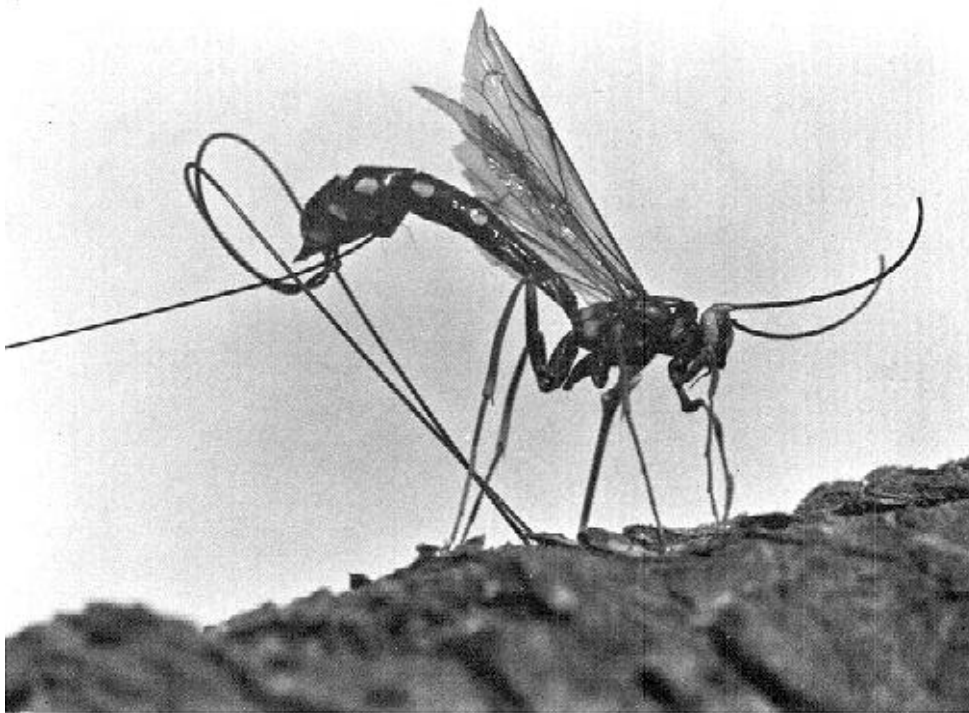


CREATION RESEARCH SOCIETY QUARTERLY



Haec credimus:

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

CREATION RESEARCH SOCIETY QUARTERLY

Copyright 1975 © by Creation Research Society

VOLUME 11

MARCH, 1975

NUMBER 4

EDITORIALBOARD

Harold L. Armstrong, Editor

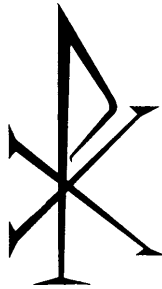
Walter E. Lammerts, Research Editor

John N. Moore, Managing Editor

Department of Natural Science

136 Brody Hall, Michigan State University

East Lansing, Michigan 48824



Donald O. Acrey. Geophysicist, Amarillo, Texas

Thomas G. Barnes. University of Texas at El Paso, Texas

Duane T. Gish. Institute for Creation Research,
San Diego, Calif.

George F. Howe. Los Angeles Baptist College,
Newhall, Calif.

John W. Klotz. Concordia Senior College, Fort Wayne, Ind.

Henry M. Morris. Institute for Creation Research,
San Diego, Calif.

William J. Tinkle. Anderson College (retired),
North Manchester, Indiana

John C. Whitcomb. Grace Theological Seminary,
Winona Lake, Ind.

Emmett Williams. Bob Jones University,
Greenville, S. Car.

* * *

Notices of change of address, and failure to receive this publication should be sent to Wilbert H. Rusch, Sr., 2717 Cranbrook Road, Ann Arbor, Michigan 48104.

* * *

Creation Research Society Quarterly is published by the Creation Research Society, 2717 Cranbrook Road, Ann Arbor, Michigan 48104. © 1975 by Creation Research Society.

TABLE OF CONTENTS

	Page
The Long-Barreled Bore	183
Willis E. Keithley	
Was Evolution Really Possible?	183
Moshe Trop	
Evidence for the Existence of an Intelligible	
Genetic Code	188
Lloyd Y. Quinn	
Perpetuation of the Recapitulation Myth.	198
Glen W. Wolfrom	
Is a Fixed Chronology of Egypt Back to	
c. 2000 B.C. Mistaken?	202
Donovan A. Courville	
Lichens: A Dilemma for the Evolutionary Model . . .	211
William J. Cairney	
Was the Ice Age Caused by the Flood?.	213
Reginald Daly	
Panorama of Science	217
Letter to the Editor	221
Book Reviews (4)	222
Index for Volume 11	224
Harold L. Armstrong	

COVER ILLUSTRATION

The cover picture shows a mounted specimen of the Ichneumon wasp, *Megarhyssa lunator*. The entire length of the ovipositor at the left is 9.5 centimetres. For more about this interesting creature, and its features which surely could never have "evolved," see the article by Willis E. Keithley, who supplied this photograph.

CREATION RESEARCH SOCIETY

History The Creation Research Society was first organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a real need for an association devoted to research and publication in the field of scientific creationism, with a current membership of about 500 voting members (with graduate degrees in science) and over 1600 non-voting members. The *Creation Research Society Quarterly* has been gradually enlarged and improved and is now recognized as probably the outstanding publication in the field.

Activities The Society is solely a research and publication society. It does not hold meetings or engage in other promotional activities, and has no affiliation with any other scientific or religious organizations. Its members

conduct research on problems related to its purposes, and a research fund is maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible.

Membership Voting membership is limited to scientists having at least an earned graduate degree in a natural or applied science. Dues are \$8.00 (Foreign, \$9.00 U. S.) per year and may be sent to Wilbert H. Rusch, Sr., Membership Secretary, 2717 Cranbrook Road, Ann Arbor, Michigan 48104. Sustaining membership for those who do not meet the criteria for voting membership, and yet who subscribe to the statement of belief, is available at \$8.00 (Foreign, \$9.00 U. S.) per year and includes subscription to the Annual Issue and Quarterlies. All others interested in receiving copies of these publications may do so at the rate of the subscription price for all issues for one year: \$11.00 (Foreign, \$12.00 U. S.).

THE LONG-BARRELED BORE

WILLIS E. KEITHLEY*

If the caliber of that title sounds a bit queer, consider for a moment the boring auger of the Ichneumon wasp. For here is a drilling tool that defies comparison or comprehension. Of course reference is made to the amazing ovipositor of *Megarhyssa lunator* and its several similar species.

Can the reader imagine boring into wood a decimeter deep with a mere thread? Or even surmise the purpose for doing so in the first place? Yet here is an insect that has the amazing ability to locate beetle larvae in the cambium layer of a pine tree by tapping the bark with the antennae. (Is this ultrasonics or sonar?)

Then the insect assumes the stance as shown in the cover illustration, and accurately aligns a "drill rig," which is composed of two spring-loaded sheaths to guide the threadlike egg tube to its ultimate destination of parasitizing the hapless larvae of the bark beetle.

The intervening layers of bark are penetrated by the ovipositor in a whip-sawing action, since that grim gimlet is equipped with microscopic saw teeth as seen in Figure 1. Many species can penetrate several centimeters of wood to reach their prey.

One can only wonder at the ingenuity of this adept drillpress. What a monumental sequence of mutations must have been necessary through trial and error to develop such a specific instrument! But can this precision be attributed to blind and unpremeditated permutation? Mere

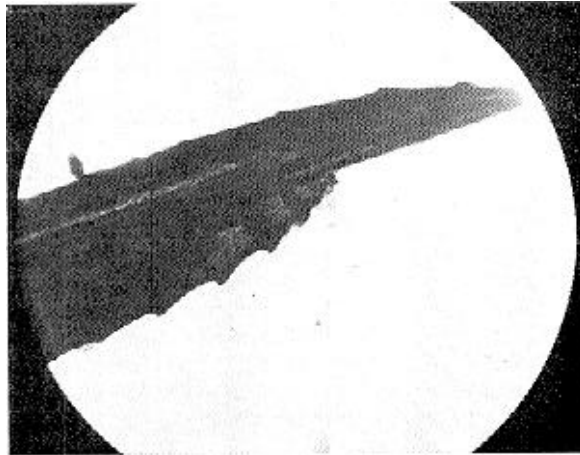


Figure 1. Photomicrograph of the drill point on the ovipositor of the Ichneumon, showing the saw-like serrations. The picture is magnified 150 times. Photo by Willis E. Keithley.

evolutionary speculation cannot suffice to bridge those yawning gaps of instinctive purpose, deliberate design, intelligent integration, and that perennial and plaguing question of survival before the perfection of such a complicated contrivance.

Confronted with such an intelligent and astute invention as an Ichneumon, it is not irrational to exclaim with John Milton,

Great are thy works Jehovah!
infinite Thy power!
what thought can measure
thee or tongue
Relate thee!

*Willis E. Keithley, an evangelist and nature photographer, lives at 1819 N.W. 25th, Lincoln City, Oregon 97367.

WAS EVOLUTION REALLY POSSIBLE?

MOSHE TROP*

The theory of evolution was propounded by Charles Darwin, who claimed about 100 years ago that all existing life on earth—animal and vegetable—developed from lower creatures, in a continuous chain of adventitious processes. The first life forms—the living cell—had come forth supposedly out of non-living material. Despite widespread acceptance of this doctrine in scientific and lay circles, it contains much that is imaginary and it will not stand critical examination in the light of modern science.

Darwin's Theory

The Origin of Species — that was the title of Charles Darwin's book, first published some 100 years ago. In it, Darwin developed a theory based on the possession by each type of creature of its specific characteristics and attributes.

*Moshe Trop, Ph.D., is with the Department of Life Sciences, Bar-Ilan University, Ramat Gan, Israel. During 1974-75 he is on sabbatical leave at the Rockefeller University, New York, New York 10021.

So long as these attributes are attuned to the natural conditions prevailing within the particular time and environment, these creatures continue to exist, proliferating generations bearing these same successful characteristics, and indeed improving them, by means of the process of "natural selection." This "natural selection" is the outcome of a continuous struggle for existence, in which the strongest survive.

On the other hand, creatures with less well adapted facilities—the “weak”—are defeated and disappear. Thus, through this process, which Darwin thought had continued through millions of years, development toward better and higher forms of life took place, until man “appeared” from forms less developed than himself.

The Modern Theory

Darwin’s theory, in its general lines, received wide acceptance in the scientific world and thereby also with the general public. However, Darwin’s original formulation and that of his many emendators, both in his own and in later generations, is not currently held by men of science. On the contrary, many of Darwin’s ideas have been found to be naive and mistaken.

Attempts at improvement, and new ideas of later researchers, led eventually to a modified theory, which contains main points as follows:

There are continual changes in forms of life, both beneficial and regressive. These changes take place in the hereditary factor (the “gene”) of the organism and are transferred to offspring. They are caused by “chemical errors” (mutations) occurring at random in the “hereditary factor” of gametes which is itself of chemical constitution and therefore is subject to chemical reaction. Since the fault is random, it may happen—and it is admitted to do so in most cases—that it will be detrimental, damaging the organism or even making its further existence impossible. But—so it is claimed—some few faults may be beneficial, and these will give their bearers and their offspring improved characteristics.

That handful of fortunate creatures—to continue the argument—in which a mistake occurs with a “beneficial effect on increasing reproductive fitness”—becomes preferred above their numerous neighbors of the same species, becoming the “strongest” who conquer the available “living space” and eliminate during the generations less fitted members of the species.

Random processes such as these—so it is contended—continue for tens of millions of years, so that gradually and slowly new, better life forms are developed, continually progressing and improving, whilst at the same time weaker forms, lacking the ability to meet the exigencies of life and the pressure of competitors, are destroyed and disappear.

Some (but Not All) of the Parts of the Theory Are in Accord with Observations

Explanations accompanying this doctrine, called “synthetic evolution,” are compatible in some ways with present knowledge about the chemical structure of the “hereditary material.” This “hereditary material”—the gene—is in fact

a portion of a molecule of DNA, found in the nucleus of cells of all life. Successful experiments and clear observations have been reported of chemical faults—“mutations”—occurring in nature.

It is even possible in the laboratory to excite artificial mutations,¹ and to isolate those organisms in which mutation has occurred. It is also possible to observe what seem to be cases of natural selection, in the development of steadfastness to difficult conditions. Examples are bacteria which can withstand antibiotics, insects impervious to insecticides, and animals and plants which can live in circumstances of cold, heat, and dryness.

(It might be added, though, that often the selection lasts only as long as the exigency which caused it. For instance, when use of an insecticide is stopped, the number of immune insects may drop to a small fraction of the total. Again, even though selection may favor black moths in certain places, some white ones continue to exist. In other words, the selection is often observed not to eliminate completely the “less fit.”)

It seems likely that because of such observations the theory of “synthetic evolution” has gained ascendancy over older versions of the theory, now largely abandoned. Of course, the newer theory is still continually being revised and modified.

New Theory Is Widely Accepted

At the present the “theory of evolution” or the “theory of the development of the species” is accepted as a matter of course by the majority of biologists, who maintain that it accounts for the origin of life as well as for the existence, distribution and typification of species. Relationships between the various families and the common factors in the morphology and systematics of the differing life types are commonly discussed in terms of the theory.

In fact, the theory is solidly entrenched in the biological sciences. Scientific literature has brought the doctrine into all institutions of learning at every level, and modern means of communication have spread it to every corner of the globe. Both intellectuals and the non-scientific public absorb the action continually as it is pressed forward by all this publicity. Any competition is neither very vociferous nor very well heard. The theory is quoted blindly on every hand and is blandly accepted by those who study it in the belief that it has been verified according to accepted scientific principles.

Evolution versus Creation

It would be fair to say that the essence of the theory of evolution, as it is usually presented, is randomness and chance. In opposition to this is the belief that the great variety of things in

the natural environment are the result of intelligent design. Such design must have come from something outside the things themselves; a Designer is implied. In cosmogony, such an origin by intelligent design from outside is commonly called Creation; and the Designer is the Creator.

Arguments will be presented shortly to show that the only reasonable belief is that the world and the things in it have come about by Creation, not by chance. At this point, however, a question might be asked. Did the Creation take place little by little, extending, perhaps, over a very long span of time? If so, it might appear superficially like the alleged evolution by chance. Or did Creation occur in a very short time, say a few days? If Creation is within a Creator's power at all, it would seem that there would be nothing impossible to Him in a quick Creation.

It may be that this question of how long Creation took is one which cannot be answered by studying the world around us, since Creation was, in any event, completed before man, the scientist, came upon the scene. The only way of deciding may be from records which are believed to be true accounts of what happened.

Since the purpose of this article is to show that Creation is the only possible explanation of the natural environment, the author does not intend to investigate how long the Creation took; the question fast vs. slow will not be considered further.

Rather, discussion will center on certain aspects of the theory of evolution as it is ordinarily proposed, on some of the effects of the theory, and whether the theory is, in fact, a reasonable one.

Students of Biology Have Been Wronged

Original researchers in biology, who accepted evolution and those who laid the foundations of the new theory, ignored the question of the statistical probability (or improbability) of supposed evolutionary phenomenon. Even now, very few critical mathematical computations have been made on this aspect. However, when such calculations have been made, the chances of the occurrence of significant changes, even in the period estimated by proponents of the "synthetic theory" at some 100 million years, have been shown to be almost nil.²

In the light of current knowledge of biochemistry, facts contradict every hypothesis proposed to explain any mechanism whatsoever for such changes and the construction of new genes. The lack of a logical explanation for the source of life is not the only deficiency of the theory; many authors have already demonstrated mathematically that random self-development of an organism is impossible in any geological period whatsoever.³

What Are the Factors Causing New Characteristics?

One need not be a savant to discover the improbability of the hypothesis of random development of complicated systems, such as materials exchange and the energy utilization of sugars, or the physiology of the muscle and nerve.

Sugars, as is well known, are the main source of energy for the body, and an important material in the making of the various compounds in life. For the utilization of grape sugar (glucose) by the body, the sugar must undergo a chain of reactions carried out through enzymes—adapted protein materials which hasten and supervise the execution of the chemical reactions of organisms. No fewer than ten types of enzyme, specially adapted for the purpose, are required for the successful execution of the process termed "glycolysis."

Nor is this yet sufficient, for the complete utilization of the products of the process requires numerous further sets of enzymes, the one interweaving with the other. These are the sets which carry out "combustion," i.e. the complete oxidation, extracting the last bit of utility from the material. Every enzyme type within the set seems to have a defined task, involving a specialized structure.

(All of the anaerobic glycolytic pathways, for instance, are interdependent, acting in sequence to supply a vital source of energy to tissues. Although occasional mutants of their respective genes are encountered in healthy subjects, these mutations are not maintained at polymorphic levels in large populations, presumably because they have no relative advantage and, indeed may be disadvantaged. This specialized structure, then, has to be very precisely constituted to be suitable for the task which it has to perform.)

The plan for this structure, including the control and fine adjustment systems, is carried in information provided in advance in a special gene or genes (nucleic acid) found in the chromosomes of the cell nucleus. These are carried forward hereditarily from generation to generation, together with all of the information locked in them. It is evident, therefore, that for a new enzyme to come into being and to be acquired by the life form carrying it, it has to appear as an item of information in the gene, i.e., a new gene must appear.

If this is to happen, it must be through the chemical mutation of another gene, as has been mentioned. The mutation would alter the gene, which would acquire a new meaning, and would be transformed, if everything should go well, into a new gene bearing new information. For a set of ten new enzymes to come about in this manner, at least ten new genes would have to

happen, through ten different, independent, mutations.

Appearance of New Cells

All muscles of the body—skeletal muscles, and muscles of internal organs—operate through contraction. This is their special characteristic, not found in other bodily cell structures. The relatively great pulling power of the muscles is produced by their contraction when they receive nervous excitation. When the excitation passes, the muscle relaxes and returns to its former state.

The exact process of contraction and relaxation is constituted through electrochemical and mechanical operations occurring simultaneously, and continues to be the subject of research, since the process has not yet been elucidated completely. It is known that muscles contract as a reaction to instructions emanating from the nerve center, which sends out signals to nerves attached to the muscle fibers; these signals cause chemical changes in the muscle and the electrochemical energy is transformed into mechanical action.

Imagine an individual muscle cell (fibril) that first appeared in the world, within some multicelled creature. With what new tools must it be equipped, in order for it to be of any utility whatsoever? It is necessary (a) for it to include several thousand new molecules of proteins called actin and myosin, and (b) for these molecules to be in a parallel, coordinated order of a special kind resembling a comb, in order for them to react simultaneously when stimulated.

And the cell must (1) be situated between two specific supporting points, (2) be equipped with a motor nerve cell to trigger it, (3) have a suitable conjunction between the nerve cell and muscle, and (4) be part of a control system for the operation of the muscle when excited by the nerve. For the appearance of a new, efficient muscle of this kind, which would be suitable for use by an animal, several tens of independent mutations are required at the very least.

Natural Selection

Unicellular creatures, or primitive multicellular ones, multiply relatively quickly; from several individuals it is possible to obtain within a short time an almost unlimited number of offspring determined only by the living space available.

Once the living space has been taken up, the life forms reach saturation point, their numbers cease to grow and remain constant, or even decline. However, it would be wrong to suppose that at saturation point the cells entirely cease multiplication. Actually reproduction continues, but the death rate grows to equal or exceed the "birth rate" and hence the number of living cells ceases to increase.

In this situation, of all the creatures "born" within a given timespan only a few succeed in establishing a widespread family. Those which do so are the more successful, in Darwinian terms; their individual characteristics grant them victory in the struggle for existence, it is said; they overcome others, multiply, and pass on their superior characteristics to their heirs.

But by this argument, for a new system of material utilization such as that of the sugars, or a new type of cell such as the muscles, to appear as a permanent part of some creature, it is necessary that the new feature give its possessor some superior attribute enabling it to succeed in the process of natural selection. However, a new feature or phenomenon can be beneficial only when there is a complete set containing the minimum number of enzymes required, or when there is a network of parts and mechanisms fully integrated with the cell and its surroundings.

Number of Possibilities Is Limited

Assume that at least ten mutations must take place at once, in one and the same cell, for such a progressive change to occur. This is of course a minimum requirement, very farfetched, and it is highly doubtful if, in fact, meeting such conditions would be sufficient.

What is the possibility of a new metabolic facility arising within all of the generations of a typical unicellular creature (such as bacteria), which could have existed on earth? An approximate calculation shows that, during two billions of years, there would have been a maximum of 10^{48} births (or cell divisions) of unicellular animals, whilst in order for it to be possible for a specific creature to acquire a characteristic involving ten mutations, 10^{80} births (or cell divisions) are required. It can be seen at once how wide the gap is, arithmetically speaking.⁴

Even more remote is the possibility of a multicellular creature acquiring a new type of cell such as a muscle cell. During two billion years there could have been only 10^{14} births or multicellular animals, while the best probability for the acquisition of a new type of cell would be one individual out of 10^{160} births.⁵

Were Life Conditions in the Ancient World Different?

Many researchers find refuge in the idea that in very ancient periods the number of mutations was greater, owing to some special conditions then prevailing. The world, they suggest, was then being bombarded with a great quantity of cosmic rays or other radiation, causing a high rate of mutation, so that all new characteristics could have appeared at random.

It is regrettable that this idea has proven a pitfall for so many, for, on the contrary, a high rate of mutation causes death and disappearance;

most mutations cause destruction of vital genes, or the appearance of degenerative phenomena. It is well known that excess exposure to radiation has destructive effects, such as destruction of cells and structures, or birth of monstrosities lacking entire limbs.

It is permissible to suppose that the maximum rate of mutation which would not lead to elimination of the species would be one per million (about the number of vital genes); even then, in the first case considered, the probability of the appearance of a beneficial metabolic characteristic would be one in 10^{60} births, and the chance for the appearance of a new muscle or nerve cell would be one in 10^{120} . Even then there would be no possibility of such an evolution in the time available and with the number of creatures which could have existed.

Not only this; there are many types of creatures which have acquired entirely new characteristics (or so it would have to be maintained according to the theory of evolution), whilst living in situations which protect them from cosmic rays to a greater or less extent. Land creatures such as moles; earthworms; cave dwellers, such as bats; and sea inhabitants of the deep waters (which cannot live near the surface) would fall into this class.

No Substitute for Creation

All calculations made of the probability of the gradual beneficial development of characteristics and new genetic systems, one after the other, in millions of life forms show that during the limited time of the existence of the earth there could have been no possibility of the random appearance of life of this nature. The doctrine of evolution was founded by men who

relied heavily on the supposition "that anything could have taken place on earth during an unlimited period." That supposition will not hold any more today. The tree planted by the original proponents of evolution has yielded fruit which has been consumed on all sides, but the tree has no roots.

The truth is that, today, men disagree about even the approach to the determination of the origins of the organisms now living on earth. Moreover, examination of astronomical bodies during space flights, and by telescopes, until now has resulted in only one conclusion—that life is a phenomenon unique to the earth, at any rate in that portion of the cosmos to which man has direct or indirect access. To the present human ingenuity has brought forth no really scientifically well-founded theory to explain the origins of life.

There is no reasonable substitute for the Creation of the world, and all its creatures, through a supernatural force above our comprehension—G-d Himself.

References

- ¹Lammerts, W. E. 1965. Planned introduction of commercially desirable variations in roses by neutron radiation, *Creation Research Society Quarterly*, 2 (1):39-48.
- ²Trop, M. and A. Shaki. 1974. Is molecular evolution of proteins possible?, *Creation Research Society Quarterly*, 11 (1):28-29.
- ³Coppedge, James F. 1973. Evolution: possible or impossible? Zondervan Publishing House, Grand Rapids, Michigan.
- ⁴Were the earth's surface equal to that of the sun, it would have been possible to get only 10^{52} births; and even were the earth's circumference as large as that of the whole solar system the number of births possible would not be more than 10^{60} .
- ⁵Sufficient to remember that the number of atoms comprising the earth probably does not exceed 10^{52} , while the sun contains no more than 10^{58} .

CREATION RESEARCH SOCIETY

Board of Directors *Biochemistry*: Larry Butler, Ph.D., Purdue University, Lafayette, IN 47907; Duane T. Gish, Ph.D., Institute for Creation Research, 2716 Madison Avenue, San Diego, CA 92116. *Biological Sciences*: Wayne Frair, Ph.D., Secretary, The King's College, Briarcliff Manor, NY 10510; George F. Howe, Ph.D., Los Angeles Baptist College, Newhall, CA 91321; Wilbert H. Rusch, Sr., M.S., Sc.S., Membership Secretary, Concordia Lutheran College, Ann Arbor, MI 48104. *Genetics*: John W. Klotz, Ph.D., Concordia Senior College, Fort Wayne, IN 46805; Walter E. Lammerts, Ph.D., Freedom, CA 95019; William J. Tinkle, Ph.D., Timbercrest Home, North Manchester, IN 46962. *Geology*: Clifford L. Burdick, M.S., 924 N. 6th Avenue, Tucson, AZ 85705; Harold Slusher, M.S., University of Texas

at El Paso TX 79902. *Medicine*: Karl W. Linsenmann, M.D., Midland Medical Center, Midland, MI 48640. *Physical Sciences*: Harold Armstrong, M.S., Publications Editor, Queens University, Kingston, Ontario, Canada; Thomas G. Barnes, D.Sc., President, University of Texas at El Paso and Consultant to Globe Universal Sciences, Inc., El Paso, TX 79902; John J. Grebe, D.Sc., 11604—114th Drive, Youngstown, AZ 85363; Richard G. Korthals, M.S., Treasurer, Arcadia, MI 49613; Henry M. Morris, Ph.D., Institute for Creation Research, 2716 Madison Avenue, San Diego, CA 92116; Emmett L. Williams, Jr., Ph.D., Vice-President, Bob Jones University, Greenville, SC 29614. *Science Education*: John N. Moore, M.S., Ed.D., 136 Brody Hall, Michigan State University, East Lansing, MI 48824.

EVIDENCE FOR THE EXISTENCE OF AN INTELLIGIBLE GENETIC CODE

LOYD Y. QUINN*

Research results are presented that strongly support the Creationist viewpoint. The genetic code, which evolutionists consider to be the highly degenerate product of random mutations, has been shown to function as the blueprint for the three-dimensional structure of proteins. This code is generally accepted to be universal, and the way it is translated into proteins by ribosomes is basically identical from the most "primitive" microorganisms to man. Scientific evidence is reviewed for a self-correcting genetic code which edits out mutational errors under normal conditions.

The genetic code has been shown, by scale model building of antigen and antibody reactive sites, to be capable of distinguishing between "self" and "not-self" protein conformations.

This demonstrated orderliness in the genetic code indicates that it was formulated as an intelligible code by the Creator.

Introduction

One of the best candidates for the most exciting biological discovery of all time was the first breakthrough in "cracking" the genetic code, first reported in 1961, by Nobel prize winner Nirenberg.¹ Nothing else in the history of science has aroused so many thousands of investigators to such urgent efforts for such a continuous period of time, and the race to decipher the genetic messages is accelerating with each passing year.

Motivation for this kind of dedication to just one tiny aspect of biological research is the conviction that genetic messages present on the genes hold the key to understanding the life processes of all living cells and organisms, from microorganisms to man. To mention only a single example of the many exciting possibilities that could follow comprehension of genetic messages, the more than 300 inherited human diseases might be eliminated through genetic engineering.

Progress in reading genetic messages has been very slow for many technical reasons. The principle problem is that, in most cells, literally thousands of different genetic messages are being transcribed simultaneously, and the chemical separation of a single message is extremely difficult. A second problem is that the genetic messages in different types of cells in an organism, such as the human, differ somewhat, and messenger ribonucleic acids (mRNA) extracts prepared from biopsied tissue usually contain mRNA from a wide variety of cell types present in such tissue.

Still another complication is introduced because mRNA extracts may contain other types of nucleic acid, such as deoxyribonucleic acid (DNA), ribosomal ribonucleic acid (rRNA), amino acid transfer ribonucleic acid (tRNA), and other, less well-defined nucleic acids, all of which interfere with chemical isolation and characterization of the mRNAs. Last, and by no

means least in importance, the long mRNA strands tend to be snipped into small lengths by a family of enzymes, the ribonucleases (RNases), when the organization within the cell is disrupted by extraction processes.

Chemical methods of isolation of a single mRNA message are necessary, since the sub-microscopic size of the individual mRNA strands precludes physical isolation by even the most expert microscopist. The size of the task involved in trying to read the entire genetic code for the human has been illustrated by Frair.² The human body contains at least ten trillion cells, and each of these cells contains about three million genes, each of which may be producing a specific pattern of mRNA messages.

Molecular geneticists appreciate this diversity and, accordingly, have studied the simplest genetic systems, namely, (1) cells of microscopic size, and viruses, that contain very few genes, and (2) highly differentiated cells that express only a very few of the myriads of genes present.

An example of the first type is MS2 bacteriophage (phage), which is a virus infecting the host bacterium, *Escherichia coli*. This phage has only three genes, and all three are always expressed in the same order, as three consecutive messages carried by a single long strand of mRNA. Translation within *E. coli* of this "polycistronic" mRNA into three different phage proteins proceeds from left to right along the mRNA strand; these proteins differ enough in chemical properties and functions to make their separation and chemical characterization possible. The single strand of MS2 mRNA also makes it possible to determine the sequence of mRNA codons (genetic words) used to code for the three phage proteins.

Three examples of highly differentiated cells that express only a few of the many possible genes are:

(a) The human multiple myeloma cell, which proliferates into a population of millions of circulating abnormal plasma cells or myeloma cells,

*Lloyd Y. Quinn, Ph.D., is with the Department of Bacteriology, Iowa State University, Ames, Iowa 50010.

each of which forms and secretes identical molecules of a specific myeloma protein that resembles the antibody or immunoglobulin (Ig) molecule in general structure.

(b) The normal plasma cell or immunocyte which is the end-product of differentiation of a lymphocyte that has become immunized against an antigenic determinant (epitope). An immunocyte expresses only those genes required for synthesis of the specific immunoglobulin required to react specifically against the epitope.

(c) Non-nucleated red blood cells (RBC), such as those of the human, seem to have lost or destroyed nearly all genes except those required for production of hemoglobin (Hb); as a result, each of the five billion RBC per ml of blood is packed with about 280 million Hb molecules. The amino acid sequence (primary structure) of Hb from many species, including the human, has been determined. Study of the corresponding mRNA codon sequences, however, has just begun.

Most of the current concepts of genetic function are based on studies of these simpler genetic systems, with the accepted operating model being that described in the following section. (A wealth of background material is available in the *Cold Spring Harbor Symposia on Quantitative Biology*.^{3,4})

Overview of Cellular Genetic Apparatus

In the 1940's and 1950's, molecular geneticists were teaching that the newly discovered DNA molecule had the remarkable ability to reproduce itself from simpler components in a direct process similar to crystallization, as for example, precipitation of salt crystals from saturated brine. DNA was hailed as the long sought life-force and the obvious first viable form to appear in biological "evolution," perhaps three billion years ago.⁵

Evolutionists anticipated that a strand of DNA would spontaneously generate life when the right variety of "primordial soup" was poured over it in the test tube, just as it was assumed to have generated the first living cell on earth. These simplest of single-celled microorganisms were expected to reflect their "primitive" natures with an unsophisticated reproductive and control mechanism that did not depend on genes; each step upward on the phylogenetic ladder was expected to show emergence of a better genetic language and a more elegant genetic mechanism, as a demonstration of the principle of "survival of the fittest."

Bacteria became the favorite organisms for research on the so-called evolutionary process, since their generation time was about 20 minutes. Many kinds of bacteria were observed to divide three times each hour, endlessly, under suitable

conditions. Millions of descendants of a single ancestral cell could accumulate in only 20 generations, and a million generations of bacteria required only 30 to 50 years. Many biologists claimed, if evolution could arise from random mutations that were assumed to occur in each generation, then natural selection would produce superior new species of bacteria, and higher forms would begin to arise in a laboratory recapitulation of the evolutionary process.

Although only 20 additional years of research in molecular genetics have passed since such predictions were made, most scientists know already how naive, even ridiculous, most of these evolutionary speculations were. Invariably, in every species of organism examined, ranging from viruses to man, at least one gene is present, and the genetic messages on this gene are written in the "universal genetic code" that uses the four-letter genetic alphabet to form a 64-word genetic "dictionary," which is the same in every organism.

Far from finding evidence of the evolution of more effective genetic machinery as increasingly more differentiated species were examined, biologists discovered that the same basic mechanism of inheritance and genetic control was in operation in all known species. This mechanism may be outlined as follows:

DNA acts as the master blueprint for construction of major cellular components, including DNA, itself: DNA functions as the reference or template for replication of DNA needed for progeny, and it also functions as a template for transcription of expendable copies formed of a slightly different nucleic acid, ribonucleic acid (RNA).

Ribonucleic acid appears in three principal forms, messenger RNA (mRNA), ribosomal RNA (rRNA), and amino acid transfer RNA (tRNA), all of which are used in the parallel translation of the sequence of words or codons in a gene into the corresponding sequence of amino acids in a polypeptide chain. The four-letter RNA alphabet differs by only one letter from the DNA alphabet, and the 64 codons in the RNA language have the same three-letter-word format as the DNA language. The rRNA appears in ribosomes, which serve as the "reading head" for mRNA messages that are being translated into polypeptides, composed of amino acids that are presented to the ribosome by tRNAs.

Although hundreds of different amino acids occur in nature, and each of these amino acids can assume both a right-handed and a left-handed form with regard to the location of the side chain which gives individuality to the different amino acids, only 20 different amino acids, all of the L-form, are ever used in translation of mRNA messages.

Amino acids all have the same "backbone" structure, with an alpha-carbon (C_α) forming the "body," the amino-group forming two "arms," and the carboxyl group forming two "legs"; the side-chain, then, could be considered the "head." Amino acids are linked by peptide bond formation to give the polypeptide molecule: during translation, one of the amino-group arms joins to one of the carboxyl-group legs of the preceding amino acid, and the components of water are lost from the union, so that the amino acids are "residues" after the peptide bond has formed.

Peptide bonds are not formed each time between arms and legs on the same side of the amino acid molecules, but the use of arms and legs is alternated in successive peptide bonds, giving a "staggered" or *trans* pattern to the linkage. Polypeptide chains most commonly are assembled into biologically active proteins such as enzymes, hormones, and immunoglobulins. The enzymes comprise the principle machinery of the cell, forming cellular components of wide variety, generating energy required for life processes, and participating as moving parts in many cellular activities.

The DNA-RNA team does not act independently to translate genes into proteins but is supported by more than one hundred other kinds of molecules which interact in precise order and in intricate relationships to insure the fidelity and balance of translation.

The complex relationships between genes that lead to differentiation of cells in multicellular organisms, control behavioral patterns such as instincts, and even operate "biological clocks" are all still far above the present level of comprehension of molecular biologists.

Built-in Safeguards Against Evolution

DNA is such a fragile, unstable molecule that it is truly remarkable for it to survive even five minutes without complete disintegration, not to mention loss, addition, or alteration of an occasional nucleotide somewhere in that very long flexible chain of deoxyribonucleotides that comprise DNA. How, then, can DNA be transcribed and replicated millions of times in fast-growing microorganisms without alteration of species characteristics? The answer lies in built-in safeguards provided by the Creator to keep DNA in its original "wild type." Some of these mechanisms have been discovered by scientists, and more will undoubtedly be disclosed, in time; the following then, are incomplete examples:

(1) Although only a single template strand of DNA is needed for expression of the genetic message of a given gene, invariably, in all complete forms of life, the template strand—when not

being copied—is stabilized by being "zipped" together with a "complementary" strand of DNA that is the genetic mirror-image of the template strand. Attraction between the template and complementary DNA strands is dependent on the strong affinity between certain pairs of purine and pyrimidine bases which are present in nucleic acids: the purine, adenine (A) strongly binds to the pyrimidine, uracil (U) in RNA and to the pyrimidine, thymine (T) in DNA; the purine, guanine (G) strongly binds to the pyrimidine, cytosine (C) in both RNA and DNA.

The Nobel Prize for 1961 was awarded to the scientific team of Watson and Crick⁶ for describing the interaction of A:U and G:C "homologous base pairs" in the production of the "Double Helix" by the DNA template and complementary strands, cross-linked position by position along the DNAs. These workers also showed that when the template DNA strand was transcribed, each A bound T, T bound A, G bound C, and C bound G; DNA polymerase enzyme then attached these homologous bases, like a string of beads, to a "thread" of deoxyribosephosphate, thus producing a strand of complementary DNA.

This process is reversible, so that the complementary strand can act as the genetic mirror-image or template for transcription of template DNA copies. White⁷ has presented a helpful description of some of the chemistry involved in these genetic processes.

Not only is the double helix of DNA much more stable than single-stranded DNA, but for about 99 percent of the life cycle of a growing cell, the DNA double helix is "condensed" or tightly coiled and is embedded in layers of protective proteins and other types of macromolecules which reduce still further the possibility of mutational injury to DNA. Only when copies of DNA are needed for progeny or for use in cell control does DNA uncoil briefly for the replication and transcription processes.

Template and complementary DNAs forming the same gene in identical individuals of the same species are completely homologous, as shown by template DNA strands being interchanged without loss of homology appearing. The same compatibility between template and complementary DNA strands does not exist when the same gene from two different species is considered.

Template DNA coding for human hemoglobin (Hb) is not homologous for long stretches of mouse complementary DNA for Hb, and if they are paired *in vitro* they zip together incompletely. The unpaired, single-stranded regions of DNA are quickly attacked by DNase enzymes found normally with DNA and are split into inactive

fragments. This is one reason why artificial hybrids formed in the laboratory between mouse and human cell cultures eliminate the human genes and revert to normal mouse cells after three to four cell divisions.

(2) Template and complementary strands of DNA act as mutually cross-checking genetic systems through a process that has been called "editing": a variety of enzymes surrounding the template strand of DNA detect missing or injured portions in the template strand and use the mirror-image complementary strand as a reference or mold to fill in the gaps or to replace injured DNA sections with the proper DNA. This process works, in reverse, to edit the complementary strand of DNA, using the template strand as the genetic reference. This self-editing process is credited with elimination of many mutations before they can be expressed in mutant organisms.

(3) All living species, including bacteria, spend at least some of their life cycle in the diploid state, in which the body or somatic cells each carry two complete sets of genes; with rare exception, one set of genes comes from each of the two parent organisms. These sets of genes pair off on chromosomes, with corresponding genes forming a pair of alleles: either, neither, or both allelic genes may be expressed in a given cell, depending on how the DNA has been "programmed" during differentiation of this cell. Frequently, one of the two allelic genes will be "dominant" over its allelic partner, which then becomes "recessive."

Fortunately, most lethal mutations are found in recessive genes, so that a heterozygous individual, bearing a lethal recessive gene from only one parent, merely shows a sickly "trait," because the normal dominant gene partially counteracts the effects of the recessive gene. Homozygous recessive individuals with a double dose of a lethal recessive gene mutation do not survive long under natural conditions, and their defective DNA is eliminated from the "gene pool" of that species.

(4) In the nucleus of cells of higher animals, there are as many as a thousand copies of the same gene; how many different genes are present in this multiplicity has not yet been established. This finding is too recent to evaluate, but it, too, can be expected to contribute to the "fail-safe" design of the genetic blueprints.

In summary, mutations tend to disappear, except under unusual circumstances, usually man made; such as, selective inbreeding, or laboratory isolation of artificial mutants.

The Translation Process

Nirenberg received the 1968 Nobel prize for identifying the 64 mRNA codons in terms of the amino acids they represent. For some time after mRNA codons were identified, it was thought that mRNA messages were merely a string of codons which the ribosome translated directly into a corresponding sequence of amino acid residues comprising a polypeptide.

Recent research results have shown that mRNA is not the simple string of codons first visualized, but is a highly structured macromolecule containing some sequences of untranslatable codons that seem to act as punctuation and formatting devices, controlling such variables as when, where, how much, and in what order, the multiple messages on a long strand of mRNA are to be translated.

So, too, the structure and function of ribosomes has recently been found to be vastly more elaborate than the original model of a bead of pure rRNA that slid along the mRNA, catalyzing polypeptide synthesis as it rolled along. Especially in animal cells, it is obvious that from 5 to 20 ribosomes are organized into chains and packets called polysomes, with each polysome acting as the organelle for reading and translating a mRNA message. Polysomes, in turn, assume an organizational pattern which seems to determine the arrangement of polypeptide chains in the quaternary structure of a multi-chain protein.

Polysomes may contain smaller-sized ribosomes for translation of smaller polypeptides, and larger ribosomes for synthesis of larger polypeptides, when the protein being assembled contains polypeptide chains of two different lengths. Each ribosome in a polysome is itself an aggregate of several subtypes of rRNA, plus about 75 specialized ribosomal proteins that interact to make translation of mRNA possible.

When first discovered, tRNAs were considered to be pliable loops of RNA with an "anticodon" at one side and the amino-acid-binding-site at the other. There were supposedly only 20 different varieties of isoaccepting tRNA, each capable of transferring only one of the 20 common amino acids, and each having a different anticodon.

An isoaccepting tRNA did not seem, at first, to be able to recognize the homologous base pairing mRNA codon with any marked fidelity. Some of the anticodons could manage a "wobble fit" with six different mRNA codon synonyms for the same amino acid, and some workers felt that a single mRNA codon synonym could be recognized by more than one tRNA anticodon. Now, however, these responses are considered artifacts: in vivo, tRNA anticodons recognize only their completely homologous codons.

The structure and function of tRNAs soon became highly controversial with regard to molecular shape, chemical composition, and specificity of transfer function. Since tRNA contains only 60 to 90 nucleotides per molecule, stabilized by base-pairing between the two sides of the folded chain, it has been relatively easy to isolate from cells. Also the sequence of bases has been determined for at least 60 different tRNAs obtained from various organisms and, in some cases, from various tissues of the same multicellular organism. Under physiological conditions, all tRNAs assume a three-dimensional structure that resembles a clover-leaf with an L-shaped handle, although the precise conformation of the isoaccepting tRNAs may depend on the amino acids to which they are bound by the coupling enzyme, aminoacyl tRNA synthetase.

Changing Concepts About mRNA

One of the cherished beliefs of molecular evolutionists has been that the genetic code, as reflected in mRNA codons, is highly defective (also called redundant, degenerate, anomalous, and ambiguous) because of accumulated mutations, as indicated by the fact that as many as six different codons may all code for the same amino acid during the translation process.

Messenger RNA was assumed, therefore, to be composed of random selections of codon synonyms for a given amino acid, as only the sequence of amino acids in a polypeptide was deemed of consequence: the hydrophobic side-chains of a polypeptide were supposedly endowed with the ability to interact with each other to give instantaneous secondary structures that represented the most stable state, and simultaneously conferred the specific biological activity on the protein.

Only in recent months has evidence for non-random (ambiguous) use of codons been suggested, as in the report of Friers⁸ that in a group of related phages which had "coat proteins" that differed by only a single amino acid at a single position, the corresponding coat protein mRNAs used identical codon sequences except for the selection of appropriate codons for the different amino acid at its position in the coat protein.

This was interpreted to mean that the selection of codons probably was essential for control of the secondary structure of coat proteins in phages. Geneticists have found such a concept appealing, for it would explain how the cell can form nearly two million peptide bonds per second and complete 2,000 multi-chain protein molecules each second without an error, no matter how many mRNA messages are present. This smooth and rapid process seems all the more remarkable when compared to the slow and inefficient chemosynthesis of protein.

The first laboratory synthesis of natural proteins, such as the enzyme ribonuclease and the hormone insulin, required remarkable patience and dedication by an army of specialists who spent millions of man-hours and billions of dollars, in a 50-year program that overcame tremendous technical obstacles. The vast majority of proteins are very readily irreversibly denatured, with loss of biological activity, by exposure to nonphysiological conditions.

Some of the smaller, less complex, proteins may be renatured to their normal conformation and function following gentle, partial denaturation. However, the renaturation step occurs slowly and seldom is complete, because polypeptide chains that have been unfolded and uncoiled during denaturation tend to refold and recoil in random patterns during renaturation. Before chemosynthesis could be attempted in a rational manner, it was essential that the exact composition and shape of a protein molecule be determined; accordingly, protein chemists worked first on development of techniques for preserving the native structure of a protein during X-ray analysis of the relative location of each amino acid residue in the polypeptide chains.

"Ground Rules" for Protein Synthesis

From these early studies came the "ground rules" for synthesis of a normal protein molecule, namely:

(1) Only the L-form of the following 20 amino acids may be used: Alanine (Ala), arginine (Arg), asparagine (Asn), aspartic acid (Asp), cysteine (Cys), glutamic acid (Glu), glutamine (Gln), glycine (Gly), histidine (His), isoleucine (Ile), leucine (Leu), lysine (Lys), methionine (Met), phenylalanine (Phe), proline (Pro), serine (Ser), threonine (Thr), tryptophan (Trp), tyrosine (Tyr), and valine (Val).

(2) Peptide bonds are formed in trans configuration, with respect to the C_α carbons of amino acid residues, and the distance between nearest neighbor C_α's is very near 3.8 Å.

(3) Those amino acids with hydrophobic (oily) side chains almost always are oriented away from the aqueous environment, and those side chains tend to bind each other through many weak "hydrogen bonds." The hydrophobic amino acids are Ile, Leu, Met, Phe, Pro, and Val.

Conversely, amino acids with hydrophilic side chains are most commonly found on the surface of the protein molecule, with their side chains oriented outward toward the aqueous environment. These hydrophilic amino acids are Asp, Arg, Glu, His, and Lys.

The remaining amino acids are neutral or ambivalent and may be inserted anywhere in the polypeptide chain; this group is made up of Ala, Asn, Cys, Gly, Gln, Ser, Thr, Trp, and Tyr.

(4) Cross linkage between side chains can only be permitted between half-cysteine residues; the disulfide-interchange enzyme forms disulfide bonds at the proper locations to produce closed loops along the polypeptide chains and link two polypeptide chains in the assembly of proteins into quaternary structure. These disulfide bonds keep the molecular structure from spontaneously denaturing.

(5) Only those spatial orientations of residues are permitted that avoid "steric hindrance" within the protein molecule between the often bulky side chains. The preferred orientations of residues usually were those giving the lowest free energy or least strain, although some of the "active sites" on proteins seemed to require a less stable configuration that tended to denature to a more stable state, with loss of the protein's specific activity.

Unless all these ground rules were rigorously followed, the attempted synthesis produced "tar" or plastic, rather than the normal polypeptide chain. Years of brilliant research were required to develop multi-step procedures that have been automated to produce, per day, six consecutive peptide bonds in a known amino acid sequence of a protein such as lysozyme; the native protein molecule could be chemosynthesized completely and demonstrated to have normal biological activity. Success in chemosynthesis of proteins was largely dependent on the selection of procedures that restricted the amino acid residues to the correct orientation.

It seemed logical to assume that biosynthesis of the same chemosynthesized protein utilized some kind of control over orientation of the residues, also. This viewpoint had some scientific support in the report by Galizzi⁹ that the unknown mRNA codon for leucine at position 48 of the α -chain of rabbit Hb would be recognized by only one of five leucine isoacceptor tRNAs.

It was possible to visualize, then, a mechanism for genetic control of the secondary structure of proteins involving a fixed codon sequence in mRNA being recognized during translation by only those tRNAs which presented the appropriate amino acids in correct orientation.

This was the kind of intelligible code that the Creator alone could have devised, I believed, but I saw no way to demonstrate its operation, scientifically. Just how the four codon-synonyms for glycine, GGG, GGA, GGC, and GGU determined the orientation of a glycine residue was baffling, and I needed an inspiration to compre-

hend what approach to take in solving this mystery.

Research on Operation of an Intelligible Genetic Code

I started my research with a prayer for a clue, and an answer came in the form of a question: "Why don't you write the codons in digital arithmetic?" The first four numbers of digital arithmetic 00, 01, 10, and 11 (0, 1, 2, 3 of the familiar decimal arithmetic) could be set equal to G, A, U, and C: since 0 and 1 are complementary numbers, the digital codons gave a valid representation of the complementarity between A:U and G:C. Since the highest six place (six bit) digital number is 111111, or 64, there were just enough numbers available for representing the 64 triplet nucleotide codons in the genetic dictionary.

When the amino acid sequence of a polypeptide was represented by certain sequences of corresponding digital codons, it was sometimes possible to predict the selection of an amino acid for the next position by summing the digital codons for the preceding residues. It also could be shown that the location of α -helical bonded regions along the polypeptide chain represented in digital codons required residues whose bit patterns of "0" and "1" in corresponding bits were complementary. These observations indicated that genetic control operated with mathematical precision, but did not indicate how this precision was achieved. Again, I needed inspiration, and my appeal was quickly answered by the positive suggestion: "Transform the digital codons into magnetic codons."

It was not until I chanced upon a collection of small arrow-shaped magnets that I could visualize this conversion; all I had to do was represent digital "1's" by the arrow of the magnets pointing upward and "0's" by the arrow pointing downward. When holes were drilled through midpoints of magnets and the magnetic codons were assembled on a wire to keep them in linear array, the 000000 digital codon for Glycine became SSSSSS in magnetic codon format.

All these magnets stayed inertly in place for this magnetic codon, but when the next magnetic codon, SSSSSN, was assembled, an unexpected pattern developed: each of the six magnets was deflected to a new position by rotating around its midpoint. The deflection of each of these magnets was measured as a clockwise rotation from the vertical and recorded. Table 1 shows the various forms for expression of mRNA codons.

The mRNA codons each gave a different pattern of rotational angles when they were represented as magnetic codons. Had there been only two angles, they might have been considered as

Table 1. Steps in Conversion of Codons into Conformers

Amino Acid Conformer	Trinucleotide Codon Acronym	Binary Codon	Magnetic Codon	Rotational Angles for Amino and Carboxyl Groups in x, y, z planes					
Gly-1	GGG	000000	SSSSSS	0	0	0	0	0	0
Gly-2	GGA	000001	SSSSSN	300	300	300	300	300	60
Gly-3	GGU	000010	SSSSNS	0	0	0	0	270	0
Gly-4	GGC	000011	SSSSNN	340	340	340	340	70	70

the "phi" positive clockwise rotation of the C_α -N axis, and the "psi" positive clockwise rotation of the C_α -C axis of the backbone of the amino acids, respectively (these being the only two rotational parameters required to describe the twists present in the ribbonlike polypeptide chain which generate its coils and folds).

These two angles are insufficient, however, to describe the orientation of the amino acid residues in three-dimensional (3-D) space; for this description the rotation angle of each residue's amino and carboxyl groups in each of three mutually perpendicular planes would be required, a total of six angles. These 3-D orientations were determined by placing a Kendrew wire model on the stage of a "universal stage" and actually performing the indicated angular rotations, leading to a spatial orientation of the model that has been called its "conformer." The four conformers of Gly that correspond to the four Gly codons are pictured in Figure 1.

Concept Tested by Kendrew Wire Models

The validity of conformers as a basis for genetic control of secondary structure could best be proved by building scale models of polypep-

tides, using known mRNA codon sequences to specify the order of conformers: production of the known secondary and tertiary structure of a polypeptide chain would constitute definitive proof.

At present, the "state of the art" in molecular genetics and protein chemistry has not reached the point where this information is available; in fact, a very few mRNA messages have been fully sequenced, such as that for the terminal 45 amino acid residues of the A-protein of phage MS2. The A-protein, in intact form, contains about 300 amino acid residues and is thought to serve as the attachment site for the host bacterium, *Escherichia coli*, although the conformation has not been determined. Proteins whose complete structures have been well-defined are numerous, but the corresponding mRNAs have not been isolated and "mapped."

Despite the limited available information about the relationships of mRNA codons and protein structure, it was decided to test the ability of conformers to assemble in "best fit" fashion to produce the known structures of polypeptides of known amino acid sequence. When this approach was taken, the conformers specified by the mRNA codons in the message for the termi-

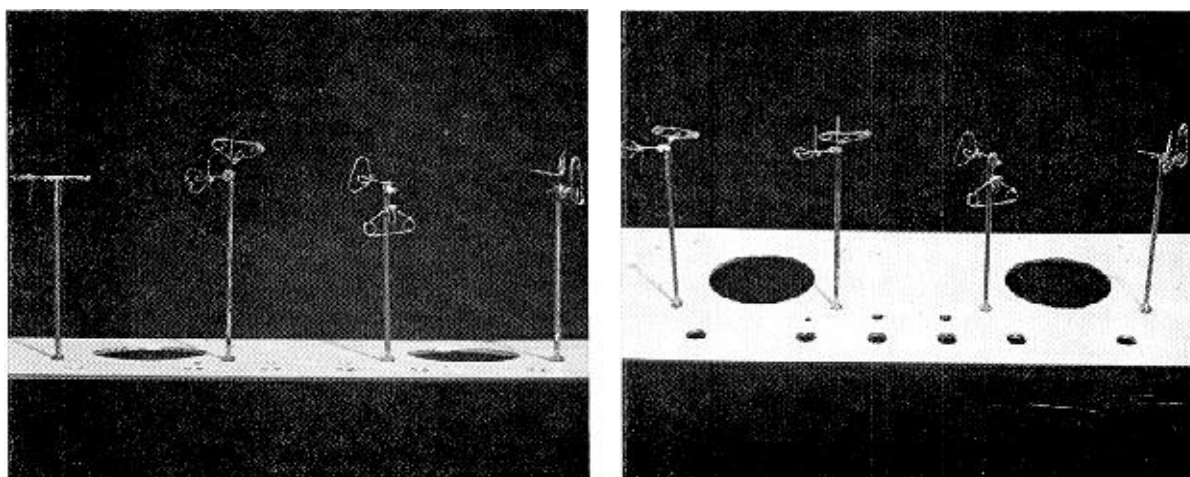


Figure 1. (a) Front view (left), and (b) Top view (right). These show the four conformers of Glycine, as Kendrew wire scale models.

In the *Scientific American*, December 1961, pp. 1-6, J. C. Kendrew popularized the use in protein structural research of scale models of amino acids whose

structures had been derived from x-ray diffraction data. These "Kendrew models" have been constructed of many materials, and the scale of enlargement from the Angstrom range has also varied at the convenience of the researcher. In this study, the amino acids were built on the scale of 1 to 100 million, and No. 18 gauge copper wire was the selected construction material.

*Some workers prefer the term, "configuron."

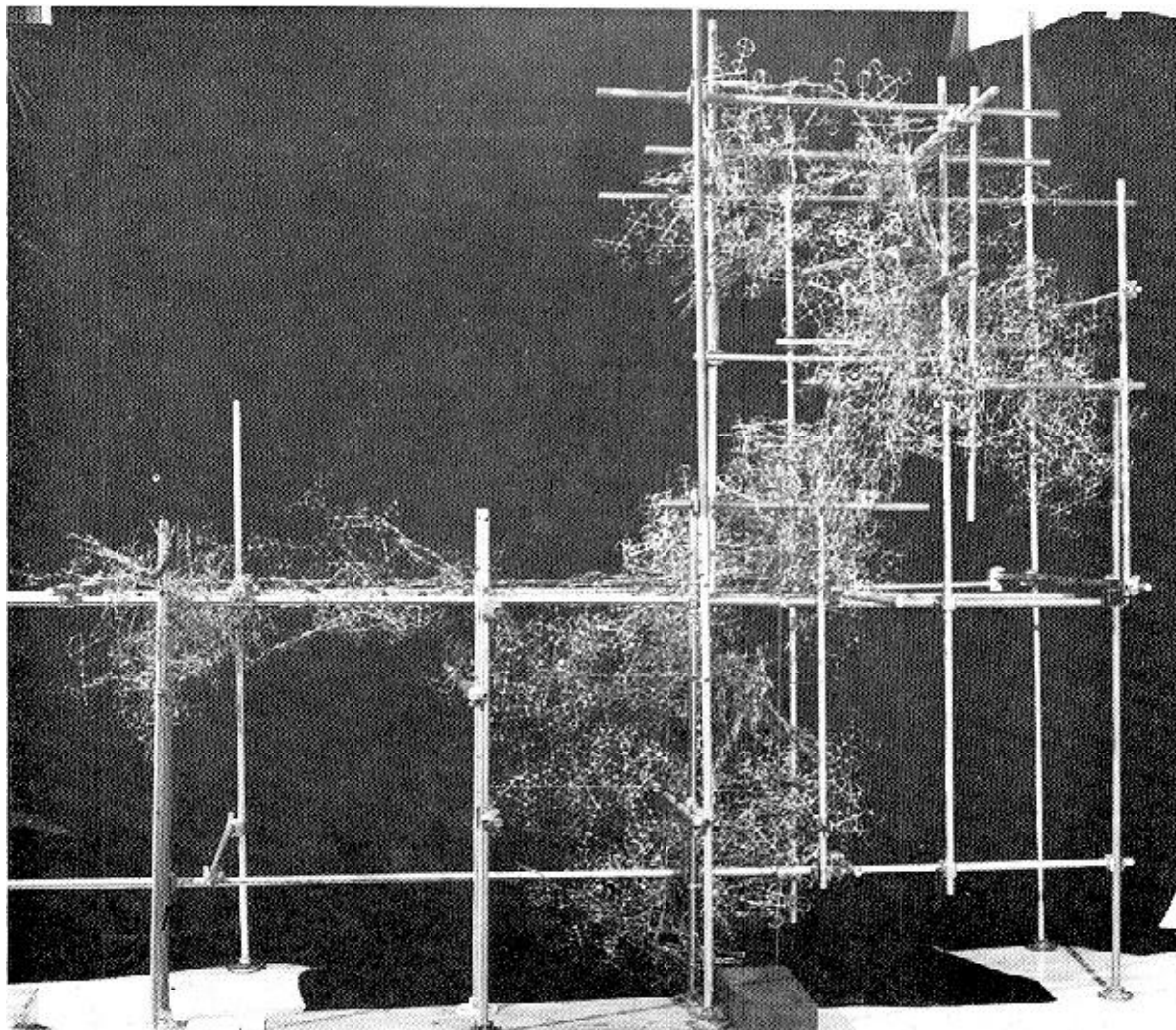


Figure 2. Kendrew wire model of Human G1(Eu) Immunoglobulin Light Chain produced by best fit conformers.

nal 45 amino acid residues of the A-protein fit together according to the ground rules of protein synthesis and generated an elongated filament in the process, not unlike the predicted shape of an attachment spike.

Even more significant, none of the other codon synonyms for amino acids could be substituted without introducing steric hindrance among the conformers. The same results were obtained when the primary amino acid sequences of well-characterized proteins were assembled by "best-fit" conformers; only one conformer satisfied all the ground rules, although several different conformers of a given amino acid sometimes could temporarily seem to fit. The models produced closely resembled the accepted protein conformations.

To an immunologist, the assembly of the L-chain of the Eu immunoglobulin from "best fit" conformers was intriguing, not only because of the unique shape of the molecule, but because the "variable" half of the chain generated half of an antibody-combining-site. When the known sequence of 214 amino acids was assembled as the corresponding sequence of "best fit" conformers, the conformation was as pictured in Figure 2.

Biophysical measurements reveal that the L-chain forms a shallow trough at the location of the antibody-combining-site at the left (amino terminal) side of the molecule, after which the chain forms a densely-packed cylindric shape extending to the right.^{10,11}

Not only did conformers give the overall shape that is considered valid for the L-chain, but hydrophobic side chains were located "in" and hydrophilic side chains were oriented "out" in this Kendrew wire model, as may be noted. From this best fit selection of conformer sequences, the corresponding mRNA codon sequences automatically appear, so that one may predict the mRNA message required to form a given polypeptide. The logical deduction follows from these results that the template DNA carries a blueprint for the exact conformation of "self" proteins.

Immunologists have puzzled over the mechanisms of the well-known immunological phenomenon involved in the recognition of "self" and "not-self" antigenic determinants which is the basis for production of specific immunoglobulins (antibodies) directed against not-self determinants. Although more than a hundred different classes of cells comprise the animal body, only one class, the lymphocytes, are able to show immune recognition, as reflected in their differentiation into immunocytes capable of showing specific immune responses against the inducing not-self antigenic determinant. Lymphocytes can recognize only epitopes, or short peptides of no more than ten residues length, as this seems to be the maximum size of peptide that can be fitted into the antibody-combining-site of immunoglobulins.

This is no real limitation to the immune recognition system, however, as a leading immunologist, Jerne,¹² has pointed out: the human body contains about one trillion lymphocytes, among which are possibly 10 million "clonal type" lymphocytes; each clonal type can respond immunologically only against a specific epitope. This clonal response seems to depend on the binding of a specific epitope to a lymphocyte that bears about 100,000 identical antibody-like receptors for this epitope.

Differentiation of this "enlightened" lymphocyte leads first to rapid proliferation, which could produce 20 million progeny within one week. Then most of these cells become immunocytes (plasma cells) which synthesize a specific immunoglobulin at the rate of 2,000 molecules per second until half the dry weight of each immunocyte is pure immunoglobulin. The basic question behind this immune recognition system is concerned with the location of the genetic processor that sorts epitopes into self and not-self markers, for normal lymphocytes never become immune against self epitopes.

Fortuitous mutations of astronomical proportions give rise to this highly complex system, according to Darwinian evolutionists, but a direct, and far more plausible, mechanism for self and not-self recognition resides in the DNA

double helix, with the template strand defining self, and the complementary strand defining not-self. This creationistic concept may be tested by model building, as outlined below.

A Role for Conformers in Immune Recognition System

Transcription of mRNA from the template strand of the gene for the L-chain of antibody active against the epitope at the amino-terminal end of the A-protein fragment and the subsequent translation of this mRNA message leads to formation of the L-chain component of the antibody-combining-site.

Now, if the corresponding complementary DNA strand is a mirror-image in genetic function of the template strand, then the mRNA transcribed from it should translate into the A-protein epitope. Lymphocytes may very well use these two DNA strands as discriminators of self and not-self during differentiation into clonal types; a clonal type of lymphocyte has the blueprint for production of antibody-combining-site in the template DNA against the not-self epitope coded for in the corresponding site on the complementary DNA strand.

The mRNA codon sequence for antibody-combining site against the A-protein epitope is not available, but the mRNA codon sequence for the A-protein epitope is, so the reverse relationship may be tested, in the following manner: translation of mRNA for the amino-terminal pentapeptide of the A-protein fragment into conformers should produce the epitope structure; the complementary mRNA is predicted to translate into the corresponding antibody-combining site. The mRNA for the epitope is GCU.AAG. GCC.CAA.AUC., which translates into the conformer sequence ala15.Lys21.Ala16.Gln54.Ilu28 that is shown assembled in Figure 3. It may be noted that this peptide forms two clockwise turns of a helix.

The complement of this mRNA codon sequence is CGA.UUC.CCG.CUU.UAG. When this mRNA is translated, the conformer sequence produced is Arg50.Phe44.Arg49.Val11.Amb37, which gives the structure shown in Figure 4. Only four conformers are assembled because the last conformer, "Amb," is a recognized "Stop" signal that terminates translation, *in vivo*.

The goodness-of-fit of these two peptides, when they are brought together, as shown in Figure 5, is compatible with the accepted "lock and key" relation between antibody and antigen.

Discussion

Darwinian evolutionists have used the observed differences in mRNA codon-synonyms as the basis for claims that the genetic code is the degenerate product of random mutations; accord-

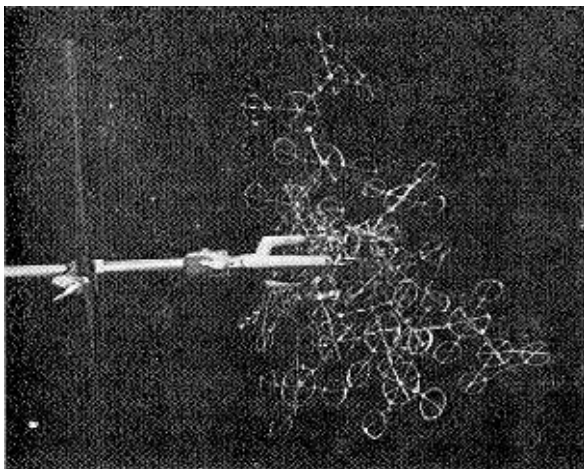


Figure 3. Kendrew wire model of Epitope of MS2 Phage-A Protein, produced by translation of corresponding mRNA Codon sequences into conformers. This mRNA codes for the Amino-Terminal Pentapeptide of the last 45 amino acid residues of A-Protein (Carboxyl-Terminal Fragment).

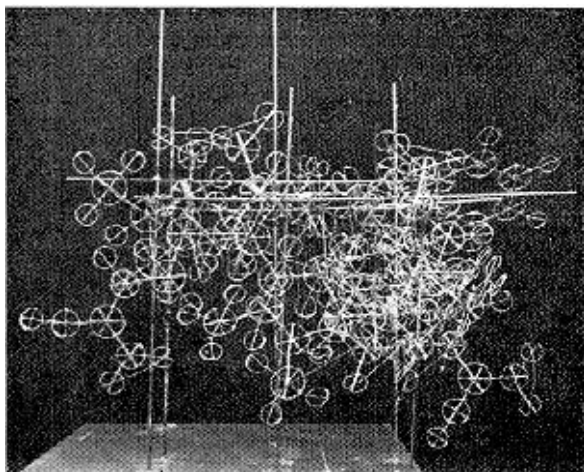


Figure 4. Kendrew wire model of proposed Antibody-Combining Site for MS2 A-Protein Epitope, produced by translation of complementary mRNA into conformers.

ingly, all scientific reports supporting orderliness in translation of genetic messages are branded as "ambiguous."

In the research reported here, a case is made for existence of a highly-ordered genetic control system that expresses itself in messages written in the form of intelligible codons. These codons are intelligent in the sense of being able to recognize each other and anticipate 'how they will interact upon translation into corresponding polypeptide chains, in vivo.

Model building experiments have been described here which support the view that 64 intelligible mRNA codons are used to control the

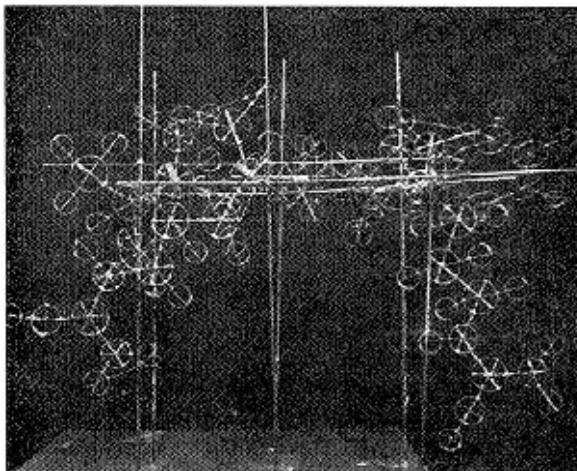


Figure 5. Kendrew wire model of MS2 A-Protein Epitope paired with proposed Antibody-Combining Site for this epitope.

three-dimensional orientation of amino acids in a polypeptide chain that is produced by in vivo translation of a specific sequence of codons.

Not only does every living cell have genes whose template DNAs control the formation of "self" proteins, but within each gene there is a genetic mirror-image copy of template DNA, in the form of complementary DNA, that forms a stable homologous base-paired double helix with the template DNA.

Evidence has been presented here that indicates lymphocytes use this genetic mirror-image relationship between template and complementary DNAs to distinguish self from not-self epitopes; mRNA transcribed from the template (sense) DNA strand is translated into the antibody-combining-site for the mirror-image epitope coded for by the DNA of the corresponding region of the complementary strand. In other words, the self epitope serves as antibody-combining-site against the antigenic not-self epitope.

Obviously, this line of research needs to be pursued much farther, but even at this point the handiwork of an intelligent Creator is clearly evident.

EDITOR'S NOTE

Already, while this article was being prepared for printing, interest in certain points has been expressed; such as, the details and interpretation of the use of the magnets. Thus it is hoped soon to have a sequel, dealing with some of these matters.

References

- ¹Nirenberg, M. W. and Matthaei, J. H. 1961. The dependence of cell-free protein synthesis in *E. coli* upon naturally occurring or synthetic polyribonucleotides, *Proceedings of the National Academy of Science, U. S.*, 47:1588.
- ²Frair, Wayne F. 1968. Life in a test tube, *Creation Research Society Quarterly*, 5 (1):34-41. June.

- ³Harris, R. G. 1966. The genetic code, *Cold Spring Harbor Symposia on Quantitative Biology*, Volume XXXI, Cold Spring Harbor Laboratory, Cold Spring Harbor, L. I., New York.
- ⁴Harris, R. G. 1968. Replication of DNA in microorganisms, *Cold Spring Harbor Symposia on Quantitative Biology*, Volume XXXIII.
- ⁵Jukes, T. A. 1969. Recent problems in the genetic code, *Current Topics in Microbiology and Immunology*, 49:178-219.
- ⁶Watson, J. D. and Crick, F. H. C. 1953. Molecular structure of nucleic acids: A structure for deoxyribose nucleic acid, *Nature*, 171:737-738.
- ⁷White, A. J. 1972. Uniformitarianism, probability and evolution, *Creation Research Society Quarterly*, 9 (1): 32-37. June.
- ⁸Fiers, W. 1973. The choice of code words in phage MS2 RNA, *Nature New Biology*, 244:186.
- ⁹Galizzi, A. 1969. The coding properties of multiple tRNA for valine and leucine in hemoglobin synthesis, *European Journal of Biochemistry*, 10:561-568.
- ¹⁰Zavayalov, V. 1973. Probable N-terminal domains conformation of human G1(Eu) Immunoglobulin, *Biochemica et Biophysica Acta*, 310:70-75.
- ¹¹Poljak, R. J., L. M. Amzel, H. P. Avey, B. L. Chen, R. P. Phizackerley, and F. Saul. 1973. Three-dimensional structure of the Fab' fragment of a human immunoglobulin at 2.8-A resolution, *Proceedings of National Academy of Science, U.S.A.*, 70:3305-3310.
- ¹²Jerne, N. K. 1973. The immune system, *Scientific American*, 229:52-60.

PERPETUATION OF THE RECAPITULATION MYTH*

GLEN W. WOLFROM†

Recapitulation, or the biogenetic "law" is shown to be held in disrepute by many biologists. Evidences from embryology as well as logical implications of the "law" if it were true are used to show that recapitulation cannot be a valid biological principle. Quotations from several modern textbooks are given to illustrate that some biologists are unwilling to reject in toto the views of Haeckel, in spite of evidence to the contrary. In fact, many authors continue to refer to fishlike gill slits in mammalian embryos, thereby perpetuating the myth of recapitulation.

Introduction

Occasionally a grossly mistaken concept is perpetuated as "evidence" for macro-evolution, especially in popular literature and even in some textbooks and journals. While many individuals may be aware of the situation, little effort is directed toward purging the literature of the misconception. Such seems to be the case with the myth of recapitulation.

Also known as the biogenetic "law,"¹ the theory of recapitulation was promulgated in the late 1800's by the biologist Haeckel. The essence of his concept was that ontogeny recapitulates phylogeny. That is, "each embryo in its development passes through abbreviated stages that more or less resemble some developmental stage of its evolutionary ancestors, both remote and immediate."²

Haeckel's views amounted to an adulteration of the concepts proposed by von Baer in 1824. von Baer's first two conclusions indicated that in the development of a vertebrate embryo, there is an early stage at which it could be recognized as a vertebrate, but it was impossible to distinguish what kind of a vertebrate it was (e.g., reptile, bird or mammal).³ At a later stage it may be recognized supposedly as a bird, for in-

stance, but it cannot be determined what kind of a bird it is. von Baer's last two conclusions express the concept that animals are more similar at early stages of development than when they are fully grown, and these similarities are diminished as the animals mature.³

Oppenheimer, a well-known embryologist, stated that the work of Haeckel was the "culmination" of the "extremes of exaggeration" which followed Darwin.⁴ She further declared that Haeckel's influence was "damaging to science."⁵ Later she continued:

The investigators [e.g., Haeckel] who have derived their ideas from the philosophical side, and examined their embryos to fit their observations into philosophical patterns already set and rigid . . . were the minds whose philosophical patterns delayed rather than accelerated the course of embryological progress.⁶

A few contemporaries of Haeckel refused to accept the biogenetic "law." von Baer himself warned against comparing "embryos of 'higher' forms to adults of 'lower' forms."⁷ Rádl mentioned that "everything important that has ever been cited against the recapitulation theory was known when the theory was first put forward; nevertheless it was widely accepted."⁸

According to Oppenheimer, "Haeckel's doctrines" were blindly and uncritically accepted not only by workers in the many related fields of biology, but also by "professional embryologists."⁹ She then categorized Haeckel as a "fanatic" who never could be considered to have been a "professional embryologist."¹⁰

*A condensed version of this paper has appeared elsewhere.

†Glen W. Wolfrom holds the M.S. degree in Animal Industries and is a Ph.D. candidate studying experimental nutrition at the University of Missouri. He is also president of the Missouri Association for Creation, Inc., and resides at 729-B DeMaret Drive, Columbia, Missouri 65201.

Fallacies Exposed upon Examination

The recapitulation theory has been examined thoroughly by embryologists and other serious scholars. Weisz declared that "Haeckel's basic thesis is invalid."¹¹ de Beer flatly concluded that "Recapitulation . . . does not take place."¹² In an excellent review, Rusch showed that "Haeckel resorted to a series of dishonest distortions in making his illustrations" which he used to support his theory.¹³ Other authors have dealt in great detail on the many shortcomings and fallacies of the theory.^{14, 15, 16, 17}

Probably one of the most widespread of the recapitulation fallacies concerns the fact that at a particular stage of development, the human embryo possesses (as do the embryos of many mammals) structures which superficially resemble the gills of fish. These embryonic features, erroneously referred to as "gill pouches" or "gill slits," are then said to "repeat or recapitulate a fish stage in our evolution."¹⁸

However, this is most certainly not the case. It is true that a series of five alternating ridges and grooves are present in mammalian embryos in approximately the same region as the gill bars of aquatic vertebrates such as fish. In fish these grooves open into the pharynx, forming the true gill slits through which water passes for respiration. In mammals, birds and reptiles, however, these structures **never** function in respiration, nor are there ever any openings into the pharynx.^{19, 20} Moreover, in mammals these pharyngeal bars (as they are more properly termed) begin immediately to undergo further development.

For example, the first arch and its pouch [i.e., groove] . . . form the upper and lower jaws and inner ear of higher vertebrates. The second, third and fourth arches contribute to the tongue, tonsils, parathyroid gland, and thymus.²¹

None of these structures, it may be noted, are associated with respiration. Thus, the use of the biogenetic "law" to support the fish ancestry of mammals and other non-aquatic vertebrates has no basis in fact.

Additional support for the evolutionary scheme of fish-amphibians-reptiles-mammals is often claimed by comparing the embryonic development of the mammalian heart with the differences between the fully developed hearts of fish, amphibians and mammals. The fish heart consists of a single tube with one atrium and one ventricle; the frog heart is a partially double tube, with two atria and one ventricle; and the mammalian heart is a completely double tube having two atria and two ventricles.²²

Recapitulation, then, would require the heart of the embryo to begin as a single tube. While

the embryonic heart of the mammal does progress from a single tube with two chambers to a double tube with four chambers, it *begins* as a double tube which fuses to form a single tube before it undergoes further changes to become the heart.²³ Once again embryology is shown to be contradictory to the biogenetic "law."

Embryonic Growth Not "Evolutionary"

The fallaciousness of the recapitulation theory can be further illustrated by other examples in which characteristics appear in ontogeny out of order of their supposed evolutionary development. de Beer stated that while teeth are supposed to have evolved before tongues, tongues of mammalian embryos appear before teeth.²⁴ As also pointed out by de Beer, Pavlov demonstrated that in the fossil cephalopods known as ammonites, the young stages often foreshadow later evolutionary developments, rather than recapitulating past development.²⁵

Another instance of reversed order is that the embryonic skeleton in mammals is first cartilaginous, being replaced by bone later.²⁶ The opposite sequence should be found according to evolutionary speculation. Thus, it can be seen that a reversed order is often exhibited by embryology, rather than the order in which various structures supposedly evolved.

A logical extension of Haeckel's "law" would have to allow for the existence of the caterpillar as a fully developed organism, for which there is no evidence.²⁷ In 1925, using the same type of reasoning, Gregory made this cutting observation:

. . . if the biogenetic law were universally valid, it would seem legitimate to infer that the adult common ancestor of man and apes was a peculiar hermaphroditic animal, that it subsisted exclusively upon its mother's milk, and that at an earlier phylogenetic period the adult ancestor was attached to its parent by an umbilical cord.²⁸

It is true that the embryos of many vertebrates (e.g., man, fish, bird, pig) are similar in the early stages of development. However, could not most of these similarities be accounted for by the fact that there are also likenesses between the adults of these species? For example, they all have jaws, skull, backbone, four appendages, etc.²⁹

Thus, it is evident that undue emphasis is placed on certain similarities between embryos of different species, or on certain unique developmental stages; while differences between embryos, out-of-sequence stages, or embryological structures with no apparent function in ancestral stages are ignored or explained away. Furthermore, the biogenetic "law" cannot be applied to the plant kingdom.³⁰

If there is to be any semblance of validity in recapitulation, it is obvious that many stages of "evolution" have been deleted and the "evolutionary" history as revealed by the embryo has been greatly condensed. However, reasons as to why this should be the case are not apparent.

Textbook Authors Commit Errors

As pointed out by Oppenheimer in 1955, "the record of many of our 'modern' textbooks is none too pure with respect to the biogenetic law."³¹ Bock has made the following observation:

... the biogenetic law has become so deeply rooted in biological thought that it cannot be weeded out in spite of its having been demonstrated to be wrong by numerous subsequent scholars. Even today both subtle and overt uses of the biogenetic law are frequently encountered in the general biological literature as well as in more specialized evolutionary and systematic studies.³²

For instance, a little book for youngsters, copyrighted in 1958 and still available, contains the following statement: "Mammals and birds go through stages with gill pouches—first like fish, then like reptiles."³³ A typical spurious illustration is included.

In a recent high school biology textbook by Frazier and Smith, the following passage may be found:

Although man is essentially a land animal, he still retains some of the features of his developmental history. . . . The human embryo resembles a fish embryo at first, It *has gill slits*, blood vessels passing through the gill bars, a fishlike heart with one atrium and one ventricle, a primitive kidney, and a tail. A little later in development the human embryo comes to resemble a reptilian embryo. The *gill slits become closed* and the blood vessels in the gill region become modified . . . the heart contains three chambers. Still later, the heart contains four chambers.³⁴ (Emphasis added)

Further evidence of the perpetuation of the gill slit myth is afforded by two additional examples. In a recent letter-to-the-editor in a local newspaper, the writer suggested that the presence of gill slits in the human embryo may be used by some individuals as evidence that the embryo is not yet human, thus justifying abortion.³⁵ The famous Dr. Benjamin Spock, in one of his books, contributed to the continuance of the recapitulation myth:

Each child as he develops is retracing the whole history of mankind, physically and spiritually, step by step. A baby starts off in the womb as a single tiny cell, just the way the first living thing appeared in the ocean. Weeks later, as he lies in the amniotic fluid

of the womb, *he has gills like a fish*.³⁶ (Emphasis added)

Baldwin, in his book on comparative biochemistry, makes the following statement:

The mammals, for instance, had fish-like ancestors, and early in its development the mammalian embryo *actually possesses gill slits like those of a fish*. . . .³⁷ (Emphasis added)

In view of the evidence presented previously, these quotations from Frazier and Smith, Spock and Baldwin are clearly erroneous and misleading. The perpetuation of such untruth, in the light of modern embryology, is truly incomprehensible.

In most of the more recent college textbooks which I have examined, the authors are careful to avoid a direct adherence to Haeckel's concepts, yet they do not divorce themselves entirely from his basic premise. For instance, Weisz stated that "recapitulation in the Haeckelian sense simply does not occur; the embryonic stages of given animals do not repeat the adult stages of other animals."³⁸ Yet, he then claimed that since these "similarities . . . are consequences of common ancestors, they may indicate degrees of evolutionary interrelationships among animals."³⁹

Hickman and Hickman stated that "we can scarcely believe that mammalian embryos retrace vertebrate evolutionary history. . . ."⁴⁰ Yet a few lines earlier they wrote:

... similarities can only be explained as an indication of common vertebrate ancestry. Embryonic development is thus a record, although a considerably modified one, of evolutionary history.⁴¹

Nason cautioned that "In some instances the sequence of events in the ontogeny of a body part is the reverse of its known phylogenetic history."⁴² But on the preceding page we find the following:

Such evidence [gill pouches] clearly implies that terrestrial vertebrates have evolved from aquatic forms with functional gills. . . . In certain respects, ontogeny during the embryonic state reflects or repeats phylogeny in a modified way.⁴³

The differences between what these authors actually accept and what Haeckel taught are not at all clear; but the desired implication (i.e., evolution) remains the same. If any differences do exist, they are so slight as to be insignificant insofar as the influence of these misconceptions on young minds is concerned.

Haeckel's concepts were actually twofold. First, "ontogeny recapitulates phylogeny"; and second, "phylogeny causes ontogeny."⁴⁴ While most modern authors have rejected the second concept, the first seems to be too deeply imbedded

in evolutionary thinking to be uprooted. Even the world-famous geneticist Dobzhansky clings tenaciously to this doctrine when he writes:

This co-called biogenetic law is no longer credited in its original form. And yet embryonic similarities are undeniably impressive and significant. . . . But why should it [human embryo] have *unmistakable gill slits* unless its remote ancestors did respire with the aid of gills?⁴⁵ (Emphasis added)

In spite of the fact that no functional gills ever exist in the mammalian embryo (which Dobzhansky⁴⁶ and others readily admit) and that these pharyngeal bars develop into structures having nothing to do with respiration, these men continue to refer to these ridges and grooves as "gill slits" or "gill arches." And, while denying that recapitulation occurs, they boldly state that these arches clearly demonstrate man's aquatic origin. In spite of the fact that the sequence of events in embryological development is often the reverse of that assumed for evolution, the authors continue unjustifiably to inject "evolutionary" significance into embryology.

Conclusions

It is my feeling that many of today's scientists are guilty of the same crime as Haeckel; i.e., "fitting the facts to the theory."⁴⁷ This error likely results from a "blind acceptance of the evolution-doctrine,"⁴⁸ as Oppenheimer accused Haeckel.

It seems that having first assumed evolution to have occurred, the data are interpreted to fit the assumption. By circular reasoning, embryological data are then cited as evidence for evolution. Emphasis is placed on certain selected structures or sequences of development which fit evolutionary dogma; while dissimilarities and reversed sequences are ignored.

I am in agreement with the geneticist Tinkle who succinctly declared, "Science should consider *all* the facts."⁴⁹

References

- ¹Some biologists use the term biogenetic law to refer to von Baer's concepts, and recapitulation theory to refer to Haeckel's views. However, most biologists seem to identify both terms with Haeckel's concepts.
- ²Watson, D. M. S. and A. Richards. 1964. Embryology (in) Encyclopedia Britannica. William Benton, Publisher. Volume 8, p. 318.
- ³de Beer, G. 1958. Embryos and ancestors. Oxford University Press, London, p. 3.
- ⁴Oppenheimer, J. M. 1967. Essays in the history of embryology and biology. M. I. T. Press, Cambridge, Mass., p. 150.
- ⁵*Ibid.*, p. 151.
- ⁶*Ibid.*, p. 166.
- ⁷*Ibid.*, p. 148. See also p. 230.
- ⁸Rádl, E. 1930. The history of biological theories. Oxford University Press, Oxford, England, p. 140. Cited by J. M. Oppenheimer, *Ibid.*, p. 152.
- ⁹Oppenheimer, J. M. *Op. cit.*, p. 153.
- ¹⁰*Ibid.*, p. 154.
- ¹¹Weisz, P. B. 1967. The science of biology. McGraw Hill, Inc., New York, p. 798.
- ¹²de Beer, G. *Op. cit.*, p. 170-171.
- ¹³Rusch, Sr., W. H. 1969. "Ontogeny recapitulates phylogeny," *Creation Research Society Quarterly*, 6 (1): 27-34.
- ¹⁴Dewar, D. 1957. The transformist illusion. DeHoff Publications, Murfreesboro, Tenn., pp. 185-217.
- ¹⁵Mennaga, A. 1969. A Christian perspective on chordate morphology, *Creation Research Society Quarterly*, 6 (3):121-126.
- ¹⁶Rusch, Sr., W. H. 1970. Analysis of so-called evidences of evolution (in) Why not creation? Edited by W. E. Lammerts. Baker Book House, Grand Rapids, Mich., pp. 336-338.
- ¹⁷Klotz, J. 1970. Genes, genesis and evolution. Concordia Publishers, St. Louis.
- ¹⁸Corner, G. W. 1944. Ourselves unborn. Yale University Press, New Haven, Mass., p. 67.
- ¹⁹*Ibid.*, p. 66.
- ²⁰Volpe, E. P. 1971. Human heredity and birth defects. Dobbs-Merrill Co., Inc., New York, p. 30.
- ²¹Hickman, C. P. and C. P. Hickman, Jr. 1972. Biology of animals. C. V. Mosby Company, Saint Louis, Mo., p. 272.
- ²²Tinkle, W. J. 1967. Heredity: a study in science and the Bible. St. Thomas Press, Houston, Texas, p. 117.
- ²³Nason, A. 1965. Textbook of modern biology. John Wiley & Sons, Inc., New York, p. 721.
- ²⁴de Beer, G. *Op. cit.*, p. 7.
- ²⁵*Ibid.*, p. 10.
- ²⁶Nason, A. *Op. cit.*, p. 717.
- ²⁷Oppenheimer, J. M. *Op. cit.*, p. 152. (Reference 4)
- ²⁸Gregory, W. K. 1925. The biogenetic law and the skull form of primitive man, *American Journal of Physical Anthropology*, 8:373. Cited by G. de Beer, *Op. cit.*, p. 11.
- ²⁹Coffin, H. G. (n.d.) Creation—the evidence from science. Life Origins Foundation, Anacortes, Washington, p. 13.
- ³⁰de Beer, G. *Op. cit.*, pp. 12-13.
- ³¹Oppenheimer, J. M. *Op. cit.*, p. 154.
- ³²Bock, W. J. 1969. Evolution by orderly law (Book Review), *Science*, 164:684-685.
- ³³Burnett, R. W., H. I. Fisher and H. S. Zim. 1958. Zoology—a guide to the animal kingdom. Hamlyn Publishing Group, Ltd., New York, p. 143.
- ³⁴Frazier, R. P. and H. A. Smith. 1971. The biological sciences. Laidlow Brothers, River Forest, Illinois, pp. 349, 444.
- ³⁵Thomas, B. 1973. Open column (in) *Columbia Daily Tribune*, Columbia, Mo., April 17.
- ³⁶Spock, B. 1957. Baby and child care. Cardinal Giant Edition, p. 223.
- ³⁷Baldwin, E. 1966. An introduction to comparative biochemistry. Cambridge University Press, London, p. 64.
- ³⁸Weisz, P. B. *Op. cit.*, p. 801. (Reference 11)
- ³⁹*Ibid.*
- ⁴⁰Hickman, C. P. and C. P. Hickman, Jr. *Op. cit.* (Reference 21)
- ⁴¹*Ibid.*
- ⁴²Nason, A. *Op. cit.*, p. 717. (Reference 23)
- ⁴³*Ibid.*, p. 716.
- ⁴⁴Weisz, P. B. *Op. cit.*, p. 798.
- ⁴⁵Dobzhansky, T. 1973. Nothing in biology makes sense except in the light of evolution, *American Biology Teacher*, 35:125-129.
- ⁴⁶*Ibid.*
- ⁴⁷Oppenheimer, J. M. *Op. cit.*, p. 269. (Reference 4)
- ⁴⁸*Ibid.*, p. 268.
- ⁴⁹Tinkle, W. J. *Op. cit.*, p. 118. (Reference 22)

IS A FIXED CHRONOLOGY OF EGYPT BACK TO c. 2000 B.C. MISTAKEN?

DONOVAN A. COURVILLE*

Scientists should always check the reliability of their instruments. Examples of what happens from failure to check are well known. At one time several astronomers believed that they had found rings around some of the outer planets besides Saturn, but an optical defect in their telescopes was involved. Again, Huxley's "Bathylbius" arose from a flaw in techniques.

Creationist scientists use Scripture as an instrument, so to speak. Scripture is taken to be reliable. If any error was found in Scripture, then some doubt could be cast on other parts. This would be especially true were errors to be found in the historical and chronological parts of Scripture.

Such errors have been claimed, on the grounds that the chronology of Scripture disagrees with other chronologies, especially that of Egypt, which many claim has been determined by astronomical methods. It is shown here that there is abundant reason to believe that the Scriptural chronology is valid, and that chronologies which disagree are really based, not on astronomy, but on questionable assumptions.

Introduction

According to current views on archaeology, the chronology of Egypt is regarded as "astronomically fixed" to a date c. 2000 B.C. for the beginning of the XIIth Dynasty and again at c. 1580 B.C. for the beginning of Dynasty XVIII. Chronology for the intervening and subsequent periods are then set to meet the demands of such fixation as needed to meet certain proposed synchronisms.

With Egyptian history thus fixed, incidents in Scripture, such as the Exodus, the Oppression and the Conquest, are given positions in Egyptian history which are based on either (1) an acceptance of the 480-year period between the Exodus and the fourth year of Solomon (I Kings 6:1), or (2) a rejection of this figure in favor of a date for the Exodus about 150 years later to allow recognition of Rameses II as the pharaoh of the Oppression.

Many discrepancies rise between details provided in Scripture and interpretations of archaeology required by either of these placements of the Exodus. The writer has gleaned a list of over 25 such discrepancies, which are either in direct contradiction to Scripture, or which lead necessarily to acceptance of views which compromise the Scriptural accounts.

Until recently, scholars were certain that the chronological figures of Scripture for the reigns of the Hebrew kings could not be interpreted to make any sense. This situation was taken as evidence for the undependability of the chronological figures of the Old Testament generally. With the re-examination of these data by Thiele,¹ these problems have been clarified to the satisfaction of most scholars. Thus this basis for controverting the dependability of Biblical figures on chronology has been eliminated.

However, in spite of this development, scholars holding to the XIXth Dynasty setting of the Exodus must reject the 480-year period of I Kings 6:1 as correctly defining the interval from the Exodus to the fourth year of Solomon. On the other hand, the placement of this incident in the XVIIIth Dynasty, as held by many conservative Bible scholars, also raises questions of considerable magnitude. The belief is now almost universal among scholars that there is no further rational hope of demonstrating harmony between these two sources by either placement of the Exodus.

The roots of this problem lie far deeper than realized by many scholars who are attempting to retain an unqualified confidence in the authority of Scripture, particularly as it pertains to the Genesis account of creation. For, if it is true that there are errors and inaccuracies of such number and of such magnitude in the later Scriptures, then how dependable are these accounts, far back in the prehistoric period?

This situation evidently remains a major problem in the thinking of many Bible scholars who have felt compelled by the evidence to accept some modifications of the creation account. Popular among such is the modification which would assume that the God of Scripture used "evolution" as His method of creation. However, that view negates such a large fraction of Scripture that little of significance is left to its religious message. The problem of the veracity of these claims of error and inaccuracy in Scripture in its historical and chronological teaching is thus one of first importance in arriving at a truly defensible answer to the problem of life origin.

The writer contends that the conflict between Scripture and archaeology is not a conflict between Scripture and the *facts* of archaeology; it is rather a conflict between Scripture and the "authoritative" *interpretations of the obscure evidences of archaeology*, just as is so true for the conflict between Scripture and interpretations of geology.

*Donovan A. Courville, Ph.D., is Professor Emeritus of Biochemistry at Loma Linda University, Loma Linda. He lives at 42 Dart Street, Loma Linda, California 92354.

There is no genuine basis for presuming that the teachings of Scripture must be modified to meet these interpretations, but there is abundant evidence for the faulty and erroneous interpretations of archaeology. It is the writer's further contention that the facts of archaeology are being interpreted on the basis of premises that have never been established as valid. These interpretations are no more certain than can be shown for the premises on which the interpretations rest.

It is the very foundation premises of archaeology that require re-examination as to their validity. When this is done, it will be found that the facts of archaeology are susceptible to an altered interpretation, within the limits of such altered premises, which confirm the reliability of the Old Testament Scriptures to a degree far beyond anything previously recognized.

Need of Corrections, Evidence Source

It has been the aim of the writer in his recently published work under the title *The Exodus Problem and Its Ramifications*² to:

- (1) point out the insecurity of certain basic premises of archaeology,
- (2) review the pertinent facts of archaeology in terms of the corrected premises,
- (3) demonstrate that when this is done, harmony is attained between Scripture and the pertinent *facts* of archaeology,
- (4) demonstrate that at the same time numerous difficulties that characterize the current views, but which are unrelated to Scripture, are eliminated simultaneously, and
- (5) show that all this is accomplished without the disregard of any established synchronism among the peoples of antiquity; rather, numerous anachronisms are eliminated and a whole new series of synchronisms appear that have not been previously recognized.

It is not feasible to encompass the evidence in support of this range of accomplishments in this article. The present discussion is limited to a demonstration that a **major error has been made** in setting up the traditional chronology of Egypt, leading to similar errors in the chronologies of other peoples of antiquity whose chronologies are tied to that of Egypt. The error has been in the acceptance of a chronological structure as "astronomically fixed," which represents an actual gross expansion of the time period involved. The net result has been that of setting the incidents of Scripture against totally erroneous backgrounds; the discrepancies are then being pointed to as examples of errors or inaccuracies in Scripture. This situation holds until one reaches a relatively late date in Old Testament history.³

Even Bible scholars, who are attempting desperately to find solutions to these problems, have assumed that it is impossible to alter the conventional chronology of antiquity to the degree needed to restore harmony without introducing far greater difficulties than those now recognized. *This conclusion is here challenged.*

The term "astronomically fixed dates" is a deceptive one. To be sure, astronomical data are used in the method for arriving at these dates, but the premises on which the interpretations depend are open to the most severe sort of criticism.⁴

In the limited space available, it is proposed to show here, by means of scientifically recognized principles, that *a gross error has been made* in setting up this chronology, and that *the error is in the direction of a grossly expanded structure*. It must be left for subsequent discussions, or to reference to the writer's more complete work, for data on the manner in which such a condensation can be attained.

Error of "Pottery Dating Scheme"

The error can be traced to the use of the dating method which is known as the "pottery dating scheme." This dating method and the manner in which it was devised can be described briefly.

In ancient times, particularly in Palestine and in Mesopotamia where stone for building is scarce, constructions of buildings or walls were of sun-dried mud brick. Unlike stone, when a structure was destroyed for any reason whatever, bricks were not conveniently reusable. It was easier to simply level off the ruins and make the new construction on top of the old. Sometimes dirt was brought in to cover the ruins, sometimes not. In any case, the repetition of this practice over centuries and millennia resulted in the formation of mounds at the sites of ancient occupation.

When archaeologists dig into such a mound, remains of past occupations are found in reverse order of their existence. Hence these occupation levels have a significance in terms of the *relative* chronology of the site. A relative chronology is gained since archaeologists deduce that any given occupational level is older than the one above it and younger than the one below it. Thus a sequence of levels may be recognized. But a sequence is not a chronology unless the various points in the sequence can be defined in terms of some scheme for expressing elapsed time in years from some common definable date.⁵

The B.C. time scale is such a scheme. But this scale was not devised until centuries into the Christian era. Hence dates in Bible history are given in terms of elapsed time from some stated incident or in terms of the year in the reign of

a given king. The same method was adopted by ancient historians.

Unfortunately, not a single written inscription has been found in a definable level of a Palestinian mound which provides an *unequivocal* clue as to the date to be assigned in terms of the ruling king at the time. Such data are not available until very late in Palestine history. Thus the assumed dates for these levels have been deduced necessarily by other methods—methods that are susceptible to error at every turn.

It was in an effort to overcome these difficulties that the pottery dating scheme was devised. Credit for the origin of the scheme is given to Petrie. The scheme was corrected and refined by subsequent investigators.

The idea behind the pottery dating scheme was to observe the changes in pottery types as one digs downward (moves backward in time) in a mound site. By such a method, it was theoretically possible to set up a pottery index by which a level in one mound could be correlated in time with a level in other mounds which revealed the same pottery types. But unfortunately, as with the setting up of the fossil index for a similar purpose in geology, no single mound was ever found that contained all of these pottery types uncovered in various mounds in Palestine.

Hence to gain a complete sequence, types were inserted into the sequence from various sites, the positions being **deduced** from recognizable types found below and above. But in so doing, the pottery index no longer represented necessarily a sequence; since proponents assumed that two types of pottery could not be in use contemporarily in different mound sites, an assumption which cannot be proven, and which would be open to severe question according to common sense reasoning.

If this weakness in the scheme is called to the attention of an archaeologist, he will defend the system as having eliminated, by other methods, any but minor errors. The common method for making such a check is based on the occasional find in Palestine mound levels of pottery items and other objects which can be dated to the reign of a given Egyptian king or at least to a given dynasty of kings. Similar finds have been made of items from other areas, such as Greece and Crete.

But this reply only moves the problem back an additional step. If one asks how the dates of the kings and dynasties of Egypt are known to permit such usage, the answer is given that certain dates have been "astronomically fixed." Then, from these fixed dates, dates for the intervening kings and dynasties can be calculated with no more than minor possible errors.

This answer is usually sufficient to suppress any further questions, since those who accept it infer that dates thus determined are not susceptible to alteration, except as one presumes to be able to show that the movements of the heavenly bodies cannot be depended upon for constancy.

As noted previously, this is the point that is challenged by the writer. The basis for this challenge has no relation to the constancy or inconstancy in the motions of the heavenly bodies. It is rather on the basis that the premises used in the interpretation of data have never been established and can be shown to be susceptible to severe question as to their validity.

The aim of this discussion is to demonstrate, by means of acceptable scientific method, that in spite of the pretentious nature of the label, the acceptance of the results from this dating method has led to a gross error in setting up the chronology of antiquity and that the error can be traced to the use of this method which does not merit the confidence placed in it.

Principles of Reasoning Considered

There is a scientific principle that has been used to great advantage in many different disciplines for arriving at truth. It has been used to excellent advantage in providing impressive support for creationism. This principle may take either of two forms which may, at first glance, seem to be unrelated but which are in reality but two forms of the same principle. One may state the principle thus: the greater the amount of disparate (dissimilar or unrelated) data that can be brought to bear in support of a given theory, the greater is the probability of its correctness.

It follows that when an enormous amount of such unrelated data can be brought to bear, as has been done in support of the creation account of origins, this theory approaches a demonstration of its correctness. As with the asymptotic curve of mathematics, which approaches closer and closer to a straight line but which never touches the line theoretically, so perhaps the Bible account of creation must remain unproven, from a scientific standpoint, in spite of this mass of supporting evidence.

However, the principle may be stated in another manner which applies to the problem of *recognizing an error of reasoning* rather than *providing support for a theory*. For this purpose, the principle may be stated thus: an error of reasoning may sometimes become apparent from the consistency of the inconsistencies that result upon application.

To illustrate, let the reader imagine himself driving along a country road looking for a specific location, which for brevity of reference might be called place X. After some difficulty

in locating X, information is requested of a gas station attendant as to how to get to X. The attendant tells you to continue straight ahead, take the fourth road to the *right*, and proceed about one-half mile to place X.

With complete confidence in the veracity of the instructions provided, you continue down the road. But the first road turns off to the *left*; there is no road turning off to the *right*. And the roads continue to turn off to the left; there are no roads turning to the right. With each successive discrepancy, your suspicion grows that the station attendant made a mistake. When the two mile road and three mile roads also turn only to the left, your suspicion reaches a point of virtual certainty.

How could this be verified or negated? You could return to that fourth road that turned to the left and drive down the road about half a mile. If location X was found, what deduction could be made relative to the instructions provided by the gas station attendant? How much additional data would it take to convince you that your deduction was correct? It is to be noted clearly, that the *reason* for the mistake could not be deduced. *One can deduce that a mistake was made and you can define clearly the nature of the error.*

Now, this same principle can be applied to the problem of claimed discrepancy between Scripture and archaeology which has led many people to deduce that Scripture is not dependable, since it contains numerous errors and inaccuracies in its historical details.

Application to Reports of Jericho

Archaeologists are in virtual agreement. They claim emphatically: "most certainly, there are major errors and inaccuracies in Scripture in its historical phases." Truth value for this claim is based supposedly on archaeological reports of investigations at the various Palestinian sites that involve Biblical history. Archaeologists will also caution that Scripture was not reduced to writing until centuries or millennia after the incidents occurred, hence discrepancies should be expected, since it is very reasonable to suppose that in the oral transmission of the accounts over such an extended period, the introduction of such errors is inevitable.

But is there an alternate interpretation to the reports of archaeologists? One could read reports about Jericho. Jericho was the first target of the Israelites in their conquest of Palestine after crossing the Jordan. The Scriptural account (Joshua 6) contains a number of details which could be found archaeologically *if* the accounts are dependable. *The reader should note carefully that no assumptions are made at this point as to the dependability of these details.*

According to the account, a selected fraction of the Israelite army marched around the city once each day in silence for six days. On the seventh day, they made the circuit seven times. With the completion of the seventh circuit the people shouted, the priests blew their trumpets, and the walls fell flat down the sides of the mound so that each man in the army could move into the city from his position in the circuit. The city was destroyed and burned. A curse was pronounced on the one who should attempt to refortify the site, the abortive attempt to be at the cost of the lives of the two sons of the attempting rebuilders. Such an attempt by Hiel in the days of King Ahab is reported in later Scripture (I Kings 16:34).

The detail relative to the fallen walls is most unique. The normal procedure for conquering a walled city by an enemy is not by tearing down the entire city wall but rather by concentrating efforts on one or a few of the more vulnerable points such as at the city gate. Only occasionally is a destruction of a city marked archaeologically by evidences of total burning. A further detail of significance is the statement indicating that the city was not to be rebuilt for a significant period of time. Hence if the Scriptural account is altogether correct in these details, the city level meeting the first two of these unique details should be followed by evidence of a prolonged hiatus of occupation, and evidences of the later abortive attempt at refortification.

Actual Findings Confirm Scripture

What, then, do archaeological reports on the site of Jericho contain? Evidence for the fallen walls was observed by early investigators. A concerted attempt to examine the mound was made by John Garstang in the 1930's.⁶ He rediscovered the evidence for the fallen walls and this evidence was photographed by him and by subsequent investigators. True to the Scriptural account, the evidence revealed clearly that the walls fell outward.

Scholars were skeptical. There was no room in their thinking for the concept of interference of a Supreme Being in the affairs of men as comprised the basis for the report in Joshua: the walls must have been undermined from the outside by a conquering army.

Garstang returned to the site and reexamined the footings of those walls. He found the foundations tilted outward at a rakish angle but with no evidence of undermining. The walls must then have been shaken down by an earthquake!

But there was the evidence of a total and violent burning of the city to be accounted for. Evidence was found indicating that brush had been brought in from outside the city to add to the conflagration, leaving ash heaps as deep

as five feet in places. This burning was certainly intentional, not accidental as from an earthquake.

The destroyed city was the latest *fortified city* to occupy the site, also in agreement with Scripture. There were evidences of occupation in an unwallled area at a much later time, but this only confirmed the attempt by Hiel to rebuild the city. There were also evidences of a revetment type wall belonging to this later period, but no evidences for a reconstruction of the city walls or gates.

On the basis of evidence found in graves from an adjoining area, Garstang deduced a date c. 1400 B.C. for the destruction of the city, which date was in agreement with an Exodus dated c. 1445 B.C. as demanded by the statement in I Kings 6:1. While most scholars of this era seem to have been convinced that there was no way to avoid the identification of the fallen walls and the destroyed city with the account in Joshua, the more widely accepted date for the Exodus demanded a date for the Conquest in the mid-thirteenth century B.C. The remaining controversy was thus over the date to be assigned to the evidence, not to its identification.⁷

To settle this problem, a further investigation was carried out in the 1950's under the direction of Miss Kathlene Kenyon.⁸ A reexamination of the pottery in association with the destroyed city led to a necessary revision of Garstang's date. On the basis of the then more refined pottery index, the pottery in association with the destroyed city was found to be datable to the twenty-first century B.C., 600 years or more prior to the era of Joshua!

The logical deduction would have been to suspect that the dates assigned to the pottery index types had been misdated. But such an admission was out of the question since the chronological structure had been "fixed astronomically," and such a redating was considered impossible.

There was also the problem of accounting for the fact that this destroyed city was the latest city on the mound. If this belonged to the era 2100 B.C., then what happened to the remains of the city destroyed by Joshua? Did the Israelites carry these remains off to some distant spot and bury them to confuse any one who might later examine the mound? At this point the reader can begin to understand the lengths to which leading archaeologists will go to avoid the obvious, if they do not want to believe the obvious.

It was proposed, and is still accepted by archaeologists, that the remains of this 600-plus years of occupation have been washed off the mound by rain. But if this were the case, then the

remnants of that 600 years should be apparent from an examination of the sides of the mound. Even if one assumes that the mud bricks had deteriorated again into soil, there should at least be evidences of the indestructable pottery remnants. *Intensive investigations have failed to reveal any such evidence.*

And if the mud bricks were still apparent from walls dated 600 years earlier, then how does one explain the absence of such bricks for the period 600 years later? Commenting on this enigma, G. E. Wright, then editor of the *Biblical Archaeologist* journal, wrote:

... It is unfortunate though true, that these results antique most of the recent treatments of the problem of the conquest of Canaan. We now have to say that we know practically nothing, from an archaeological point of view, regarding Joshua's conquest of Jericho. The evidence is too scanty for us to know when it was or the nature of the city conquered. An inference would be that whatever was there at the time was not the imposing city which we had previously envisioned from the earlier excavations. The *radical denudation* of the site and the *failure to find the expected materials washed down the slopes* of the mound are *very puzzling facts* indeed. If the settlement there in Joshua's time had a fortification wall at all, it would almost have to have been a re-use of the last Middle Bronze Age bastion, though of *such re-use there is no evidence.*⁹ (Emphasis added)

In terms of the illustration on road directions, the reader is at the point where the first road does **not** turn off to the right as expected from the directions given, but rather in an opposite direction. In the case at hand, evidences corroborate each of the unique details provided in Scripture and were so recognized by earlier investigators, but the date demanded by popular chronology is centuries too early. Thus there is a basis for an *initial* suspicion that a mistake has been made in assigning dates to the various pottery types in the pottery index. But at this point, there is only a suspicion, so attention will now be directed to the site of ancient Ai.

Attention to Reports on Ai

Ai was the second target of the invading Israelites. Again, from the Biblical account, there are several details that could be found archaeologically. According to the account, the city was a walled city (for it had a gate),¹⁰ and its destruction as a walled city was so thorough that it was to remain a "heap" forever.¹¹ The date for the destruction of Ai, as indicated by the associated pottery should be the same as for the destruction of the Jericho site.

Archaeological research of the site revealed the heap of rocks. The reports actually emphasize the uninteresting nature of the investigations of the rock heaps in contrast to the more interesting investigations of neighboring sites.¹² As at Jericho, so at Ai, the evidence of a later occupation was found, but in an area which had not again been refortified. The pottery in association with the destroyed city is of the same era as that of the destruction at Jericho (late Early Bronze),¹³ though specific dates cannot be defended in either case. The reader is now at the point corresponding to the second road turning to the left, rather than to the right. Thus suspicion grows that a mistake has been made in the assumption of a fixed chronology, and that the difficulty lies in a misdating of the pottery types in the pottery index.

In fact, at this point in his investigations, the writer directed an inquiry to a leading Biblical archaeologist as to why no serious consideration was being given by archaeologists to the possibility that the real difficulty lay in misdating of pottery. The archaeologist explained that while such a solution might solve the problems at Jericho and Ai, this was not true at other sites in Palestine. So, again there is only a suspicion of error, but attention will now be shifted to the site of Shechem to see whether or not this inconsistency remains consistent.

Attention to Reports on Shechem

According to Judges 9, Abimelech, son of Gideon the previous judge, murdered all save one of his 70 brothers and usurped the judgeship. Abimelech lived at Shechem. The people of Shechem revolted at his method of securing the judgeship.

Abimelech retaliated by raising an army, slaughtering the people who were working outside the city walls in the fields and besieging the city, since the gates had been closed against him. Defense of the city gate was assigned to a group of men who took positions in a tower adjacent to the gate, evidently to enable them to hurl stones down on anyone who attempted to force the gate entrance.

Eventually, the men in the tower were no longer able to hold the defense and fled, with the people still inside the city, to "an hold of the house of the god Berith." The roof of the hold was burned down over the heads of those taking refuge there, and the city was completely destroyed. (Destruction was evidently by fire since this was the stated method for gaining entrance through the city gate and in gaining entrance to the hold in the conquest of the neighboring city of Thebez.)

And what do the reports of the archaeological research of the site contain? One of the early

discoveries was that of a massive building with walls seventeen feet thick at the extant foundations. Evidences of cult objects in the court made imperative an identification of the massive structure as a temple. Some of the investigators objected; temples were not erected with walls seventeen feet thick; the structure must have been an internal fortification of some sort. The director of the investigations was adamant in his contention. He wrote in his report:

Consequently, there seems to be no need for further quibbling. The evidence from the court shows that two sacred standing stones and an altar are almost as old as the building itself. It is therefore a temple, and originally built as a temple.¹⁴

But there was the enigma of the seventeen-foot thick walls. The answer to the enigma was found in the Scriptural account which referred to a structure that was "an hold" as well as being a "house of the god Berith." The agreement with this *most unusual detail* led the director to maintain as a "must" the identification of this massive structure with that of the Abimelech story, a view that was retained through most of the period of excavations at the site.

However, other investigators did not agree with this deduction. Investigators in the area of the city gate and tower had observed evidences of violent destruction by burning, datable to the tenth century B.C., and again in the sixteenth century, but no such evidence at any point between these dates. There was rather a smooth transition across the area to be assigned to the twelfth century which, by Bible chronology, must be assigned to Abimelech.

The evidence consisted of fourteen successive floors, beginning long before the twelfth century and continuing to a point much later, yet with no indications whatever of any such disturbance as that expected from the Abimelech story.¹⁵

With the discovery of additional evidence that the massive structure could not have survived to the era assigned archaeologically to Abimelech, and with the finding of evidence at several locations on the mound of violent burning and datable also to the sixteenth century, there was no choice but to abandon the identification of this massive structure with that in the account of Abimelech; an identification which had been regarded as a "must," because there was agreement in such a remarkable manner with details of Scripture. Yet according to leading archaeologists, evidences of violent destruction must be assigned to this earlier era and attributed to the Egyptians.

... The tower was violently destroyed and the guardroom filled with burned brick, charcoal, broken jars, dishes and rubbing stones

for grinding grain, pestles and the bones of at least three different people, all mixed in wild disorder, so that little could be pieced back together again. The pottery dates from the period called "Middle Bronze IIC"; it is clear that the destruction was a very violent one and the evidence points to the Egyptians as the cause.¹⁶

This situation forced the placement of the Abimelech story at a point archaeologically where there were no evidences of destruction in the tower area. This placement also left the investigators with virtually nothing to represent the rebuilding of the city by Jeroboam as stated in I Kings 12:25.¹⁷ As at Jericho and as at Ai, the evidences corroborated details provided by Scripture, but these evidences must be dated centuries earlier according to leading archaeologists.

The reader is now at what corresponds to the third road in the illustration on road directions, a third inconsistency which is consistent with the suspicion that the dates assigned to the pottery types of the pottery index are in gross error. Suspicion of such an error increases. So attention will now be given to the site of Samaria.

Attention to Reports on Samaria

The point of interest at the Samaria site is the reference in I Kings 16:24 about King Omri of Israel who bought a hill from Shemer and built his new capital on the site, calling it Samaria after the name of the previous owner. The incident is of particular interest archaeologically, because one might infer that the capital was built on a previously unoccupied site, since it is doubtful that Shemer owned an entire city.

If such reasoning is valid, then the lowest evidences of occupation should be datable to the early ninth century B.C. The pottery associated with the lowest occupation should then be that of the ninth century, and should serve as a check on the accuracy of the dates assigned to pottery types in the pottery index.

Investigators at the site, however, quickly ran into trouble.¹⁸ Foundations of recent structures were laid so deeply into the soil that there were no definitive archaeological levels that could be recognized. Also, the area was being used agriculturally and had been plowed and replowed so that items from all levels were found even at the surface. The situation, nevertheless, was not hopeless. On the basis of the pottery index, pottery types comparable to the oldest in the index should be like that datable to the early ninth century elsewhere, if the types had been correctly dated. *This position was stated in the reports of the investigations and all questions as to the validity of the index for dating purposes were eliminated. Or were they?*

As other scholars examined this pottery, some significant questions were raised as to the correctness of these datings to the ninth century. Albright, as informed an archaeologist as any then living, examined an intact vase from the excavations and was obliged to assign it a date in the eleventh century B.C.¹⁹ As for the sherds, some of these were dated as far back as the thirteenth century! It would seem that there was a significant amount of "wishful thinking" in the assignment of the dates as reported.

Because of these developments, I Kings 16:24 was reinterpreted to mean that King Omri did not purchase an empty hill, but a hill with a "small village on it." However, doubt was cast on the validity of this interpretation. Eventually, some foundation blocks from the lowest city were found still in their original position.²⁰ The masonry was of an unusual type, examples having been noted at several other places. Unfortunately, in most cases, the masonry could not be dated since there were no associated pottery remnants. But in one case it could be dated, namely at Ras Shamra, where the same peculiar masonry type could be dated to the thirteenth century!

Four inconsistencies in the matter of dating, all consistent with the deduction that the dates assigned to the pottery index are in gross error, have been identified. Dating of materials at the cities of Jericho, Ai, Shechem, and Samaria has been questioned. And since dates were assigned on the basis of correlation with a chronological structure regarded as "astronomically fixed," it follows that a mistake *has been made* in the acceptance of such dates as final and that the method of dating does not merit the confidence placed in it.

Still Further Examples of Errors

I will now provide still further examples which will place the suspicion of dating errors according to the "pottery dating scheme" on the level of virtual certainty. The case of the chronology of the Hittites will serve as an additional example.

According to Scripture, the Hittites lived in the area of Hebron, south of Jerusalem, from the time of Abraham (Gen. 25:9, 10). Early scholars had denied the very existence of the Hittite people, since no evidence had been found for their existence from the era assigned to Abraham in the Twelfth Dynasty, and no reference to such a people had been recognized in the ancient inscriptions. Later, however, people known as the Hatti were identified in the Assyrian inscriptions, and as the Kheta in the Egyptian inscriptions were also identified indeed as the missing Hittites of Scripture.

But the discoveries caused a severe enigma; the Hatti and the Kheta belonged to an area far

to the north of Palestine, which is now known as Asia Minor (Anatolia).

Since it is not known what the Indo-European people called themselves before migrating into Anatolia, the Hatti of the Assyrian inscriptions and the Kheta of the Egyptian inscriptions must refer to the composite people that resulted from the Indo-European people absorbing the name and culture of the non-Indo-European race. The mistake in interpretation was in the failure to recognize that the non-Indo-European people were the Hittites of Scripture who had recently been driven out of Palestine at the time of the conquest under Joshua.

Since there was not a shred of evidence to indicate that the "Hatti" had ever occupied so much as a square foot of territory in Palestine, the identification of this people with the Biblical Hittites presented a severe enigma. Gurney referred to this enigma in the following words:

We now have to deal with the paradoxical fact that, whereas the Hittites appear in the Old Testament as a Palestinian tribe, increasing knowledge of the history of the ancient people of Hatti has led us even farther from Palestine, until their homeland has been discovered in the heart of the Anatolian plateau. . . .

The presence of the Hittites in Palestine before the Israelite conquest thus presents a curious problem. So far from explaining it, all our accumulated knowledge of the people of Hatti has only made it the more perplexing.²¹

A still further perplexity became apparent from attempts to set up a tentative chronology of the Hittites. A list of their kings could be synthesized which represented a period of about 700 years. The beginning date of the list of Hittite kings was set at c. 1900 B.C. to agree with Scripture for the time of Abraham, but without reference to the enigma noted above. This called for a demise of the Hittites c. 1200 B.C. But strangely, historical references to the Hittites continued to appear, both in Scripture and in the secular inscriptions. But there was no known history of the people for the next 500 years, only evidences of their existence and of their culture to reappear after this lapse of time. Ceram commented on this odd situation thus:

As we climbed back to the expedition's camp, we talked about the mystery of this strange survival of a cultural form. . . .

At this point there is a great gap in our knowledge of history. Those 500 years between 1200 B.C. . . . and about 700 B.C., when the last Hittite city-states were absorbed by the Assyrian Empire, are at present quite obscure to us. It is very rare indeed for an empire to break down while the cul-

ture goes on persisting. . . . for 500 years among isolated racial groups surrounded by extremely different peoples and exposed to numerous alien cultural influences.²²

The solution to these enigmas becomes crystal-clear when it is recognized that this non-Indo-European race were the Hittites of Scripture recently driven out of Palestine by the Israelites (Exodus 23:28; Joshua 3:10), only to have their name taken over by this Indo-European race. The Hittites of archaeology should thus be identified as this composite race. Actually, it is now apparent that this people was a mixture of two peoples of distinct physical appearance.

The Hittites of Anatolia should then be related chronologically to the *post-conquest* period with a beginning dated after c. 1400 B.C., not c. 1900 B.C. This error has resulted in not only dating the Hittites this 500 years too early but also in erroneously dating all of the Chaldean dynasties, at least through the First Dynasty at Babylon.²³ Since Hittite chronology is also tied to that of Egypt, this same error is also reflected in a grossly expanded chronology of the Nile area.

If further examples are required, reference could be made to discovery of Greek writing in Egypt many centuries before it was found in Greece,²⁴ with the necessary recognition of an inexplicable gap of a multiplicity of centuries in Greek history.²⁵ A still further example is the placement of the XXIInd Egyptian dynasty, and those kings with Assyrian names, many centuries earlier than the era known to be characterized by the control of Egypt by the Assyrians.

Conclusions

This list could be notably extended. But why multiply the examples? An ample list has been presented of examples of consistency of the inconsistencies all pointing in the same direction, i.e., to an error in assigning dates which are centuries out of line with Bible chronology and the B.C. time scale. The surprising fact is *not* that discrepancies result from attempts to set the incidents of Scripture against the faulty background provided by such an erroneous chronological structure, but rather that it has been possible to conceal the error by means of claimed discrepancies in Scripture and by the use of so many "explanations" for difficulties that cannot be explained.

Such unsound premises and faulty reasoning should have no place in scientific discussions. Except as this gross perversion of scientific method is corrected, the chronological phases of archaeology must eventually be recognized as deserving no higher standing than mere scientism.

In the illustration used, the suspicion of error could be supported by the simple procedure of driving down the fourth road to the left for half

a mile. When the location X was found, validation of the suspicion of error was complete.

With regard to some archaeological research, suspicion of error in dating has reached enormous proportions due to the multiplicity of examples of a common inconsistency resulting from application of the premise of assumed "astronomical fixation of dates." In contrast numerous unique details of Scripture were confirmed archaeologically. By following this clue, and devising an altered chronology of antiquity that is consistent with Scripture, all claims of error and inaccuracy in Scripture are simultaneously eliminated. Also a large number of other difficulties in the current views which are not related to Scripture are eliminated by the altered time scale. There is abundant evidence upon which to conclude that such an altered time structure is correct, at least in general outline.

Other points of discussion might include review of weaknesses and fallacies in the dating methods used and in the premises on which cur-

rent views rest,²⁶ and review of the archaeology of the pertinent sites of Palestine against such an altered chronology. The reader will find treatment of such tasks in the writer's volumes on the *Exodus Problem and Its Ramifications*.

There is no longer any basis or requirement that conservative Bible scholars quail before the pretentious label of "astronomically fixed dates," or before the claims of errors or inaccuracies in Scripture, or before the claim that it is not possible to alter this conventional structure without introducing more and larger problems than now exist.

Conservative Bible scholars are now in a position to move from a defensive position to an offensive position, in the "warfare of Science with Scripture," in terms of archaeology as has been found possible in the warfare against evolutionary speculations.

(NOTE: The volumes on *The Exodus Problem and Its Ramifications* are available through Crest Challenge Books, P.O. Box 993, Loma Linda, Calif. 92354. Mailed post paid at \$9.95, plus tax where applicable.)

References

- ¹Thiele, E. R. 1965. The mysterious numbers of the Hebrew kings. Erdmans Publishing Company, Grand Rapids.
- ²Courville, D. A. 1971. The Exodus Problem and Its Ramifications. Crest Challenge Books, Loma Linda, CA. See note above for availability.
- ³Kenyon, K. M. 1960. Archaeology in the Holy Land. London, p. 32.
- ⁴Courville, *Op. cit.*, Vol. II, Chap. IV for more complete discussion.
- ⁵Kenyon, *Op. cit.*
- ⁶Garstang, J. and J. B. E. Garstang. 1948. The story of Jericho. Revised edition. London. See also Tushingham, A. D. 1953. Excavations at Old Testament Jericho, *The Biblical Archaeologist*, XVI:46f.
- ⁷Albright W. F. 1956 Edition. The Archaeology of Palestine. Pelican Book, p. 38. See also *Biblical Archaeologist*, p. 67, as given in reference 6.
- ⁸Kenyon, K. M. 1957. Digging up Jericho. London. See also reference 2, I:64ff.
- ⁹Wright, G. E. 1953. Archaeological news and views, *The Biblical Archaeologist*, XVI:67.
- ¹⁰Joshua 8:29.
- ¹¹Joshua 8:28.
- ¹²Callaway, J. A. 1969. The 1966 Ai (Et-Tell) Excavations, *Bulletin of the American Schools of Oriental Research*, 196:4.
- ¹³Kenyon, *Op. cit.*, p. 115.
- ¹⁴Wright, G. E. 1965. Shechem. London, p. 87.
- ¹⁵Campbell, E. F. and J. F. Rose. 1963. The excavations of Shechem and the Biblical tradition, *The Biblical Archaeologist*, XXVI, p. 10.
- ¹⁶Wright, G. E. 1957. The archaeology of the city [Shechem], *The Biblical Archaeologist*, XX:32. See also reference 2, II:180.
- ¹⁷Wright, G. E. 1957. The second campaign at Tell Balatah (Shechem), *Bulletin of the American Schools of Oriental Research*, 148:23.
- ¹⁸Crowfoot, J. W., K. M. Kenyon, and E. L. Sukenik. 1942. The buildings at Samaria. London, p. 3; Wright, G. E. 1959. Israelite Samaria and iron age chronology, *Bulletin of the American Schools of Oriental Research*, 155:17.
- ¹⁹Albright, W. F. 1958. Recent progress in Palestinian archaeology; Samaria-Sebaste III and Hazor I, *Bulletin of the American Schools of Oriental Research*, 150:22.
- ²⁰Crowfoot, et al, *Op. cit.*, pp. 5-7.
- ²¹Gurney, O. R. 1954. The Hittites. Pelican Book, p. 59.
- ²²Ceram, C. W. 1956. The secret of the Hittites. Alfred A. Knopf, New York, p. 239.
- ²³See reference 2, II:Chapter XVII.
- ²⁴Petrie, F. 1935 Edition. A history of Egypt. London, III:160.
- ²⁵This gap has been the subject of comment by many writers. A number of such references with quotations are provided in reference 2, II:271.
- ²⁶Reference 2, II:Chapters I-VI provide a mass of data on these problems.

LICHENS: A DILEMMA FOR THE EVOLUTIONARY MODEL

WILLIAM J. CAIRNEY*

Lichens are a class of organisms in which a fungus and an alga live together in an association frequently cited as the classic example of symbiosis. Only certain fungi and certain algae form lichens. No naturalistic means has been found for supposed evolutionary development of such an association, and attempts to synthesize lichens from component organisms have usually led to death of the alga. Where lichenization has actually occurred in the laboratory, conditions have been carefully and intelligently contrived to bring about the association. The creationist view of the lichen association is the one which best fits lichen synthesis data.

Introduction

A number of terms are used commonly to describe relationships between organisms: (a) "Antibiosis," "parasitism," and "predation" describe relationships in which one organism is antagonistic to another. (b) An association of two organisms producing effects not caused by either alone is referred to as "synergistic."

(c) Relationships between organisms where at least one organism is benefited while the other *may* be benefited (at least not hurt) are referred to as "mutualistic." The mutualistic relationship is called "commensalism" where one organism is clearly benefited while the associated organism is not inhibited (although not necessarily helped). (d) If an association is beneficial to both partners, but not really essential to their survival it is labeled "syntropism."

(e) Where two organisms rely on each other for survival and both organisms are clearly benefited (although one may benefit more than the other) the relationship is called "symbiosis." Interdependence of the partners is a *requirement* if the association is truly symbiotic.

Numerous examples are given of true symbiotic relationships. They include the association of herbivorous animals and ruminant flora, nitrogen-fixing bacteria and leguminous plants, and mycorrhizae (the non-disease-producing association of a fungus with the roots of certain higher plants). Perhaps the classic example of symbiosis is the association of a fungus with an alga, commonly known as a "lichen."

Lichen: Special Biological Relationship

A lichen is a very special biological relationship. It is an association which forms a discrete, identifiable, morphological entity distinct from either of the partners. In a lichen, the cells of the fungal partner (the mycobiont) and the cells of the algal partner (the phycobiont) are intimately associated histologically and physiologically. An alga simply growing over the top of a mushroom is not a lichen, nor is it likely to become one. Lichen gross morphology and histology are consistent and dependable, so much

so that until the middle of the 19th century they were considered to be a distinct group of plants.

A key feature of the lichen relationship is the tremendous survivability of this fungus-alga association. Lichens are found in nearly every environment from arctic to tropic, from desert to rain forest. Lichens are sometimes the only organisms to withstand the rigors of certain environments, e.g. high altitude and arctic sites where vascular plants and even many lower plants are unable to survive.

Roughly 26 genera of algae have been found as members of lichen associations. Of these 26 genera, 17 genera are green algae (*Trebouxia* spp. being most common), 8 genera are blue-green algae (*Nostoc* spp. being most common), and one genus is a yellow-green alga.¹

Much is known of the contributions of the phycobiont to the lichen system. *Nostoc*, for instance, fixes nitrogen and excretes large amounts of nitrogenous compounds into the immediate environment. It produces a number of vitamins, including nicotinic acid, biotin, riboflavin, and thiamine, as well as several polysaccharides.² The major contribution of the algal partner would appear to be nutritional. The uptake of these nutrients by the fungus has been confirmed by C¹⁴ studies.³

Fungi forming lichen relationships come predominantly from the class Ascomycetes, orders Caliciales (subseries Loculomycetes) and Lecanorales (subseries Discomycetes). A few lichen fungi come from the class Basidiomycetes (family Thelephoraceae). All fungi entering into a lichen partnership with an alga are either totally or partially dependent on external sources of thiamine. Some require both thiamine and biotin. Others require thiamine, biotin, and any one or more of a number of other vitamins. The major contributions of the fungus include protection of the alga from dessication and injury, providing the alga with ideal light intensities for maximum photosynthesis, and supplying the alga with adequate minerals and water.⁴

Speculation, Studies on Lichen "Origin"

The special nature of the lichen symbiosis has led to considerable speculation on the part of lichenologists as to how this relationship could have "developed."

*William J. Cairney is a Ph.D. candidate in mycology at Cornell University, Ithaca, New York 14850.

Some workers propose that the fungus actually parasitizes the alga and that only those algal cells which survive the parasitism form the lichen relationship. This notion is superficially plausible except that once isolated in pure culture as separate entities, it is nearly impossible to get the two components back into an associated state.

In a series of papers by Henriksson, the lichen *Collema tenax* was separated into mycobiont and phycobiont components and an attempt was made to bring them back together. Instead of forming an association with the alga, the fungus destroyed any algal cells in the vicinity of the fungal hyphae.^{5, 6, 7, 8} In other studies by Ahmadjian and Henriksson, the fungal partner of *Collema tenax* was brought together with *Trebouxia impressa* (the phycobiont of another lichen). Again, instead of a symbiotic association developing between fungus and alga, the alga died and dead algal cells were filled with fungal hyphae.⁹

Ahmadjian, a world authority on lichens, reports "some success" in lichenization by bringing phycobiont and mycobiont together on media on which *neither* partner could grow independently.¹⁰ Some of Ahmadjian's synthesized lichens were transferred from the laboratory to natural habitat and survived. Lichens synthesized in this manner progressed very slowly and required a carefully controlled program of environmental alterations.

While this may appear to solve the dilemma of how lichens began initially, there remains the question of what environment existed before the partners became associated. All evidence to date indicates that the lichen relationship *breaks down* when the partners can exist independently in the environment. If the environment becomes incompatible, both partners die. The association is not favored in either case. If the fungal partner cannot exist independently, in a certain environment, it would be imperative that germinating fungal spores "find" the critical algal partner immediately.

One Man's Views on "Origin"

D. G. Scott fully realizes that to propose "evolutionary" beginnings for lichens is to go out on a "scientific limb." He realizes that botanists do not have clues to such beginnings.

Scott states that if chance processes are accepted as the *modus operandi* of the lichen association, then numerous remnants of abortive attempts should be evident in the natural historical record. That this is not so indicates (to Scott) that unsuccessful "experiments" in lichenization are immediately eliminated or that whatever determines success for the lichen relationship functions at a very early stage.¹¹

There are few, if any examples in nature of "trial and error" lichenization in progress. Lichenologists retain a certain optimism over the anticipation of finding such a half-way association. Some consider that new lichen species may be forming constantly in nature and that the environment harbors fungi and algae in all degrees of lichenization. Unfortunately, the large gap in lichen "evolution" remains unfilled. Only thousands of successful associations are known and scanty evidence of any "evolutionary progression" leading to them.

A so-called evolutionary approach to lichen formation is based upon the postulate that separate existence of the partners preceded symbiosis. Since many lichenized fungi bear very close morphological resemblance to certain independent fungi, the assumption that mycobionts were once free-living is rarely questioned. Scott, by his own admission, *accepts* this *postulate* as *fact* because he cannot conceive of two genetically different organisms "evolving" simultaneously (i.e. in the same space and time) from a common ancestor as a physiologically interdependent unit.¹²

Matters are actually even more complex. In order to uphold an evolutionary model for lichens, unless one assumes that all phycobionts had a common ancestor, and that all mycobionts had a common ancestor, one *must* conclude that associations (unlikely as they would appear to be anyway) would have to have been attempted by *more* than one fungus and by *more* than one alga (perhaps up to 26 genera), with similar mechanisms probably in operation to make the symbiosis work.

Only Two Choices Open

When scientists who are Christians appeal to divine creation as the only rational answer to this dilemma of lichen origin, they are usually charged with using God as a catchall for everything not yet fully understood. Considering the lichen association, however, scientists really have only two choices.

The first choice is to surmise a sequence of what lab data indicate to be highly improbable events, using scientific vocabulary to lend plausibility. Faith that the evolution model is the correct one and will ultimately be a means to an answer is a necessary part of this choice.

Choice two is to cease resisting that which is accompanied by a body of reasonable evidence, that the components were intelligently assembled and associated. Choice two is the simplest model which fits all known data without contradiction, hence is most consistent with the scientific method.

That a scientist can induce lichenization to a limited degree in the laboratory in no way dis-

credits the creationist model of lichen synthesis. It simply shows that even man can achieve a *somewhat* successful lichen association through *intelligent manipulation* of the organisms and their environment.

References

- ¹Moore-Landecker, E. 1972. Fundamentals of the fungi. Prentis-Hall, Inc., Englewood Cliffs, p. 383.
- ²*Ibid.*, p. 384.
- ³*Ibid.*, p. 385.
- ⁴*Ibid.*, pp. 384-385.
- ⁵Hendriksson, E. 1957. Studies on the physiology of the lichen *Collema*. I. The production of extracellular nitrogenous substances by the algal partner under various conditions, *Physiologia Plantarum*, 10:943-948.
- ⁶Hendriksson, E. 1958. Studies on the physiology of the lichen *Collema*. II. A preliminary report on the isolated fungal partner with special regard to its behavior when growing together with the symbiotic alga, *Svensk Botanisk Tidskrift*, 52:391-396.
- ⁷Hendriksson, E. 1960. Studies on the physiology of the lichen *Collema*. III. The occurrence of an inhibitory action of the phycobiont on the growth of the mycobiont, *Physiologia Plantarum*, 13:751-754.
- ⁸Hendriksson, E. 1961. Studies on the physiology of the lichen *Collema*. IV. The occurrence of polysaccharides and some vitamins outside the cells of the phycobiont, *Physiologia Plantarum*, 14:813-817.
- ⁹Ahmadjian, V. and E. Hendriksson. 1959. Parasitic relationship between two culturally isolated and unrelated lichen components, *Science*, 130:1251.
- ¹⁰Ahmadjian, V. 1962. Investigations of lichen synthesis, *American Journal of Botany*, 49:277-283.
- ¹¹Scott, G. G. 1973. Evolutionary aspects of symbiosis (in) *The lichens*. Edited by V. Ahmadjian and M. E. Hale. Academic Press, New York, p. 591.
- ¹²*Ibid.*, p. 582.

WAS THE ICE AGE CAUSED BY THE FLOOD?

REGINALD DALY*

A previous article on the connection between the flood and the ice age received considerable attention, and led to a number of questions.† In view of the importance of this matter for the doctrine of a young Earth, it has seemed worth while to answer some of the questions and to enlarge on certain points.—Editor.

"Water, water - - - everywhere"?

There is only one way to solve the problem of "Where did the floodwaters go?" and that is by reading and believing that "God made a wind to pass over the earth and the waters asswaged," that is, by evaporation which is the natural result of a strong wind.

The objection is often raised that the earth's atmosphere could not absorb more than a "3-inch layer of water," or a maximum of "30 centimeters," according to one calculation, even if calculated at "100% saturation and 90° F." In reply, it is only necessary to read once again *and believe* the record that "the waters returned from off the earth continually." That is, the rain came "from heaven," not from the clouds which are admittedly totally inadequate as a source, and the waters "returned," away from this planet entirely.

If the objection is raised that no known wind has ever attained the escape velocity necessary to overcome the earth's gravitational pull we need only believe the record that this was a supernatural wind made for this purpose, for

"God made a wind to pass over the earth and the waters asswaged."¹⁻³

Once the supernatural origin of the flood is acknowledged other pieces of the puzzle begin to fall naturally into place. The ice age follows as the natural aftermath of the flood. Each cubic centimeter of water that evaporated removed 540 calories of heat from the surroundings. A layer of water five miles deep, covering the earth's 197 million square miles of surface would lower the temperature by 2.2×10^{27} calories which is more than sufficient to explain the ice age on the land, and also the 25° fall in temperature of the oceans as stated by Sir Arthur Holmes:

The mean annual temperatures . . . were 25° C. . . . The general fall in temperature since the Chalk was deposited has been estimated from pollen and other plant remains as well as by the oxygen-isotope method . . . the cooling affected the bottom waters of the open Pacific until they were reduced nearly to the freezing point. . . . Today the oceans are cold because of the vast amount of melted ice they received . . . but at the onset of the Ice Age there was no melting ice to cool the oceans. Nevertheless, cool they did.⁴

The words "since the Chalk" means of course, according to Holmes, since the Cretaceous Age of Chalk, 65 million years ago, but according to flood geology, since the heavier calcium carbonate of chalk was precipitated in the closing days of the flood.

The record states that "the mountains were covered"⁵ and this implies that Antarctica's ice-

*Reginald Daly, M.S., has taught physics at Colorado State University, North Idaho Junior College, Chico State College, and Humboldt State College. He is author of the well known 1972 book, *Earth's Most Challenging Mysteries* (Published jointly by Baker Book House, Grand Rapids and Craig Press, Nutley, New Jersey). He lives at 9 Seabird Avenue, Poulsbo, Washington 98370.

†Daly, Reginald. 1973. The cause of the ice age, *Creation Research Society Quarterly*, 9 (4):210-217.

cap floated off northward. This six-million-cubic-miles icecap would absorb 1.8×10^{24} (1.8 septillion) calories of heat in melting, or three septillion calories if figured on the basis of a larger 10-million-square-miles icecap, one mile thick, such as probably existed prior to the flood. (See author's *Earth's Most Challenging Mysteries* for quotes proving the earlier icecap to be much larger in area and thickness than the present-day six-million-square-miles icecap.)⁶

Formation of Ice Masses

The "Climatic Optimum" that, according to C. E. P. Brooks, climatologist, raised earth's temperature 5° is the natural aftermath of the ice age and follows it automatically.⁷ Just as every cubic centimeter of ice absorbs 80 calories of heat in melting and a further 540 calories in vaporizing, so it returns 540 calories in condensing and a further 80 calories in freezing. A six-million-square-miles icecap one mile thick would "heat" (that is, moderate the bitterly cold Antarctic climate) by 1.4×10^{25} calories (14 septillion), which would be sufficient to raise the earth's temperature the required 5° and account for the hitherto unexplained "Climatic Optimum."

Now it has been objected that this is merely a juggling of figures, because the 540 calories absorbed in one locality are released in another and therefore it is claimed, produce no net heating (or cooling) effect on the earth as a whole and therefore provide no valid explanation for the "Climatic Optimum" (or the ice age). Although this objection may perhaps be valid in part, it should however be noted that the 540 calories needed to vaporize each cubic centimeter of water is new heat, received from outside the earth's system, that is from the sun.

But even if it were to be admitted that the objection may be valid that the 540 calories heat of condensation released over Antarctica (and Greenland) was balanced by an equivalent loss of heat in vaporization in the tropics, yet surely it will be granted that the melting of 10^7 cubic miles of ice is an entirely new factor which is not (*at that time*) balanced by any condensation. And although the objection is readily admitted that the melting of 10^7 cubic miles of ice cannot cool 4×10^8 cubic miles of ocean, yet it is *more than sufficient to initiate an ice age*. And the freezing again after the ice age, on Antarctica's mountains, is sufficient to raise the earth's temperature the required 5° to account for the "Climatic Optimum." This is by no means a mere transfer of heat from one locality to another, but is a net cooling effect as the melting antediluvian icecap initiates the ice age and a *subsequent* net "heating" effect as the freezing postdiluvian icecap brought on the "Climatic Optimum."

At the present time, and presumably during the entire period of the flood-ice-age, two calories of heat, per square centimeter, per minute reached the surface of the earth from the sun. This amounts to 1.3×10^{24} calories per year (which amount will be greatly reduced when an estimated factor for reflectivity from ice and water is included). A little arithmetic will show that this stupendous quantity of heat is enough to melt the Antarctic icecap and/or the European and American ice sheets in such a surprisingly short period of decades, or at most centuries, that the flood-ice-age proponents have no difficulty whatsoever in fitting the entire ice age into a few centuries or millenia following the flood.

Melting, Freezing, Refreezing

Under normal conditions heat input from the sun is balanced by an equivalent loss of heat by radiation into space that maintains the over-all temperature of the earth in equilibrium. But the melting of the icecaps, and evaporation of the floodwater, and subsequent refreezing of icecaps are *three new, major factors* that upset the balance and caused a gigantic oscillation of climate that did not return to equilibrium until 500 B.C., according to Richard Flint, glaciologist of Yale, who has written that "as recently as 500 B.C. the climate was still slightly warmer than today."⁸ And according to Charles H. Hapgood:

The strange period of high temperature that followed the ice age . . . this warm period has been well established but its cause has been unknown . . . a large part of Antarctica may have been ice-free.⁹

And in another place Richard Flint of Yale has maintained that "the present glaciers of the Alps . . . are glaciers newly created within roughly the past 4000 years."¹⁰ This time of 4000 years since new glaciers replaced old glaciers fits smoothly into flood chronology.

The actual date for the brief interglacial, ice-free period between the melting of the old and the freezing of the new icecaps has been fixed at 6000 years B.P. by carbon 14 dating of green algae, grown in the warm, ice-free interglacial and fossilized on the Beardmore Glacier moraine, 200 miles from the south pole. "Algal remains," wrote Arthur Holmes, "dated at 6000 B.P. have been found on the latest terminal moraines."¹¹ Holmes believes that it grew there during the "Climatic Optimum." Flood theorists suggest that it may have been floated in, probably later than 6000 B.P. since early carbon dates are usually exaggerated.

The late Richard J. Lougee of Clark University asserted that "Iceberg-rafted erratic stones and boulders became grounded on the submerged topography of northern Kentucky, southwestern Missouri and eastern Iowa."¹² At the time at which this happened, then, probably

most of the United States (exclusive of the mountains) was still submerged under the receding floodwaters.

But the objection has been raised that these icebergs floated "not in the open sea, but in an inland lake, contained by the northern slope of land depressed under the ice." However, there was no inclosed inland lake covering "northern Kentucky, southwestern Missouri and eastern Iowa." Actually the "Leverett Sea," named after geologist F. Leverett, extended from Ohio to Montana and from the Gulf of Mexico to the Wisconsin driftless area. Very possibly the ice age followed the flood so closely that icebergs broke off the continental ice sheet as it entered the "Leverett Sea," drifted across, and were stranded on the emerging "mountains of Kentucky."

It has been objected, and is herewith admitted, that it is not quite fair to expose the absurdity of the shifting crust "theory" that North America drifted down from the Arctic at the fantastic speed of a meter per day, for the reason that "the Pleistocene glaciation is not generally attributed to continental drift." The quotation objected to is from Charles H. Hapgood who suggested that "a movement of the crust that would move North America southward about 2000 miles . . . beginning about 18,000 years ago and ending about 8000 years ago."¹³ This is 1000 feet a year, or a meter per day!

Continental Drift Considered

This presents proponents of continental drift and "plate geology" with an intolerable contradiction. But *there is no way to evade the arithmetic*. And it is even more fantastic to conceive of America (and Europe) drifting north to the Arctic four times, and back again three times, in order to explain the four ice ages of the Pleistocene and the three intervening "interglacials."

But instead of acknowledging the absurdity and throwing out continental drift entirely, geologists have evaded the facts and compromised by attributing Pleistocene glaciations to *some other cause*, and attributing to continental drift *only those ice ages that can be said to have occurred prior to the Pleistocene*, as for instance the supposed movement of America northward "back in the Mesozoic," and southward movement of Australia to Gondwanaland, in the Paleozoic.

"There is good reason, in fact," wrote Ronald Fraser, "to accept the evidence that Laurasia split into two parts—now North America and Europe—back in the Mesozoic period."¹⁴ He also wrote of "Australia's journey south in Pre-Carboniferous times" and of its return, "from the heartland of Antarctica in mid-Mesozoic times."

Neither India nor Africa had to be made to journey south to the Antarctic, in order to explain their ice ages, because they both presumably

originated as parts of the mythological continent of Gondwanaland and are said to have drifted around the south pole in "doodle-like-loops," or "migrations" while being glaciated. F. Ahmad of India's Aligarh Muslim University wrote that "if the route of drift followed doodle-like-loops as traced by the wandering of the south pole during the Permian period, which fossil evidence indicates, then the movement must have been much faster than 15 cm a year."¹⁵ And Arthur Holmes of the University of Edinburgh has stated,

It is another of the queer facts of geology that until quite recently in its long history Africa seems never to have drifted far from the Antarctic regions. Its migrations were over and around the south pole until it began the long northward drift that followed the Ice Ages of the Permo-Carboniferous: a migration that it shared with most of the other continents.¹⁶

But surely there must be something wrong with the "fossil evidence" or its interpretation if it indicates "doodle-like-loops" and "migrations" and 5000-mile journeys through solid rock. On this Fraser wrote,

Guided by convection currents in the mantle the four continental masses of South America, Africa, India and Australia were scheduled to set sail from the heartland of Antarctica in mid-Mesozoic times for their present anchorages: voyages of anything up to five or six thousand miles in the last two hundred million years, at a cruising speed of two or three centimeters a year.¹⁷

Astronomer Ernst J. Opik has commented,

Alfred Wegener and his followers actually tried to explain in such a purely mechanical manner all paleoclimatic changes: the succession of warm and cold periods was ascribed to the transplantation of the same locality from the tropics to the Arctic Circle and back again.¹⁸

This concept of migrations to and from the poles involves such utter confusion in four trips of America to the Arctic, "doodle-like loops" of India and "migrations" of Africa *before* "Gondwanaland sundered" and their 5000-mile journey *after* they "tore loose," that geologists are forced to abandon the absurdities of continental drift and are left without any acceptable causal agent whatsoever, as J. K. Charlesworth of Queen's University, Belfast frankly admitted:

The cause of all these changes, one of the greatest riddles in geological history, remains unsolved, despite the endeavors of generations of astronomers, biologists, geologists, meteorologists and physicists it still eludes us.¹⁹

That is an amazing confession; almost unbelievable, that all the world's physicists, astronomers, geologists and meteorologists, the finest minds from the world's universities, cannot invent even as much as a respectable theory to solve the ice age. According to A. P. Coleman, University of Toronto glaciologist:

Scores of methods of accounting for ice ages have been proposed . . . no theory is generally accepted . . . hopelessly in contradiction with one another and good authorities are arrayed on opposite sides.²⁰

And according to Gordon Robin:

More than 60 different hypotheses of the origin of the ice age have been proposed and further suggested causes are published every year or two. . . . Similar contradictions appear throughout the literature. There is, however, no need for pessimism. . . .²¹

Cause, or Causes Remain Mystery

But not only is the "cause" acknowledged as an insoluble mystery, but also the various aspects and detailed features, which Dr. R. A. Daly of Harvard University frankly recognized: "The Pleistocene history of North America holds ten major mysteries for every one that has already been solved."²²

And Adrian Scheidegger generalized far beyond the limits of the ice age and continental drift, and included in his thinking convection currents, polar wanderings and all the theories of orogenesis of mountains. Yet he concluded with the sweeping generalization that "Something fundamental is wrong with each and every one of the theories."²³ The importance of these problems," wrote Hapgood, "compels us to admit that we do not have an integrated, effective theory of the earth we live on."²⁴ And he stated further, "Nothing could better betray the extent of our ignorance of the dynamic processes that have shaped the face of our earth than this confession of ignorance."²⁵

This presents the scientific world with a master problem that underlies most so-called mysteries: Why cannot scientists solve problems of historical geology? And the answer to this question is relatively simple: Scientists have subdivided the sum total of reality into two supposedly conflicting hemispheres, the natural and the supernatural. They have then arbitrarily consigned the supernatural to the realm of the mythological, and—*ipse dixit*—declared it to be "unscientific." Hence the ice age with its supernatural cause embedded in the universal flood remains a tantalizing enigma for which the community of scientists have no solution.

As the ice age remains a tantalizing and frustrating "mystery," so does the earth itself, as is admitted by Hans Cloos, geophysicist: "We know only the unimportant things and the details. Of

the great slow strides of the earth's gigantic history we comprehend hardly anything at all."²⁶

The explanation is the same. Just as the ice age with its cause embedded in the supernatural, cannot be understood apart from the Biblical flood, so the earth itself with all its features cannot be understood apart from its supernatural origin. Whereas by contrast, when the supernatural is acknowledged, most of the so-called mysteries, of mountain formation, origin of oceanic trenches and ridges fit easily into place as is shown in detail in the author's *Earth's Most Challenging Mysteries*.

If it were possible for any geologist to explain the earth or its features on a purely naturalistic, nonsupernatural basis, one would expect Sir Arthur Holmes to be the best qualified to present a sound formulation, for he received the Vetlesen Prize, awarded in 1964, "for scientific achievement in a clear understanding of the earth, its history and its relation to the universe." But at the close of his 1250-page search for an understanding of the earth's geological features he can offer only the hope that some day, in the indefinite future, a sound theory of the earth might be forthcoming: "So we need not despair of ultimately finding at least an adequate explanation. . . . Meanwhile that happy day has not arrived."²⁷

Scheidegger, in his *Principles of Geodynamics*, presented a full and critical discussion of all the leading "theories" of orogenesis, including contraction, convection currents (with which he links continental drift), polar wandering and rotational variations, and the undulation group with various implications of gravity tectonics. He concluded that "something is wrong with each and every one of the theories," and that "the problem of finding the cause of the various geodynamic features must be regarded as still unsolved."²⁸

Jeremiah wrote: "They have forsaken me, the fountain of living waters, and hewed them out cisterns, broken cisterns, that can hold no water."²⁹ Likewise here, we see that as soon as people forsake God's account of origins and of the earth's history, they find themselves with theories which indeed cannot hold water. Or as expressed by geophysicist Adrian Scheidegger, "Something fundamental is wrong with each and everyone of the theories."³⁰

References

¹It may be noticed that the "wind" could have been a "spirit" for the words are the same in Hebrew. If "spirit" is indeed intended, that makes the supernatural element even more explicit.

²Genesis 8:1.

³Genesis 8:3.

⁴Holmes, Arthur. 1965. *Principles of physical geology*. Ronald Press, New York, pp. 718-720.

⁵Genesis 7:20.

- ⁶Daly, Reginald. 1972. Earth's most challenging mysteries. Craig Press, Nutley, N. J., and Baker Book House, Grand Rapids, p. 174.
- ⁷Brooks, C. E. P. 1949. Climate through the ages. McGraw-Hill Book Co., New York, p. 296.
- ⁸Flint, Richard F. 1957. Glacial and pleistocene geology. John Wiley and Sons, Inc., New York, p. 487.
- ⁹Hapgood, Charles H. 1958. Earth's shifting crust. Pantheon Books, New York, pp. 54 and 58.
- ¹⁰Flint, *Op. cit.*, p. 491.
- ¹¹Holmes, *Op. cit.*, p. 718.
- ¹²Lougee, Richard J. 1958. Ice-age history, *Science*, 21 November, 1958.
- ¹³Hapgood, *Op. cit.*, pp. 194 and 249.
- ¹⁴Fraser, Ronald. 1964. The habitable earth. Basic Books, New York, pp. 91, 97, and 100.
- ¹⁵Ahmad, F. 1966. *Science Journal*, London, p. 11. June.
- ¹⁶Holmes, *Op. cit.*, p. 739.
- ¹⁷Fraser, *Op. cit.*, p. 91.
- ¹⁸Opik, Ernst J. Ice ages, The Earth and its atmosphere. Basic Books, New York, p. 154.
- ¹⁹Charlesworth, J. K. 1953. *Science Progress*, London, January.
- ²⁰Coleman, A. P. Ice ages recent and ancient. Macmillan, New York, p. 246.
- ²¹Robin, Gordon de Quetteville. 1966. Origin of the ice ages, *Science*, p. 53. June.
- ²²Daly, R. A. 1934. The changing world of the ice age. Yale University Press, New Haven, p. 111.
- ²³Scheidegger, Adrian. 1958. *Principles of geodynamics*. Verlag, Berlin, pp. 289 and 291.
- ²⁴Hapgood, Charles H. 1959. *Saturday Evening Post*, January 10.
- ²⁵Hapgood, *Op. cit.*, pp. 79-80.
- ²⁶Cloos, Hans. 1953. Conversations with the earth. Translated by E. B. Garside. Alfred A. Knopf, New York, p. 84.
- ²⁷Holmes, *Op. cit.*, pp. 1247-48.
- ²⁸Holmes, *Op. cit.*, p. 1248.
- ²⁹Jeremiah 2:13.
- ³⁰Scheidegger, Adrian, *Op. cit.*, pp. 289 and 291.

PANORAMA OF SCIENCE

More Evidence of a Cretaceous Catastrophe

Recent studies of "guyots"—submerged mountain tops—in the mid-Pacific and in Japanese waters have shown that many of them were submerged in Cretaceous times (according to the common geological reckoning) as based on available fossils.¹

There is more and more evidence to show that what is commonly called the Cretaceous times ended with a catastrophe, in which flooding was involved. Here is another piece of such evidence.

It should be worthwhile for creationists to consider these findings very carefully. For, given the correct interpretation, they may include some of the details, beyond those provided in Scripture, of what happened at the time of the Flood and shortly afterwards.

Ptolemy's Data Questioned

It is reported, after careful comparison with the results of modern investigation, that some of the data given in Ptolemy's *Almagest* were "fudged," and did not come from actual observation at all.²

This matter is mentioned in the thought that it may be of interest to readers of the *Quarterly* for the following reason: Some readers are interested in chronology; and in certain cases chronology has been based on particular information from Ptolemy. It does not seem that the matters concerned in the report cited here are likely to come up on chronology; but if some things really have been fudged, then care and caution should be encouraged in the consideration of all data.

Wishing Upon a Star May Not Provide Planets

Although it is often stated as a fact that there are very many planetary systems, something like the Solar System, in the universe, the amount of

actual evidence for such a claim is extremely tiny. In fact, one of the chief exhibits is "Barnard's star," which has certain irregularities in its motion. These have been interpreted to be due to the motion of a planet, apparently an extremely large one, near it. Of course this planet, if it is there, has never been observed.

Some recent analysis of the motion of this star has shown, it is now reported, that the star has at least two "dark companions"; and that the planes of their orbits are inclined to one another by at least fifty degrees.³

Such an arrangement, of course, would be much different from that of the Solar System, in which the planets are almost in the same plane. One might wonder whether the arrangement of orbits in highly inclined planes would be stable.

Perhaps the irregularities observed are not due to planets at all, but have some completely different cause. And even if there are planets, it would seem possible that their peculiar arrangement might make them unsuitable as homes of living beings.

Indeed, contrary to what some say, the evidence for corporeal living beings outside the earth is so small as practically not to exist at all.

The Testimony of Halos in Rocks

Halos formed in various rocks and minerals by radiation from bits of radio-active material included in them have been mentioned before in the *Quarterly*. It is possible to judge from the nature of the halo the kind of radio-active material which caused it; and the half-lives of the radio-active materials are known. In many cases it is extremely hard to see how, according to the usual uniformitarian cosmogonies, the radiation could have gone on for long enough to cause the halos, which presumably were formed after the rock had hardened.

Reports on these findings are now being seen in the conventional scientific journals. A recent one discussed halos, which seemed to be due to isotopes of polonium, found in rocks conventionally classed as pre-Cambrian. As was pointed out, it is hard to see how that could be, according to the usual uniformitarian cosmogonies, but the facts are there.⁴

The whole article, which contains much information about these halos and about other studies of halos, should be read.^{5, 6}

Evidence for the Accuracy of the Masoretic Text

Creationists believe that the Bible is God's record of His actions in times past, and that thus it contains an accurate account of the origin of the world and the things in it. There can, however, be some uncertainty, because of existence of several different versions of the Bible.

(I am not talking about translations, i.e. recent translations. But as for the Old Testament, as well as the Masoretic Text there is the Septuagint, and for the Pentateuch the Samaritan version. These three are some centuries earlier than those coming next in time, such as the Vulgate and the Syriac. Nobody, I believe, claims for such books as the Book of Jubilees any special authority. And while some claim canonical authority, or nearly so, for those books commonly called the Apocrypha, those books in fact concern the present question little, for they contain little about origins.)

And as for the New Testament also, the Textus Receptus differs somewhat from some of the old manuscripts which have been discovered. But again, this hardly concerns questions of origins.

Two recent articles, although they are concerned primarily neither with origins nor with Creation, may be of interest here. The author of one suggests that the Jews may have considered the Septuagint, in many cases, not so much as Scripture but rather as a sort of Greek Targum. In that case, it was permissible to interpolate comments or supposed emendations. Indeed, evidence is presented to show that such interpolations have been made in the Septuagint, some of them being as old as the original translation, or nearly so.⁷

The other article is concerned with chronology. There, too, it is found in almost all cases that the Masoretic Text shows evidence that it was the original.⁸

It is suggested that a curious phenomenon may often be seen in targums and elsewhere where scribes have attempted to emend—as they thought—the text of Scripture. The scribes, it seems, were accustomed to work with one very small section at a time, without taking much notice of the larger context. Thus it sometimes

happens that what were supposed to be emendations introduce conflicts with some part a little farther away.

Certainly this is known: the Masoretic Text, as far back as it can be traced, has been held inviolate. If it was thought that emendations were needed, they were written in the margin, the original text being untouched as the body of the book. And when it came time to introduce the vowels, they were written around the consonants, the latter not being disturbed at all. Everything considered, very strong grounds are known for holding the Masoretic Text inviolate before setting it aside in favor of one of the other textual forms.

Insects Tar (and Feather?) Their Enemies

There has been occasion, in these pages, to comment on creatures, such as the Monarch butterfly, which use the juices of some of the plants on which they feed to make themselves unpalatable (to say the least!) to predators. It now appears that there is at least one case of what might be called a more direct application of this strategy.⁹

The larvae of the sawfly, *Neodiprion sertifer*, live on the pine, *Pinus sylvestris*. Apparently the larvae are able to store some of the terpenoid resin of the pine; and if they are attacked they discharge it, in the form of an oily material. Sometimes at least, it appears that this may deter a predator.

While the question almost becomes monotonous, yet it should be asked again. How could such a state of affairs have "evolved"? A hypothetical (proto-) sawfly, able to (proto-) spit a (proto-) bit of (proto-)oily fluid would not have benefited at all from such a (proto-) ability. No, this strategy had to come into being fully developed.

And what is more, as well as whatever organs are required, the instinct, or whatever one may choose to call it, to use this strategy, had to be there. So it is doubly impossible that such a behaviour could have "evolved."

Marks May Be Ascribed Wrongly to Glaciers

One piece of evidence that some believe supports the notion of continental glaciers and ice ages is the existence of grooves and scratches in the rock. So when some such marks were found in North Carolina, they were ascribed to glaciers. The explanation has been questioned, however; some investigators suggest that the grooves more likely come from some human activity, quite possibly from cables which were dragged over the rocks during logging operations some time ago.¹⁰

This may show that such marks need not be ascribed to glaciers. The notion of an ice age is one that may possibly cause some difficulty to

the belief in a young earth, although the difficulty is not insuperable. Presumably, whatever ice ages there may have been must have fitted in at the conclusion of the Flood. So there is not much time available.

Perhaps it would be worthwhile for creationists to re-open the question, whether, in fact, there really was an ice age of any consequence. Howorth, for one, doubted it; and it would appear that his arguments have not been refuted.

In particular, creationists should notice that if many geological formations are ascribed to the Flood, then there was a time, after the Flood, when surface rocks were still fairly soft. Indeed, this would be true not only of sedimentary rocks, but of many igneous ones.

Now at that time the rocks could have been scratched and marked easily, just as concrete can be changed before it has completely set. Maybe floating debris could have done the job, as the partly hardened rocks were emerging from the water. There is room here for more investigation.

Evolution—A Problem in Parallelism

When comparing various creatures, evolution theorists find that widely diverse beings often possess structures which are to all intents and purposes *identical*. Generally they dodge the question by the assertion that such similarity reflects "convergent evolution" in which the exact same structure arose independently two or more times. Yet some evolutionists recognize that such logic is flimsy and such explanations often create more problems than they solve.

The Preers and A. Jurand have recently fostered a fascinating review dealing with the nature of the mysterious "kappa" particles found in the cytoplasm of certain paramecia.¹¹ A paramecium which contains these readily visible kappa units is called a "killer," because it causes nearby "sensitive" paramecia to die. The sensitive individuals do not possess the kappa particles.

In the present review, these investigators marshal considerable evidence to support the view that the kappa particles in the "killer" cytoplasm are actually bacteria that live within the cytoplasm of the host paramecium (endosymbiosis—endosymbionts).

Yet closer analysis of the kappa particles reveals that these internal bacteria contain a so-called "R-body" which is apparently a virus infecting the bacterium! One is of course reminded at this point of the small flea with smaller fleas that prey on him, and so *ad infinitum*!

The authors present excellent illustrations clearly showing under electron photomicrography that the R-body viruses have the form of a neatly coiled roll of ribbon which can unroll at higher temperatures.

But more to the point concerning origins, it seems that these R-bodies bear a close resemblance to the trichocysts of the algal genus *Pyramimonas*, and to the protozoa *Chilomonas paramecium*! Such trichocysts in algae and protozoa when stimulated can unroll and in some cases serve as miniature harpoons—touching some object outside the cell.

The problem facing evolutionists at this juncture is clearly stated by these authors and no additional commentary is necessary to show the inherent weakness of "evolutionary" explanations:

The difficulty in imagining how convergent evolution could have produced such bizarre and similar structures in widely different organisms is only matched by the problem of how an apparently virus-induced bacterial structure . . . can be phylogenetically related to an algal structure. No vestiges of bacterial or virus structures are found in *Pyramimonas*; its trichocysts appear to be normal cell organelles.¹²

—Contributed by George F. Howe

Language and Reading in Man and Chimpanzee

Biblical special creationists assert that man was created separate from other forms of life and is thus both spiritually and biologically unique.¹³ It has also been noted in the pages of *C. R. S. Quarterly* that rationalists (as opposed to empiricists) believe there is something very special and "innate" about the human capacity for speech.¹⁴ One creationist suggested that God Himself endowed man with the capacity for speech and then taught Adam to communicate.¹⁵

These assertions seem somewhat weakened if not refuted by recent research claims as to the ability of primates (chimpanzees) to learn language and to read! Right here, it should be made very plain that the Biblical concept of man's uniqueness is not controverted if some other creatures can be shown to communicate by means of language.

Biblically speaking, man's special attribute of being created "in the image of God" is reflected not alone in speech but in such matters as personality, will, God-consciousness, etc. So even if it were discovered that chimpanzees, porpoises, or other creatures could carry out meaningful and abstract communication, this would by no means undermine the reality of man's creation in the image of God.

However, it appears that not all psychologists and linguists are ready to admit that chimpanzees are learning language or reading, in the same sense that man does, and it may be quite worthwhile for creationists to listen to the debate which is presently taking place.

Authors Janet Mistler-Lachman and Roy Lachman have analyzed several of the current studies dealing with supposed communication in infra-human primates, especially chimpanzees.¹⁶ They affirm that there are two types of criteria by which to judge such experiments—"weak criteria" and "strong criteria." Their weak criteria include the use of labeling, syntax, and semantics, while "strong criteria" require that

... linguistic performance of non-humans be accomplished by mechanisms similar to those of men. This criterion entails a far heavier burden of evidence; that is, it must be shown that the organism learns its language by mechanisms similar to those of men, makes similar errors, shows a similar developmental pattern, effects its language use by similar neurological structures, and demonstrates any pattern that can be shown to be true of all human languages (that is, linguistic universals).¹⁷

They conclude that Premack, using operant conditioning has trained his chimpanzee Sarah to perform according to the weak criteria.¹⁸ But they maintain that Premack's use of operant methods "... preclude the strong criteria."¹⁹ They demonstrate that studies such as Premack's do not satisfy their strong criteria required for man-like speech.

These same authors review another piece of work in which Rumbach, Gill, and von Glasersfeld claim that their chimpanzee, Lana, has accomplished "... computer-controlled language proficiency" and reading.²⁰ Rumbaugh, *et al.* asserted that the ultimate goal in such research was to "... better understand the etiology of language development in man," while their immediate goal was to "determine unequivocally the anthropoid's capacity for linguistic production, including conversation."²¹

In the work of Rumbaugh, *et al.* the chimpanzee (Lana) used a push-button computer console instrument to designate short sentences such as "please machine make window open." After analyzing such data, the Lachmans concluded that "Lana has not been shown to use language by any criterion strong enough to exclude rats, worms, and any other conditionable animal."²² The Rumbaugh team was given space for a two-page reply to the Lachmans.

If this current exchange of ideas regarding speech in chimpanzees demonstrates anything, it evidently shows that scientists had better define what is meant by the word "speech" as applied to human beings.

Evidently many of the so-called "speech" experiments amount to very little more than operant studies with a linguistic twist, as the Lachmans assert. If their strong criteria are

adopted, then Lana, Sarah, and other chimpanzees under analysis have evidenced nothing remotely comparable to human speech and man still stands alone in that faculty, among others.

But whatever the outcome of this present controversy may be, it still seems that Lord Brain's statement made 10 years ago is just as valid now as it was when he delivered his speech to the British Association for the Advancement of Science:

Man's relationship to his fellows and to the universe is uniquely different from that of any other animal. He faces different problems and solves them in different ways. Man's superiority is due to his intelligence, and his ability to manipulate objects in the universe around him. These manipulations help him to increase his perception ... most important of these manipulations is the use of verbal and printed symbols which we call language. Of all known life forms, only man is self-conscious. Only man is aware of himself as a part of the greater world, and only man has ideas of right and wrong and theories concerning his feelings.²³

—Contributed by George F. Howe

References

- ¹Matthews, J. L., B. C. Heezen, R. Catalano, A. Coogan, M. Tharp, J. Natland, and M. Rawson. 1974. Cretaceous drowning of reefs on mid-Pacific and Japanese guyots, *Science*, 184 (4135):462-464.
- ²Newton, R. R. 1973. The authenticity of Ptolemy's parallax data, *Quarterly Journal of the Royal Astronomical Society*, 14 (4):367-388.
- ³Black, D. C., and G. C. J. Suffolk. 1973. Concerning the planetary system of Barnard's star, *Icarus*, 9 (3): 353-357.
- ⁴Gentry, Robert V. 1974. Radiohalos in radiochronological and cosmological perspective, *Science*, 184 (4132):62-66.
- ⁵Gentry, Robert V. 1966. Cosmological implications of extinct radioactivity from pleocentric halos, *Creation Research Society Quarterly*, 3 (2):17-20.
- ⁶Gentry, Robert V. 1968. On the invariance of the decay constant over geological time, *Creation Research Society Quarterly*, 5 (2):83-85.
- ⁷Gooding, D. W. 1974. On the use of the LXX for dating midrashic elements in the targums, *Journal of Theological Studies*, XXV Part 1 (April) 1-11.
- ⁸Thiele, Edwin R. 1974. Coregencies and overlapping reigns among the Hebrew kings, *Journal of Biblical Literature*, 93 (2):174-200.
- ⁹Eisner, T., J. S. Johnessee, J. Carrel, L. B. Hendry, and J. Meinwald. 1974. Defensive use by an insect of a plant resin, *Science*, 184 (4140):996-999.
- ¹⁰McKeon, J. B., J. T. Hack, W. L. Newell, J. O. Berklund, and L. A. Raymond. 1974. North Carolina glacier: evidence disputed, *Science*, 184 (4132):88-91.
- ¹¹Preer, J. R., Jr., L. B. Preer, and A. Jurand. 1974. Kappa and other endosymbionts of *Paramecium aurelia*, *Bacteriological Reviews*, 38 (2) (June):113-163.
- ¹²*Ibid.*, p. 127.
- ¹³Howe, G. F. 1969. Evolution and the problem of man, *Creation Research Society Quarterly*, 5 (1): 23-33.

- ¹⁴Howe, G. F. 1971. Note and quotes on linguistics and the gift of speech, *Creation Research Society Quarterly*, 8 (3):193-194.
- ¹⁵Custance, A. C. 1971. Another excerpt from *Who Taught Adam to Speak*, *Creation Research Society Quarterly*, 8 (3):195-196.
- ¹⁶Mistler-Lachman, J. R., and R. Lachman. 1974. Language in man, monkeys, and machines, *Science*, 185: 871-872. September 6.
- ¹⁷*Ibid.*, p. 871.
- ¹⁸Premack, D. 1971. *Science*, 172:808.
- ¹⁹Mistler-Lachman, *Op. cit.*, p. 871.
- ²⁰Rumbaugh, D. M., T. V. Gill, and E. C. von Glasersfeld. 1973. Reading and sentence completion by a chimpanzee (*Pan*), *Science*, 182 (4113):731-732.
- ²¹*Ibid.*, p. 733.
- ²²Mistler-Lachman, *Op. cit.*, p. 871.
- ²³Lord Brain. 1965. Human behavior, *Science News Letter*, 86:151. (5 September)

LETTER TO THE EDITOR

"Scientific" Relativity

While it cannot be denied that the "theory of evolution" was a brilliant attempt on man's part to explain origins and general life processes of self improvement, much material has been written by creationists clearly denouncing the speculation as anti-Biblical and therefore false. Even at its best, the so-called theory demands that God works in chance processes.

Alternately, few objections are heard from scientists, who are Christians, regarding the theory of relativity. Cannot such thinking eventually lead to the conclusion that God works in relative ways, destroying any basis of absolutism on which Christians stand?

One reading of Martin Gardner's article entitled, "On the Contradictions of Time Travel" (*Scientific American*, May 1974), will impress anyone with the mind-bending problems that must be explained should relativity theory in fact be true. But relativity theory is not necessarily true, as implied by a mathematician ad-

vertizing in Box 274, *Science*, 184:1015 (1974), who requested the aid of a coauthor in the writing of a book giving the "mathematical proof that the Special Theory of Relativity was born of mathematical errors."

As believers, creationists should critically evaluate "scientific" relativity, encouraging those who are qualified to express their views in a Biblical context and not forgetting that Satanic influences are not limited to the biological sciences. Along these lines, an excellent Bible truth recorded in James 1:17 should be remembered:

Every good gift and every perfect gift is from above, and cometh down from the Father of lights, with whom is no variable-ness, neither shadow of turning.

Sincerely,
Charles L. Webber, Jr., Ph.D.,
Max-Planck-Institut,
W. G. Kerckhoff Institut,
D-6350 Bad Nauheim,
Parkstrasse 1,
Federal Republic of Germany

CREATION RESEARCH SOCIETY

Statement of Belief Members of the Creation Research Society, which include research scientists representing various fields of successful scientific accomplishment, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution), both of the universe and the earth with its complexity of living forms.

We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. In 1970 the Society published a textbook, *Biology: A Search for Order in Complexity*, through Zondervan Publishing House, Grand Rapids, Michigan 49506. Subsequently a Revised Edition (1974), a Teachers' Guide and both Teachers' and Students' Laboratory Manuals have been published by Zondervan Publishing House. All members of the Society subscribe to the following statement of belief:

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically

and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.

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

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

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

BOOK REVIEWS

Evolution: Possible or Impossible? by James F. Coppedge. 1973. Zondervan Publishing House, Grand Rapids, Michigan. 276 pages. Price \$3.95.

Reviewed by Emmett L. Williams*

This reviewer has heard many evangelical apologists for the theory of evolution claim that although evolution is highly improbable, it is still possible. James Coppedge has shown how impossible this "possible" is.

The main theme of the book centers around the chance formation of protein molecules. Interestingly, all of the amino acids in proteins are made of L-amino acids. This is an excellent argument for teleology in itself.

Coppedge builds his argument very nicely, always allowing in his approach for necessary evolutionary postulations. In one place he uses H. J. Marowitz's assumption that the simplest free-living organism capable of duplicating itself would require a minimum of 239 protein molecules.

Assuming that there are 10^{52} protein molecules present (an estimation of all of the protein molecules that ever existed on the earth), the chance of forming a set of 239 protein molecules, all with L-amino acids, is 1 out of 10^{8318} .

In another place Coppedge calculates the probability of forming a single protein molecule by chance to be 1 in 10^{161} . Yet again, using the assumption that 10^{75} protein chains could form during the supposed evolutionary age of the earth, and allowing for overlapping sets of 239 each, the probability of forming this minimum set (239) of proteins in the entire evolutionary age of the earth is 1 in 10^{119701} .

In another interesting calculation Coppedge shows that one could expect a useable gene to form by chance (nature, natural selections, etc.) in 10^{147} years. It should be abundantly clear to any open-minded person that "evolutionary" schemes are totally beyond any reasonable hope of ever having succeeded. How "possible" are all of the forementioned events? The word "never" could be substituted for "possibly" in all cases.

A strong case is made for design in many sections of the book, particularly in the discussion of DNA. There are excellent sections on the molecular evolution speculation and evidences for a young earth and moon. Arguments for the accumulation of micro-mutations over long periods of time are demolished.

Since the book was written primarily for people without much scientific training the author ram-

bles in places. At times he talks about electron orbitals as if they were real rather than a part of quantum theory. In one place he makes the mistake of calling Dr. J. L. Henson of Bob Jones University a physicist. Dr. Henson is a biologist. But these slips do not hurt the validity of the case against evolution.

The reviewer recommends this book. It is an unusual and worthy addition to the growing creationist literature. It is well documented and for the most part very readable.

☆ ☆ ☆

The Rationality of Belief in God. Edited by George I. Mavrodes. 1970. Prentice-Hall, Inc., Englewood Cliffs, N. J. 208 pages. Price: \$2.95 paper; \$7.95 cloth cover.

Reviewed by T. Robert Ingram*

Like all anthologies, this one is unsatisfactory. Few will agree fully with any editor's selections. This collection, however, has the additional unsatisfactoriness in that the basis of selection seems to be that true rationality must avoid commitment.

There is certainly a value, when considering any argument, of also taking into account objections that may be raised against the argument. But it is questionable whether there is any real value in giving attention to extended arguments of those who disagree simply because they disagree, or because they do not accept the basic premise under discussion—in this case, the nature of rationality. If reason can be thought of as operating without God or without reference to God, then it makes sense to include such writers as Hume, Kant, William James and Soren Kierkegaard: but this is the very question at issue.

One can hardly account for the inclusion of J. J. C. Smart, a contemporary Australian, however, who has no more to offer than the familiar pronouncements of an agnostic whose basic position is, "All I can say is, that I do not know." His claim to have proved that nobody knows, or that nobody has demonstrated reasonable proof (proof beyond a reasonable doubt) is simply sophomoric.

It is not true that all the five traditional arguments for the existence of God have been shattered. It is true that, on Smart's commitment to "evolution," the traditional arguments will not stand. Many are aware of that. For example, in regard to the so-called argument from design, Smart concludes:

*Emmett L. Williams, Ph.D., is chairman of the Department of Physics, Bob Jones University, Greenville, South Carolina 29614.

*Rev. T. Robert Ingram is well known for his work in Christian education. He is Rector of St. Thomas' Episcopal Church and School, P. O. Box 35096, Houston, Texas 77035.

This type of argument has lost its persuasiveness, for the theory of evolution explains why our teeth are so luckily placed in our jaw bones, . . . and so on.

One who has not been able to see through the fallacies of "survival of the fittest" can hardly be mentally equipped to tilt against the great minds of all time and mock them.

For those who do not have ready access to the major contributions on this subject, however, such as selections from Anselm, especially with the contemporaneous criticism from an unknown Gaunilon and reply, and Thomas Aquinas, this book is worth owning.

The commentary on Aquinas by Frederick Copleston and the treatise by Alfred E. Taylor are also well worthwhile. Creationists would do well to give ear to the lines of reasoning which, from the earliest times, have endorsed St. Paul's dictum that

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. (Romans 1:20)

This anthology might have been enlivened had the editor seen fit to include Augustine's brilliant argument for the existence of God from the existence of reason itself, and that from no more than the existence of what we call pure mathematics.

The real question raised by the title of this book is far more satisfactorily presented by a contemporary writer, Robert Hoopes, in his *Right Reason in the English Renaissance*, who divides systems of thought on the ground of what value is placed upon reason, which he hints may well be identified in its most exalted nature with what is known Biblically as the Word or Wisdom of God. Unfortunately, even in the Christian camp there has been division over the reasonableness of Faith.

☆ ☆ ☆

Seed to Civilization. The Story of Man's Food by Charles B. Heiser, Jr. 1973. W. H. Freeman and Co., San Francisco. 243 pages. Price, \$7.50 cloth; \$3.50 paper.

Reviewed by C. E. A. Turner*

Here is a book well produced in linen binding, cleanly printed on quality paper, containing numerous excellent illustrations, and written by a university professor. It is packed with interesting and valuable information, tables and diagrams, the accuracy of which may be verified. Quite properly, it draws attention to many of

the problems connected with food, especially malnutrition and over-population, and warns of the too-few solutions.

Unhappily, like too many books on science written for the layman, it contains the twin themes of "evolution" and the age of many millions of years for the earth; and so it becomes a less valuable and even a misleading work. In addition to the inclusion of "evolution," it contains a number of quotations from Holy Scripture and from the literature of other religions. This could lead people to regard the other books as of equal validity with the Bible; and the "theory of evolution" with the valuable scientific facts which are recorded in this work.

The book opens with the bald assertion: "Man has been on the Earth for some two million years. Except for a tiny fraction of that time, he has been a hunter of animals and a gatherer of plants, strictly dependent on nature for his food." The author has many references to the subject of domestication of animals and plants in various countries of the world.

What emerges from these references can be heartening to members of the C.R.S. It is this: there tends to be a consensus of view that, whatever the area or the method of dating may be, man was domesticating animals and plants no earlier than about 10,000 years ago. So Adam can thus be shown to have been the first farmer as well as the first man after all!

☆ ☆ ☆

Creation Revealed in Six Days by Air Commodore P. J. Wiseman, C.B.E. 1948. Marshall, Morgan & Scott, Ltd., London and Edinburgh. 144 pages. Price: 8s. 6d.

Reviewed by T. Robert Ingram*

Creationists should read this book carefully; not to relieve the strain on the question of the age of the universe, but because it contains information and sharp analyses that add depth and width to the understanding both of Scripture and of the uniqueness of Creation.

Commodore Wiseman is best known, of course, for his celebrated work, *New Discoveries in Babylonia about Genesis*, in which he did much to explain sensibly and simply the composition of this marvelous book and to establish the antiquity of the records. He showed that most probably they were all contemporaneous with the events recorded, and were received and transmitted through the line of the Promise to Moses who published them.

In this book the author undertakes to show that the six days connected with Creation ac-

*C. E. A. Turner, M.Sc., Ph.D., is Chairman of the Evolution Protest Movement in England. He lives at The Lodge, Farm Close, Fishbourne, Chichester, Sussex, England PO 188AW.

*Rev. T. Robert Ingram is well known for his work in Christian education. He is Rector of St. Thomas' Episcopal Church and School. P. O. Box 35096, Houston, Texas 77035.

counts were not intended to be understood as describing God's works, but rather as the series of God's revelations to a man (Adam?) about origins.

He makes it plain that he believes his thesis concerning the Creation account makes room for the assumption of aeons of time involved in Creation without doing violence to a literal and historical reading of Scripture. This is in no way necessary, however. Rather his interpretation may quite as well accommodate a total and instantaneous Creation as imagined by Milton.

The point is that it seems that Genesis should not be understood to be telling how long it took God to create, whether ages or in a flash. This is unknowable. Commodore Wiseman holds that the six days must be 24-hour days, but that they were the days of revelations, not works.

In this he follows Augustine in a striking way, although he seems not to be familiar with the great African since he repeats the calumny popular among Reformed writers that Augustine believed the six days of creation meant six extended periods of time. Augustine held no such thing; in fact, quite the opposite.

Augustine hinted strongly that he believed the whole Created order appeared instantly in response to the Divine will. He developed at length

the implications of the words, "in the day that the Lord God made the earth and the heavens." (Chapter 2, Verse 4). In fact Augustine stated,

The unity of that day is underlined by its not being called "the first day," but "one day." Thus the second day, and the third, and the rest are not different days; the same "one day" was repeated to complete the number of six or seven, *to represent the seven stages of knowledge, the six stages comprehending the created works, and the seventh stage embracing God's rest.*" (City of God, Bk XI, Ch. 9). (Emphasis added)

Commodore Wiseman renders quite justifiably the Fourth Commandment, "For in six days the Lord *shewed* the heavens and the earth and all that in them is and rested on the seventh day." (Emphasis in the original.) He likens this revelation of origins to that given to Moses on the mount.

Much of the argument of this book is illuminating and helpful in understanding how far above human understanding are God's works of Creation: there is no possible way to understand them from the works seen in time (Isaiah 55:8 and 9). It is equally important to consider the likelihood of the contemporaneousness of the record with the events.

INDEX FOR VOLUME 11 OF CREATION RESEARCH SOCIETY QUARTERLY 1974-1975

The subscription year for the Creation Research Society Quarterly begins with issue Number 1 in June and continues through publication of three other quarterlies which usually appear in September, December, and March.

In Volume 11 Number 1 contained pages 1 thru 88; Number 2, pages 89 thru 136; Number 3, pages 137 thru 180; and Number 4, pages 181 thru 228.

All pages of the quarterlies have been numbered consecutively; hence only the beginning page number is provided for each reference.

Letters to the Editor are designated with the symbol (L).

Items in "Panorama of Science" are listed alphabetically, in a separate section, according to the contributor.

All Book Reviews and a Film Review are listed in a separate section at the end of the Index according to titles.

A

Additional Notes Concerning the Lewis Thrust-Fault. By Clifford L. Burdick, 56.

Armstrong, Harold L.

Is the Bible a Book of Science?, 159.

On the Distinction Between Religion, Philosophy, Science, and History, 10.

B

Barkley, Phillip J.

Some Thoughts on the Creation of Time, 156.

Barklow, Carole

Christian Concern About Government Schools (L), 84.

Beginnings. By A. G. Tilney, 104.

Biblical Framework for a Course in Physical Science, A. By Emmett Williams and George Mulfinger, 8.

Brown, R. H.

More on Patriarch Ages (L), 132.

Burdick, Clifford L.

Additional Notes Concerning the Lewis Thrust-Fault, 56.

C

Cairney, William J.

Lichens: a Dilemma for the Evolutionary Model, 211.

- Camping, Harold
Let the Oceans Speak, 39.
- Can There Be True Science Without True Religion? By T. Robert Ingram, 6.
- Christian Concern About Government Schools (L). By Carole Barklow, 84.
- Clark, Harold W.
Fossil Man and the Creation Concept, 115.
- Clough, Charles A.
On the Danger of Over-Sweeping Generalizations About Ages (L), 133.
- Comments on Scientific Theology (L). By Samuel Wolfe, 85.
- Comments on Thermodynamics Before and After the Fall (L). By S. J. Jansma, 177.
- Courville, Donovan A.
Evolution and Archaeological Interpretation, 47.
Is a Fixed Chronology of Egypt Back to c. 2000 B.C. Mistaken?, 202.
- Cover Picture, Number 1. Fish with tusks. Provided by John N. Moore.
- Cover Picture, Number 2. Fossil fish inside a fish. Provided by Mary Frey.
- Cover Picture, Number 3. See the Strange Hoatzin.
- Cover Picture, Number 4. See the Long-Barreled Bore.
- Custance, Arthur C.
Lebzelter Principle: a Generative Idea, The, 157.

D

- Daly, Reginald
Was the Ice Age Caused by the Flood?, 213.
- Design in the Human Body. By David A. Kaufmann, 91.
- de Young, Don B.
Geochemistry of the Stable Isotopes, 32.
- Diversity of Opinions Found in Creationism (L). By Henry M. Morris, 173.

E

- Evidence for the Existence of an Intelligible Genetic Code. By Loyd Y. Quinn, 188.
- Evolution and Archaeological Interpretation. By Donovan E. Courville, 47.

F

- Fisk, Lanny H.
More of Fossil Thorns (L), 84.
- Flood and the Ark, The. By J. E. Schmich, 120.
- Food Laws (L). By Alfred L. Greenlaw, 107.
- Fossil Man and the Creation Concept. By Harold W. Clark, 115.
- Fossils and Uncertainty. By H. H. Grimm, 111.
- Frey, Mary
Cover Picture, Number 2. Fossil Fish Inside a Fish.

G

- Genesis Flood and the Geological Record, The. By G. L. Johnson, 108.

- Geochemistry of the Stable Isotopes. By Don B. de Young, 32.
- God's Personality Revealed by Nature. By William J. Tinkle, 139.
- Greenlaw, Alfred L.
Food Laws (L), 107.
- Grimm, H. H.
Fossils and Uncertainty, 111.

H

- Hybrid Corn: Man's Glory and Limitation. By William J. Tinkle, 37.

I

- Ingram, T. Robert
Can There Be True Science Without True Religion?, 6.
- Is a Fixed Chronology of Egypt Back to c. 2000 B.C. Mistaken? By Donovan A. Courville, 202.
- Is the Bible a Book of Science? By H. L. Armstrong, 159.
- Is Molecular Evolution of Proteins Possible? By M. Trop and A. Shaki, 28.

J

- Jansma, S. J.
Comments on Thermodynamics Before and After the Fall (L), 177.
- Johnson, G. L.
Genesis Flood and the Geological Record, The, 108.

K

- Kaufmann, David A.
Design in the Human Body, 91.
- Keithley, Willis E.
Long-Barreled Bore, The, 183; Cover Picture for Number 4.
Picturing the Lighter Side of Creation, 30 and 108.
- Kofahl, Robert E.
Reply Concerning Entropy Prior to the Fall (L), 175.
- Kohoutek, Comets, and Christianity. By Peter A. Stevenson, 68.

L

- Lammerts, Walter E.
On the Rapid Formation of Beaches and a Graded Series of Flattened and Rounded Stones, 101.
- Lebzelter Principle: a Generative Idea, The. By Arthur C. Custance, 157.
- Legendary Evidence for the Confusion of Tongues. By James E. Strickling, 97.
- Lester, Lane P.
Mimickry (L), 85.
- Let's Deflate the Big Bang Hypothesis. By Roger L. St. Peter, 143.
- Let the Oceans Speak. By Harold Camping, 39.
- Lichens: a Dilemma for the Evolutionary Model. By William J. Cairney, 211.

Long-Barreled Bore, The. By Willis E. Keithley, 183; Cover Picture for Number 4.

M

Magnificence of Kinds as Demonstrated by Canids, The. By Hilbert R. Siegler, 94.

Marsh, Frank L.

Strange Hoatzin, The, 139; Cover Picture, Number 3.

Variation and Fixity in Nature, 60.

Mimickry (L). By Lane P. Lester, 85.

Monkeys and Typewriters. By A. J. White, 128. Moore, John N.

Cover Picture, Number 1. Fish with Tusks.

Some Definitional Formulations, 3.

More on Fossil Thorns (L). By Lanny H. Fisk, 84.

More on Patriarch Ages (L). By R. H. Brown, 132.

Morris, Henry M.

Diversity of Opinions Found in Creationism (L), 173.

Mulfinger, George

Biblical Framework for a Course in Physical Science, A, 8.

O

On the Danger of Over-Sweeping Generalizations About Ages (L). By Charles E. Clough, 133.

On the Distinction Between Religion, Philosophy, Science, and History. By H. L. Armstrong, 10.

On the Rapid Formation of Beaches and a Graded Series of Flattened and Rounded Stones. By Walter E. Lammerts, 101.

P

Perpetuation of the Recapitulation Myth. By Glen W. Wolfrom, 198.

Picturing the Lighter Side of Creation. By Willis E. Keithley, 30 and 108.

Q

Quantitative Comparison of the Carbon in the Biomass and the Coal Beds of the World, A. By Harry V. Wiant, 142.

Quinn, Loyd Y.

Evidence for the Existence of an Intelligible Genetic Code, 188.

R

Reply Concerning Entropy Prior to the Fall (L). By Robert E. Kofahl, 175.

Report of 1974 Board Meeting, 126.

S

Schmich, J. E.

Flood and the Ark, The, 120.

Scientific Relativity (L). By Charles L. Webber, 221.

Sex and Ear Size in the Bullfrog. By E. Norbert Smith, 46.

Shaki, A.

Is Molecular Evolution of Proteins Possible?, 28.

Siegler, Hilbert R.

Magnificence of Kinds as Demonstrated by Canids, The, 94.

Smith, E. Norbert

Sex and Ear Size in the Bullfrog, 46.

Some Definitional Formulations. By John N. Moore, 3.

Some Thoughts on the Creation of Time. By A. J. White and Phillip J. Barkley, 156.

Stevenson, Peter A.

Kohoutek, Comets, and Christianity, 68.

St. Peter, Roger L.

Let's Deflate the Big Bang Hypothesis, 143.

Strange Hoatzin, The. By Frank L. Marsh, 139; Cover Picture, Number 3.

Strickling, James E.

Legendary Evidence for the Confusion of Tongues, 97.

T

Tilney, A. G.

Beginnings, 104.

Time Upside Down. By Erich A. von Fange, 13.

Tinkle, William J.

God's Personality Revealed by Nature, 139.

Hybrid Corn: Man's Glory and Limitation, 37.

Trop, Moshe

Is Molecular Evolution of Proteins Possible?, 28.

Was Evolution Really Possible?, 183.

V

Variation and Fixity in Nature. By Frank L. Marsh, 60.

von Fange, Erich A.

Time Upside Down, 13.

W

Was Evolution Really Possible? By Moshe Trop, 183.

Was the Ice Age Caused by the Flood? By Reginald Daly, 213.

Webber, Charles L.

Scientific Relativity (L), 221.

White, A. J.

Monkeys and Typewriters, 128.

Some Thoughts on the Creation of Time, 156.

Wiant, Harry V.

Quantitative Comparison of the Carbon in the Biomass and Coal Beds of the World, A, 142.

Williams, Emmett

Biblical Framework for a Course in Physical Science, A, 8.

Wolfe, Samuel

Comments on Scientific Theology (L), 85.

Wolfrom, Glen W.

Perpetuation of the Recapitulation Myth, 198.

PANORAMA OF SCIENCE

Armstrong, H. L.

Attractive thought about magnets, An, 77; Bacteria may alter element concentration, 76; Bacteria put termites in clover, 75; Behaviour of lava on water contact, 76; Comets: evidence of young Solar System, 74; Comets point to a young universe, 161; Competition not important in nature, 160; Dating by amino acids, or by tree rings, 73; Decay constant: really constant?, 75; Entropy always—repeat always—increases, 161; Evidence for the accuracy of the Masoretic Text, 218; "Fossil record" admitted to be faulty, 162; Germ of an idea, The, 74; Glaciers or floating ice, 163; How quickly a population can spread, 160; In-fighting should be out, 72; Insects tar (and feather?) their enemies, 218; Intricacies of natural sonar, The, 72; Marks may be ascribed wrongly to glaciers, 218; Marks of the Flood on the ocean floors, 162; Meteorological effects now a clue to former times?, 164; Misleading concentrations of isotopes?, 163; More evidence of a Cretaceous catastrophe, 217; Optical design by the Creator, 74; Peculiarities in the composition of shells, 161; Ptolemy's data questioned, 217; Rock formations moved millions of years!, 163; Testimony of halos in rocks, The, 217; Ultra-violet features matched for bees and flowers, 162; Uniformitarian dates struck by lightning?, 75; Varves, bands, and layers, 163; When is an artifact not an artifact?, 163; Wishing upon a star may not provide planets, 217.

Burdick, Clifford L.

Alleged evidence for evolution questioned, 166; Evolution no help to the prospector, 123; Footprints in the stones of time, 164; More Precambrian fossils, 165; More Precambrian pollen, 122.

Howe, George F.

Evolution, a problem in parallelism, 219; Language and reading in man and chimpanzee, 219.

Lammerts, Walter E.

Does nature really select selection?, 168; Insect family tree may become a forest, 124; On the age of the universe, elements, 77; Theory of evolution of primates questioned, 166.

Marsh, Frank L.

Dinosaurs, 125.

BOOK REVIEWS

Bankruptcy of Evolution, The. By the Bible Science Association of Canada. Reviewed by Harold Armstrong, 79.

Biological Transmutations. By Louis Kervran. Reviewed by H. L. Armstrong, 81.

Center of the Earth. By Andrew J. Woods. Reviewed by George F. Howe, 171.

Creation Revealed in Six Days. By Air Commodore P. J. Wiseman. Reviewed by T. Robert Ingram, 223.

Earth's Most Challenging Mysteries. By Reginald M. Daly. Reviewed by Erich A. von Fange, 81.

Evolution: Possible or Impossible? By James F. Coppedge. Reviewed by Emmett Williams, 222.

Evolution Science Falsely So-Called. By the International Christian Crusade. Reviewed by H. L. Armstrong, 83.

Evolution. The Fossils Say NO! By Duane T. Gish. Reviewed by Bolton Davidheiser, 130.

God's Method in Creation. By William J. Tinkle. Reviewed by H. L. Armstrong, 170.

God Who Cares, The. By Harold F. Roellig. Reviewed by Larry G. Butler, 80.

How to Lie with Statistics. By D. Huff. Reviewed by H. L. Armstrong, 82.

Natural Theology. By Wm. Paley. Reviewed by H. L. Armstrong, 79.

Perspectives in Zoology. By Alan Boyden. Reviewed by Wayne Frair, 129.

Population, Species, and Evolution. By Ernst Mayr. Reviewed by Allen B. Cornell, 170.

Quantum Mechanics in a New Key. By A. Landé. Reviewed by H. L. Armstrong, 172.

Rationality of Belief in God, The. By George I. Mavrodes (Editor). Reviewed by T. Robert Ingram, 222.

Seed to Civilization. By Charles B. Heisner, Jr. Reviewed by C. E. A. Turner, 223.

FILM REVIEW

Fossil Record. Reviewed by W. Dennis Burrowes, 131.

See the current *CRSQ* for current book offers