri originem and mutationes generales, quas aut jam subiit, aut olim subiturus est, complectens* 1681) and with William Whiston (Compare *A New Theory of the Earth, From its Original, to the Consumation of all Things. Wherein The Creation of the World in Six Days, The Universal Deluge, And the General Conflagration, As laid down in the Holy Scriptures, Are shewn to be perfectly Agreeable to Reason and Philosophy* (1696).
- This trio is taken as representative as regards early deluge, geology; however, wholly unjustly. Burnet and Whiston did not leave intact the biblical framework of early history and undermined at will the inspired authority of scriptural passages or even of whole books; consequently, they were no more deluge geologists than theistic evolutionists are real creationists.
- A recent evaluation of Woodward's work is given by V. A. Eyles, "John Woodward, F.R.S. (1665-1728)," *Nature*, Vol. 206, No. 4987, May 29, 1965, pp. 868-870.
- ²⁰Ph.H. Kuenen, "Experiments in Geology," *The Transactions of the Geological Societt of Glasgow*, Vol. XXIII. 1858, p. 1.
- ²¹See *Histoire de l'Academie Royale des Sciences*, Annee 1710. Avec les *Memoires de Mathematique et de Physique, pour la meme Annee*, pp. 19-21, 1712. Compare *Journal des Scavans*, Octobre 1713, p. 459, 1713.
- ²²Benoit de Maillet, *Telliamed*, Tome II, pp. 19-20; Compare p. 58; Nouvelle edition 1755.
- ²³See "Preuves de la Theorie de la Terre," Art. VII, *Oeuvres Completes de Buffon et de ses Continueurs*, Tome I, pp. 150-162; 1828.
- ²⁴*Ibid.*, Art. I, pp. 110-123.
- ²⁵Buffon, "Des Epoques de la Nature," passim.
- ²⁶Loc. cit., Art. V; *Ubi sup.*, p. 135. Compare Gen. 8:11; this biblical passage constitutes a classical argument against biblical catastrophism; it was dealt with by Samuel Bochart, *Hieroicoicon*, Lib. I, Chap. 6; Bocharti Opera, Tom. III, pp. 27-30; 1712; by Mattheus Polus and Simon Patrick, *Verklaring van Mozes eerste Boek, genoemd Genesis, uit de Engelsche Verklaringen van de heeren Patrik, Polus Wels, en andere voorname Engelsche Godgeleerden*, H.1., pp. 98-99; 1741—being the Dutch translation of their exegetical studies; by Theodorus Christophorus Lilienthal, *Die gute Sache der in der hl. Schrift Alten und Neuen testaments enthaltenen gottlichen Offenbarungen*, Chap. XV, Par. 8; 1760-1780; and a recent discussion of the question is given by John C. Whitcomb and Henry M. Morris, *The Genesis Flood*, pp. 104-106.
- ²⁷George Cuvier, *Histoire des Progres des Sciences Naturelles, depuis 1789 jusqu'a ce jour*, p. 184; presente 1808; 1826.
- ²⁸Jean-Andre Deluc, *Lettres Physiques et Morales, sur l'Histoire de Terre et de l'Homme*, Tome, 1779, p. 7.
- ²⁹Horace-Benedict de Saussure, *Voyages dans les Alpes, precedes d'un Essai sur l'Histoire naturelle des Environs de Geneve*, Tome I, pp. 145-149; Tome II, pp. 376-386; 1803.
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- ³¹*Ibid.*, pp. 649-650.
- ³²Willem Bilderdijk, *Geologie*, p. 109; 1813-published anonymously.

- ³³Jean-Andre Deluc, Ubi sup., pp. 490-505; compare Willem Bilderdijk, Ubi sup., Chap. 6.
- ³⁴Jean-Andre Deluc, Ubi sup., p. 498.
- ³⁵*Ibid.*, p. 505.
- ³⁶George Cuvier, "Discours sur les Revolutions de la Surface du Globe," pp. 6-8 et passim.
- ³⁷*Transactions of the Royal Society of Edinburgh*, Vol. I, Part II, 1788, pp. 293-294.
- ³⁸*Ibid.*, p. 221.
- ³⁹John Playfair, *Illustrations of the Huttonian Theory Of the Earth*, facsimile reprint, Dover Republications 1956, p. 117.
- ⁴⁰Sir Charles Lyell, *Principles of Geology* (or the modern changes of the earth and its inhabitants considered as illustrative of geology), Vol. I, Bk. I, Ch. XIV, 1867. p. 325.
- ⁴¹The controversy between catastrophism and uniformitarianism is discussed as a whole by R. Hooykaas, *Natural Law and Divine Miracle*, 1960, 2nd impr. 1963; the view of many geologists of today in this case is expressed by M. G. Rutten, *The Geological Aspects of the Origin of Life on Earth*, 1962; Dutch edit., 2, 1965, pp. 23-39.
- ⁴²Willem Bilderdijk, Ubi sup., p. 104.
- ⁴³George Fairholme, *New and conclusive Demonstrations*, 1837, pp. 392-404. (I should appreciate a reader's informing me on the dates of George Fairholme.)
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MICROFLORA OF THE GRAND CANYON

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Introduction

About two years ago, I made a study of the micro-fossils of the Chinle formation (Mesozoic) in the Petrified Forest area, Arizona. The remarkable variety of spores found there has been reported by Roadifer et al.¹

Since the resistance of the outer or exine layer of pollen grains gives them a stability in time (geologically speaking comparable to that of diatoms, foraminifera and other minute siliceous animal bodies), the study of palynology has become, rather rapidly, of great importance in determining the flora of the past.

Recent reports of finding fossil Angiosperm pollen in the Cambrian (Leclercq²) led to the suggestion that a study of the micro-fossils of the various Grand Canyon formations might prove of interest. Several trips into the canyon were made, the last one on November 18, 1965, with Harold Slusher, geophysicist of Texas Western College, El Paso, Texas.

The following is a report on the various types of spores found in various formations.

The micro-fossil slides are available in my collection for reference, and will be deposited in whatever museum the Creation Research Society declares as their official source location for material published in their journal.

Acknowledgments

The author wishes to express his indebtedness to the University of Arizona for use of laboratory facilities during part of this study. My original training in palynology was under the direction of Dr. Gerhardt Kremp, who first interested me in this phase of Paleobotany. The observations and conclusions reported in this paper, however, in no way reflect the thinking of the Paleobotany department of the University of Arizona, or that of Dr. Kremp. I also wish to express my appreciation to Harold Slusher, who made my last trip into the canyon possible, and to Dr. Walter E. Lammerts for his careful evaluation of the manuscript, botanical descriptions and general pertinence of the data submitted.

Material and Methods.

The maceration technique, though somewhat similar to that used by Roadifer et al, is one which I have especially perfected. Contamination by modern spores would seriously confuse results, so all samples were collected with great care. New plastic bags were peeled off a new

pack, the surface of which was protected from exposure to the air during the trip. Exposed weathered rock was carefully chipped away until fresh unfractured rock was available. Then samples were cut and placed in the bags, labeled and securely tied. The sealed bags were taken to the laboratory for maceration, and the rock was crushed in the bags. The following is both a general description of sampling technique and my own modification of technique previously used.

Maceration Technique

Whatever instruments are used for grinding the rock samples must be thoroughly clean. After use all equipment is carefully washed with detergent.

The chemical technique will vary with the type of sample. Coal or peat requires boiling with K-O-H or Schultz solution to dissolve the carbonaceous material, nitric acid and potassium chlorate. For modern pollen the acetolysis method is used where the pollen and plant fractions are preserved in glacial acetic acid until time for treatment.

The chemical method has been the most commonly used technique for the maceration of spores and pollen. Sulfides are removed with concentrated nitric acid, and carbonates with hydrochloric acid. Much of the rock is composed of silica, which can only be dissolved with hydrofluoric acid. This acid is highly toxic when it comes in contact with the skin, or when the fumes are breathed. Therefore, it is necessary to use this acid under the ventilated hood, and with the operator wearing goggles and rubber gloves.

While the exine of the spores is not easily destroyed with acids, there is always danger of some damage. The writer has therefore been employing a more simplified method, as follows:

1. Clean the specimens. The sample should be well cleaned to remove all contamination, with brush under running water.
2. Disaggregation. If a mortar and pestle are used to break up the rock, they should first be well scrubbed with brush and abrasive cleanser, then dried with compressed air before use. Break up the rock until it passes a 1 mm. screen; if ground much finer the spores may split.
3. Place about 1 gram of sample in a 100 ml. lusteroid centrifuge tube.

4. Add enough Varsol or other cleansing solvent to cover the sample, making sure it is wet all through.

5. Add 5 to 10 drops of a non-ionic detergent (such as Lux or Joy) and stir.

6. Fill tube with distilled water, shake thoroughly, then place in transducer tank of ultrasonic generator for about ten minutes. Stir occasionally if standing open, or shake if tube is stoppered. This greatly speeds up disaggregation of particles.

7. Remove tube from tank, stir or shake, and place in rotating drum for several hours to complete the disaggregation.

8. Centrifuge for 2-3 minutes at 1,500 r.p.m. and decant.

9. Fill with 10% hydrochloric acid solution, stir, then centrifuge and decant. Wash and centrifuge 2-3 times to get rid of hydrochloric acid. The acid will keep solution from clouding.

10. After decanting, fill with zinc bromide heavy liquid of 2.2 specific gravity. Stir or shake manually or with machine for a few minutes.

11. Pour into double plastic tubes inserted into larger centrifuge tubes. Place in centrifuge and rotate at 1500 r.p.m. for 2-3 minutes.

13. The sediment goes to the bottom and the spores float. The plastic tubes are pinched off just below the float and the top is decanted into smaller tubes. The residue may be saved for rechecking later to see how good a separation took place.

14. Since the spores have a specific gravity of about 1.5, they will float in the heavy liquid. The tubes are now filled with distilled water, which reduces the specific gravity below 1.5; thus the spores will sink.

15. Stir or shake, centrifuge and decant. Fill again with distilled water, centrifuge and repeat washing until heavy liquid is gone. The residue is now mixed with glycerine and centrifuged to get rid of most of water.

16. The small amount of residue containing the spores is now drained off into small vials for storage after labeling.

17. A small amount of glycerine jelly is placed on a glass slide and heated until it melts; to which is added a like amount of the spore residue. After mixing, a cover glass is placed over it and after drying, is sealed with some type of sealer such as fingernail polish. The slide is labeled and filed away, or placed under the microscope for examination.

18. The best spores or pollen are photographed if the microscope is equipped with a photographic camera.

Geography and Geology of the Grand Canyon.

Though well known to most everyone in a general way, a brief description of the various formations in descending order will help to clarify results obtained. The formations are identified in the usual way, but without attaching to them the usual time significance assumed by most modern geologists. For the geologist and non-geologist alike the vast chasm of the Grand Canyon with its multicolored rocks is truly one of the greatest spectacles in the world.

On the south rim of the canyon you stand on a whitish marine limestone of the Permian period and Paleozoic era. It is called Kaibab limestone and is an accumulation of lime and sandstone with fossils of corals, sea shells and sponges.

Immediately below the Kaibab and Toroweap (also Permian) come the Permian white cliff forming sandstone with cross bedded sandstone formed by wind causing dune formations. Tracks of lizard-like creatures are found in this formation called the Coconino sandstone.

Hermit shale is next below the Coconino sandstone and is considered by paleontologists as still part of the Permian formation even though lithologically radically different from the sandstone above. It is an accumulation of mud and sandy sediments, evidently formed by the flow of sediment-laden, slow moving waters from the northeast. Trails of worms, salamanders, and impressions of ferns are preserved. About 35 species of fern and cone bearing plants have been found.

The Supai formation, also Permian, is next below the Hermit shale and is the thickest seen from Grand Canyon Village, measuring about 800 feet thick. It consists of altered layers of hard sandstone and soft shale or hardened mud. Some twelve to fifteen notable alternations can be seen when viewed from a distance, and many more when examined at close range.

Since the Supai is a non-marine formation, some combination of river and flood action must be postulated to explain this interbedding or cyclic sedimentation. A rapidly changing provenance or source area for the origin of this series of deposits is also necessary. No adequate tectonic agent has thus far been suggested. This formation is notable for its flaming red color which also colors the Redwall limestone below. Large tracks of some four-footed animal as well as tracks of smaller creatures have been found.

The Redwall limestone next is a great cliff-forming rock, mostly red and about 550 feet thick. It contains many kinds of marine fossil life sea shells, corals, and sections of crinoids. This formation is Mississippian in age, and thus dis-

tinct paleobotanically from the various formations above. The iron containing sediments of the overlying Supai are fire-brick red, and the descending water has carried this color to the Redwall below. When not overlaid by the Supai, the "Redwall" is not red, but whitish like the Kaibab. This is quite evident as one descends the Kaibab trail, but to date I have not seen any report on the significance of this phenomenon. Later I will discuss this in relation to the proper interpretation of what we are really seeing here.

The Devonian period is not well represented at this part of the canyon. A small section of lavender colored rock, immediately below the Redwall, containing fish scales is the extent of that period. The lower Devonian, Ordovician, and Silurian are missing altogether. This represents an hiatus of over 100,000,000 million years according to usually accepted theory as presented in the "standard" geological column. The Mississippian Redwall limestone rests apparently conformably on the Cambrian. This is called **paraconformity**, and presumably represents a long period of time when neither erosion nor deposition of sediments occurred in this area. All physical evidence for this gap in deposition of strata is lacking. No angular discordance or erosion surface can be found.

The Muav limestone lies next below the Mississippian Redwall at most places in the canyon. At a distance it actually appears as a continuation of it. However it is of Cambrian age, was deposited beneath a sea, and contains fossils of sea life, typically Cambrian as regards species and genera.

The Bright Angel shale lies next below the Muav limestone and also is classified as Cambrian. Lithologically it is very different and a striking greenish grey color. It contrasts more sharply with the Muav limestone than the Muav contrasts with the Redwall limestone, even though both are Cambrian in distinction from the Mississippian Redwall. The Bright Angel shale ranges 450 to 650 feet in thickness and the fossils are all marine.

The Tapeats sandstone lies below the shale and is 225 foot thick and brown in color. This is the bottom stratum of the Cambrian and likewise the Paleozoic era. It rests on an erosion surface of Pre-Cambrian. The Tapeats forms a great, nearly flat platform known as the Tonto platform. North and south, normal vertical faults cut across the canyon, slicing the Pre-Cambrian so that in places the Tapeats rests on or contacts Shinumo quartzite, in other places the Tapeats lies over the Hakati shale, Bass limestone and even the older pre-Cambrian Vishnu schist or intrusive granite.

The only life so far reported in the Pre-Cambrian is fungi and algae, very simple plants structurally speaking, without a vascular system. The Colorado River has cut a deep gorge of about 1000 feet into the pre-Cambrian Vishnu schist.

Such, in brief, is the order of formations seen as one descends into the Grand Canyon and some of the structural problems in need of explanation.

Present Grand Canyon Vegetation.

The Canadian zone does not generally typify the vegetation even at the top. However in the colder parts typical Canadian zone Douglas fir, Engelmann spruce, Colorado blue spruce and quaking aspen are found. Mostly the top of the canyon which is 7000 feet high is typically transition zone or the yellow pine belt. Here are found, where water is available, the juniper, some pinion pine, cedar, scrub oak, manzanita, brittle brush, cottonwood, willow, long-stemmed grasses, and various asters. Desert types such as the burro brush catclaw, mesquite, and narrow leaf yucca are also found. Down lower we come to the Sonoran zone characterized by the box elder, Wilcox live Oak and the redbud or Judas tree. The Mormon tea is one of the few remaining members of the ancient joint-fir family and is found in the lower Sonoran zone.

An abundance of wild flowers are in bloom on the Tonto plateau in late April and May. Pollen of these were not found as fossils.

The Angiosperm Pollen Grain.

Since many of the non-botanical members of our society are unfamiliar with the structure of pollen grains and spores a brief description is in order.

The Angiosperm pollen grain is built up of three concentric layers. The center is the living cell, which germinates on the stigma and forms the pollen tube that penetrates the style, and brings the fertilizing nuclei down to the ovum. The middle layer is the *intine*, the composition of which is at present not well known, but it is thought that part of it consists of cellulose. These two parts of the pollen or spore are quite easily destroyed.

The *exine* is formed of one of the most extraordinarily resistant materials known in the organic world. It is the exine which survives ages of decay processes and is relatively unchanged after lengthy chemical treatment. This remarkable durability is the basis of palynology. Its resistance to destructive forces is due to its unusual chemical composition. The exine of pollen, as well as spores, contains a highly polymerized, cyclic alcohol termed *sporopollenin* by

Wyssling. It is related to suberine and cutin but is more resistant than either.

The exine is structurally complex, with at least two layers. The inner layer, the *endexine*, is a continuous homogeneous membrane. The outer layer, the *ektexine*, is composed of numerous small elements whose development and distribution produce great variability in structure. If the outer elements of the exine do not form a continuous covering, the type is called *intectate*. On the other hand, if the covering is continuous, the type is *tectate*.

Most pollen grains possess openings or thin areas of the exine through which the pollen tube emerges at germination. Two general types of apertures exist, known as the *furrows* and *pores*. Furrows are boat-shaped depressions in the exine, while the pores are tiny holes in the exine. One-furrowed grains are common in monocotyledonous and gymnospermous plants. Three furrows or pores are typical of dicotyledonous plants.

If the pollen is divided into lobes longitudinally, they are known as *dicolpate* or *tricolpate*, according to whether there are two or three lobes. These occur mainly in the dicotyledons.

Spore Morphology

Since the pollen are specialized types of spores, the above description of pollen also covers spores in a general way. Spores are usually elongate instead of spherical in shape, with three contact faces and radial symmetry. The universal distinction between the two fundamental spore types is the tetrad scar. It is usually well defined and easily discernible as *monolete* or *trilete*.

Regarding size, spores are divided into two classes, the *megaspores*, or large female spores, and the *microspore*, or small male spores. The latter are much more numerous, and include the pollens. The spores belong to the algae, ferns, lycopods, the Psilophyta, the Arthropophyta, and non-seeding plants. Spores and pollen vary in size from 5 microns to 200 microns or more.

Pollen is usually produced in large quantities and the pollen dispersed to the ground is known as *pollen rain*. The wind has been known to have dispersed pine pollen as far as 60 miles from the nearest pine forest. Pine pollen is equipped with wings or bladders which help them float afar, so that the presence of pine pollen in soil or rock does not necessarily mean that pine trees grew in that exact location. The spores and algae and water plants are carried by water largely. It has been estimated that a single anther of *Canabis sativa* produces as many as 70,000 grains. Since only a comparatively

small percentage of pollen grains will ever fulfill the purpose for which they grew, their production is very prolific.

Results of Examination of Slides from Maceration of Rocks from Various Formations.

The following identifications are only tentative, but at least are indicative of the type of spores found in various formations, and usually are certain at least to the genus unless otherwise indicated.

The Supai Formation (Permian)

The shaly members of this lowest of the Permian series are relatively thin and are the ones sampled. One slide showed about 20 vesiculate pollen grains of Conifers. This was not unexpected since the Permian is not very far from or below the Triassic, which, in the Chinle formation at the Petrified Forest, produced so many fossil conifer pollen grains. There were also about half a dozen pollen grains of various Angiosperms, both polyplicate and disaccate.

Technical Description

Genus *Podocarpitis* Cookson

Diagnosis: Disaccate pollen grains with the equatorial outline of the central body oval to polygonal; marginal crest usually visible; sacchi large, pendent distally; length of the sacchi always greater than that of the central body.

Podocarpitis species. (Plate I, Figure 2)

These grains because of their marginal crest and large sacchi are provisionally compared to the genus *Podocarpitis*. The ornamentation of the sacchi is radial; body granulose. The pollen grains average 110 microns in breadth. Found in about the center of the Supai formation vertically speaking. These grains also have a resemblance to *Picea complantiformis*.

Plate I, Figure 1 shows a tiny bit of bark that somewhat resembles a lycopod, showing the characteristic leaf cushions pattern on scar left from the fallen leaf stems. These were found commonly in coal measures and are an arborescent type of plant. The rock samples were taken 30 feet west of the Kaibab trail, about 5 miles east of Grand Canyon Station on O'Neill Butte flats. They are from a prominent 6 foot thick seam of shale between sandstone layers.

Ephedra species. (Plate I, Figure 3)

These grains measure 35 x 52 microns and are prolate to sub-prolate. They have about thirteen longitudinal ridges separated by well defined grooves. When the pollen grains germinate, the exine dehisces, splitting into two or more parts through the grooves. Wodehouse has observed

PLATE I

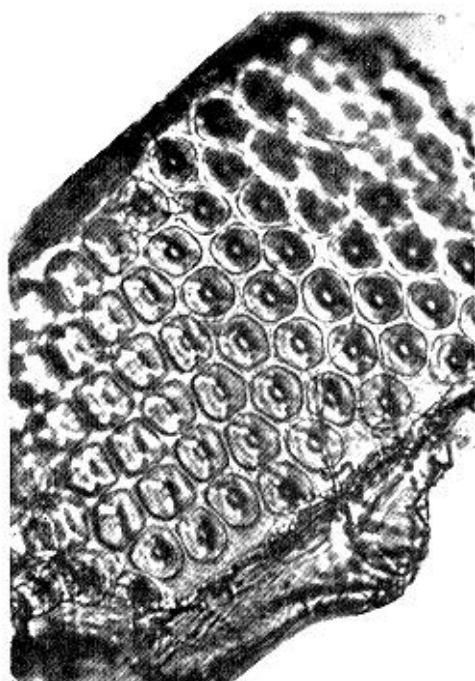


Figure 1



Figure 2



Figure 3

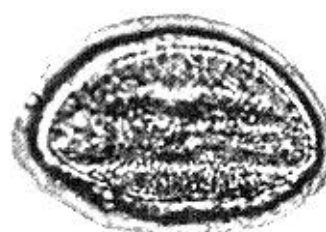


Figure 4



Figure 5

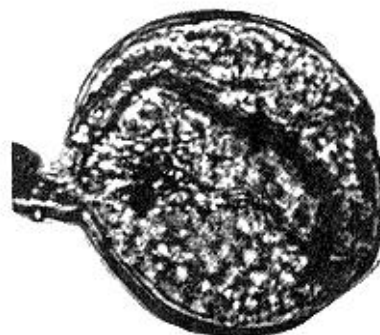


Figure 6

this kind of dehiscence in the grains of *Ephedra intermedia*.

The same phenomena has been recorded by Stapf (1879) for other species. His figures show a grain split that way with the protoplasm emerging from the split end. The exact species cannot be determined but comparison indicates close resemblance to *Ephedra eccenipitis*. This genus is a Gymnosperm and is commonly found in the Eccene Green River formation, an oil bearing shale. This specimen is from the same rock sample as described above.

Gymnosperm as yet unidentified (Plate I, Figure 4)

This is a small pollen grain about 30 microns in length and is evidently monocolpate or monosulcate. It is either a Gymnosperm or a monocotyledon spore which often have only one furrow.

Genus *Alisporites* (Daugherty) Potenie and Kremp.

Diagnosis: Disaccate grains; proximal outline including sacchi more or less oval; longest axis of the oval central body about as long as bladder bases; distally a distinct relatively narrow germinal groove with thin exine, bordered by the parallel straight bladder bases. The bladders are only slightly pendant and crescent shaped.

***Alisporites opii*, Daugherty (Plate I, Figure 5)**

These pollen grains are identified as being identical to those reported by Daugherty from the type locality in the Petrified Forest so are undoubtedly of this species. (Compare with Daugherty's Figure 1, proximal view.) Diameter 110 microns.

Unidentified spores (Plate I, Figure 6)

A definite identification of these spores is not possible. There are three fossil spores described which come close to matching it. Phlug³ illustrates one he calls *Shizoplanites bipolaris* Phlug. It also resembles Bolhovitina's⁴ *Selagenella reclusa*. Another possibility is *Azonialetes*. All three genera are typical of the Cretaceous, or are Mesozoic in the literature so far available. The spores average 110 microns in diameter. They are possibly dicotyledonous plants with tricolpate pollen grains.

The Redwall Formation

This Mississippian formation lies under the Supai and measures about 550 feet in thickness near the Grand Canyon Station. Samples were not taken of the limestone but from some of the numerous shaly seams interbedded with the limestone in the Redwall. Reddish colored oblate spores were found of unknown origin as

well as some vesiculate coniferous ones. The samples described were taken from a shaly seam sandwiched between limestone strata in the back of a prominent cave on the south side of the Kaibab trail, 100 feet from the Redwall-Supai contact down the trail vertically. This was at a point where the trail passes from the west to the east side of the rock exposure.

Technical Description

***Selagenella* species (Plate II, Figure 1)**

Here is illustrated what appears to be a tricolpate spore but a definite classification is impossible. Bolkhovitina⁴ describes a similar spore or pollen grain of Jurassic age which he classifies as *Selagenella reclusa*. The usual horizon for this spore is middle Mesozoic and mid-Tertiary, yet here we find it in the upper Paleozoic. The spores average 120 microns.

***Alisporites opii* (Plate II, Figure 2)**

This is a spore 110 microns in diameter shown in proximal view. The spores of this species are described above as one usually found in my Supai formation slides. This spore is also illustrated in Plate I, Figure 5. The smaller size shown in the illustration is due to a lower magnification.

The Bright Angel Shale

This yellow Cambrian formation lies below the Muav limestone, also classified also as Cambrian, which in turn lies unconformably beneath the Redwall limestone. It is a shale formation several hundred feet thick, actually 450 to 650 feet thick at the location where collected. Samples were taken 9 feet south of the Kaibab trail from a vertical exposure where the trail leads westward for a short distance about 200 feet below the Bright Angel-Muav limestone contact line.

Technical Description

***Alisporites opii* Daugherty (Plate II, Figure 3)**

The similarities and variations in this spore are illustrated by comparison with Plate I, Figure 5 and Plate II, Figure 2. The spore diameter averages about 110 microns.

Tricolpate dicotyledon (Plate II, Figure 4)

This somewhat triangular spore resembles *Shizoplanites bipolaris* described by Phlug. If so it is a tricolpate dicotyledon. Identification—even to the genus has not yet been made.

Unidentified spore (Plate III, Figure 1)

This spore was 80 microns long. Picture taken at 100x. The spores were reddish in color.

Unidentified spore (Plate III, Figure 2)

This spore was 70 microns in diameter. The picture is at 100x.

PLATE II



Figure 1

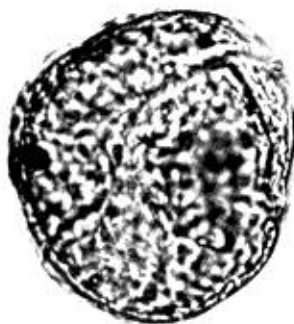


Figure 2



Figure 3



Figure 4

Disaccate spore (Plate III, Figure 3)

This disaccate spore is 40 microns in diameter. Picture taken at 100x. A reticulate structure is shown.

A disaccate Gymnosperm spore (Plate III, Figure 4)

A disaccate spore 100 microns in diameter is shown. The spore was yellow in color, and undoubtedly is a Gymnosperm.

Vesiculate spore (Plate III, Figure 5)

This elongated reddish spore was vesiculate in appearance. It was 120 microns long and the picture is taken at 100x.

Though identifications have not been made on the above spores even to the family they are shown to give some idea of the variety of spores found in the Bright Angel shale.

The Hakati Shale Formation

The Hakati is in a vertical fault block and lies below the Cambrian Tapeats sandstone from which no spores were obtained even though many macerations were made. The Hakati is several hundred feet thick at its exposure on the Kaibab trail and of brick red color. It is a prolific source of spores, Fungi were found as well as tricolpate pollen of Angiosperm plants. Articulate stems were found and also lycopods. The predominant type of pollen was vesiculate characteristic of conifers. Approximately 50% of all spores found were coniferous. The vegetation which contributed these windblown spores was evidently similar to that from which the Permian Supai was derived. All specimens were obtained from a single slab of rock taken ten feet from the Kaibab trail on the east side right at the government marker describing the Hakati shale.

Technical Description

Genus *Podocarpidites* Couper

Diagnosis: This a monad, disaccate, non-aperaturate spore with reticulate ornamentation and a sort of a granular exine covering on the central body. The central body is oval to round. Cookson proposed the sporotype *Podocarpidites* for fossil pollen grains with two air bladders, of the type met with in *Podocarpus*, or when it is not known whether they have been derived from *Podocarpus*, *Dacrydium* or some extinct member of the family Podocarpaceae. Studies by Cranwell and others have shown that the number of air bladders is relatively unimportant in the separation of generic groups, but the nature of the thickenings of the air bladders is a good diagnostic feature.

***Podocarpidites marwickii* Couper (Plate IV, Figures 1, 2)**

Discussion: Locality usually Mesozoic; in this case Grand Canyon, Arizona. Common to abundant in many localities. This species is characterized by having large air bladders well extended beyond the central body, which is heart-shaped. The line of bladders beyond the central body is slightly cambered. The surface is ornamented, with reticulate granular surface. Length of spore is 140 microns. Specific locality: Hakati shale, Grand Canyon, at the government marker designating the Hakati formation. Figure 2 is a little smaller, about 100 microns, and the specific location is near the top of the Hakati formation. About twelve vesiculate fossil spores were photographed, but space does not permit publishing all of the Hakati specimens here. Color: reddish.

Genus *Parcisporites* Leschik

Diagnosis: Monad, discaccate, nonaperaturate, reticulate ornamentation. The air bladders not well developed, most have two small wings. The bodies are circular with rough, reticulated exine covering.

***Parcisporites annectus* Leschik (Plate IV, Figure 3)**

Discussion: This is the genotype of *Parcisporites* Leschik. Diameter 30 microns, body circular and spore circular except for the rudimentary bladders protruding from each side. Rough, heavily reticulated surface of both body and bladders. The Figure here shown is a double spore, the two still attached after being ejected from the spore mother cell. The coloration is deep red, quite different from the lack of coloration of many recent spores. Thickness of reticulum 2 microns.

Genus *Tricolpites* Cookson, ex Couper

Diagnosis: Cookson described a new sporomorph *Tricolpites reticulatus*. *Tricolpites* is here considered a form genus and is diagnosed as follows: Free, isopolar, tricolpate. Exine variable in thickness and sculpture. Size variable.

***Tricolpites matauraensis* Couper (Plate IV, Figure 4)**

Discussion: Monad, ornamentation, reticulate, non-aperaturate, free, isopolar, tricolpate, colpae long, broad, no trace of ora, grain sub-prolate to prolate. Exine 2 to 3 microns thick, exine 1 micron, sexine 1-2 microns, clavate, baculate, forming a fine-pitted reticulate sculpture in surface view; lumen of reticulum less than 1 micron across. 50 microns polar. Usual range, lower Tertiary.

PLATE III

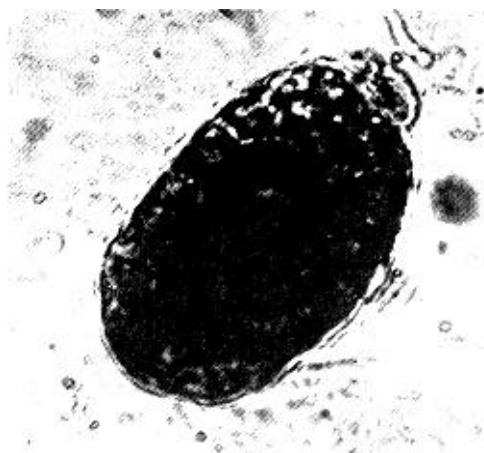


Figure 1

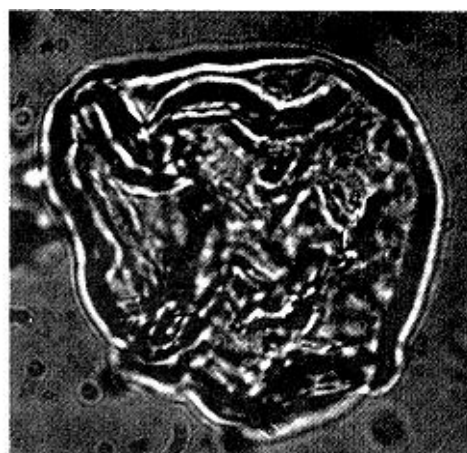


Figure 2

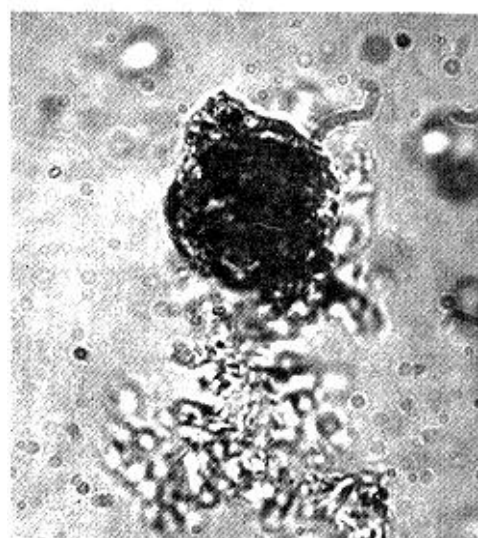


Figure 3

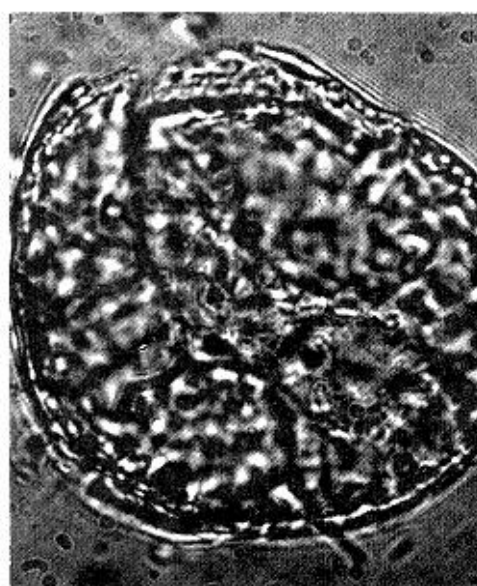


Figure 4

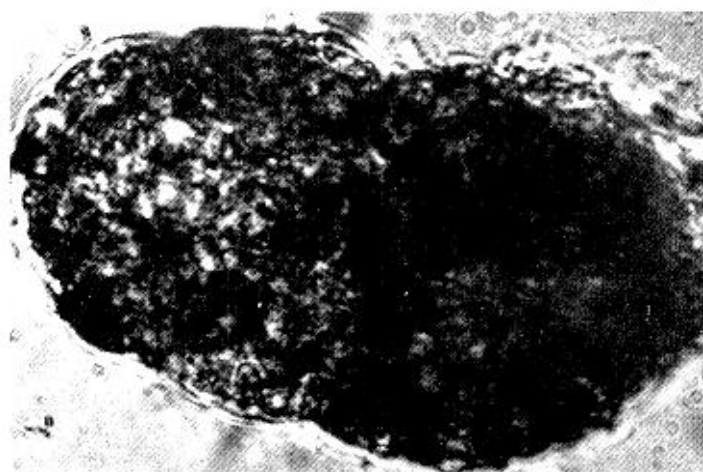


Figure 5

Plate 4, Figure 5 is fossil spore that I will not try to describe with certainty. There appear to be three fossil spores that have been described that come close to matching this fossil spore found in the Hakati near the bottom of the formation. Pflug describes a fossil spore that closely resembles Figure 5 which he calls *Schizoplanites bipolaris* Pflug, 1953. (Cretaceous age) The Russian Bolkhovitina describes a similar fossil spore that closely resembles Figure 5, as *Selagenella reclusa*, Bolkhovitina, 1956. This too is Mesozoic. Another possibility is that it may belong in the genus *Azonaletes*, also Mesozoic.

Schizoplanites is an Angiosperm (or flowering plant) often found in the Cretaceous, and though tentative, I am of the opinion that the spore shown is from a plant closely related to this species. In any event it is a typical Angiosperm type of spore.

Plate 4, Figure 6 illustrates a small tricolpate pollen grain that I also will not try to identify; there are several possibilities. Potonie describes such a pollen as *Pollenites*. Under this genus he describes a host of species but *P. maculites* bears a close resemblance to the one photographed. He gives a Miocene age for this fossil.

The Russian palynologist, Bolkhovitina, 1953, also describes a similar fossil tricolpate pollen as *Sambucus pseudocanadensis*. His horizon for this fossil is Upper Cretaceous.

Discussion

In pre-Pleistocene times before the glacial epochs, there is abundant fossil evidence that not only pines but sub-tropical flowering plants (Angiosperms) ranged much further north than what we now know as the arctic region. This study of the micro-fossils of the Grand Canyon formations is the first one indicating that Conifers and Angiosperms extended backward into what is usually called Cambrian and Pre-Cambrian times. Though variations in percentages of spore types occurred, in general the same type of characteristically wind blown pollen was found in **all the formations** from the Permian on down through the Pre-Cambrian. The vesiculate, disaccate spores or pollen (a specialized type of spore really) outnumber all others about two to one.

Spores were not found in the sandstone and limestone rock layers even though many macerations were made. We cannot rule out the possibility that with sufficient work spores from this lithological type of formation might be found. However it does seem significant that of the many macerations made only those from the same lithological type of rock formation, namely shale, yielded spores.

Furthermore, three of the four shales were practically the same color, brick red. The Bright Angel shale is greenish grey to yellow buff. Not all the shale formations yielded spores, since the Hermit shale immediately above the red Supai formation has so far produced nothing from the many macerations made from it.

The Bass limestone lies just below the Hakati shale and according to evolutionary theory contains the oldest life in the Grand Canyon. Many samples were run from this formation, but so far only one small spore was found. It appeared to be from a modern grass, and bore no resemblance to the large reddish vesiculate conifer pollen grains.

It should also be stated that not all macerations even of the spore bearing formations yield spores. Thus one of my associates ran about sixty samples from the Supai before he was able to isolate a single spore. Obviously these wind blown spores are not evenly distributed through the rocks and patience as well as a certain amount of "good luck" is necessary for this sort of "grab bag" study as any palynologist will testify. For this reason negative results are dangerous as far as conclusions are concerned.

However continued lack of success with sandstone and limestone would seem to indicate a relationship between the type of deposition and the chances of spore entrapment. Therefore, the suggestion is made that the cohesive qualities of clay particles together with a relatively quiet phase of fine particle sedimentation are two essentials for spore entrapment and fossilization.

It is important to note also that an entirely **different** type of vegetation is indicated by the fossil spores than that which is now growing in or near the Grand Canyon. Thus *Podocarpidites* simply means a fossil plant resembling the genus *Podocarpus*, a group of species in the yew family or Taxaceae. This genus is found in rather moist areas, such as Japan, and indicates that prior to the deposition of the formations of the Grand Canyon, the climate was not so dry and arid as now.

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

PLATE IV

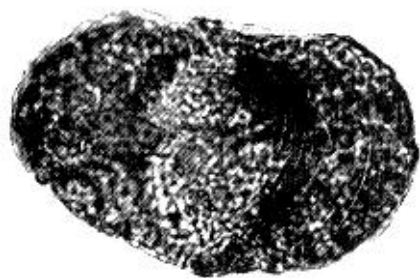


Figure 1



Figure 2

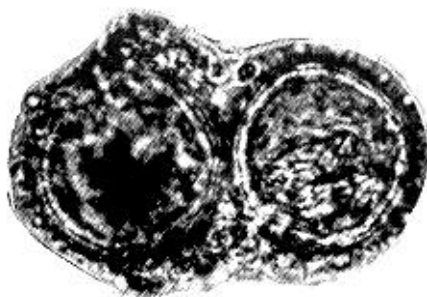


Figure 3



Figure 4

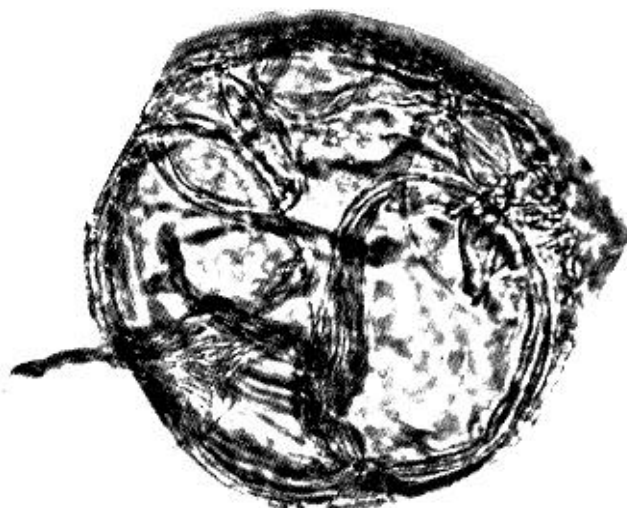


Figure 5



Figure 6

For those who insist on a time significance to the various formations, discovery of both Gymnosperm and Angiosperm pollen grains in the Cambrian and Pre-Cambrian does indeed present problems. A parallel situation in the animal kingdom would be location of mammals in the Pre-Cambrian.

I am inclined to consider retention of the idea of time significance more a matter of faith than science. The unusual fact that **all** formations yielded essentially the same types of spores would seem to indicate that all the formations were formed within a relatively short period of time.

It is really difficult to conceive of Podocarpus-like plants existing for several hundred millions of years **close enough** to the slowly submerging synclines to contribute pollen to the four different shales representing this time span from the Permian to the Pre-Cambrian!

The peculiar fact, that when not overlaid by the Supai, the Redwall formation is **not red** is important. Why did oxidation of the iron in the Supai not occur until all of this Permian formation was eroded away from the surface of that portion of the Redwall which is white? For, when overlaid by the Supai, the Redwall is always red. During at least 198,000,000 years of its existence, the iron was not oxidized, according to the presently accepted practice of attaching a time significance to the various formations.

According to the usually accepted geological time scale, the Supai was deposited on top of the Redwall some 200,000,000 million years ago. Yet, according to usually accepted theory, the erosion of the canyon did not begin until the uplift of the Colorado plateau about ten million years ago. Erosion and cutting of the canyon then continued until all the Supai was removed from portions of the canyon leaving the uncolored "Redwall" exposed.

Let us assume that this was complete by about 2,000,000 years ago. The problem then is, why should about 198,000,000 years of the existence of the Supai pass by without oxidation of the iron, thus leaving the underlying "Redwall" whitish in appearance? For it is the red oxide of iron that makes the Supai so beautifully contrasting with the white Coconino sandstone above. If the iron had been oxidized earlier **all** of the Redwall formation would be red instead of only that covered by the Supai.

As discussed in a previous article (Burdick⁵), the many repetitive lithological alternations present further difficulties in the way of accepting the usual interpretation and explanation of how these strata were formed.

It is not the purpose of this paper to present the many lines of evidence indicating rapid deposition of these and other stratified rocks during a world wide catastrophe of gigantic proportions. I do wish to point out that such facts as the white "Redwall" formation areas are easily explained as the result of very rapid erosion of the relatively soft sediments soon after their deposition during the subsidence period in the centuries following the world wide Flood. Soon is here used in a relative sense as compared with the usual concepts of hundreds of thousands or millions of years.

The presence of a flora liberating pollen followed by entrapment in suitable fine clay particles must be clarified. Destruction by flooding, outpouring of lava and other volcanic activity even miles away would liberate millions of wind blown spores. Even though the plants themselves would no doubt for the most part be destroyed, leaving only occasional areas where fossil stem and other parts could be found, the pollen and spores would be much more wide spread in their distribution.

Whenever currents from the areas in which these plants grew had subsided enough to drop all the heavier sand particles, the remaining finer suspended clay particles would settle out and entrap whatever spores might happen to be present. The limestone was probably from a different or marine source and so would normally not have any pollen. The ebbing and flowing of various currents then built up the formations we now see.

With patience and fortunate chance we can gradually unravel the chain of events at least locally which took place. Little by little these must then be fitted together to give an overall concept of exactly how the complex of events making up the world wide catastrophe actually occurred. The total effect here at the Grand Canyon is indeed one of grandeur.

Summary

1) Evidence is presented indicating that pollen grains of Angiosperms and Gymnosperms are found in four shale formations of the Grand Canyon, beginning with the Permian Supai on down to the Pre-Cambrian Hakati shale.

2) Sandstone formations did not yield any spores even though many maceration were made.

3) Attention is called to the difficulty of explaining the white "Redwall" portions of this formation in terms of the usual concepts giving time significance to the various formations.

4) Finding of spores of plants at least closely related to pines in the Pre-Cambrian makes it

extremely difficult to visualize any evolutionary development of these specialized plants. The undoubted occurrence of pollen of flowering plants is even more difficult to explain in usually accepted evolutionary concepts.

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HYDRAULICS, SEDIMENTATION, AND CATASTROPHISM

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PART 1

Role of Water in Geologic Interpretation

Of all physical factors involved in the study of geology, one of the most obvious and certain facts is that water has been the primary geophysical agent in shaping the earth's surface. The planet Earth, uniquely among all bodies in the universe in so far as any real knowledge goes, has been equipped with an abundant supply of water, and this fact is profoundly important in the understanding of earth history.

This water supply is intricately associated with almost all the physical processes and structures of the earth. Approximately 71% of the earth's surface is, in fact, covered with water. Practically all plant and animal life is composed mainly of water; the human body, for example, is more than two-thirds water! Most chemical processes of importance involve water, as do biologic processes. No wonder the Apostle Peter said:

. . . heavens came into existence long ago by word of God, and an earth also which was formed out of water and by means of water. (II Peter 3:5b, Amplified Bible).

It is obvious that even the 29% of the earth's surface which is dry land has in the past been covered with water and that most of the rocks on the surface were originally laid down by moving water. Rock formations are usually classified as igneous, metamorphic or sedimentary, with the latter formed primarily by deposition of sediments out of water after transportation from some source area. It is significant that most surface rocks are sedimentary rocks.

By volume, sedimentary rocks are about one-tenth as abundant as igneous rocks in the earth's crust; but when it comes to the rocks exposed at the earth's surface, sedimentary rocks, or sediments, as they are sometimes called, cover nearly three-fourths of the land surface.¹

Furthermore, many of the igneous rocks at the earth's surface are underlain by sedimentaries, upon which they flowed after eruption through volcanic vents or fissures. Similarly, many of the metamorphic rocks at the surface represent rocks which once were sedimentary rocks (e.g., marble, transformed from limestone by processes of metamorphism).

Thus it is evident that probably all of the

earth's surface either now is, or has been, at some time or times, completely submerged by water, and that these waters have been profoundly effective in the very formation of the rocks themselves, as well as the surface features of the earth's physiography.

This, of course, is not surprising to the student of Scripture. According to Biblical revelation, there have been two periods in earth history when the surface of the earth was completely submerged by water. The first was immediately after the Creation of heaven and earth, when the earth is said to have been covered with water (Genesis 1:2, 3). Second, the earth was again fully inundated at the time of the Great Flood, in the days of Noah (Genesis 6-9). In both cases, it is certain that much geological work must have been accomplished on the earth's crust by the waters, as affirmed in II Peter 3:5, 6.

But modern geologists have been unwilling to accept such an apparently simple explanation for the earth's sedimentary rocks, especially since it involves a worldwide catastrophe with supernatural overtones. Instead, it has, for more than a hundred years, been assumed more "scientific" to explain the great masses of sedimentary rocks, sometimes several miles in thickness, in terms of the ordinary processes of sedimentation which are in operation in the present world.

Biblical and other ancient literature of the Middle East is dominated by a tradition of universal deluge. Characteristic of this view is an extremely short time scale for the duration of our planet-measured in thousands rather than in billions of years. One flood during this period sufficed to explain all evidences of former seas on land.

Little by little, the excrescences of the Middle Ages were shaken off by the developing science of geology. . . By the end of the nineteenth century, only religious fundamentalists . . . refused to accept the overwhelming evidence that not once but many times the seas have crossed where land lies now.²

Uniformitarian versus Catastrophic Sedimentation

There thus seem to be two possible types of explanations for the fact that essentially all of the earth's surface has been, at some time or times in the past, beneath the sea. One is that

of catastrophism, the other that of uniformitarianism. In the one, a tremendous cataclysm of water, pouring down from the skies and up from the subterranean deeps, produced a year-long debacle of erosion and deposition of sediments that could have accounted for at least most of the sedimentary deposits in the earth's crust. In the other, the very slow processes of weathering, denudation, river flow, delta deposition, land subsidence and emergence, and similar geomorphologic processes, acting over many hundreds of millions of years, have combined to produce these formations.

In both cases, the amount of geologic work accomplished is the same, but the power required—the time-rate of work accomplished—is vastly different. It is a question of whether great forces and energies were at work during a short period of time, or small energies operating over great expanses of time.

In either case, the bulk of the work was accomplished prior to the writing of the secular records of human history (excepting, of course, the Biblical record in the early chapters of Genesis). The events which formed the sedimentary strata are non-reproducible events and, since the very essence of the scientific method is experimental reproducibility, it is impossible to prove, scientifically, whether catastrophism or uniformitarianism provides the true explanation (unless, of course, we are willing to accept as trustworthy the apparently eye-witness accounts of the catastrophic events described in Genesis 7 and 8; this would be a valid scientific approach, but one which is nevertheless arbitrarily rejected by most historical geologists).

The best that can be done is to examine the ancient sediments and compare them with modern processes of sedimentation, to see whether the latter are producing deposits which are comparable in character to those of the geologic column, and also, on the basis of what we know about hydraulics, to try to estimate the possible type and extent of sedimentation that could occur in a world flood, in order to evaluate the sedimentary rocks in terms of this possibility.

The decision between the two alternatives will very likely be, to some extent, subjective. A deposit which seems to one student to give overwhelming evidence of rapid deposition will be explained by another as having been laid down very slowly and gradually. It may well be impossible to delineate, *scientifically*, which is ultimately right, for the simple reason that the deposits cannot be reproduced experimentally.

The use of laboratory models to study such large-scale and long-duration phenomena as

these must always be of very limited and doubtful value, and comparison with modern sedimentary phenomena is likewise a very difficult and subjective procedure. Our purpose here, therefore, is simply to show that aqueous catastrophism provides a very reasonable explanation for the sedimentary rocks, and that uniformitarianism, on the other hand, is beset with exceedingly serious difficulties. The conclusions one may draw from this fact will depend largely upon his own philosophic preferences, or perhaps prejudices.

Difficulties in Uniformist Theories

We shall consider first some of the difficulties encountered by uniformitarian explanations of the ancient sediments. It is incumbent upon the uniformitarian, of course, to explain the formation of these sedimentary rocks in terms of the same processes of sedimentation (including the erosion, transportation, deposition, and lithification of sedimentary materials) that are now taking place in nature.

One of the major difficulties encountered in accomplishing this is the fact that we do not even understand much about how these processes operate right now! Processes of sedimentation are highly complex phenomena and do not yield very readily to any kind of rational, quantitative formulation. One leading hydrologist says:

It is difficult to imagine a recognized field of science which is broader and more complex than sedimentation . . . In the process between erosion and deposition, soil particles are acted upon by many forces which are difficult to measure and evaluate. Sediment rates are highly variable because the many inter-related factors themselves vary in time and space.³

Because of the great practical importance of sedimentation in reservoirs, canals, rivers, and the like, a great deal of research has been devoted during the past few decades to an attempt to obtain a quantitative understanding of the process. But these have been only partly successful and in a very preliminary sort of way.⁴

Now if we do not even understand the nature of sedimentation as it occurs at present, how can we be justified in confidently extrapolating to the tremendously vast sedimentary deposits of the past on the basis of an arbitrary application of the principle of uniformity? Any use of present rates of erosion or deposition, for example, as an index to the time required for the deposition of a certain formation is utterly meaningless, if not indeed quite deceptive.

Even to attempt to identify ancient environments of sedimentation (as deltaic, lagunal, lacustrine, geosynclinal, etc.) on the basis of an

imagined similarity with deposits of the present is, in very large measure, arbitrary and unrealistic. Most sedimentary rocks are believed to have been deposited in shallow marine waters.

The attempt to discover the characteristics of such deposition as it exists at present is quite difficult and has barely scratched the surface so far. Dr. Bruce Nelson, formerly at V. P. I., and now Geology Department Head at South Carolina, who for several years conducted field studies on sedimentation processes in Chesapeake Bay, says:

A review of the various aspects of our recent sediment program as it has been conducted during the last year will show that we have come into contact directly with over a dozen separate scientific disciplines in an effort to decipher our geological problems . . . Our understanding of the geological processes leading to the production of recent sediments and their conversion into sedimentary rocks, therefore, will depend upon how thoroughly we, as geologists, can understand and master these bordering sciences.⁵

A good example of the inadequacy of the uniformity concept in the interpretation of sedimentary rocks is found in the geosynclinal theory. A geosyncline is conceived of as a tremendous near-shore trough, into which sediments are continually poured by the rivers carrying them to the sea. However, the trough is never very deep, so that the sediments are deposited in fairly shallow water.

As the sediments accumulate, the trough gradually subsides, leaving the sediment surface elevation about the same all the time. Eventually great thicknesses of sediment are built up in this way, many miles in depth!

As geologic time goes on, the geosyncline is finally uplifted and folded to become a great continental mountain range. Most of the earth's mountain ranges, such as the Rockies and Appalachians, have been explained largely in this way.

The importance of the geosyncline theory to stratigraphic studies is indicated by Clark and Stearn:

The geosynclinal theory is one of the great unifying principles of geology. In many ways its role in geology is similar to that of the theory of evolution that serves to integrate the many branches of the biological sciences. The geosynclinal theory is of fundamental importance to sedimentation, petrology, geomorphology, ore deposits, structural geology, geophysics, and practically all the minor branches of geological science. Just as the doctrine of organic evolution is universally

accepted among thinking biologists, so also the geosynclinal origin of the major mountain ranges is an established principle in geology.⁶

Now it does seem odd that a theory of such fundamental significance to all branches of geologic science as this one seems to be has not yet been explained in terms of the even more fundamental geological concept of uniformity! The origin, nature, causes of subsidence and causes of uplift of the great geosynclinal troughs are even yet unsettled, although many theories have been put forward at one time or another. Kennedy has discussed the problem as follows:

The problem of the mechanics of the formation of deep troughs of low density sediments is heightened when their full history is considered. Many are known in the geologic record. In most, sediments accumulate for perhaps a hundred million years and reach a total thickness of as much as 100,000 feet. These thick, highly elongate lenses of sediments may then be slowly folded and uplifted to form mountain ranges which may initially stand as much as 20,000 feet high. Surprisingly, the geologic record shows that a large fraction of the mountain ranges of the world have been formed from rocks of these thick, geosynclinal troughs. Extensive volcanic activity may accompany and continue beyond the time of the formation of the mountain ranges. The mystery, then, of the down sinking of the sedimentary troughs, in which low density sediments apparently displace higher density rocks, is heightened when we note that these narrow elongate zones in the earth's crust, downwarped the most, with the greatest accumulation of rock debris, shed by the higher portions of the continents, become in turn the mountain ranges and the highest portions of the continents.⁷

The only modern crustal feature believed to be comparable to these ancient geosynclines is the deep trough in the Gulf of Mexico, which is believed to be subsiding at about the same rate as the annual increment of sediment deposited on it by the Mississippi River. Kennedy notes an interesting problem in this connection:

Each year (the Mississippi) brings to the Gulf of Mexico approximately 750 million tons of dissolved and solid material . . . the rate of erosion for the entire United States approximates one foot in 10,000 years. At this rate, all the land masses of the world would be eroded to sea level in something of the order of 10-25 million years.⁸

This length of time is geologically minuscule, of course, and seems hard to reconcile with the almost universally accepted evidence that the present continents and ocean basins are es-

entially stable features of the earth's crust. There are supposed to have been many transgressions and regressions of the sea throughout geologic time, but the main continental masses and ocean basins are believed to have remained essentially as they are today for at least the past two billion years.⁹

Kennedy and many others are convinced today that the only possible way of accounting for these anomalies is in terms of "phase changes" of the material in the rocks deep under the surface, at high pressures and temperatures. The level at which such changes occur is the so-called "Mohorovicic Discontinuity." Without entering into the details of the theory, the essence is that the density of rocks under the mountains or under the ocean bottoms adjusts in response to changes in load, as the mountains are eroded or as the troughs are filled. This is not primarily a change of density due to compaction, but due to an actual change of state in the material.

However, the physical evidence that such an explanation is valid is still lacking. In fact, the Gulf of Mexico "geosyncline" (actually this is a misnomer, as there are many discrepancies between the characteristics of this modern geosyncline and those of the ancient geosynclines which have been uplifted to form the present mountain ranges) seems to contradict the theory.¹⁰

Uniformitarian explanations, therefore, have been unable as yet to account for the most important of all the sedimentary rock deposits. There seems to be no really legitimate way to extrapolate from the sedimentation processes of the present to explain the sedimentary phenomena of the distant past. This is true not only in the case of geosynclines, It is equally difficult to show similarities between ancient deposits which are supposedly deltaic in origin and modern deltas. The same applies in general to the identification of most other possible depositional environments. In fact, many sedimentologists have taken the position that study of modern processes of sedimentation is of essentially *no help whatever* to their identification of sedimentary structures, preferring to use other methods!¹¹

In this Part I, it has been pointed out that the geologic postulate of uniformity is inadequate to explain the sedimentary rocks. These deposits are of course the most significant geologic phenomena as far as the theory of evolution is con-

cerned, since it is in the sedimentary rocks that fossils are found, purportedly providing a documentary record of the development of all the various forms of living creatures which now inhabit the earth. And if uniformity is inadequate, it ought to be at least permissible to consider catastrophism as a possible frame of interpretation for the sediments.

This will be done in Part II (which will appear in a later Quarterly—Editors).

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A GRAVITY STUDY OF THE KILBOURNE HOLE AREA, NEW MEXICO

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Introduction

This investigation is one of a number of geophysical studies in progress of an area running east from the Guadalupe Mountains of West Texas to the Potrillo Mountains of Southern New Mexico. It is hoped that these studies will reveal the structure of the mountain ranges and also the intervening bolsons in this area thus providing important clues to cause of mountain building.

In the Kilbourne Hole area there has been no previous geophysical investigation, except by geophysical exploration crews of oil companies, and their work is generally not available for study. Kilbourne Hole was chosen for study, since an interesting controversy has raged for years as to the cause of the structure. Many ideas have been put forth, but most of these are reducible to two principal hypotheses.

One hypothesis maintains that a basaltic in-

trusion of high temperature was formed under the crater-like structure, Kilbourne Hole, vaporizing the subterranean water there and raising it to a high pressure. The pressure supposedly became so great that a vast explosion occurred creating the Hole.

The other hypothesis maintains that the hole is merely a weathered collapse hole into which the basalt from the north has flowed.

Geologic Setting

Physiography

Kilbourne Hole is a crater-like structure generally elliptical in shape. The major axis is about two miles, and the minor axis is about 1.25 miles. From the edge of the Hole to the lowest point is a change of elevation of 280 feet. A rim of slightly varying height rises 170 feet above the surrounding desert terrain.

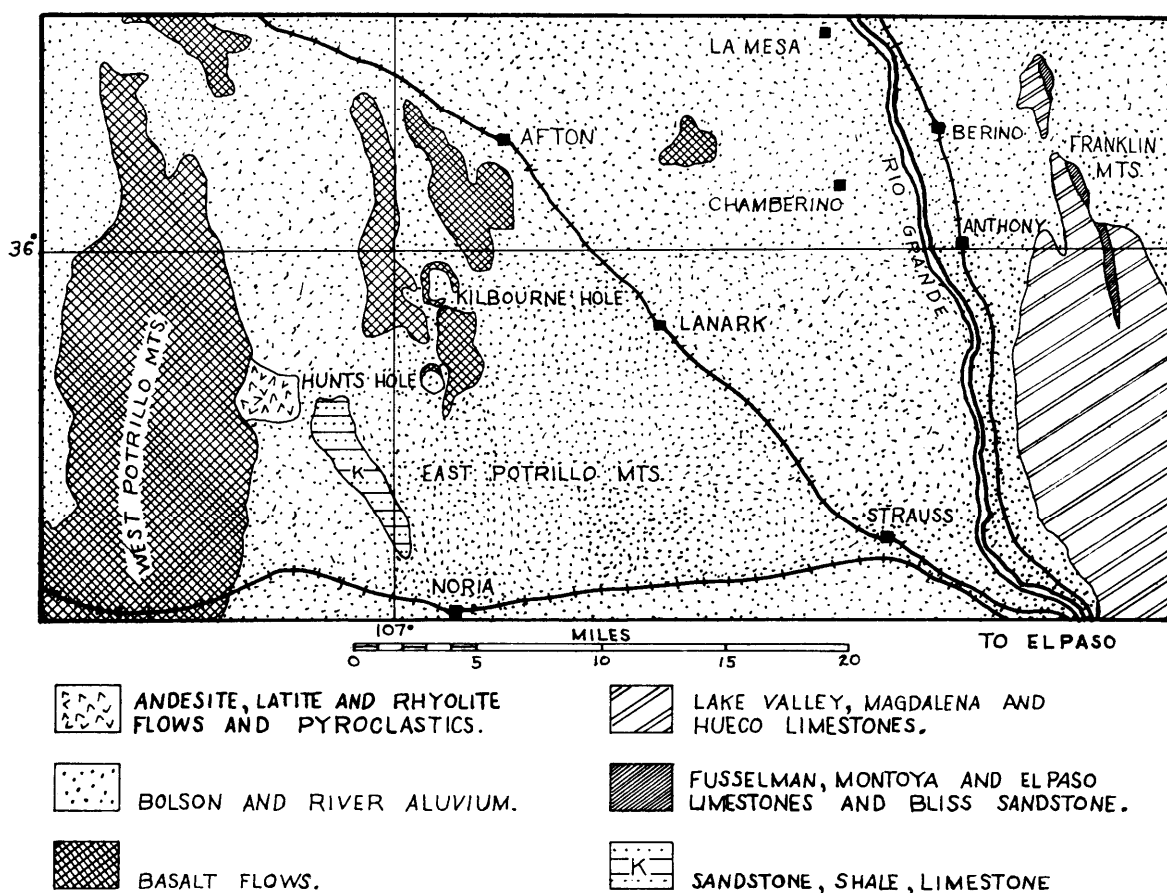


Figure 1 Geologic Map of Kilbourne Hole Area

Directly to the south is Hunts Hole, a similar feature except smaller, having a depth of 100 feet and major and minor axes of 1.25 miles and 0.75 miles, respectively. To the west of these features are the Potrillo Mountains rising to heights exceeding 5,000 feet.

All these features are located on an extensive tableland, eastern boundary of which forms the western edge of the Rio Grande Valley rising about 400 feet above the valley floor. The Franklin Mountains are to the east of this edge of the mesa and rise to a height of 6477 feet.

Rocks of the Area

Kilbourne Hole is filled with bolson and alluvium material intermixed with basalt flow material. Along the sides of the Hole are huge blocks of basalt. Basalt flows can be traced back from the edge of the Hole thus giving the appearance of basalt flows into the Hole. There are numerous and very extensive basalt flows surrounding Kilbourne Hole. Many volcano cones are located to the north, east, and west of Kilbourne Hole.

In this area there are mesa like structures about 100 feet in height built up of basaltic flow material. The West Potrillo Mountains are mainly composed of basalt. Mount Riley on the eastern edge of this range is composed of andesite, latite, and rhyolite flows and pyroclastics. The East Potrillo Mountains are made up of sandstone, shale, and limestone layers and are classified as Cretaceous according to the type of fossils they contain.

The Franklins to the east are composed of limestone and sandstone with andesite and granite intrusions. It is interesting to note that in the Franklins, layers classified as Ordovician are resting conformably on layers classified as Cretaceous without the slightest physical evidence of thrust movement. The surface distribution of the rocks may be seen in Figure 1. (These conformable layers are discussed in the paper immediately following: "Supposed Overthrust in Franklin Mountains."--Editors)

Gravity Survey

Gravity Field Methods

Gravity stations were established in the vicinity of Kilbourne Hole and Hunts Hole. A LaCoste-Romberg gravity meter was used. These observations were made during the years of 1962 and 1963 while some have been made very recently during February and March, 1966. Latitude positions of the stations were determined to an accuracy of $\frac{1}{2}$ foot in elevation and 50 feet in latitude position.

Gravity reductions

Gravity values were reduced to the Bouguer anomaly. A density of 2.2 gmcm^{-3} was found to be most suitable for most of the area. Terrain corrections were omitted since they are fairly uniform throughout the area, and those of a local character are insignificant for most stations. The results are shown on the Bouguer anomaly map in Figure 2. The gravity values are given in Table I.

Gravity interpretation

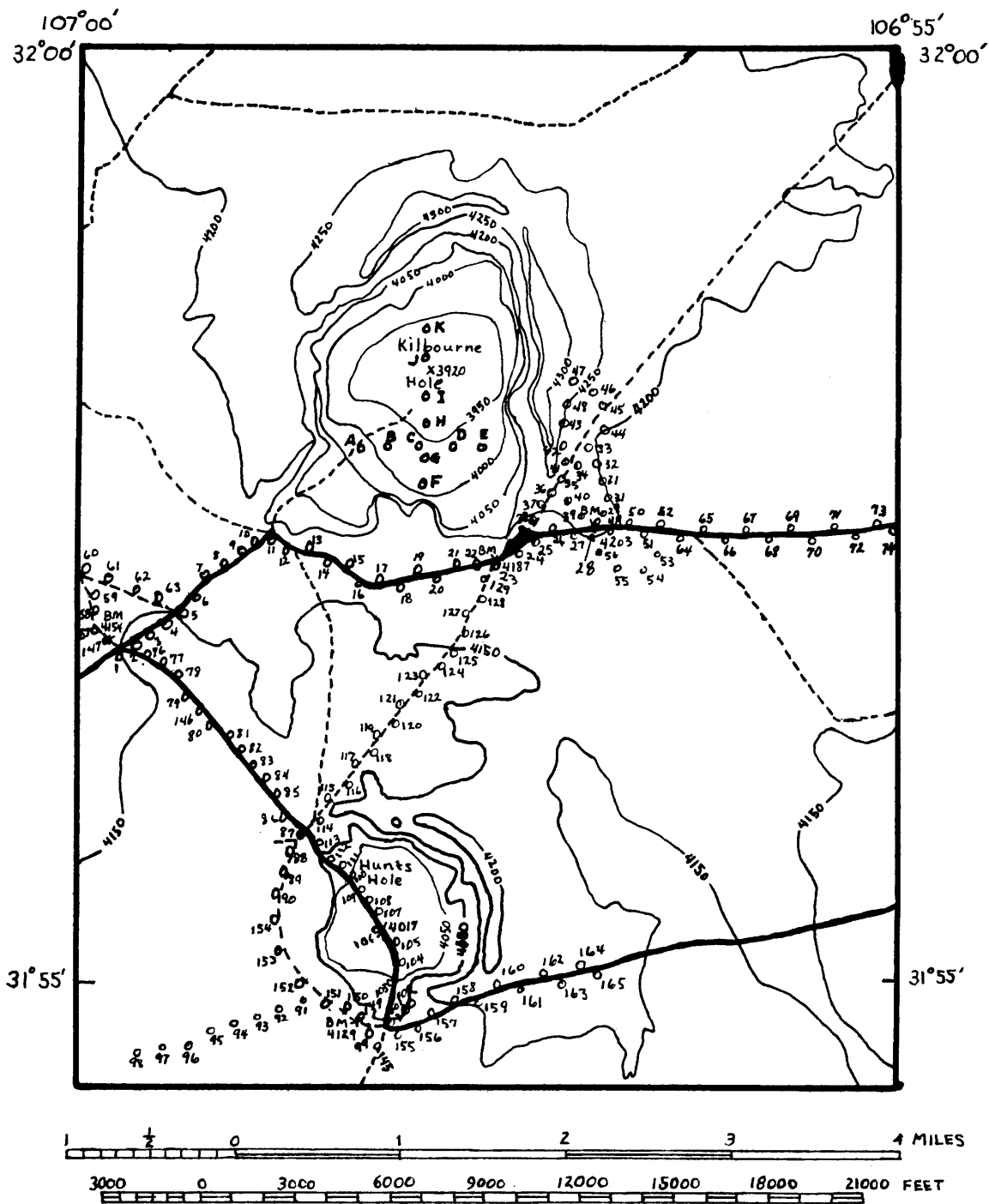
Study of the gravity values available would indicate that Kilbourne Hole is a collapse structure into which basalt lava has flowed. The gravity highs do not exist over the Holes thus indicating that anomalous igneous plugs do not exist under the Holes.

However, the stations are so arranged that it is difficult to obtain a Bouguer contour gravity map. It may be that material has flowed out from under the Hole thus causing a collapse.

This paper represents a preliminary study and certainly is not complete. Establishment of more gravity stations to fill in the gaps for the area is anticipated. A more complete picture and report on this study is planned for the future.

Acknowledgments

My students provided much valuable assistance. J. VanVelkinburgh helped considerably with the data reduction of the gravity readings to the Bouguer gravity values. J. B. Gillespie, Jr.; Isaac Segura; and James Johnson did much field work in obtaining the data. J. Powell did the drawings.



THE SMALL CIRCLES INDICATE THE LOCATION OF THE GRAVITY STATIONS. TABLE 1 GIVES THE GRAVITY VALUE IN MILLIGALS FOR EACH STATION RELATIVE TO STATION 28.

Figure 2 Bouguer Gravity Map

TABLE I

Station	Gravity Value in Milligals	Station	Gravity Value in Milligals	Station	Gravity Value in Milligals	Station	Gravity Value in Milligals
A	285.50	34	279.60	78	291.13	122	284.26
B	284.53	35	279.61	79	290.31	123	283.60
C	284.28	36	279.52	80	290.09	124	282.23
D	282.89	37	279.23	81	289.76	125	282.66
E	282.61	38	279.69	82	289.38	126	282.81
F	284.68	39	279.39	83	288.87	127	281.62
G	285.78	40	279.34	84	288.94	128	281.22
H	283.90	41	279.82	85	288.55	129	281.07
I	283.88	42	279.85	86	288.13	145	
J	283.25	43	279.97	87		146	
K	283.73	44	280.24	88	288.68	147	
1	293.44	45	279.93	89		148	281.73
2	293.04	46	280.55	90		149	288.14
3	292.26	47	280.48	91	288.53	150	288.37
4	291.87	48	280.32	92	289.13	151	288.64
5	291.15	49	278.95	93	289.74	152	289.19
6	290.41	50	278.86	94	290.22	153	289.56
7	289.67	51	278.79	95	290.86	154	289.61
8	289.07	52	278.72	96	291.31	155	289.71
9	288.32	53	278.76	97	292.24	156	285.08
10		54	278.93	98	293.37	157	
11	286.94	55	278.85	99	287.70	158	
12	286.38	56	279.05	100	287.28	159	284.96
13	285.68	57	293.46	101	287.45	160	284.30
14	284.97	58	292.93	102	287.46	161	284.30
15	284.67	59	292.56	103	287.31	162	284.00
16	284.35	60	292.05	104	287.24	163	283.74
17	283.65	61	291.51	105	287.23	164	282.44
18	283.03	62	290.65	106	287.58	165	282.17
19	282.52	63	290.01	107	287.81	166	281.01
20	281.94	64	278.73	108	287.67	167	281.34
21	281.67	65	278.76	109	287.60	168	
22	281.11	66	278.83	110	287.71	169	
23	280.62	67	278.88	111	288.99	170	282.70
24	280.18	68		112	288.04	171	282.72
25	279.91	69	279.12	113	287.44	172	282.82
26	279.65	70	279.29	114	287.76	173	282.83
27	279.54	71	279.48	115	287.40	174	282.82
28	279.28	72	279.72	116	286.84	175	282.93
29		73	280.07	117	286.36	176	
30		74	280.37	118	285.96	177	
31		75	280.66	119	285.56		
32		76		120	284.98		
33	279.54	77	292.24	121	284.50		

SUPPOSED OVERTHRUST IN FRANKLIN MOUNTAINS, EL PASO, TEXAS

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This brief note is in regard to a supposed overthrust in an area on the southwestern slope of the Franklin Mountains known as West Crazy Cat Canyon. West Crazy Cat Canyon has the striking structural feature of massive Upper Ordovician limestone immediately overlying the Upper Cretaceous on the west side of the canyon,

The west side of the canyon has an elevation of 4368 feet, and the highest elevation on the east side is approximately 4200 feet. Crazy Cat Mountain is the high point joining the two sides of the canyon at its north end.

Alluvial deposits are abundant in Crazy Cat Canyon, and the presence of these deposits makes collection of geological information difficult since they conceal many of the structural features of the area. However, the Ordovician, Silurian, Permian and Cretaceous are well exposed in the Canyon.

The Ordovician is capped in the northwest corner of the Canyon by a section of Fusselman limestone of Silurian classification. On the east side of the Canyon, across a creek bed running in a north-south direction, lower Cretaceous beds are exposed which rest conformably on Permian beds.

The outcrops on the west side of the canyon are mainly Cretaceous overlain by Ordovician as shown in Figure 1.

The west face of the canyon is considerably eroded but the outcrops are very distinct. Figure 2 is a photograph taken looking northward along

the boundary between outcrop of Cretaceous rock of very light grey color and the Ordovician of a dark grey color running to the top of the

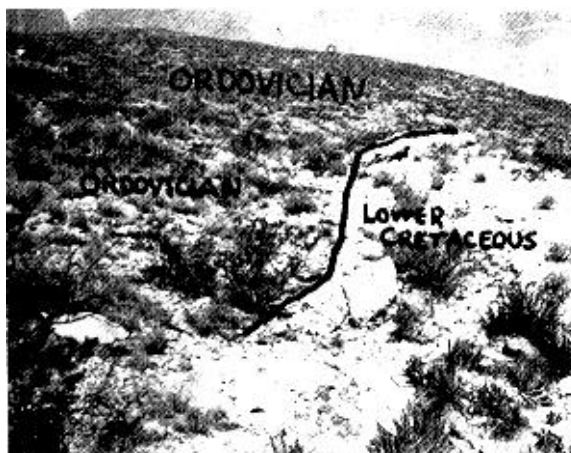


Figure 2

canyon. The other Figures are photographs of the west face of the canyon taken from the east side.

I asked the geologist who accompanied me on the initial trip to study the area if there was actual physical evidence of the block of Ordovician being thrust from the upper slopes of Mt. Franklin down onto the Cretaceous. He replied that there was no actual physical evidence discovered but that since fossils were completely out of order an overthrust was assumed. A more complete investigation is planned for the near future.

MONTOYA LIMESTONE	ORDOVICIAN
BUDHA LIMESTONE	CRETACEOUS
GRAYSON DEL RIO	
MAINSTREET SANDSTONE	

Figure 1

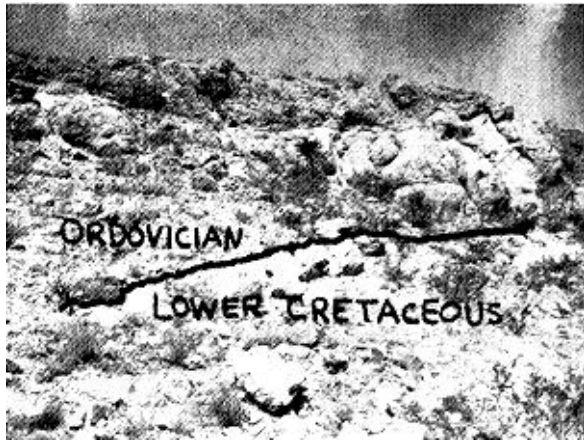


Figure 3



Figure 4

NEW PUBLICATION

Why Scientists Accept Evolution by Robert T. Clark and James D. Bales. Baker Book House, 1019 Wealthy Street, S. E., Grand Rapids, Michigan 49506 (Telephone 456-1489, Area Code 616). Hardcover, \$2.50, paperback \$1.50.

The aim of this book is not to delve into arguments pro and con for the hypothesis of evolution. It is to deal with the real reason why it was accepted in the nineteenth century and then passed on to the twentieth century.

This is a valuable book for the open-minded evolutionist to trace the development of his hypothesis. It is valuable for the non-evolutionist to assure himself that he need not castigate himself as being unscientific.

James D. Bales is Professor of Bible and Robert T. Clark is Vice President in charge of Research at Harding College, Searcy, Arkansas.

OVERTHRUST FAULTS OF GLACIER NATIONAL PARK

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Glacier National Park, among other marvelous features, is famous because of the Lewis overthrust. In fact, the very essence of this unusually lovely national park is dependent on the resistance to erosion of the Pre-Cambrian limestones which comprise the mountains in contrast to the softer Cretaceous shales below, out of which the valleys are carved.

A preliminary report on my study of this area is given in Morris and Whitcomb's *The Genesis Flood*, pages 189-191.¹ The photographs shown there were taken in August of 1956.

In August of 1957, I visited Glacier National Park again. I was fortunate in securing the services of Ray Siers of Chief Mountain Ranch who drove a Dr. Hines and me right up the side of the ridge to within about 1½ miles of the steeply rising cliff of Chief Mountain. Since only low brush covers the Cretaceous shale the hike on up from there was easily made.

We easily found the contact line, shown from a distance in Figure 1. A closer view is shown in Figure 2. Here the contact line is just below the lighter limestone above as shown by the arrow. The limestone juts out in places because of the rigorous pickax work of Dr. Hines and me. The dark appearance of the Cretaceous shale upon which pieces of limestone are lying should be noted. These larger pieces have fallen, over the years, from the Pre-Cambrian cliffs above.

Figure 3 is a closeup view of the contact line where we had chipped away the shale in order to make a close examination of the physical nature of contact between the limestone above and shale beneath. It should be noted that the

line of contact is almost level. This was **generally** true at the base of Chief Mountain.

The shale was soft and crumbly. There were many **intercalations** of limestone and shale below the main contact line and even several layers of limestone several feet thick! Thin, crumbly, approximately 1/2-3/4 inch layers of shale were in between these intercalations. The shale here was much softer than that at the base of Mt. Wynn.

Just as at Mt. Wynn and at the contact line near Glacier National Park Hotel, a very thin layer of shale was present at the main line of contact, and it was often cemented to the limestone above. The particles in this layer were comparable in size to those of the lower layers of shale, and so gave every appearance of water deposition rather than being the result of grinding action, such as would occur in the presumed overthrusting.

While I was taking pictures Ray Siers and Dr. Hines hiked on up to the top of Chief Mountain. When they finally returned Ray Siers reported that **8-10 feet of granite** was on top of the mountain. He is not a geologist and may have been mistaken, but most keen outdoor men of his type at least know granite when they see it, or its metamorphic equivalent.

I had asked him to check especially as to whether any remnants of the shale, which according to the theory of overthrusting should at one time have covered the limestone, could be found. He reported that he could not find **even a shred of shale**. And by the time he had been with us, pickaxing around at the base of mountain, he certainly knew what shale was.



Figure 1. Base of Chief Mountain, Arrow indicates the contact line.



Figure 2. Close-up of contact line showing Allyn limestone (above) and Cretaceous shale (below).

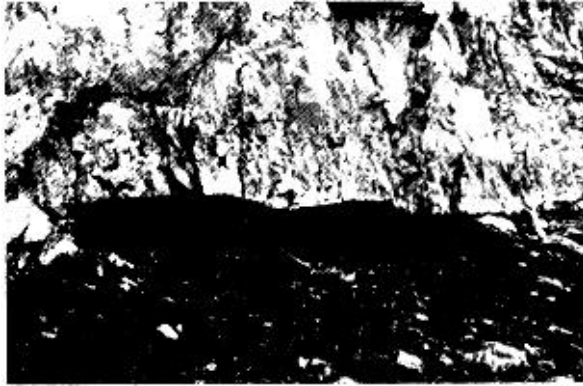


Figure 3. Limestone and Cretaceous Shale (below) at the contact line.

Yet an oil well core made on the slope leading on up to Chief Mountain was drilled through 11,000 feet of shale before hitting any limestone. What has happened to the shale above the limestone supposedly thrust over the shale? Its total disappearance from the tiny area on top of Chief Mountain might not pose too much of a problem for the usual orthodox geological interpretation of this area.

However, the next day, all of us hiked over to the Granite Park Chalet, arriving just in time for one of their marvelous dinners one can really enjoy after about a ten mile hike! The next morning we hiked up to Swift Current Peak Lookout; a stiff climb but well worth it. On the way we were of course hiking **on top of** the limestone. I was tremendously impressed by the many wave and ripple marks, raindrop marks, and mud cracks, phenomena similar to those so splendidly reported by Rupke.²

Here is indeed a strange situation: vast areas of limestone supposedly deposited over 500 million years ago, and then later thick sediments of shale. Finally long sections on the west fractured were uplifted, and thrust over the shale

toward the east. Since then or **at least since the deposition of the shale**, all of it was presumably eroded away from on top of the limestone but **only on the area overthrust**. And all this went on without such ephemeral records as ripple marks and raindrops being eroded away!

This is indeed hard to believe and I find it more in harmony with objectivity to postulate simply that the limestone was deposited on top of the shale. As the final part of the deposition occurred the water was so shallow as to allow the formation of wave and ripple marks. A short time later as the surface was drying and before hardening, raindrops were recorded, and finally mud cracks formed.

The clear preservation of these indicates (1) that a relatively short time has occurred since their formation, i.e. a few thousand years, and (2) that most of the time during precipitation they are covered with snow or ice.

One of the most profitable avenues of research open to the Creation Research Society is a detailed study of many so called "thrust faults," of which there are thousands of examples, from the viewpoint of Flood geology. Also a careful study of oil well cores reported in the American Society of Petroleum Geologists would show how really localized such so called "world-wide" formations as the Cambrian, Silurian, Devonian, Permian, Cretaceous and indeed all those used as "time markers" really are. As we get better organized let us hope that funds for studies such as these may be obtained.

Literature Cited

¹Morris, Henry M., and Whitcomb, John C., Jr., *The Genesis Flood*. Presbyterian and Reformed Publishing Co., Philadelphia, 1961. Also available through Bible-Science Association, c/o Walter Lang, secretary, Caldwell, Idaho.

²Rupke, N. A., "Prolegomena to a Study of Cataclysmal Sedimentation," *Creation Research Society 1966 Annual*, pp. 16-37.

THE ICE AGE PHENOMENA AND A POSSIBLE EXPLANATION

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Pacific Meridian Publishing Company,

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The subject of the Ice Epoch (sometimes known as the Ice Age or Ice Ages) is one which has been difficult for catastrophists to locate in time; most have placed it following the Genesis Flood. This would mean that it is located, more often than not, between 2,000 and 2,500 B.C. or a little earlier.

Uniformitarians have dated the Ice Epoch variously between 1,000,000 B.C. and 8,000 B.C., with datings between 15,000 and 8,000 B.C. being most common in recent decades.¹ Most of them ignore the idea of a Flood, or relegate it to a local phenomenon.

There is a third alternative which has for some reason never been considered. This concept is that the Flood and onset of the Ice Age may have been simultaneous events. It is the purpose of this paper to first present the facts dealing with the occurrence of ice, and then to suggest an explanation which will take them into account. The following then are the requirements which any adequate theory must meet,

Requirement 1 The Frozen Mammoths: An Illustration of Sudden Freezing

Vast volumes of ice, as vast as 30,000,000 cubic miles, is one issue with which any theory for glaciogenesis must deal. But such an issue is quite different from the issue of suddenness. Was the ice deposited upon the Earth slowly in terms of centuries and/or millenia? Or was it deposited upon the Earth suddenly in terms of days and weeks?

Mammoths were, along with mastodons, the largest members of the elephant family. They have become mummified in two manners, both of which suggest cataclysm and suddenness. In Alaska and Siberia, mammoths have been mummified, apparently by the millions, both in ice and in sedimentary strata. These twin types of fossilization support the proposition that the Flood and the Ice Epoch were simultaneous global catastrophes (or rather, differing phases of the same catastrophe.)

In some areas, it is as if mammoths were deposited in watery graves, in which the alluvium was freshly deposited, then compressed and re-compressed. In other areas, mammoths were encased suddenly in ice, ice which has remained unmelted since the event. Their entombment

and refrigeration have been so effective that mammoth carcasses have been thawed to feed sled dogs, both in Alaska and Siberia (Figure 1). In fact, mammoth steaks have even been featured on restaurant menus in Fairbanks.

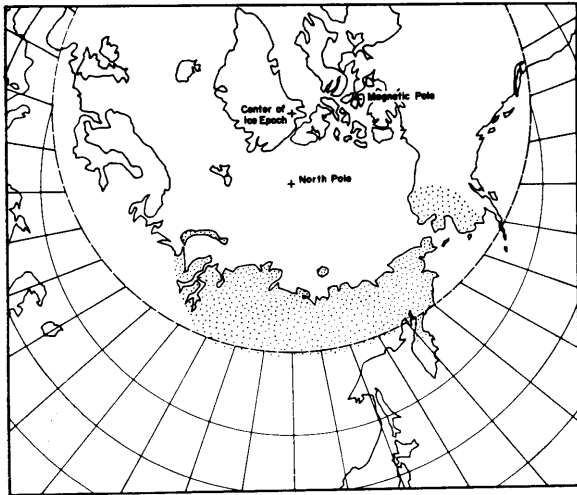
Every indication is that the mammoths died (1) suddenly, (2) in intense cold, and (3) in great numbers. Death came so quickly that the swallowed vegetation is yet undigested in their stomachs; other vegetation is yet unswallowed in their mouths. Choice grasses, bluebells, buttercups, tender sedges and wild beans have been found, still identifiable and undeteriorated, in their mouths and stomachs.²

What killed the mammoths with such suddenness and such unearthly cold? An illustration, well known and substantially recorded, may explain this strange phenomenon. We refer to the case of ancient Pompeii, and the people engulfed therein. One observer was Pliny the Elder, a Roman naturalist, who himself lost his life in his investigations of the erupting Vesuvius.

Pliny recounts that as the eruption began, many Pompeiians at first did not take it seriously; this sort of thing had happened before, and had quickly settled down again. This particular time, however, the mountain continued to roar and rumble in increasing crescendoes; smoke kept belching, cinders kept falling in increasing volumes, and hot, toxic, gaseous fumes continued to be expelled in increasing volumes.

The people became apprehensive, and soon began to panic. Long streams of refugees began to flee from the doomed city. As the cinders and sulphurous fumes turned day into night, and as the variable winds shifted, sudden squalls brought hot, toxic, sulphurous fumes down upon groups of fleeing refugees. Asphyxiation dropped the refugees in sudden death, seemingly within one breath. Their fossil remains have been preserved by a blanket of pumice; the dying expressions yet remain on their faces, and the details in the fabric of their garments remain vividly imprinted in the pumice temple.³

Excavations of Pompeii have revealed how swiftly the fleeing victims were (1) asphyxiated, and (2) promptly encased, in this case in pumice. In the case of the mammoths, the span of time between death and freezing can be estimated quite accurately through an examination of the



LOCATION OF THE ICE FOSSILS

Figure 1

carcasses. This is determined by the extent of the water separation within cells, for water begins to separate within a cell at death, and it ceases to separate at freezing. The small extent of separated water within the cells indicates that the mammoth carcasses were frozen rapidly, perhaps at temperatures below -150°F .

Temperatures of this severity exist in our solar system, but not at the surface of the Earth under its present rotation and orbital scheme. This kind of temperature exists for example, among the frozen atmospheres of Jupiter and her icy satellites such as Callisto and Ganymede, and the icy crusts of Saturn's satellites, or rings. Among satellites such as Saturn's Mimas, Enceladus, Iapetus or Hyperion, these temperatures are normal, as is the presence of vast volumes of ice. And apparently the same is true for many of Uranus' satellites, such as Miranda, Ariel, Umbriel, Titania and Oberon.

If icy particles in temperatures nearing -200°F . were deposited upon the Earth from such an astral visitor, this could produce a great, icy avalanche of supercooled ice, possibly reproducing the supercooled conditions under which the mammoths so suddenly met their death. Under such conditions, even a huge, woolly mammoth would immediately perish, not to mention bison, camels, rhinoceroses, sheep and other animals, which have been found similarly encased in ice. They may have perished by asphyxiation because, at these temperatures, their lungs were suddenly frozen solid. They dropped immediately; freezing of the carcass ensued shortly.

Actually, the temperature of the ice which killed the mammoths may well have been below -300°F . The surface temperature of Neptune, Nereid and Triton is about -325°F .

Wrangell, the Arctic explorer, observed on Bear (Medvizhi Ostrova) Island that the soil consisted of only sand, ice, and such a quantity of mammoth bones that they seemed to be the chief substance of the island. On the Siberian mainland, he observed that the Siberian tundra was dotted with more mammoth tusks than with Arctic shrubbery.⁶

Pallas related that there was not a river bed in all Russia or Siberia, from the Don to the Bering Strait, which did not contain bones of elephants and other animals.⁷ It has been recorded that during two consecutive decades (1880 to 1900) at least 20,000 elephant tusks were taken from one single Siberian mine. Ivory trade has a history as old as the recorded annals of the area.⁸ Traditions of Siberian ivory are at least as old as the historians of the Roman Empire.

The long series of astounding finds of frozen carcasses are too voluminous to relate here.⁹ The findings of Howorth, Nelson, Rehwinkel, Sanderson and Vail are notable. But the important thing is that an adequate explanation is needed, and furthermore, an adequate explanation should be possible. The slow-snow theory intrinsic to uniformitarian notions is based on the assumption that climatological (and meteorological) observations must contain the explanation.¹⁰

Requirement 2 The Regions of Sudden Chilling

The regions of sudden chilling occurred in both hemispheres. The locations were in high latitudes with respect to both (1) the geographical poles and (2) the magnetic poles. However the regions covered by the ice coincides 75% more closely with the Magnetic North pole than it does with the Geographic North Pole.

In Antarctica, less than 200 miles from the South Pole, Byrd found evidences of a former climate which nurtured luxuriant forests.¹¹ On the island of Spitzbergen (Svalbard), palm leaves ten and twelve feet long have been fossilized, along with fossilized marine crustaceans—which could only inhabit tropical waters. This suggests that at one time the temperatures of the Arctic Ocean were similar to the contemporary temperatures of the Bay of Bengal or the Caribbean Sea, Spitzbergen is half way between the northern tip of Norway and the North Pole, at a latitude of 80°N . Today, ships can reach Spitzbergen through the ice only about two or at the most, three months of the year.

And in the New Siberian Islands (slightly warmer than Spitzbergen, at a latitude of 75°N ., between Siberia and the Geographic North Pole) explorers claim to have found species of

tropical plants, apparently including breadfruits, encased in ice, as were mammoths. How could this be? Were explorers spinning yarns?

Antarctica, Spitzbergen and the New Siberian Islands are but three places where evidence occur that coldness came with extreme suddenness, wiping out a previous tropical climate with a finality which has lasted over many thousands of years. This directly leads to two queries: First, what caused the abrupt change which so dramatically froze the fauna and flora?¹² And secondly, and probably more important, what was the nature of the previous climate? This second question may be considered in a future article, together with reasons as to why this is ultimately the more significant of the two questions. Meanwhile, the immediate question is, What happened? Was the sudden coldness natural or unnatural, seasonal or unearthly? To say the least, uniformitarian-minded geologists are hard pressed to produce a satisfying answer.

Requirement 3 The Depth of the Ice Mass

The suddenness of the onset of the Ice Epoch has been briefly considered, relative to not just one but both hemispheres. The evidences are amazing and phenomenal. Of no less import, and of no less amazement, is the depth to which ice occurred. Sudden frost, as measured in a fraction of an inch, may be one thing, and winter snows to a depth of 20 to 50 feet, such as on the Matterhorn or Mt. Rainier, are another thing. What was the depth of the ice mass in the Northern Hemisphere? What was the depth in the Southern Hemisphere?

It has been established, from the direction of ice flows, studies of gradients, distances, and other related data, that there were several nodes of ice on the Canadian Shield. The Keewatin Node, centering East of Great Slave Lake and north of Lake Winnipeg is among the leading examples. The depth of ice in this node was between 15,000 and 17,000 feet. Fifty feet of winter snows, located in mountain regions is not comparable to 15,000 feet of ice, located on a North American plain, many miles distant from the Arctic, Atlantic and Pacific oceans.

Do we find similar depths of ice in the Southern Hemisphere? This question is complicated by the fact that the floor of the Antarctic shelf is often well below sea level. Furthermore the Northern Hemisphere has a predominance of land in the high latitudes where glacial mass flows can be recognized, traced and measured. This includes glaciation in three continents; Asia, Europe and North America. No such comparable circumstance exists in the Southern Hemisphere.

However there are indications that the Ice Epoch covered such diverse locations, beyond Antarctica, as Patagonia, the Kerguelen Islands, New Zealand and Tasmania. This is comparable to about a 5,000 mile diameter of the ice sheet in the Northern Hemisphere.

In 1958, an ice core was taken on the Antarctic Ice Cap near Byrd Station. Drilling commenced at an elevation of about 5,000 feet above sea level. The thickness of the ice sheet was 10,000 feet. The drill went through solid ice all the way until it hit bedrock, at 5,000 feet below sea level.¹³

Uniformitarian theory claims that snow flakes fell over unending epochs until ice was built up to 10,000, or perhaps 15,000 feet on the Canadian Shield. Then it began to melt faster than the rate of buildup. This theory, to be consistent, also should explain the ice packs at 5,000 feet below sea level.

Now when snow falls into brine at 25° to 32° F., it will not sink; it will dissolve into a sort of floating slush. And we know what just a little bit of salt will do on a frozen pavement. The real question is not whether it may be ludicrous to propose that ice might be formed in brine, some 5,000 feet below sea level, by falling snow flakes. The real question is whether or not uniformitarians require us to believe other propositions equally ludicrous.

In the work, *The Biblical Flood and the Ice Epoch* (See footnote #12), it is demonstrated that the Flood was tidal in nature, including tides of great magnitude; tides both in the hydrosphere and in the lithosphere. It is demonstrated that the recent series of mountain uplifts occur in scallop-like curves which merge into great circles, (Figure 2) suggesting a global scale of orogenetical uplift, caused by massive tides of magma within the Earth's crust. It is further demonstrated that the scallop-like or arcuate curves comprising mountain ranges traverse across continental massifs and oceanic basins with seeming equal ease. Consider the parallel. Here, it would seem, ice was deposited in the high magnetic latitudes, irrespective of sea level, and on both a continental shield (Canada) and on the Antarctic shelf, well below sea level. This parallelism (actually a twin parallelism) must **not** be disregarded in evaluating the nature and the cause of the Ice Epoch of the planet Earth.

Requirement 4 The Volume of the Ice Mass

The ice sheet is pretty well traced in the Northern Hemisphere due to the prevalence of land at high latitudes (Europe, Russia, Siberia,

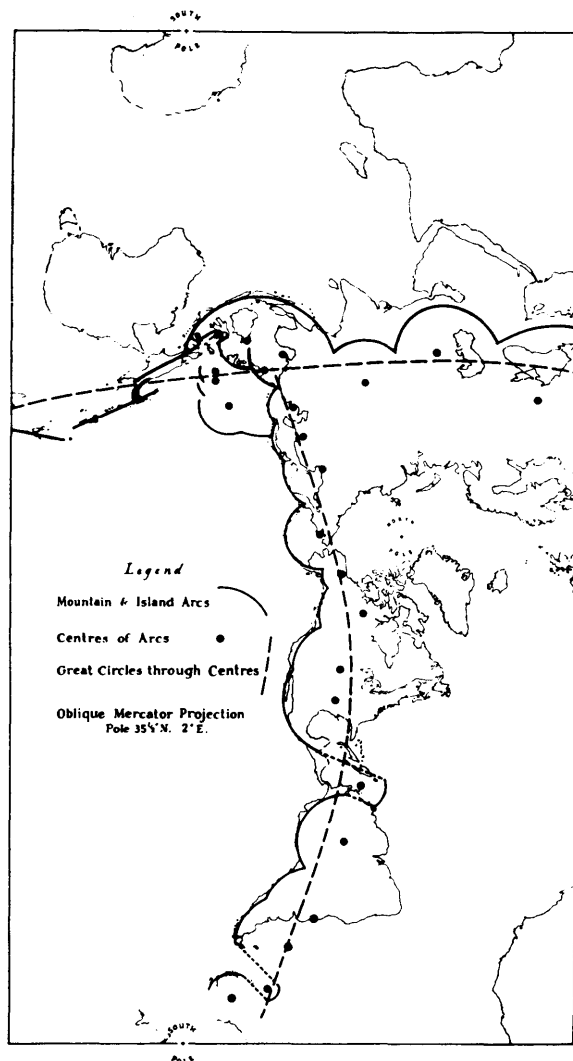


Figure 2. The Great Circle Alignment of the Two Recent Zones of Orogenetic Uplift.

(After J. Tuzo Wilson, *The Earth as a Planet*, ed. Kuiper, p. 138, Chicago: Univ. of Chicago Press, 1954.)

Alaska, Canada and the United States.) Figure 3 illustrates this region, which apparently extended from Alaska to Central Europe, and from the fringes of Siberia to the Central United States. Its location is polar, but it more closely coincides with the Magnetic North Pole than the Geographic North Pole. It is about 75% closer to the Magnetic North Pole; furthermore there is substantial evidence for the conclusion that the magnetic pole was once located between Baffin Island and Greenland, the center of the ice sheet. The eccentricity of geographical latitudes with the ice sheet must be considered significant. Simultaneously this observation does nothing for the uniformitarian proposition that the Ice Epoch developed in the high latitudes because

that is where little sunshine is received, and climates are cooler. Illinois, at 37° N. latitude, was glaciated; Siberia, at 70° N. latitude was unglaciated; however Illinois is closer to the magnetic pole, and has a better view of the Aurora Borealis.

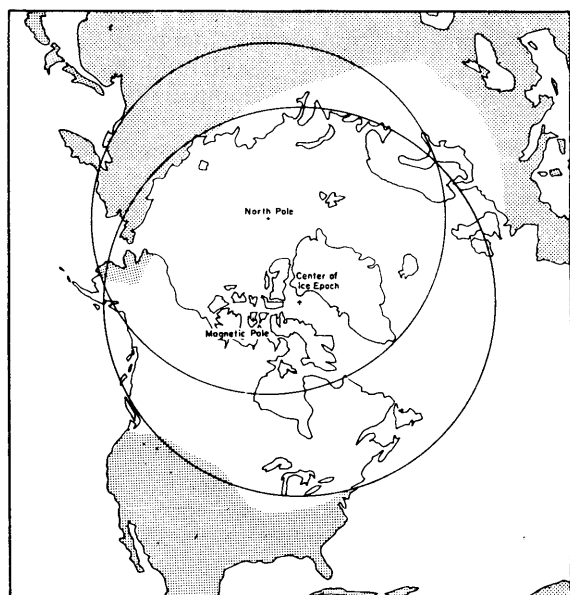
If the ice sheet was about 5,000 to 5,200 miles wide, and 3 miles deep, feathering out toward the edges, the resultant volume of ice is about 15,000,000 to 20,000,000 cubic miles. The former number will be used since there is virtue in being conservative. This is still a lot of ice to account for; particularly when it is realized that **another** 15,000,000 cubic miles was deposited in the Southern Hemisphere.

Of course this is not a great deal of ice by the standards of Callisto, Neptune, Uranus, or even tiny, icy Iapetus, with a diameter of 1,000 miles and a very heavy percentage of ice among its components. But it is a lot of ice to account for by uniformitarian standards, where 50 feet of snow is sometimes viewed as a phenomenon.

The volume of heat required to reduce 30,000,000 cubic miles of water from 70° F. to below freezing and turn it into ice exceeds 7 septillion calories. Seven septillion calories of heat loss is sufficient to freeze 400 cubic feet of ice for each and every cubic foot of the Earth's surface. Imagine 400 blocks of ice stacked vertically, upon each square foot of Earth's surface. This is the magnitude of heat exchange which must be explained, apart from the obvious suddenness, which also must be explained. This is enough heat exchange to reduce about 7 Earth atmospheres to absolute zero.

There is another method to check out this estimated volume of ice which was deposited upon the Earth. It involves review of the increase in sea level, as adjudged by the continental shelves. The Hudson River Valley, for instance, does not end at New York. It continues for about 100 miles beyond New York to the edge of the continental shelf. The Delaware Valley is a similar case. Other continents contain other examples. The North Sea has been inundated within recent geological times, if the stumps which are raised therefrom are any indication.

Evidences point to a recent rise in sea level of between 300 and 450 feet. If this is attributed to the addition of juvenile ice to the Earth's hydrosphere, which melted in the early post-diluvian age, then this tends to substantiate the previous volume estimate. It also corroborates the observation in Genesis that some 200 to 300 years after the Deluge, the land mass became divided, (Genesis 10:25) for rising waters tend to divide islands off from continents, and archipelagoes from islands.



THE GEOGRAPHICAL LOCATION OF THE ICE AGE IN THE NORTHERN HEMISPHERE

with regard to (1) the Geographical Center of the Ice Age
(2) the Geographical North Pole
(3) the Magnetic North Pole

Figure 3

Requirement 5 The Geometry of the Ice Sheet

Any acceptable theory on the Ice Epoch must accommodate itself to the conical geometry of the ice formation. On the Canadian Shield, there were several nodes with ice elevations around 15,000 feet. From these areas, the ice flowed outward in all directions, in a radial pattern, corrected only by local topographical considerations or coriolis force. This kind of pattern occurs when honey is poured onto pancakes, or pancake batter on the griddle.

It flowed over hills a thousand or more feet high, en masse for hundreds of miles. As the ice flowed, it gathered rocks, timber and other debris, which were ultimately dropped at or near the edges, forming lateral or terminal moraines. The extent of the ice flow is determined from, and orthogonal to the terminal moraines; the direction of flow was parallel to such formations as drumlins and lateral moraines. The path of flow is also plotted by locations of erratic boulders, striations and other methods.

According to uniformitarian theory, the ice was supposedly formed by snow, which had been transported by planetary wind systems from moist, warmer regions where waters evaporated abundantly. It built up until the process was exceeded by principals of outflow and melt. But this hypothesis does not agree with the manner of flow of the ice mass; neither does it agree with the direction of ice flow.

Perhaps the best illustration is found in the coldest area of the Earth, Interior Antarctica. In Interior Antarctica, the air is not only very cold, but is incapable of containing much water vapor. It is also very dry. In fact, Interior Antarctica ranks along with the interior of the Sahara Desert in lack of precipitation.¹⁴ It is rather at the fringes of Antarctica where substantial snows occur, for this is the region where warmer and more humid maritime air mixes with cold, dry, polar air.

Snowfall in Antarctica therefore takes on a saucer-shaped pattern, being greatest at the rim and least at the center. This saucer-shaped pattern of snowfall also occurs in the Northern Hemisphere. The regions of abundant snowfall are mostly at maritime locations on the Arctic peripheries where warm humid maritime air mix with colder and drier Arctic fronts. The saucer-shaped pattern is more irregular in the Northern Hemisphere than the Southern, due to the irregular distribution of polar seas and continental massifs; however the same principle in general holds.

If falling snow is presumed as the cause of the Ice Epoch, then it would be logical to conclude that the ice would build up deepest where the snow fall is deepest. There would be a thicker accumulation at the edges than at the dry interior, where little humid air would penetrate, and where temperatures would not allow the air to retain much humidity. Yet geological study of ice masses reveal that the ice mass was conical in shape; not saucer-shaped, as uniformitarian theory would logically suppose.

Furthermore, the pattern of ice flow does not agree with the slow-snow uniformitarian hypothesis. Today there are slow-snow glaciers in the Cascade Mountains along the Pacific Ocean, from Alaska, through British Columbia and Washington, and into Oregon. Here, glacial flow is similar in pattern to riverine flow. This is known as a dendritic, or river-like pattern. The glacial flow is between hills and ridges, and is concentrated in the valleys.

Requirement 6 The Ice Cave Phenomena of Eastern Washington

A most unusual phenomenon is that of ice sandwiched between lava formations. Lava (igneous rock) usually is considered as being laid down in temperatures which are either warm or hot, and at the very least, at temperatures other than below freezing (32° F.)

In the intermontane region of North America which is located west of the Rockies and East of the Cascades, there was a great outpouring of lava during the Flood catastrophe. In some

places, the lava deposits exceed 8,000 feet in depth overlaying the original bedrock. It is punctuated systematically by paper-thin layers of shales, as if the lava had alternately bled out, and had been washed and compressed by immense oceanic tides.

Several great outbleedings of lava occurred, forming basaltic plateaus. One was in Abyssinia; one was in Brazil; one was in India. But the one in North America was unique in that in this region, the ice deposition coincided with the lava outflow. Here ice and lava are mixed with fossil debris and alluvium.

This area covers approximately 150,000 square miles, in five states and one Canadian province, namely Idaho, Oregon (Eastern), Washington (Eastern) and a small portion of northern California, Utah and British Columbia.

At the northern edge of this lava plateau, inflowing ice complicated geophysical features. Great coulees were formed by rivers of flowing ice. Rivers were alternately formed, blocked and rerouted. The Columbia Valley, Grand Coulee and Moses Coulee are among the examples. Throughout this area, particularly Eastern Washington, Eastern Oregon and Southern Idaho, there occurs a phenomenon known as ice caves. Apparently, much ice was sandwiched in between alternating layers of lava, and has thus been insulated by the surrounding lava from copious melting. Where melting has occurred, ice caves have resulted.

When the Milwaukee Railroad was being built in this impressive, volcanic, desert-like region, ice caves were discovered in Southern Grant County. They were used for refrigeration of food for the railroad construction gangs. When highway construction crews made great cuts through the lava hills, they also ran into pocket after pocket of ice which has been there certainly for thousands of years (but we doubt for millions of Lyellian years.)

In Okanogan County, in the hills above Tonasket, an ice cave exists which spelunkers have followed for 7,000 feet without finding its end.¹⁵ And it has been reported that outside of Bend, Oregon, a man was digging a foundation for a house, and encountered an ice cave.¹⁶ In Deschutes County, there are reportedly several ice caves.

A small ice cave is located about 15 miles downstream from Grand Coulee Dam, in the hills overlooking the Columbia, on the Norman Ailing ranch. It has been inspected by this writer. This particular cave apparently had been known to the Indians. In the homestead days, the Allings used the cave for refrigeration, and

thus ate beef during the hot summer months while their neighbors ate salt pork. Even today, by family tradition, as the family fathers on each 4th of July, one of the foremost of festivities is the making of home-made ice cream with the old wooden bucket and the rotating cylinder and crank, using fresh ranch cream. And they use ice from the ice cave—ice which is obviously old, perhaps 5,000 years old in terms of its terrestrial existence.

This ice cave is at the base of a natural lava terrace. Rising above and back of the cave is a large hill, composed almost entirely of ice and lava. Its face, almost a cliff, is about 300 feet high, and beyond that are further rises. The chill, constant draft emanating from within the cave is felt as one stands in front of the cave, which is prehistoric in existence, and located between layers of lava. Upon entering one sees the massive icy stalactites and stalagmites and marvels at their architecture and origin.

At the base of the lava terrace, in addition to the ice cave, is a spring formed by melting water from the ice contained within the hill. Its temperature is a constant 34° F., summer and winter, since it comes from the cave interior which is 32° F. The rate of water flowing per hour from this icy cool spring is unknown. It is known that it is sufficient to accommodate ranch needs, including watering the livestock. The amount of water lost in seepage is thought to be far greater than the amount of water flowing from the spring itself.

If the rate of flow of the icy water, including both that from the spring and the lost seepage, is five gallons per hour¹⁷ (and since we endorse the many virtues of conservatism, this is most assuredly a conservative estimate), then by simple calculations, at least 1 million tons of ice have melted from within this hill over the last 5,000 years. And no one knows how much ice yet remains unmelted; unquestionably both amounts are vast when viewed from any perspective.

Recall that these temperatures exist today, sandwiched between lava formations which must have contained much original heat. In this external climate, the annual temperature average is not 34° F. or 32° F., but a little more than 40° F. Also it must be realized that temperatures increase vertically within the Earth's crust, at a rate of about 16° F. per 1000 feet. Thus this ice and lava sandwich overlays rock which, some 10,000 feet down, contains temperatures which approach boiling. For ice to maintain its state under these conditions for millenia is no small feat. The fact that the ice has not fully remained at 32° F. has resulted in formation of the ice caves.

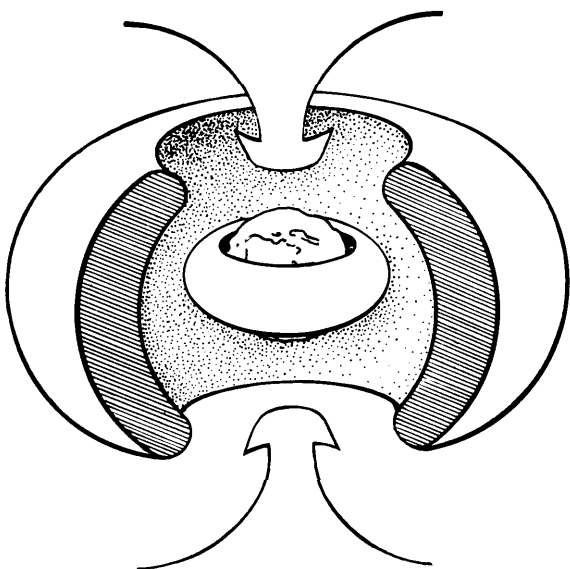


Figure 4. The Van Allen Belts and the Direction of Descending Ice.

For the ice to maintain its temperatures, imbedded in igneous rock, is remarkable. But how did it get there? By falling snow flakes? How was it that this condition occurred not just a few times in one county, but hundreds of times over a tri-state region?

But in the Ice Epoch, the flow was radial, not dendritic. It flowed out in all directions, with no relation to hill or dale, and engulfing both as it moved on for hundreds of miles. This radial pattern of flow, like the example of the mammoths, requires suddenness and not gradualness as a major explanatory feature.

Discussion

Siberians generally get a poor view of Aurora Borealis, not because of their colder climate, but because of their remoteness to the North Magnetic Pole, which is located in Northern Canada. Illinois is about 500 miles closer to the Magnetic Pole than is Northern Siberia. More glaciation occurred in Illinois despite the fact that glaciated areas occur at latitudes as low as 37°, which is well over half the way from the North Pole to the Equator (almost 60% of the way to the Equator.)

In noticing the location of the Aurora Borealis in association with the region of the ice sheet, one might realize that in geography, associative relationships may be as meaningful as "cause and effect" relationships. The Aurora is related, not to the Ice Epoch, but rather to the Van Allen Belts and the magnetic poles. Could it be that the Ice Epoch also is related to magnetic principles?

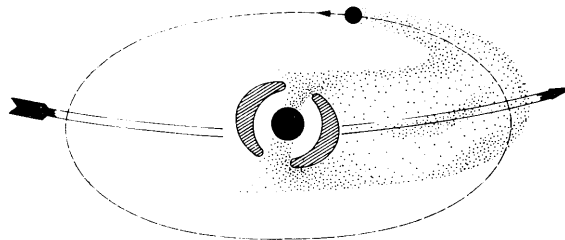


Figure 5

If the Deluge was tidal in its essence, this means that the Earth underwent an extreme gravitational disturbance. This means the Earth-Moon system may have temporarily been faced with an icy intruder. But the Earth has two fields; one is gravitational and the other is magnetic. If the Earth experienced historical gravitational chaos, might it not simultaneously experience magnetic havoc? And if astral ice particles were captured, possessing both extremely low temperatures and dielectric charges, would not they respond to magnetic deflections?

There seems to be a relationship between the geographical poles and the magnetic poles, the nature of which is not yet understood. They are located about 1300 miles apart in each case. It is supposed in this essay that had the magnetic poles been located in tropical climes, the Ice Epoch would have been located there also.

It is further supposed in this essay that a volume of astral or celestial ice, in a volume of 30,000,000 cubic miles, was captured simultaneously with the gravitational havoc (the Flood). Therefore the uniformitarians were incorrect in concluding that the Ice Epoch was antediluvian. And the catastrophists such as Price, Rehwinkel and Morris were incorrect in concluding that the Ice Epoch was a postdiluvian development. The two were simultaneous. However it needs to be added that the catastrophists, such as those just previously mentioned, did read the geological record correctly in ascribing glacial deposition and scouring to the postdiluvian age. It took weeks, months, years for the waters to drain off, and reach a new equilibrium.

Similarly, it took the ice many centuries to outflow, and melt down. And also similarly, the oceans were filled with a great volume of cold juvenile ice water. It took the oceans several millenia to reach a new temperature equilibrium. This is why the climatology of the ancient postdiluvian world was somewhat different from today. This is why Arabia was a well-watered region in Job's time; humidity, temperature and precipitation conditions resembled the mid-latitude conditions of today and not the horse latitude conditions to today's Sahara. This is why olive groves extend deeply into Cirenaica, and

Cyrene along with Carthage were metropoli. Their hinterlands were much greater than today, since the planetary wind systems have become warmer (and for those areas, more dessicating.)

It is finally supposed in this essay that at the time of the Flood catastrophe, millions of cubic miles of extremely cold, charged ice particles were engulfed in the Earth's magnetic field (Figures 4 and 5). They were shunted around, not dissimilar to ions during times of sunspot activity. They were deflected toward the magnetic polar regions. Here, these high speed particles tended to converge. In converging they collided. In colliding, they decelerated. In decelerating, they descended. Their pattern of descent was some 5,000 miles in diameter; their depth was 3 miles in the central magnetic regions, and increasingly less toward the peripheries.

Summary

Six major groups of facts are presented in relation to the occurrence of ice both as regards the present and the past. The evidence is clear that mammals, particularly mammoths, were frozen very suddenly by the millions. The regions of this sudden freezing coincide 75% more closely with the magnetic north pole than with the geographic north pole.

The depth of ice in both polar areas is from 10,000 to 15,000 feet. In the south polar area 5000 of the 10,000 feet of ice is below sea level. The volume of ice conservatively estimated is

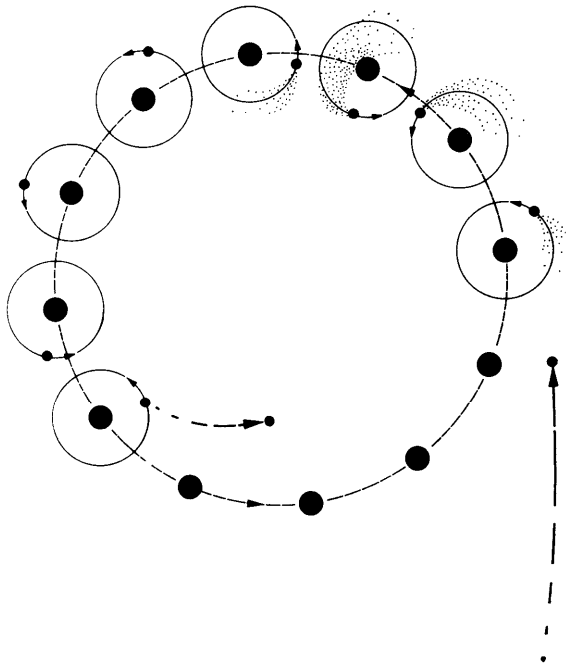


Figure 6. Era of Flood Catastrophe and Era of Ice Capture.

about 30,000,000 cubic miles. The ice evidently was conical in its geometric outline, and acted in its outflow like honey that is poured onto pancakes. One of the most unusual phenomena is the occurrence of ice caves sandwiched between lava formations.

It is proposed that the earth temporarily captured a small satellite (Figure 6) from outer space similar to one of the moons of Saturn having about the same icy composition. As a result the earth captured about 30,000,000 cubic miles of ice particles at the same time as it suffered great gravitational havoc resulting in the Flood. Evidence is given suggesting that this capture was related to the magnetic poles due to the dielectric charges of the ice particles.

Diagrams illustrating this concept are presented and for further detailed data the reader is referred to a book soon to be published by the author entitled *The Biblical Flood and the Ice Epoch*. Pacific Meridan Publishing Co., Seattle, will publish this book.

Literature Cited

¹Charles Lyell, the originator of the uniformitarian Geological Time Scale, originally ascribed the dating of the Ice Epoch to 1,000,000 B.C., a "recent" event. This dating was as arbitrary as his many other datings.

Later, it was pointed out to Mr. Lyell that Niagara Falls was a "geological clock." An escarpment, a crystalline structure, lies across Northern New York and Eastern Ontario between Lake Ontario and Lake Erie, two lakes which were formed at the end of the Ice Epoch. Across this escarpment flows the Niagara River. The crystalline escarpment is underlain by a layer of soft limestone, which erodes out from under the harder surface layer, causing an eroding of Niagara Falls from the original escarpment line back towards Lake Erie.

Lyell viewed this recession. He knew the distance which it had eroded back from the original escarpment line. He inquired of local residents as to the rate of recession. The consensus of the local residents was that the rate was 3 feet per year. Lyell's calculations indicated that this was about 12,000 B. C., which was much too recent for his Geological Time Scale. He immediately concluded that the local residents were exaggerating. He allowed 12 inches per year rather than the 36 inches which the local residents had considered reasonable. He proceeded to revise his earlier pronouncement; the Ice Epoch ended at 40,000 B.C.

We now know that the local consensus was not exaggerated, it minimized the current rate by at least 50%. Furthermore it is reasonable to assume that the rates of erosion immediately after the end of the Ice Epoch were greater, not less, than the current rate. This is because of a much greater amount of water flowing over the falls, together with more debris and ice. Lyell's error in dating in reality was over 99%; this brief review notes that he ultimately acknowledged 96% of that error. The essential point to gather is Lyell's arbitrariness in organizing his Geological Time Scale, one which is still considered sacrosanct by uniformitarian geology.

²Ivan T. Sanderson "Riddle of the Quick-Frozen Mammoths," *Readers Digest*, April, 1960, p. 123. (Also see author's "Riddle of the Frozen Giants," *Saturday Evening Post*, Vol 232, Part 4, January 16, 1960, pp. 39 and 82, 83.)

⁷The fossils of these people, dead for 2000 years, have been found by a careful search of the ruins of Pompeii. Where a person died and was covered by pumice, the body decomposed, but the pumice did not subsequently shift. The result was a cavity in the pumice which, if filled with plaster of paris, produces a perfect specimen of the dying individuals, with dying expressions on their faces, in positions reaching for loved ones. Even the detail of the fabric of their clothes, along with wrinkles are preserved.

⁸Sanderson, *loc. cit.* "It takes a great deal of cold to freeze a warm-blooded mammal. Men have been out in temperatures of — 100° F. for up to half an hour without their lungs freezing. Sled-dogs in the Arctic and Antarctic have been out in blizzard conditions in temperatures well below —80° F. for many hours and even days without freezing, and admittedly moving air is more chilling than still air. In 1911 when Scott took his ill-fated dash to the South Pole, his little Shetland ponies survived until their food gave out.

"At —40° F. it takes 20 minutes to quick-freeze a dead turkey, 30 minutes to preserve a side of beef. But these are mere bits of meat, not the mammoths clothed in fur, at a temperature of about 98° F. Unless we have tremendous cold outside, the center of the animal we are trying to freeze will remain comparatively warm for some time, probably long enough for decomposition to start. Meanwhile, the actual chilling of the flesh will be slow enough for large crystals to form within its cells. Neither event occurred with most mammoths, although one of them has been found by the radio-carbon dating method to be just over 10,000 years old. The flesh of many of the animals found in the muck is remarkably fresh. Frozen-food experts say they must have been frozen at well below —150° F.

"Further, several studies indicate that mammoths were not especially designed for the Arctic; nor did they live in Arctic conditions. The Indian elephant, which is a close relative of the mammoth . . . has to have several hundred pounds of food daily just to survive. But, for more than six months of the year, there is nothing for any such creature to eat on the Arctic tundra. Yet there were tens of thousands of mammoths."

⁹Janles S. Pickering, *1001 Questions Answered about Astronomy*, New York: Dodd, Mead & Co., 1959, p. 68.

See also p. 59 for discussion of satellites of Jupiter, p. 61 for discussion of Saturn and its ice structure, and page 62 for discussion of the rings of Saturn. Interestingly, Pickering says, on page 58:

Jupiter has more atmosphere than any of the other Planets, excepting possibly Saturn. . . . Rupert Wildt, a modern astronomer and an authority on the planets, has constructed theoretical models of both Jupiter and Saturn. His model of Jupiter shows an atmosphere of hydrogen, methane, and ammonia which is about 8,000 miles deep. Beneath this, there is a layer of ice about 10,000 miles deep over the entire core of Jupiter. These dimensions leave about 38,000 miles for the diameter of Jupiter itself.

The following references should also be noted by the reader: Robert H. Baker, *Astronomy*, Princeton, N. J.: D. Van Nostrand Co., 1959, pp. 218, 228; Gerald P. Kuiper et. al., *Planets and Satellites*, Chicago: University of Chicago Press, 1961; and George Abell, *Exploration of the Universe*, New York: Holt, Rinehard and Winston, 1964, p. 298 for good discussion of the origin of comets.

¹⁰Byron C. Nelson, *The Deluge Story in Stone*, Minneapolis: Augsburg Publishing House, 1931, p. 122.

¹¹Nelson, *op. cit.*, p. 125. "The remains of mammoths are incredibly numerous in Siberia and, strangely enough, their numbers increase farther north toward the Arctic Ocean. Their bones are spread over the bottom of that ocean, where ships have dredged them up. And 200 miles to the north, in the New Siberian Islands, not much farther from the North Pole than New York is from Chicago, mammoth remains are thickest of all."

Author's note: The reason that the New Siberian Islands and other offshore islands in the Arctic Ocean were populated by fauna are (1) there was a subtropical climate in the antediluvian age, and (2) there was a lower mean sea level, approximately 400 feet lower than the current level. Thus not only were the New Siberian Islands connected with Siberia; the Bering Strait also did not exist, and Alaska was connected with Siberia. Africa, Asia, Europe and North America were one interconnected land mass in that age.

¹²Charles H. Hapgood, "The Mystery of the Frozen Mammoths," *Coronet*, September, 1960, pp. 71-72.

¹³Hapgood, *Op cit.* p. 74. "Baron Edward Toll, the explorer, reported finding a fallen 90-foot fruit tree with ripe fruit and green leaves still on its branches, in the frozen ground of the New Siberian Island. The only tree vegetation that grows there now is a one-inch high willow."

¹⁴The writer has taken courses in geography and related subjects in two different colleges, and has discussed this problem with uniformitarians in several different departments. The tendered explanations were nearly identical. The following kind of suggestion was the normal explanation:

Perhaps some mammoth started walking across the ice in a blizzard on a recently-frozen lake. Perhaps he wandered into an area where the ice was too thin, and the mammoth fell through and drowned. Perhaps he had been carrying his breakfast of buttercups, wild beans and tender sedges with him across the ice, and drowned with them yet in his mouth. Maybe through some freak of nature, his drowned body did not deteriorate, and was not cannibalized by fish. Perhaps it was preserved until a permanent change of climate occurred. And possibly this sort of thing happened to thousands or millions of animals over long periods of time—animals including bison, horses, lions, rhinoceroses, sheep and others.

The author totally disagrees with such inadequate and incongruent explanations, no matter how sincerely tendered, no matter by how many professionals, no matter how devious and complicated the path of explanation may be. Logic just happens to be overstrained.

¹⁵Dolph Earl Hooker, *Those Astounding Ice Ages*, New York: Exposition Press, 1958, p. 44, as taken from *National Geographic*, October 1935. Admiral Byrd wrote as follows:

The rock fragments from this mountainside invariably included plant fossils, leaf and stem impressions, coal and fossilized wood. Here at the southernmost known mountain in the world, scarcely two hundred miles from the South Pole, was found conclusive evidence that the climate of Antarctica was once temperate or even sub-tropical.

¹⁶Author's note: It is suspected that many geophysical alterations, changes and upheavals took place simultaneously in this gravitational-magnetic crisis period. One was tidal upheaval of the oceans (fluid hydrosphere.) One was tidal upheaval of magma (fluid lithosphere.) One was a reorganization of the climatological regime. One is the relocation of the geographical poles, quite

likely accompanied by a change in the angle of the axis to the perpendicular of the ecliptic (currently $23\frac{1}{2}^{\circ}$). This may assist in explaining many things, and the existence of warm-water crustaceans in Arctic latitudes is only one. Further reference is made to *The Biblical Flood and the Ice Epoch*, Seattle, Pacific Meridian Publishing Co., 1966, written by the author.

¹³Hooker, *op. cit.*, p. 68.

¹⁴Hooker, *op. cit.*, p. 30. "The everlasting wind blowing from the pole is as dry as the winds over the Sahara."

¹⁵Mr. Arthur Patten, Tonasket, Washington.

¹⁶Mr. Rupert Shaw, Seattle, Washington.

¹⁷Mr. Arthur Kalmen, Grand Coulee, Washington. Mr. Kalman, an employee of the Department of Interior, Bureau of Indian Affairs, is a credit manager for the Colville Indians. He is familiar with this particular ice cave, the Ailing ranch, and surrounding area. Our estimate of 5 gallons per hour from the spring at the base of the hill containing the ice cave is considered markedly conservative by Mr. Kalman.

NEW PUBLICATION

"The Fallacy of Reconstructions" (Paper #33) by Arthur C. Custance, Ph. D. Doorway Papers, Box 1283, Station B, Ottawa, Canada, 1966. The price is 50¢. post free.

This Paper is an attempt to show that in dealing with living forms of the past, especially those which have to do with man's supposed evolution, there has been a lack of complete honesty on the part of experts when it comes to providing the public with pictorial reconstructions. This is particularly true in the case of Anthropology, a subject which occupies most of the Paper. Photographs and line drawings derived from well-known texts are used to show the extent to which the evidence has either been falsified or "distorted" to reinforce in the public mind the claim that evolution of man is based on solid grounds.

This Paper, very carefully documented, is a 28 page symposium of the kind of reconstructions that are commonly found in the literature, plus 11 pages of figures.

THE GALAPAGOS ISLAND FINCHES

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Freedom, California

Introduction

Gregory and Goldman's *Biological Science* (Green version in B.S.C.S. series) gives an impression of a most remarkable adaptive variation in the Darwin finches of the Galapagos Islands (page 729).¹ Though somewhat more realistic, the B.S.C.S. Yellow version, *An Inquiry Into Life*, illustrates the same group on page 593.² Forms presumably resembling humming-birds, woodpeckers, large and small seed crushers, and insect-eating types are shown as derived from a single pair of original birds.

It was my good fortune to be able to study the large collection of Darwin's finches at the California Academy of Science in the Fall of 1965 and Spring of 1966. The following is a report on the variations observed and measurements made.

Acknowledgments

I wish to acknowledge the kind cooperation of Dr. Robert F. Orr, ornithologist of the Academy, who permitted me to examine the specimens in this fine collection. He also showed me the remarkable range of variation in the collection of specimens of the song sparrow, *Melospina melodia*.

Material and Methods

The California Academy of Science collection consists of 37 trays, each with about 100 specimens; some 3700 well-preserved Darwin finches. I first made detailed measurements of the height, curvature, length and breadth of each mandible of several specimens of each species. Overall length, breadth, and height of the body and wing measurements were taken. It was soon apparent that such a high correlation usually existed in these various measurements that only four will be reported in this paper, as follows:

- 1) Length of bird from tip of bill to end of tail.
- 2) Height from belly to top of the back
- 3) Total length of the bill.
- 4) Width of the ventral side of the lower mandible of the bill. (Figure 1)

All the specimens in each tray were first given a general examination, and then those which showed **extremes** in variation for curvature, width and length of the bill were carefully measured. Then the various trays, **irrespective of**

their island origin, were compared both in general appearance and detailed measurements. Unless otherwise mentioned 25 specimens of each species and subspecies were measured.

Results of the Examination

The Darwin finches are a rather drab gray to brownish colored group of birds, except for the almost fully black dorsal plumage of the males of some species. The whole collection had an appearance of general uniformity. Only the *Certhidea* or the Warbler finches seemed truly distinctive.

Were it not for the historical importance of these finches as one of the "pillars" of evidence for the evolution of adaptive variation, I doubt if much attention would be given to them. A resume of the collection may best be given by arbitrarily calling the tray containing the largest finches Tray 1. This is also the order from top to bottom in which they are filed in the collection. (Body measurements are given in centimeters, and bill in millimeters throughout.)

Tray #1

Tray #1 consisted entirely of specimens labeled *Geospiza magnirostris* from Culperrerr, Wenman, Abingdon, Bindloe, Tower, and James Islands. This "species" has the largest bill and body. Much fluctuation in measurement was found however.

Body variation: 3½-4 high x 14½-15 long.
Bill variation: 13-18 wide x 19-20 long. Total of specimens measured—50.

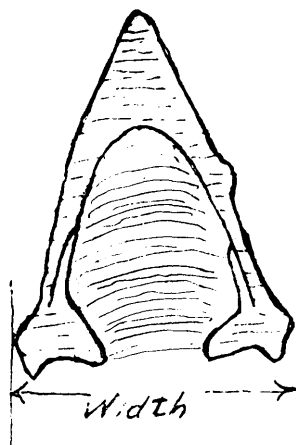


Figure 1. Typical Ventral view of lower mandible of *G. magnirostris*

The general impression was one of remarkable uniformity except for bill variation. The males were mostly black.

Tray #2

G. magnirostris from James, Jarvis, Seymour, Indefatigable, Albemarle and Barrington Islands.

Same range in variation shown except that one specimen had a bill only 13mm. wide x 15mm. long. Most of the males had black plumage. Total of 80 specimens measured.

Tray #3

All specimens were labeled *Geospiza fortis*. My first impression was that here we have a small version of *G. magnirostris*. The specimens were from Wenman, Abingdon, Bindloe, James, Jarvis, Daphne, and Seymour Islands.

Body variation—2.5-3 high x 11.5-15 long. Bill variation—9-11 x 10-15.

Tray #4

Also *G. fortis*. Mostly lighter gray forms from Seymour, Indefatigable, and Duncan Islands.

Body—2½-3 x 11-14½. Bill—9-12 x 11-15.

One specimen was as large as the smallest *G. magnirostris*, i.e.: 3½ cm. high x 14½ cm. long.

Tray #5

G. fortis from Duncan and Albemarle Islands. Many black colored males with mostly small bills. One had a bill 13 mm. x 15 mm., exactly similar in shape (curvature size and size of mandibles, 13 x 15 mm.) to the specimen in Tray #2, all of which were labeled *G. magnirostris*.

Tray #6

G. fortis – specimens from Albemarle, Marborough, Barrington, and Chatham Islands. Some specimens had bills as large as 13 mm. wide and 18 mm. long. This bill was on a male 3 cm. high x 13 cm. long. There was also a great difference in the curvature of the bills. Thus one specimen, #5357, was much broader than #6270, as shown in Figure 2. There were many black-plumaged males in this collection.

Tray #7

G. fortis from Chatham, Hood, Gardner, Charles Islands.

Body—3½-3¾ high x 14-14½ long. Some birds were fully as large as *G. magnirostris* in this tray, both regarding body and size of bill.

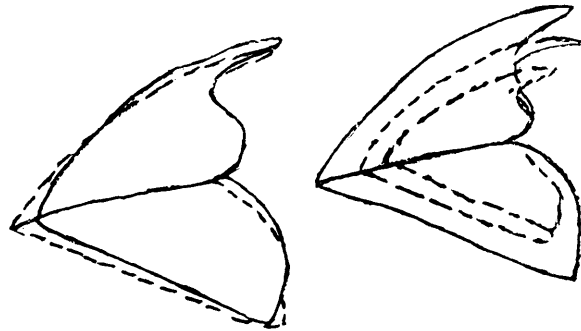


Figure 2. Left: solid line, small *G. magnirostris*; broken line, large *G. fortis*. Right: large, intermediate, and small form of *G. fortis*.

Tray #8

G. fortis from Charles Island. There were many large specimens as Lack reported.³ As he states it, "where *G. magnirostris* is absent, *G. fortis* is large." But careful study failed to reveal any **difference** between these and *G. magnirostris*, **other than the label!**

Thus specimen #5260 had a bill 12 mm. x 17 mm. and a body 3.2 cm. wide x 12 cm. long. Others had bodies fully as large as the smaller *G. magnirostris*. The bill shape often **identical** as may be seen in Figure 2. Though the bill of the specimen shown is slightly longer, many were exactly the same length and height.

Tray #9

All *G. fortis* from Charles Island. All were grayish-brown specimens and averaged large for the size of the species. One had a bill 13 mm. wide by 17 mm. long. Another (#5501) was 3 cm. x 14½ cm. with a bill 13 mm. x 18 mm.

Tray #10

All *G. fortis* from Charles Island. All except two black-colored males were gray colored on sides and belly and brownish above. One specimen, #6321, was 3.2 high and 14 long with a bill 13 mm. wide x 15 mm. long.

Tray #11

G. fortis from Charles, Champion, Gardner, and *G. fuliginosa fuliginosa* from James, Jarvis, Seymour, and Indefatigable Islands. The *G. fortis* specimens were similar to those in Trays 8, 9, and 10. *G. fuliginosa fuliginosa* however had dimensions as follows:

Body—2.5 cm. high x 10 cm. long. Bill—7 mm. width x 11 mm. long.

At first glance this seems a very sharp break in continuity. However one of the smaller *G. fortis* in Tray #3, #6189, had a body 2.5 cm. x 11.5 cm. and a bill 9 mm. x 12 mm.

Tray #12

G. fuliginosa, var. *fuliginosa* from Indefatigable, Duncan, Albemarle. Here a great variation in bill size and conformation occurs, as some were long and slender, (5 mm. x 10 mm.) and others were wider (8 mm. x 13 mm.) About half were black colored males and the rest were light gray to brownish females.

Tray #13

G. fuliginosa fuliginosa from Albemarle, Marborough, Brattle, and Barrington Islands. These had much coarser beaks but many were quite hooked, or rather showed great mandible curvature.

Tray #14

G. fuliginosa fuliginosa from Chatham Island. Many males with black coloration. The specimens were more uniform than most,

Trays #15 and 16

Tray #15 was also *G. fuliginosa fuliginosa* from Chatham, Hood, Gardner, Charles Islands and Tray 16 from Charles and Captive Islands.

Some beak variation, but body size was slightly smaller than that of Tray #11.

Further comparisons with *G. fortis* are as follows:

	Body	Bill
<i>G. fuliginosa fuliginosa</i>	2.6X11	8X10
Seymour island (typical black male)		
specimen #5781 (black male)	2.5X11	8X12
specimen #6567 (Indefatigable)	2.5X11	9X11
<i>G. fortis</i> (typical black)	2.7X12	10X13
<i>G. fortis</i> Abingdon #5184	2.5X10.5	8X12
<i>G. fortis</i> Indefatigable #5187	2.5X12.5	10X12

So, although *G. fuliginosa fuliginosa* averaged smaller, complete intergradation was found.

Tray #17 and 18

All *G. difficilis*. Body variation – 2.5-2.75 x 11-11.5 long. Bill variation—6-65 x 11-12.

The specimens in general had a more rufous colored tail but there was complete intergradation as regards this characteristic with that typical of *G. fuliginosa fuliginosa* and *magnirostris*.

Tray #19, 20 and 21

G. scandens from Abingdon, Albermarle, Bindloe, Charles, Chatham, Duncan, Indefatigable,

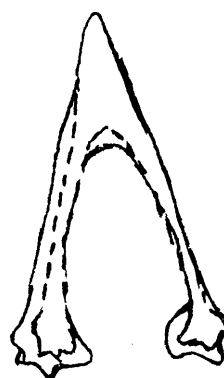


Figure 3. Solid line *G. conirostris*, broken line *G. scandens*. Ventral view of lower mandible adapted from Figure 61 of Bowman's article.

Jervis, and Seymour Islands. At first glance these specimens seemed remarkably uniform for a long narrow bill, and I thought that here at last was a really distinctive species.

The following are some characteristic measurements: Bill—8 x 18; 9 x 20; 9 x 19; and 10 x 19. The body was rather uniform: 3½ cm. high x 14 cm. long. However specimen #7173 had a bill 10 x 20 with a body 3½ x 13.

Tray #22, 23 and 24

G. conirostris conirostris from Culpepper, Hood and Tower Islands. The body was 3-3.5 x 13.5-14 cm. and samples of bill measurements were as follows: 10 x 15, 10 x 17, 12 x 15, (identical to one specimen of *G. magnirostris* in both size and curvature of the bill), and 10 x 18 (identical to *G. scandens* in size and curvature of the bill).

The individuals of the species then are a connecting, intergrading link between *G. magnirostris* and *G. scandens*. Incidentally this fact is also referred to by Bowman on page 285 of his *Morphological Differentiation and Adaption in the Galapagos Finches* where he says, "It would seem, then, that in size and shape the bill of *G. conirostris* spans the morphological 'gap' between *G. magnirostris*, *G. fortis*, and *G. scandens*."

To be fair in my quotation from him I might also state that he considers *G. conirostris* unique in its structural plan of the mandibles and skull area. His discussion of these slight distinctions on page 247 is not too convincing however in view of the great variation shown. (For comparison of **typical** forms see Figure 3.)

Tray #25, 26 and part of 27

G. crassirostris: the plumage is generally more brownish and the males are black only on the head area. Otherwise this species is so similar

in size to *G. magnirostris* that after a few preliminary measurements further study was not made. The bill also varied greatly such that identical measurements of length and width could easily be found in both "species."

Bowman who is mightily impressed with minute skull differences, shows seventeen differences in his comparative analysis. It would seem that he is comparing the typical or perhaps average rather than those which show marked intergradation. A better comparison emphasizing the similarities is shown in his Figure 56 where variations in *G. magnirostris* are shown. Unfortunately he does not show the marked and overlapping variation found in *G. crassirostris*.

Tray #27, 28, 29, 30, 31, 32, 33 and 34

Camarhynchus psittacula, *habeli*, and *affinis* from Abingdon, Albermarle, Barrington, Bindloe, Charles, Duncan, Indefatigable, James, Jervis, Marborough and Seymour Islands. All were predominantly gray in color although much variation was found in coloration and some were as brown as *G. conirostris*. Again some *G. magnirostris* were fully as gray as specimens of the "genus" *Camarhynchus*.

	Body	Bill
<i>C. habeli</i>	3 x 12	9 x 13
<i>C. psittacula</i>	3 x 13	11 x 12
<i>C. affinis</i>	2.5 x 11	7 x 10
<i>C. pauper</i>	2.5 X 11	7 x 10
<i>C. parvulus</i>	2.5 x 10.5	7 x 7
	2.8 X 10.7	7 x 10
	2.8 X 12.5	7 x 10

These all intergraded and except for the difference in species labels would most certainly be considered as a variable group of light gray individuals of the same species.

Tray #35 and 36

Cactospiza pallida from Albermarle, Chatham, Duncan, Indefatigable, James, Jervis, and Seymour Islands. All were very light gray, especially as regards the side and belly plumage coloration. The size was quite uniform, varying only slightly from a body of 2.5 x 12 and bill of 7 x 15.

Figure 4 shows a comparison of the typical *G. magnirostris* at the top, then *G. fortis*, *G. fuliginosa* and *G. difficilis* compared to *G. scandens* on the right. All are males. The variation in color of bill is not significant for color is a highly variable feature, both intra- and interspecifically.

Figure 5 is a comparison of *G. fortis* at the top, then *G. conirostris* and *G. scandens* at the

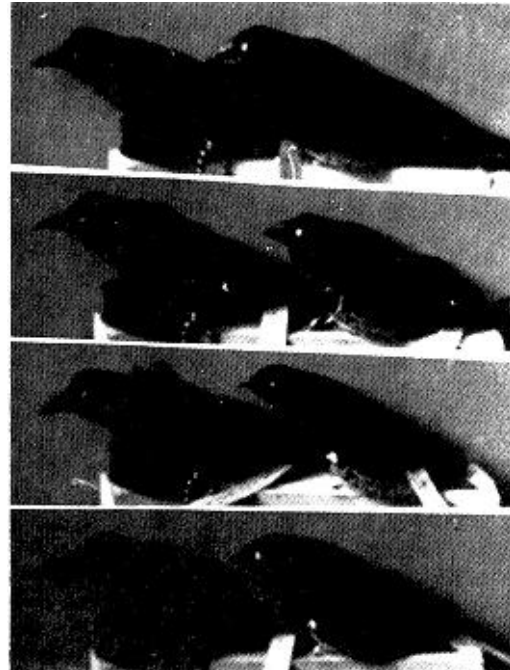


Figure 4. a) *G. scandens* (left) vs. *G. magnirostris* (right) b) *G. scandens* (left) vs. *G. fortis* (right) c) *G. scandens* (left) vs. *G. fuliginosa* (right) d) *G. scandens* (left) vs. *G. difficilis* (right). All specimens are black plumaged males.

bottom. The upper two birds are females, the lower one a male. Note the variation in plumage color of background birds.

Discussion

If one were to remove all the species labels and arrange the Darwin finches from the largest to the smallest in body and bill size, complete intergradation would be found. The same is true of bill length and width. As mentioned above there is complete intergradation of plumage coloration although the smaller birds tend to have lighter gray feathers.

The situation is exactly comparable to that of the song sparrow, *Melospiza melodia*, where one finds a comparable range in size of bird and bill. Here also the small desert forms are light gray in color.

Bowman works hard to show that there is a basic difference in skull configuration between *G. magnirostris*, *fortis*, and *conirostris*. However his Figure 30 is not very convincing to me. For we must remember that the **broken** lines of *G. fortis* show the **variation** in skull size and the **solid** line of *G. magnirostris* upon which he places much confidence is only an average of many skull size measurements. Also Figure 56 is quite revealing in showing the gradation. One cannot help but feel that the pattern of **distinct-**

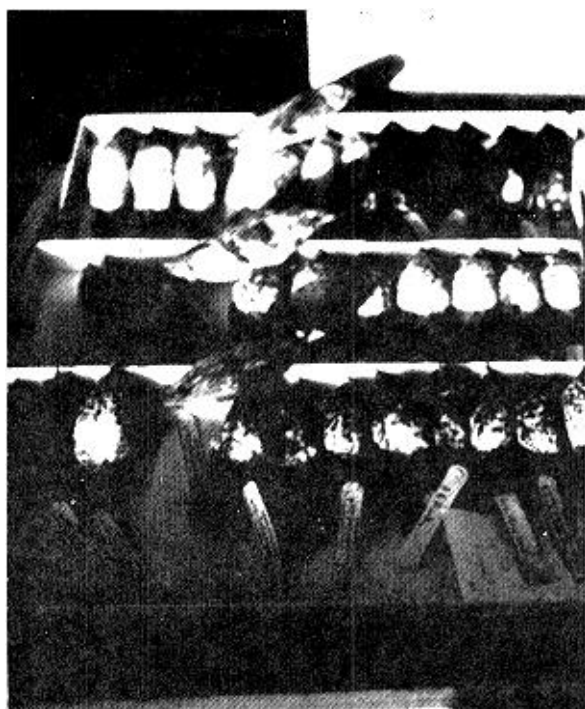


Figure 5. Top: *G. fortis* female (much beak curvature). Middle: *G. conirostris*, female. Bottom: *G. scandens*, male. *G. fortis* varies in curvature of beak some being identical to *G. conirostris*.

tion exists more in the mind of Bowman than in the reality of specimens observed and so carefully measured.

If species are to be erected on such minute norms, then indeed we will be burdened with an almost infinite number of names.

It seems much more in line with reality to consider these birds as all one species, broken up into various island forms as a result of chance arrangement of their original variability potential, as regards the rather minor variation in bill and body size, skull features and plumage coloration. A Sewell Wright random variation pattern would give exactly this sort of thing. Presumably many pairs of finches from either Ecuador or even Central America happened to fly there and settle on these islands.

The *Certhidea* or Warbler finches surely are distinctive though I doubt if the four species are more than merely color variations. *C. fuscus*, *becki*, *olivacea*, and *mentalis* were the labels shown on the various individuals in the collection. There was so much intergradation in color that it seemed rather strange to have different labels on these all of which were rather similar in size.

Evidently a different original stock with quite a distinctive variability potential resulted in these Warbler finches, which incidently are remarkably distinctive in feeding habits also, Present feeding habits are the result of the particular types of bills the individuals happened to have inherited. Most emphatically I cannot accept the idea that the variations in size of bill are "adaptive divergencies" resulting from natural selection.

The various races now labeled as species and genera certainly exist and are not imaginary. But they are more comparable to the tribes of Indians existing in North America before Columbus discovered it, than to species, let alone genera. Ornithologists call attention to the fact that these forms remain distinct and have different song patterns. However, Orr reports that the basic song is the same. Again this would be comparable to the various languages of the Indians, all variations of the same basic pattern.

Evidence as to the amount of natural hybridization is far from adequate. Possibly some of the intermediate forms, such as *G. conirostris rothschildi*, are really hybrids. Who really knows? Attempts so far to interbreed the so-called "species" in captivity have failed according to Robert Bowman's assistant, Miss Cutler. However she points out that mating even between **individuals** of the **same** species is difficult to achieve in cages.

One conclusion is certain, the entities called species are certainly not comparable in distinction to the basic species as in the genus *Rosa* or *Prunus* of the family Rosaceae. When it comes to genera, would any ornithologist claim *Geospiza*, *Camarhynchus*, *Cactospiza*, and *Platyspiza* are comparable to the genera *Rosa*, *Rubus*, *Prunus*, *Fragaria*, (Strawberry), or *Pyrus* (pear)? With all due respect to the importance of taking seriously subtle and not "easily recognized" differences, I submit that we are here considering variations on a totally different level.

This leads to an even more important question: Are not the families, genera, and species of all mammals and birds based on a lower order of diversity than those existing in plants?

Postscript on Needed Research

Familiar as I have to be in my work with a wide range of flowering plants, and especially the genera of the family Rosaceae and Composite, it has for many years seemed to me that the families, genera, and species of vertebrates are based on characteristics which in plants would be classed as genera, species and varieties.

Furthermore there is an undue emphasis on bone structure, as if this feature outweighed all other characteristics in establishing the validity and importance of the various distinctions.

This emphasis was understandable before we became aware of how the DNA system of inheritance works. But surely it must be apparent now that bone structure really has no more significance than such apparently ephemeral characteristics as color of the hair or indeed the finger print pattern of a foot or hand. For defects in the DNA code show up just as often in defective bone structure as in other parts of the body such as the brain. It is only the **relative permanence** of the bones in terms of time that has given them a **false importance** in the evaluation of resemblances and differences.

We must have a new look at vertebrate systematic in order to bring the classification of animals more in line with reality. On the basis of a world catastrophe we would expect air breathing creatures to be much more reduced in variety than plants or insects (which are preserved as eggs or pupae). Here the facts of nature are in accord with God's revelation in Genesis. For according to the inspired narrative, only representatives of the various **kinds** of animals and birds were preserved. Furthermore the genetic potential of the clean animals and birds is recorded as being greater than that of the unclean ones, since three pairs of clean animals and only one pair of unclean animals were preserved.

Do we indeed now find greater diversity of clean than unclean animals? Lack of space forbids a complete analysis but let us look at a few cases.

The horse is classified as unclean, and we have only **one living** species as compared with the dozen or more living before the Flood, ranging in size from the little five toed, forest dwelling *Eohippus* to the large, open plains and still living *Equus*. We have only two species of camels, yet many are recorded as fossils.

The hog is most interesting. *Mammals of the World* page 1357⁵ lists five genera and nine species. The genus *Potamochoerus* has only one species *porcus* living in Southern Africa, Madagascar, and Impalita Islands. It weighs 75 to 150 kg. and resembles the genus *Phacochoerus* and *Sus*. There is less hair on *Phacochoerus* and it has more teeth. The ears are more tufted than those of *Sus*. It is known as the European wild hog but is also living in North Africa, Asia, Japan, and the Malaysian islands.

Frankly, I see little justification for placing *Sus* and *Potamochoerus* in different genera on the basis of differences such as tufting of the

ears. *Sus* is credited with five species but they certainly look remarkably similar to one another. *Sus salvanica* is often put in a separate sub-genus *Porcula* simply because it is small, weighing up to 75 kg. By contrast the giant forest hog *Hylochoerus meinertzhayeni* weighs from 160 to 275 kg. It lives in the forests and bamboo jungles of Africa and looks like a great big *Sus*. It does not however have facial glands.

The wart hog, *Phacochoerus aethiopica*, is distinguished mainly by its warts, which are prominent only in the male. They are located on the side of the head and front of the eye.

The above differences seem simply the expression of heterozygosity for size, location of hair, and presence or absence of warts, often a heritable genetic defect.

There appears to be no basically distinctive pattern such as distinguishes the genus *Fragaria* (Strawberry) from the genus *Rosa* (Rose). I am not here claiming that all of these nine species of hogs came from only one ancestral pair, but rather that the distinctions compared to those defining the genera of the family Rosaceae are **relatively slight**. Careful breeding research may indeed show that all are capable of interbreeding and so, as in domestic dogs, are really the result of segregation from an originally heterozygous pair. Mutations for other differences may well have also occurred during the **early phase** of their distribution and so added to the distinctions now observed as characteristic.

The case of the fifth genus *Babyrousa* with its single species *babyrussa* is fascinating. Here we have a remarkable example of how an animal can continue to live **in spite** of its **obvious defects**. It lives in such odd places as the North Celebes, Togian Islands, the island of Burn, and Sula. This creature is almost entirely devoid of hair, and has a rough skin which is brownish grey, and hangs in loose folds as if reduced from twice its former weight. It now weighs about 90 kg. Most interesting is that the upper tusk grows through the top of the muzzle and then **curves backwards** and so is of no use as a weapon. Even the lower tusks are little used since they are not kept sharp. The young are not striped like most pigs.

Surely this creature should long ago have been eliminated were natural selection the potent agent for survival of the fittest as usually claimed. Genetically, it seems to be the result of real-functioning of several DNA molecules which resulted in such an abnormal expression of ancestral *Sus* traits.

In birds we have many types of unclean kinds which are now represented by only a few species. Thus the Grebes of the world total 20.

If comparable to western ones I have seen (listed incidentally in Peterson's, *A Field Guide to Western Birds*), they might well be reduced to as few as 10. The pelican is represented by only six species, two of which are in the west. There are only two eagles listed.

By contrast among the clean animals we have dozens of species of grosbeaks, finches, sparrows, and buntings (Fringillids), tanagers (Thraupidae), meadowlarks, blackbirds, orioles (Icteridae), and warblers (Parulidae).

There does indeed seem to be a correlation in survival between the greater number of clean birds and animals saved and their present greater diversity, as compared to the single pair of unclean kinds saved and their present lack of variety. Careful research into this aspect of animal classification is needed.

This paper is presented mainly with the hope of arousing interest on the part of creation research oriented naturalists. It is admittedly only

introductory to this vast subject of survival patterns. However I believe it demonstrates that often the picture of genetic diversity given as the result of natural selection is, to put it mildly, exaggerated.

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