

EDITORIAL

WHEN ASSUMPTIONS CEASE TO BE ASSUMPTIONS

If we were prohibited from using assumptions, regardless of their implication or complexity, civilization as we know it today would cease to function properly. While this statement may seem brash at first, let us take a minute or two and examine the consequences of such a statement. Before proceeding, let me define what an assumption is. Turning to my preferred lexicon (**Webster's Unabridged**, of course!) **assumption** is defined as: "the supposition that something is true." **Supposition** is defined as "to believe in as true in absence of positive knowledge or of evidence to the contrary." In other words, an assumption is the adoption of a position that an aspect or statement is true, *even though* there may not be positive evidence to support that position! Let me illustrate.

The whole foundation of credit is based upon assumptions. First, the grantor of credit assumes that the grantee will pay his bill at the proper time. Second, the acceptor of credit assumes that the grantor of credit will disburse the funds. This continues on down the line from individual to international. Granted, there is some evidence whether or not one's credit is good; however, the whole concept of credit still hinges on the assumption of ultimate remuneration.

Another example based entirely upon assumptions is the guarantee. Many times an individual will purchase the item with the "best" guarantee when making a choice between two equivalent items. But, what is a guarantee? It is nothing more than the assumption that the company offering the guarantee: 1) is going to stay in business and 2) will comply with the stipulations of the guarantee. If either assumption is not met, the guarantee is not worth the paper upon which it is written.

Moving from the mundane to the more esoteric aspects, we observe that major segments of the sciences are based upon assumptions. What happens if these assumptions are incorrect or are accepted as truth without challenge? What happens when a scientific assumption moves across that sometimes-hazy line between assumption and truth? When does that assumption cease to be an assumption? Should that assumption be accepted unchallenged? These are questions that merit serious consideration.

There are many areas of science in which proclaimed assumptions make little or no influence to the average citizen. However, in the area of **origins** the assumptions of scientists may have immeasurable implications

for the average citizen's philosophy. In light of this strong influence, let us examine two major assumptions about origins in detail.

The first assumption is that all life originated through the processes of evolution. The second assumption is that life on planet Earth has existed for millions of years. The first assumption instantly constrains the second assumption to be factual, because it seems impossible to evolve life to its current level of complexity in a short period of time.

It has been forcefully asserted that the preponderance of evidence supports the evolution of life from abiotic material. One of the strongest sources of evidence cited in favor of evolution is the geologic column. At the bottom of the column, in the Precambrian sediments, are found fossil bacteria. Above these layers, beginning in the Cambrian, are found fossils of simple "lower" life forms. A progression of "complexity" is then declared to flow upward through the column until modern forms are found at the top of the column. It is this progression from "simple" to "complex" that is the nucleus of the supporting evidence for evolution. But what about the other evidence to the contrary?! What about the extreme complexity of the "simple" bacteria cell? What about the chemical processes taking place within that "simple" cell? Irrespective of its position within the geologic column, the cellular complexity defies statistically random processes!

The assumption about the length of time for the existence of life is derived from the radiometric ages of the rocks associated with the various fossils. At this point our problems become compounded, because absolute radiometric age dates are also based upon a series of assumptions, the greatest of these being the **Zero Reset hypothesis**. (This hypothesis assumes that the radioisotope pairs before and after a geologic event are always differentiated.) Many times, in the scientific literature, the zero-reset hypothesis has been demonstrated to be an unreliable assumption. The criteria for its applicability is never firmly established, but instead varies from situation to situation as circumstances and results dictate.

For many, the assumptions of evolutionary beginnings and long ages have ceased to be acknowledged as assumptions and are accepted as true. This unchallenged approbation of assumption as truth results in sometimes-interesting consequences.

One of the most paradoxical consequences that ensues from the approbation of evolution as fact is the acceptance of spontaneous generation for the "beginning" of life on the one hand, but the total repudiation of such processes on the other hand. The acceptance of evolution as fact necessitates the endorsement of untenable chemical reactions under

unrealistic conditions occurring at absurdly small statistical probabilities for life to begin. In short, by accepting evolutionary processes for the origin of life, one must deny any evidence which supports another paradigm, or interpret that evidence in such a manner as to support evolution, regardless of the position such an interpretation may demand.

When an assumption ceases to be an assumption, the investigator is led in one of two directions. If the assumption is supported by the data, then the path should lead towards ultimate TRUTH and understanding. On the other hand, if the cessation of an assumption requires the investigator to adopt an unreasonable and/or illogical interpretation of data, the path cannot help but lead ultimately away from TRUTH!

As mortal members of modern society, we must be willing to recognize that assumptions are not always testable; therefore, we must attempt to validate every assumption before we accept it as fact. We must be willing to search for assumptions that fit as much data as possible, realizing that assumptions which have been proven either true or false are no longer assumptions. Only when such a course is charted will ultimate TRUTH become available, and maybe not even then.

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REACTIONS

Readers are invited to submit their reactions to the articles in our journal. Please address contributions to: ORIGINS, Geoscience Research Institute, 11060 Campus St., Loma Linda, California 92350 USA.

Re: Brown: Correlation of C-14 Age with the Biblical Time Scale (ORIGINS 17:56-65)

Dr. R. H. Brown deserves the full appreciation of all recent creationists for his tireless efforts to integrate C-14 observations with a Biblical Flood framework. His article represents a major, quantitative step forward in his endeavor. The article presents an empirically derived relationship for converting C-14 age to “real” age. I doubt that anyone could produce a better relationship for this much-needed conversion than that which Dr. Brown has presented, if one begins with the assumption that an Ussher-like date for the Flood is correct, as Dr. Brown has done.

However, the application of this conversion relationship produces some strange results which seem to argue strongly against its general validity, and prompt reconsideration of the assumptions upon which it is built. For example, consider the case of certain trees. Individual tree specimens of bristlecone pine containing several hundred or even several thousand consecutive growth rings are known to exist. C. W. Ferguson (see Fig. 1, p. 239 of Nobel Symposium 12, Ingrid U. Olsson, ed.) used one such tree exhibiting 580 consecutive growth rings in the construction of his bristlecone pine chronology. The C-14 age of the first growth ring of this tree is roughly 5700 B.P. while that of its final growth ring is roughly 6150 B.P. When I rescale these C-14 ages according to Dr. Brown’s relationship I find that the “real” age of the first growth ring is about $T = 4340$ years and for the final growth ring it is about $T = 4420$. If these dates are correct, then this tree produced 580 growth rings in 80 years. That is, it averaged more than 7 growth rings per year!

This example could be augmented with that of many more trees of similar radiocarbon age from various locations on the globe. For those trees with the greatest C-14 ages, Dr. Brown’s conversion relationship implies a growth rate of up to 20 rings per year. But these are trees which normally produce only one ring per year today. This, of course, does not mean that they could not have produced 20 growth rings per year in the

past, but it is not at all obvious how any environmental conditions, no matter how different from those normal at the present time, might bring about such a feat.

As one further example, consider the following archaeological data from Jericho (see, for example, John R. Bartlett, “Cities of the Biblical World: Jericho,” Eerdmans, 1982). At one location in the ancient mound 26 building stages were excavated all belonging to the PPNB period. This data implies that a succession of 26 consecutive house building programs was undertaken at this site during the PPNB. Houses of this period were ruggedly constructed of mortared brick, with carefully plastered rectangular rooms. Conventional radiocarbon dates imply that the PPNB lasted a little more than one millennium, roughly coinciding with the seventh millennium B.C., which suggests that houses had to be rebuilt at Jericho about once every forty years — a conclusion which seems entirely reasonable. Now let us suppose that these radiocarbon dates are wrong and need to be rescaled as Dr. Brown’s conversion relationship suggests. We will have to compress these 1000 radiocarbon years of the PPNB period into about 70 “real” years. But this immediately leads to the unreasonable conclusion that these brick houses had to be completely rebuilt during the PPNB at Jericho once every 2.7 years! Even modern houses last longer than this!

As I stated at the outset, I do not think anyone could do any better with the radiocarbon data than Dr. Brown has done, if their thinking is constrained by an Ussher-like date for the Flood. The problem is that presently available radiocarbon, tree-ring, and archaeological data appear totally irreconcilable with the Flood date in either the third or fourth millennia B.C. It seems the Flood must have occurred well before these dates.

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Brown’s reply:

Before publication it was recognized that “Correlation of C-14 Age with the Biblical Tune Scale” would produce extensive negative reaction from a wide range of viewpoints. The treatment in that paper was offered as the best that can be done with the limited knowledge available. I must thank Dr. Aardsma for the opportunity to elaborate my initial presentation.

Given the capability of trees for producing more than one growth ring within a calendar year under appropriate circumstances (Glock & Agerter 1963, Gladwin 1976), our uncertainty concerning the climate patterns at bristlecone pine growth sites over the first three millennia after the Genesis flood as a consequence of all the climate changes associated with glaciation and deglaciation and the continental plate movement that must have occurred during that time, I see 1000 ring sequence wood samples as a challenge to dendrochronology, but not as definitive evidence against a time frame based on the data in the eleventh chapter of Genesis.

I do not have sufficient knowledge of Jericho archaeological evidence to discuss whether the available data must be interpreted as requiring rebuilding every 2.7 or every 40 years. The interpretive model for C-14 age that was presented in the last issue of *Origins* brings the age of an Alaskan musk ox down from 7000 years to a reasonable 50 years, and the dung accumulation from a viable population group of ground sloths in the Grand Canyon from an average of about one dung deposit every three years up to at least one dung deposit every four days (Brown 1986). Given a choice between this interpretive model and one chosen to avoid an archaeological interpretation which indicates home rebuilding every 2.7 years, I will choose the former and hold the archaeological interpretation in question.

Where our knowledge limits or our biases prevent a satisfactory resolution of such difficulties, I am confident that sufficient information will eventually become available for validating to everyone's satisfaction the testimony which has been collected in the Bible.

I hope that a competent archaeologist will discuss in *Origins* the issue that Dr. Aardsma has raised concerning the remains of ancient Jericho. From my personal inquiries to individuals who have done site work in this area and are well informed concerning archaeological study in the Middle East, I have been informed that the Jordan Valley experienced an all-time high rainfall during the Neolithic; that during this time Jericho houses were of mud-brick construction, rarely, if ever, plastered on the outside; that these houses needed frequent major repair, possibly on an average of every two years at some locations; that the floor level of many of the houses needed constant (every few years) raising to prevent rainwater from running in off the street, since erosion of the mud-brick houses produced a continual rise of the reed-paved streets, and consequently of the city mound (tell). This information gives me increased appreciation of

the need for a paradigm that brings the real-time equivalent of C-14 ages prior to 3500 BP into harmony with the chronological data in the Bible.

R. H. Brown

REFERENCES

- Brown RH. 1986. Radiometric dating from the perspective of biblical chronology. Proceedings of the First International Conference on Creationism, Vol. II. Pittsburgh, PA: Creation Science Fellowship, p 31-53, specifically p 48.
- Gladwin HS. 1976. Dendrochronology, radiocarbon and bristlecones. *Anthropological Journal of Canada* 14:2-7.
- Glock WS, Agerter S. 1963. Anomalous patterns in tree rings. *Endeavour* 22(85):9-13.

ARTICLES

THE ANTEDILUVIANS

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WHAT THIS ARTICLE IS ABOUT

Some features such as names, places, and events from Genesis 3-6 that describe the period between creation and the flood are compared with early Mesopotamian texts which refer to the same persons and events. The comparison shows that both sources knew of a number of the features of this period and its people. The most likely explanation is that both sources ultimately go back to the same period, the Bible having transmitted such information in an accurate, historical narrative, while the Mesopotamian sources mythologized them.

INTRODUCTION

Genesis 3-6 tells of the experiences of some of the earliest members of the human race — those who lived during the interval between creation (as recorded in Genesis 1-2) and the flood (as recorded in Genesis 7-9). From an evolutionary approach to biology, geology, or biblical studies, the “antediluvians” cannot be historical figures. A more direct reading of the biblical text, on the other hand, indicates that the author of these narratives and lists understood them to be historical individuals. The archaeologist cannot assist our search for evidence of their existence, for his spade only works upon the surface of the earth as it was modified by the Noachian flood. Although evidence for antediluvians should lie deeper in the geologic strata, geologists have not yet produced such evidence.

Is there any other avenue that might be explored for evidence relating to these individuals? Yes: through “literary archaeology,” i.e., explorations of our remote past through some of the most ancient written records of mankind. Scholars who work with literary and archaeological texts from the ancient Near East agree that writing was invented by the Sumerians, probably around 3000 B.C. in terms of traditionally assigned dating. The hieroglyphic writing of Egypt followed soon thereafter in terms of

its development, but pride of first place in writing goes to the cuneiform or wedge-shaped script impressed upon clay tablets in Mesopotamia.

The first cuneiform texts were written in the Sumerian language, an ancient-world linguistic island whose closest modern relatives are the agglutinative languages of Finland and Hungary. This same script was subsequently adopted by scribes who wrote and spoke languages from the eastern branch of the Semitic language family, Akkadian, which is best known from its representatives in the Assyrian and Babylonian dialects. Because Akkadian and biblical Hebrew belong to the same linguistic family, we can examine early Sumerian and Akkadian myths (stories dealing with the actions of the gods) and epics (stories emphasizing the activities of human heroes) for similarities to the early biblical stories that are found in Genesis 3-6. (We will ignore Egyptian texts, which are generally more removed from the biblical scene.)

The Sumerians, Assyrians, and Babylonians had creation stories, flood stories, and stories about individuals who lived between these two events. In a previous issue of *Origins*, I discussed some parallels between the biblical and Babylonian creation-flood stories.¹ This study suggests that the parallels between the biblical and Babylonian sources of knowledge about the antediluvians point to a common origin of such details and that those sources in turn indicate that they are rooted in the history of the actual individuals who lived through such experiences.

One precaution must be issued: I believe that the historical details are more accurately represented in the biblical text and that these details have gone through mythological modifications as they were transmitted by other individuals in the ancient world. Nevertheless, these sources demonstrate a resemblance sufficient to posit that they ultimately came from the same source and have diverged in different directions, the biblical retaining its historical narrative character, and the Babylonian turning into mythology.

Whereas other ancient Near Eastern texts studiously avoid any moral charge in their presentation, the biblical text tends to inject the moral element into its narratives, e.g., in the story of the Fall, in the experiences of the antediluvians, and in the reason for the worldwide flood.

THE FALL

The biblical story of mankind's fall (Genesis 3) is well known and does not need repeating. Are there any parallels in ancient Near Eastern sources? Yes: the Adapa Epic.² While the Adapa Epic contains elements of myth in which humans interact with the gods, the story concentrates

upon a human hero and thus qualifies better as an epic. For the purposes of this discussion, we need only a summary of this epic as it relates to the Genesis 3 account of mankind's fall.

Adapa was a wiseman (not a king) of Eridu, the first antediluvian city in the Sumerian king list. As such, he belonged to the first "significant" generation of mankind. On one occasion while he was fishing in the Persian Gulf, the south wind capsized his boat. In anger he cursed and broke the wing of the south wind. For this offense he was summoned to heaven to appear before Anu, the great high god. There he was offered the bread and water of life. Unfortunately, following the advice of Enki, the god of wisdom and the patron god of his city, Adapa refused the gods' offer of nourishment, thereby inadvertently passing up his opportunity to gain immortality. Instead, he was sentenced to return to earth and live out the life-span of an ordinary mortal. Moreover, because of his offense and his refusal, certain consequences, such as diseases, passed upon mankind.

While some elements in this story have been mythologized, some basic points are similar to the biblical story of the fall. These are summarized as follows:

1. Both subjects underwent a test before the deity.
2. The test was based upon something that the subjects were to consume.
3. Both failed the test and thereby forfeited their opportunity for immortality.
4. As a result of their failure, certain consequences passed upon mankind.
5. According to their respective sources, both subjects qualify as members of the first generation of mankind.³

A significant difference between these two stories is that Adam violated the moral law of God, while Adapa violated the physical laws of nature.

A final point of comparison requires a brief examination of the linguistics involved; specifically, the labial letters — b - w - m - p — the phonemes which are pronounced especially with the lips. In different dialects within the larger language family, words containing these phonemes differ in pronunciation. A modern example of labial shifts is found in the name of the Korean city which is now pronounced Busan instead of Pusan. An example from antiquity was the word for sun and the sun-god. In Hebrew it was Shemesh (cf., the town of Beth-Shemesh, the town of the temple of the sun-god). The Akkadian pronunciation differed

only in vowels to produce Shamash. In Canaanite, however, this word was pronounced Shapsh (or Shapash if fully vocalized), i.e., the middle consonant simply shifted from an M to a P. I believe that the same phonetic shift occurred between the names of the heroes of these two epics, which phonetically at least, are the same. The M in Hebrew Adam has shifted to the final P in Akkadian, and the Akkadian retains or employs a final vowel which the Hebrew did not. To the above list of similarities between these two stories we may add a sixth detail: they carry the same name when a minor phonetic shift is recognized. Thus, both the biblical Hebrews and the ancient Mesopotamians had a knowledge of this representative from the first generation of mankind: he had the same name, and his deeds resulted in similar consequences.

THE GENEALOGIES OF GENESIS 4 AND 5

The book of Genesis provides paired genealogies of two lines of antediluvians. The second half of Genesis 4 gives the genealogy of the line of Cain, while Genesis 5 consists mainly of the genealogy of the line of Seth down to the time of Noah and the flood. The line of Cain can be designated as the “secular” line, for the sole achievements of the different generations seem to be related to their material accomplishments. The line of Seth introduces a religious, if not moral, distinction between the two lines, by mentioning the righteousness of Enoch, followed by Noah and the flood narrative.

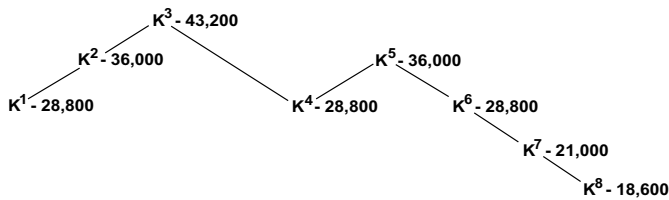
The Babylonian sources also provide two lines of the more-famed antediluvians, but they are no longer distinguished upon the basis of their righteousness or moral qualities. One line contains the wisemen or *apkallus*, headed by Adapa. In the other line are the kings of the antediluvian cities. Given the importance of the kingship in the political theology of the Sumerian (and Akkadian) city-states, one can understand why this element has been emphasized. The Sumerian king list identifies five antediluvian cities and lists the eight rulers who ruled them.⁴ The minor variations in the different textual editions, especially in the order of cities number two, three and four,⁵ will not affect the broader points of comparison in our discussion.

Not only do the Sumerians and Babylonians know of two major lines of men before the flood; they also handled the references to them in somewhat similar ways. In Genesis 5 the birth ages, life ages, and total ages of the patriarchs are given, while in Genesis 4, no ages are given for the line of Cain. A similar phenomenon occurs in the case of Babylonian literature, for only the list of kings is assigned ages. The

ages of the wisemen are not given. Once again, however, a transformation has occurred. The life ages in the biblical record have become ages of reign in the Sumerian king list. The underlying distinctions, seen in the realm of moral theology versus political theology, can be outlined as follows:

- Bible: Genesis 4 — unrighteous line, no ages
 Genesis 5 — righteous line, life ages given
- Babylon: line of wisemen, no ages
 line of kings, regnal ages given.

When we use the text critical edition established by T. Jacobsen⁶ for the study of the Sumerian king list, we can see an interesting pattern in the regnal ages of these long-lived kings. After one gets past the first four kings, for which there is a rise and then a dip, there follows a steady decrease in the length of the reigns of the next four kings. These ages can be plotted in a graph-like sequence:



This general pattern of decline in the lengths of reign, as conceptualized by the ancient Sumerians, continued after the flood. The Sumerians depict an even-more dramatic drop than does the biblical pattern, probably because they began with suspiciously grand figures. Nevertheless, both sources convey the idea that the antediluvians were a race of very long-lived persons. While the dates are given according to the length of reign, it is obvious that they paralleled the lengths of life. The drop after the flood fell to about 1000 years per king for the first post-diluvian dynasty, which was located at Kish (24,510 years for 23 kings) and then it declined further to about 200 years per king at Uruk (2,310 years for 12 kings). Finally, it ended at a mere 40 years per king at Ur, the location of the third post-diluvian dynasty (177 years for 4 kings). Thus the downward trend of the lengths of reign, and hence ages of life, continues the pattern that was established in the antediluvian period. The same pattern is followed in general, but with different figures, through the genealogies of Genesis 5 and 11.

There is also an interesting development in the tradition about the antediluvian wisemen in the Babylonian sources. The Sumerian king list gives the names for five antediluvian cities to which the institution of kingship was successively transferred. While the biblical record does not exclude the possibility of other antediluvian cities, it mentions only the city which Cain built and named after his son (Genesis 4:17). When one studies the list of wisemen in the earliest Babylonian texts, it becomes apparent that all were originally connected with the first antediluvian city, Eridu.⁷ If there really was only one antediluvian city, it would have made sense for the post-diluvian Sumerians and Akkadians to have originally collected the names of all these wisemen around one center initially. In later texts, however, as the tradition became adapted, the wisemen were distributed to the other antediluvian cities.

To summarize this section, both the biblical and the Babylonian sources knew of two main lines of very long-lived antediluvian personages. Thus we have two different testimonies to the actual existence of those individuals.

THE CITY AT THE COMMENCEMENT OF THE LIST IN GENESIS 4

The genealogy of Genesis 4 clusters several of its individuals around the city which we have mentioned above. It says that Cain, after leaving the presence of the Lord, founded that city east of Eden (v 16-17). The name of the first antediluvian city in the Sumerian king list was Eridu, which strongly resembles the name of Cain's grandson, Irad (Hebrew *Cyrad*). The first part of this name — *Cyr* — is the word for "city." To this is attached a *d* or *dalet*, which appears to have been left dangling. Hebrew has resolved this problem by preceding it with an *a*-vowel. On the other hand, the Babylonian form has a *u*-vowel following it. Around the age of Moses, the Hebrew language lost these final vowels, but it can be argued that originally there should have been such a vowel at the end of Irad's name. The Hebrew letter *Cayin* with which this name begins is not represented in the cuneiform script of Sumerian and Akkadian, so there is a virtually complete correspondence between these two names, with the minor exceptions mentioned.

One problem remains: the Hebrew text says that the city of Eridu was named after Cain's "son," Enoch, not his grandson Irad. Can this discrepancy be resolved? The pronominal suffix on the noun "son" is the Hebrew letter *w* or *waw*, used here as a vowel letter. One possible explanation is that the vowel letter was a simple addition by a later scribe, with a more original text stating that the city was named after

the son of Enoch: Irad. It should be remembered that the Hebrew word for “son” refers to any descendant, just as the word “father” refers to any ancestor. One could, therefore, refer to Irad as a son of Cain, because there was no technical word for grandson. Given this understanding of the biblical text, these two names do correspond. The name of the first city should be Irad, and the name of the first antediluvian city in the Sumerian king list was Eridu. Both names can be taken as direct phonetic equivalents, and both sources give the first city the same name.

Furthermore, in the Babylonian tradition, Enki was the patron god of the city of Eridu. As the god of wisdom, he was consequently a special patron of the wisemen who resided there. Is there any echo of Enki’s name in the biblical record from one of the antediluvian personages who became mythologized or deified? Let us examine the name of Enoch, written as *henok* in Hebrew. If the strong laryngeal letter at the beginning of this name were assimilated into the initial vowel that is found in Enki’s name, we have the same name, with the Sumero-Akkadian version adding the final vowel. Thus the name of Cain’s son, Enoch, is now deified into the name of the god of the first city.

Where was this first city located? Genesis 4:16-17 says that Cain went to the land of Nod, east of Eden, his wife bore a son, and he built a city and named it after his son. The logical connection is that Cain built the city in the land of Nod, a name that might be echoed in the Babylonian traditions. One of the addition names for Enki, the patron god of Eridu, was Nudimud,⁸ which means that the land of Enki is also the land of Nudimud. If one drops the last element (*-mud*) from this name, or, as an alternative derives it from the biblical word for east (*qedem*), the remainder of the name associated with Enki is Nud, which corresponds quite directly with the biblical name of Nod.

We can also connect the name of the city’s builder. In the Greek tradition, his name was Oannes, but in the earlier Babylonian cuneiform, his name was *u₄-an*.⁹ Some have attempted to link this name with Enoch, i.e., *henok*. This correspondence does not seem too direct, however, because of the final *k* in the biblical name. Instead of a final consonant, one could suggest that an initial consonant is missing, because the *u*-vowel at the beginning of the name stands alone, unconnected with the following *a*-vowel to make a diphthong. What reasonable consonant could we suggest here, and why? In Hebrew consonantal form, Cain’s name is spelled *qyn*, and it is vocalized as *qayan*. If we apply the *q* from the beginning of Cain’s name to the beginning of *u₄-an*’s name, the result is (*q*)*u-an* or *quan*, respectably close to the biblical Cain,

allowing for variations in vocalization. This suggests that the name of the builder of Eridu, Oannes in Greek and Uan in Akkadian, resembles Qain, the biblical name of the builder of the first antediluvian city.

We have now compared five names that are connected to the first antediluvian city. They are summarized and compared as follows:

BIBLICAL			BABYLONIAN	
First human	Adam	=	Adapa	First wiseman of the first city
Name of the first city	Ḫenok	=	Enki	Patron god of the first city
Builder of the first city	Qain	=	Q ₄ -an	Builder of the first city
Grandson of the builder of the first city	Irak	=	Eridu	Name of the first city
Location of the first city	Nod	=	Nudimud	Title of the first city's god

Even with allowances for phonetic shifts and modifications in the course of transmission, it is possible that both sources connect five pairs of similar names with the first antediluvian city. These similarities point to their joint knowledge of the originals from which they have been taken, i.e., the historical city that existed before the flood, along with the various personages who were associated with it.

THE CULTURAL COMPLEX AT THE END OF THE GENESIS 4 GENEALOGY

The final generation listed in the Genesis 4 genealogy (the line of Adam's less-righteous descendants) is elaborated so that three sons are mentioned. The chief materialistic accomplishment of each son is listed as: 1) animal husbandry for Jabal, 2) musical instruments (pipe and lyre) for Jubal, and 3) metallurgy for Tubal-Cain. Let us examine the Mesopotamian approach to the development of these cultural accomplishments in antediluvian times.

The feature of animal husbandry among the antediluvians is seen in the Sumerian king list. The third and last king of the second antediluvian city, Bad-Tibira, was given two specific designations. He was deified as "the god Dumuzi," and he was identified as a shepherd. The other kings were not identified with an occupation other than king. Also, even if a secondary occupation were selected, a "shepherd" would be unusual. There is a stark contrast between a shepherd with his flocks and a king with his throne in his royal palace in his capital city. Nonetheless, the Sumerian tradition insisted upon linking these two with a deified figure.

Both the biblical text and the Babylonian tradition emphasize animal husbandry as a part of the work of antediluvian society.

The second cultural accomplishment is the invention of musical instruments — the flute (pipe) and the harp (lyre). The Babylonian tradition logically credits the wisemen for such an invention. Nugal-Priggal, one of the later sages in the list of the seven wisemen before the flood, was the inventor of the lyre. While there does not appear to be any direct correspondence between the inventors in the biblical and Babylonian traditions, both agree that this was one of the inventions of the antediluvians.

The third cultural feature is metallurgy, and Tubal-Cain forged instruments of bronze and iron. The same tradition about the antediluvians appears through several avenues in Babylonian lore. The second antediluvian city was associated with metallurgy, for its name, Bad-Tibira, means “wall” or “fortress” of the “metalworkers.”¹⁰ We can compare the personal name of Tubal with the city name of Tibira. Vocalization aside, we can see that the only consonantal element in which they differ is in the final consonant, the biblical name presenting an *l*, while the Babylonian name was written with an *r*. These two letters are classified phonetically in the category of phonemes known as laterals because they are pronounced especially with the lateral margin of the tongue. U.S. soldiers employed this phonetic feature in World War II by using passwords in the South Pacific that included *r*, because that sound was difficult for Japanese soldiers to pronounce, and it came out as an *l* in their speech. With a phonetic shift it would not be difficult to equate these two names.

Sippar, the name of the fourth antediluvian city according to the Babylonians, refers to bronze, one of the two antediluvian metals identified by Genesis 4. The last antediluvian capital city in the Sumerian king list was Shurruk, and its last king was Ubar-Tutu. (He was the father of the flood hero, Ziusudra, the Sumerian Noah who saved his family in the Ark through the flood.) Ubar-Tutu presumably died before the flood, for the total of his regnal years is given in the Sumerian king list. His name is similar to some names at the end of the Genesis 4 genealogy. If the elements are reversed, his name becomes Tutu-Ubar, and if a phonetic shift is employed for the final lateral, as was suggested above, it could be transformed into Tutu-ubal. If we were to drop one of the duplicated syllables in the first element of this name, we would have Tu-ubal or Tubal, which is also found in the name of Tubal-Cain in Genesis 4, the third and last of the brothers responsible for developing the arts and the sciences before the flood. While Ubar-Tutu is not specifically connected

with metalworking in the Babylonian tradition, he and Tubal-Cain are located in the last generation before the flood, and the names resemble each other with minor alterations. Thus, both the city of the metalworkers and the city of bronze have been located in antediluvian times, and one of the last antediluvian kings has a name similar to the name of the developer of metallurgy.

In summary of this section, we can conclude that all three features of the Babylonian traditions correspond to those mentioned in Genesis 4: animal husbandry, musical instruments, and metal working.

THE FLOOD HERO AT THE END OF GENESIS 5

Each ancient Near Eastern flood story has a hero: the biblical hero is Noah, the Old Babylonian hero is Atra-Hasis, the Sumerian hero is Ziusudra, and the Neo-Assyrian hero is Utnapishtim. Because their names cannot be connected linguistically, it may appear that Noah's name is unknown outside the Bible. In this regard, one other flood story from Mesopotamia or Anatolia should be considered: the Hurrian Flood story, the tablet for which was found in the archive at Boghazkoy, the ancient Hittite capital of Hattushash. Fortunately, though the tablet is badly damaged so that very little of the text is legible, enough can be read to recognize that the text presents a flood story whose hero is named na-ah-ma-su-le-el.¹¹ Assyriologists have observed that the name has a general resemblance to Noah, but they have not gone further with the comparison. E. A. Speiser has observed about this name: "Comparison with Noah has been suggested; such a possibility cannot be ruled out, but neither can it be relied upon."¹²

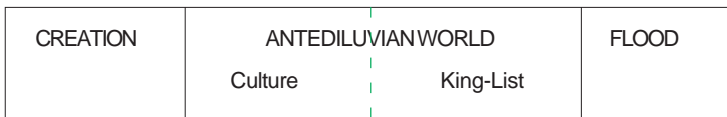
I would suggest a more detailed comparison between this name and Noah's. Is it possible that the names of two antediluvian patriarchs were joined here? The first name would be na-ah, which corresponds quite directly with Noah. The most likely candidate for the second name, ma-su-le-el, would be Methuselah, or ma-(tu)-su-le-el. The final element or sign in this name, -el, is the word for God or god. It might have functioned as a determinative or phonetic complement for "god" from a Semitic (non-Hurrian) language. As Methuselah was the longest-lived, antediluvian patriarch, it would not be surprising that some memory of him would also be preserved.

THE TRIPARTITE DIVISION OF LIFE BEFORE THE FLOOD

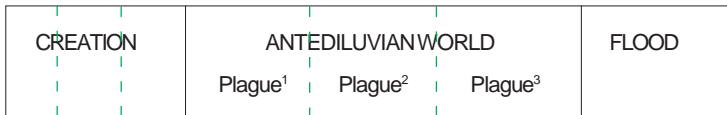
In an earlier (1984) study published in *Origins* (Vol 11, p 9-29), I provided a comparison of the literary structure of "creation-flood"

stories with the literary contents of Genesis 1-9. I concluded that creation and flood stories were linked in the ancient Near East; they did not just circulate separately and independently. The tripartite structure (the extended format containing a narrative of creation, antediluvian life, and the flood) is found in the Sumerian creation-flood story (the Eridu Genesis) which dates from the early second millennium and the Old Babylonian creation-flood story known as the Atra-Hasis epic. Only the Neo-Assyrian form of the flood story lacks this type of literary structure, for there the flood story is independent of the creation story and has only a brief reference to the antediluvians before the flood. In other words, the two older forms of these texts contain the extended format while the later form does not. In my previous study I diagrammed these comparisons along with the parallel outline of the biblical text in the following manner:¹³

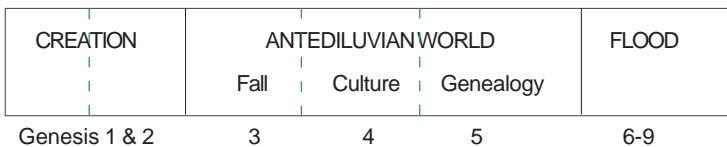
I. The Sumerian Creation-Flood Story; the Eridu Genesis, ca. 1600 B.C.



II. The Akkadian Creation-Flood Story; the Atra-hasis Epic, ca. 1600 B.C.



III. The Hebrew Creation-Flood Story; Genesis 1-9



We will concentrate on the middle third of these outlines — the antediluvian period of life. The two lower diagrams suggest a further tripartite subdivision of the antediluvian period, and this subdivision is evident from both biblical and extrabiblical sources.

The biblical materials, being probably the best known, will be considered first. After the description of the fall in Genesis 3, the biblical text relates the story of Cain and Abel in Genesis 4, before it launches

into the more extended genealogy in the latter part of the chapter. The sad and unfortunate fratricide was an isolated incident in human history. While demonstrating the malice that man's now-fallen nature was capable of, it did not provide a lengthy description of the general conditions of the time. Further details are seen in Genesis 4:12 (and reiterated in v. 14), when God pronounces Cain's fate: the ground and fields would no longer yield him their strength, and he would be a wanderer and a fugitive on earth.

In short, Cain would live a nomadic or semi-nomadic existence. Having no permanent roots, he would have to be a food-gatherer, along with whatever he could obtain from his herds and flocks. This, then, appears to be the first lot of man, as it is described more extensively for this branch of Adam's family than the type of existence under which the line of Seth lived.

This description of Cain's life after he murdered Abel is closely paralleled by the type of existence that was predicated for man, according to the Eridu Genesis.¹⁴ After creating man, the birth goddess abandoned him to his own devices. Unable to thrive under those circumstances, man was basically a dirty, ragged, uncultured, semi-nomadic herder of animals. We might designate the nomadic and outcast stage as Phase One of antediluvian life, which was apparently limited and restricted more to the direct descendants of Cain. In the extrabiblical, ancient Near Eastern source, this stage has been generalized and broadened to represent the experience of all mankind.

Phase Two of antediluvian life might be described as one of prosperity, success, and longevity. This is represented in particular by the genealogy of Genesis 5 and the kings and cities of the Sumerian king list. Neither list provides much information about living conditions, but the Babylonian sources emphasize the prosperity that flourished after the birth goddess showed pity toward her creation by establishing cultural centers and bestowing the gift of kingship upon mankind. In fact, conditions improved so much that some kings reigned over cities and countries for periods up to and in excess of 36,000 years. While Genesis 5 does not present as self-congratulatory a picture, it emphasizes the fact that there was a race of long-lived giants, and thereby conveys the idea that the pristine, primitive world was beneficial for mankind.

This primeval and prosperous picture did not last. Phase Three (the final phase of antediluvian life) was one of adversity and decline. Because mankind perverted the gifts of the Creator (Genesis 6), God took the serious step of appointing a worldwide flood to purify the earth

and its inhabitants from their wickedness. Once again the biblical story conveys a moral lesson that is lacking from the Babylonian epic. Although the Babylonian sources also indicate a time of adversity for the antediluvians, this decline was not caused by the moral evil of mankind; it occurred by the virtual whim of the gods. This is revealed more clearly in the Atra-Hasis Epic which describes three periods of physically bad experiences for the antediluvians: a plague executed by the god Namtara, a drought activated by the god Hadad, and a famine as a climax.

In each adverse case, however, the people were able to escape because Enki, the god of wisdom, told Atra-Hasis which god would relieve the dire circumstances if he were offered sacrifices and worshipped. Atrahasis followed Enki's instructions carefully, and in each case relief came to the people. Enlil, the chief active administrative god, however, was not appeased, and after the plans for mankind's destruction had been thwarted, Enlil determined to bring the ultimate solution to eradicate all of mankind. Rather than appointing one god to accomplish his intentions, he persuaded the entire council of the gods to agree to this procedure of total devastation by flood. This time, the general population was destroyed, and only the flood hero, along with some of his family and livestock, escaped. The final solution *almost* accomplished its purpose, but Enlil was enraged because some persons from mankind remained.

There is a discrepancy in the way that the extrabiblical sources portray antediluvian life. The Eridu Genesis and the Sumerian king list convey the idea that the antediluvian world thrived until the time of the flood. In contrast, the Atra-Hasis Epic depicts life as worsening drastically. Are we to assume that its author knew of the antediluvian period only as one of fear, terror, and dread, while the author of the Eridu Genesis viewed it as having unbridled prosperity and success? If so, then the authors of these two texts did not have access to the alternate views which the opposite texts present. This would leave a very narrow line of transmission for distinct and contrasting pictures of antediluvian life.

Other portions of these stories overlap enough for us to realize that they do not diverge, for the most part, until they describe the final events before the flood. The tension between the Eridu Genesis and the Atra-Hasis Epic is resolved by arranging their episodes of antediluvian life in sequence. The Eridu Genesis emphasized the first phase, man's nomadic condition leading into the flowering under kingship. The Sumerian king list described the second phase, man's prosperity, success and longevity, while the Atra-Hasis Epic concentrated upon the final phase, the declining period that occurred shortly before the flood.

There is no contradiction unless one attempts to superimpose all three types of conditions upon the same period of time. The biblical text narrates the three phases of antediluvian life in chronological order, presenting the entire time span between creation and the flood. While Genesis 4 and 5 discuss the series of long-lived and apparently righteous men, at least in one of the lines of Adam's family, Genesis 6 focuses on the moral evil of men as reaching its peak until it brought on the flood. If the extrabiblical cuneiform sources are arranged to follow this sequence, the elements of the Eridu Genesis are paralleled by Genesis 4, the Sumerian King List is paralleled by Genesis 5, and the Atra-Hasis Epic is paralleled by Genesis 6.

One final point might be made about the chronology. There is no explicit chronology for the first phase, either in the Bible or in the Eridu Genesis. The chronology of the second phase is bounded by the lengths of reign of the Sumerian king list from Babylonian sources and by the patriarchal dates in the biblical record as recorded in Genesis 5. While the dates are not the same, both sources discuss events upon a long magnitude of time, as compared to present-day human life-spans. The numbers are different, but the general trend of long-lived kings remains.

The chronology of the final phrase is short in both the Atra-Hasis Epic and in Genesis 6. According to Genesis 6:3, God determined that this period of probation, as E. A. Speiser puts it,¹⁵ was to last for 120 years. This was a relatively short time in terms of the lengths of the lives of the patriarchs as given in Genesis 5. The Atra-Hasis Epic has a similar period of time for the adversities that mankind experienced just before the flood. The text of both passages dealing with the plague and the drought begins by noting that "1200 years had not yet passed,"¹⁶ and this leads up to the occurrence of those adverse events. The fact that all three of these adverse events occurred within a 1200-year period indicates a quasi-probation period even by implication in the Mesopotamian source.

Here we wish to emphasize the very close similarity between these two final periods of existence before the flood, as described by the biblical and the Babylonian writers. They relate to each other by a factor of 10, expanding from 120 to 1200. There is also a parallel ratio involved. The lives of the biblical patriarchs approximated 1000 years, and the probationary period at the end was approximately 100 years. In the Babylonian sources, on the other hand, the lengths of the reigns of the kings were given in 10,000s of years, and the probational period approximated 1000 years. A logical supposition would be that both writers

knew of the same events in a similar relationship, even though their details differed. In addition, we notice again that the Babylonian source has shifted from a moral to a physical causation.

After having reviewed this evidence, we can modify the chart that was utilized above, by adding more details that are seen when all these sources are brought together:

	A	B			C
	CREATION	ANTEDILUVIAN WORLD			FLOOD
		Phase I Nomadic Period	Phase II Longevity & Prosperity Period	Phase III Evil Period (moral/ physical)	
Bible	Genesis 1-2	Genesis 4	Genesis 5	Genesis 6	Genesis 7-9
Sumerian	Eridu Genesis —	Eridu Genesis —	Sumerian King List	— —	Eridu Genesis —
Akkadian	Atra-Hasis Epic	—	—	Atra-Hasis Epic	Atra-Hasis Epic

SUMMARY AND CONCLUSIONS

In the preservation of their traditions about origins, the ancient Mesopotamians (the oldest writing society in the world) retained a full format of ideas about creation, the people who lived in the world immediately afterwards, and the flood — the great deluge which swept over the world and destroyed the antediluvians. When information about the antediluvians from these ancient Mesopotamian traditions are compared with the narratives that are preserved in the early chapters of the Bible, a number of rather direct and striking similarities are seen.

Babylonian sources identified two great lines of antediluvian patriarchs, but instead of classifying them according to their righteous or unrighteous conduct, they transformed these lists into two lines of political figures, kings and wisemen. That these individuals were very long-lived

is even more emphatically stated in cuneiform literature than in the Bible. When examined carefully in the light of comparative linguistics, the names of some of these individuals resemble biblical personalities, especially those that cluster around three points, at the beginning and the end of the genealogy of Genesis 4, and at the end of the genealogy in Genesis 5. Both the biblical and the extrabiblical sources describe the same cultural accomplishments for the antediluvians: the building of a city or cities, animal husbandry, metallurgy, and musical instruments.

In addition to these cultural features, both sources have characterized various successive periods of antediluvian experience. The different periods are divided into three eras. The period of nomadism that followed man's creation, according to the Eridu Genesis, is reflected in Cain's experience after he became a vagabond and a wanderer (Genesis 4:12,14). The period of the long-lived patriarchs which followed is reflected in both the Sumerian king list and the genealogy of Genesis 5. Both sources describe the final antediluvian period as being evil. In the Bible it was a morally evil time, whereas in the Atra-Hasis Epic, the gods imposed evil, physical conditions upon mankind for their own selfish reasons.

Our study has shown similarities between the biblical account and the Babylonian traditions of the antediluvian period. We can best describe their relationship by saying that their respective bodies of knowledge about these persons and events is derived from a common source. That source should ultimately be the historical persons and events that were preserved through oral tradition and written form in their respective societies. Under the influence of divine inspiration, the biblical account retained its historical narrative character, while the Babylonian treatment of these traditions became greatly mythologized, though some of the original contents and their similarities to the biblical record remain.

ENDNOTES

1. Shea WH. 1984. A comparison of narrative elements in ancient Mesopotamian creation-flood stories with Genesis 1-9. *Origins* 11:9-29.
2. (a) Speiser EA. 1955. Akkadian myths and epics. In: Pritchard JB, editor. *Ancient Near Eastern Texts Relating to the Old Testament*. Princeton: Princeton University Press, p 101-103. (b) For my detailed analysis of the Adapa Epic, see: Shea WH. 1977. Adam in ancient Mesopotamian traditions. *Andrews University Seminary Studies* 15:27-42.
3. Shea 1977, p 39 (Note 2b).
4. For a useful discussion of these wisemen and the sources in which they are referred to, see: Hallo WW. 1970. Antediluvian cities. *Journal of Cuneiform Studies* 23:62.
5. For a discussion of these textual variants, see *Ibid.*, p 61-63.

6. Oppenheim AL. 1955. Babylonian and Akkadian historical texts. In: ANET, p 265-266 (Note 1).
7. Hallo, "Antediluvian Cities," p 62 (Note 4).
8. Ibid.
9. Ibid., p 64.
10. Ibid., p 65, n 95.
11. Speiser EA. 1985. Genesis. Anchor Bible. 3rd ed. Vol. 1, p 42. Garden City, NY: Doubleday.
12. Ibid.
13. Shea WH. 1984. A comparison of narrative elements in ancient Mesopotamian creation-flood stories with Genesis 1-9. *Origins* 11:25.
14. Jacobsen T. 1981. The Eridu Genesis. *Journal of Biblical Literature* 100:513-529. For the discussion of man's nomadic conditions before he was granted the gift of kingship, see especially p 516-518.
15. Speiser, Genesis, p 42 (Note 11).
16. Lambert WG, Millard AR. 1969. *Atra-Hasis: the Babylonian story of the flood*. Oxford: Clarendon Press, Oxford, p 67, 71, 73.

ANNOTATIONS FROM THE LITERATURE

MOLECULAR PHYLOGENY

Kemmerer EC, Lei M, Wu R. 1991. Structure and molecular evolutionary analysis of a plant cytochrome c gene: surprising implications for *Arabidopsis thaliana*. *Journal of Molecular Evolution* 32:227-237.

Summary. *Arabidopsis* is a plant belonging to the mustard family. The *Arabidopsis* cytochrome c gene is a single-copy gene, consisting of three exons and two introns. Cladograms for cytochrome c amino-acid sequences, and DNA sequences for histone H3, alcohol dehydrogenase, and actin genes place *Arabidopsis* with yeasts or *Neurospora* rather than with other higher plants.

Comment. This result contrasts with the classic picture of cytochrome c as an excellent "molecular clock." It seems that increasing the number of species being compared results in increasing problems for the molecular-clock concept.

Shapiro SG. 1991. Uniformity in the nonsynonymous substitution rates of embryonic beta-globin genes of several vertebrate species. *Journal of Molecular Evolution* 32:122-127.

Summary. Placental embryonic beta-globin gene sequences are more similar than adult beta-globin gene sequences. The greater similarity is due to the nonsynonymous coding sites in the DNA. This is interpreted as suggesting greater functional constraints on the structure of the embryonic beta-globin genes than on the adult genes.

Comment. The theoretical basis for the molecular clock includes the necessity that most mutations be neutral and not subject to natural selection. This necessity appears to be violated in the case of embryonic beta-globin.

Westerman M, Edwards D. 1991. The relationship of *Dromiciops australis* to other marsupials: data from DNA-DNA hybridisation studies. *Australian Journal of Zoology* 39:123-130.

Summary. The possible relationships of Australian marsupials to South American marsupials is of considerable interest to biogeographers and evolutionists. South American marsupials mostly belong to two

groups: the opossums and the shrew-like caenolestids. *Dromiciops*, a South American marsupial, was first assumed to be an opossum, but some studies have suggested it might be more closely related to the Australian marsupials than to the other South American marsupials. This paper reports on DNA-DNA hybridization of *Dromiciops* and several other marsupials, representing both Australian and South American groups. The results are interpreted as indicating that *Dromiciops* is distinct from both groups of marsupials, and should be classified in a group by itself.

ORIGIN OF LIFE

Avetisov VA, Goldanskii VI, Kuz'min VV. 1991. Handedness, origin of life and evolution. *Physics Today* 44:33-41.

Summary. This paper discusses some of the theoretical requirements for the origin of life. Two parts of the problem are studied in detail: the problem of "handedness," and the problem of self-replication. Many organic molecules occur in two alternate forms, which can be called left-handed (L form) or right-handed (D form). Only D forms of sugars are used, and only L forms of amino acids. This feature is called homochirality. Homochiral molecules are required for life. This means that self-replication must be stereospecific, preserving the homochirality of the molecules. How such a system could have arisen is the subject of this paper.

Life requires both homochirality of polymers and very high stereospecificity in self-replication. The question is, Which came first, the high stereospecificity or the homochirality? Calculations show that the formation of homochiral polymers requires one of two types of conditions. If the stereospecificity is not very high, then the medium must be essentially chirally pure. If the medium is not essentially chirally pure, then the stereospecificity must be extremely high. The authors conclude that homochirality is necessary for extremely high stereospecificity, so stereospecificity could not have arisen first. This means that a chirally pure medium must have been present in order for life to originate.

The production of a homochiral medium presents difficult problems. Some mechanism can be postulated which will increase the rate of the D form of a molecule relative to the rate of formation of the L form. The concentration of D form in the medium would increase through this hypothetical process. At the same time, however, the concentration

of D form would decrease as it was used in constructing polymers. This means that L and D forms would be in equilibrium, and the probability of avoiding addition of an L form would approach zero as the length of the polymer increased. Addition of an L form would disrupt the secondary structure of the molecule, preventing life from arising. The authors propose a different mechanism to achieve homochirality of the medium. They propose a “bifurcation” type process, and suggest that such a system is capable of producing a chirally pure medium just long enough for stereospecificity to arise.

Comment. A scientific explanation for the origin of life involves many apparently insoluble problems. This paper illustrates the seriousness of just one of these problems, the origin of homochiral replication.

PALEONTOLOGY

Benton MJ. 1991. Polar dinosaurs and ancient climates. *Trends in Ecology and Evolution* 6(1):28-30.

Summary. Scientists have generally considered dinosaurs to have lived in warm, tropical, usually humid environments. However, dinosaur fossils have been found at several locations within the arctic or antarctic. Locations include Spitsbergen, the North Slope of Alaska, Northwest Territory, Yukon Territory, southern Australia, New Zealand and Antarctica. How could such large animals live in an area with the long periods of darkness typical of polar regions? One suggestion is that the dinosaurs were “warm-blooded.” No one really knows whether they were or not, but their reptilian structure is usually associated with being “cold-blooded.” Another suggestion is that the dinosaurs migrated long distances to avoid the winter cold. Required distances for migration may have been 2000-4000 km each way. Another suggestion is that polar regions were warmer at the time the dinosaurs lived.

Comment. Whatever the answer, it appears that conditions were once greatly different from what they are today.

Buick R. 1991. Microfossil recognition in Archean rocks: an appraisal of spheroids and filaments from a 3500 m.y. old chert-barite unit at North Pole, Western Australia. *Palaios* 5:441-459.

Summary. Various claims of Archean (lower Precambrian) fossils have been made, but controversy has surrounded the claims. The author summarizes some criteria that should be applied to claims of fossils in

Archean rocks. Several examples of supposed Archean microfossils from Western Australia are described. None of these claimed microfossils is convincingly supported. The author suggests that claims of Archean microfossils be examined closely, applying the list of criteria he has prepared.

Coates MI, Clack JA. 1991. Fish-like gills and breathing in the earliest known tetrapod. *Nature* 352:234-236.

Summary. The amphibian-like *Acanthostega* is one of the earliest known tetrapods. This paper reports the discovery of a gill-support structure on a specimen of *Acanthostega* that was collected from the Upper Devonian of Greenland. The specimen also has front feet with 8 digits, a stapes, and fish-like bones in the skull. *Ichthyostega* is generally considered a link between fishes and tetrapods. Some of the characteristics of *Ichthyostega* resemble the tadpole stage of an amphibian, but interpretation is complicated by the lack of any modern representatives of the group to which it belongs.

Reisz RR, Laurin M. 1991. *Owenetta* and the origin of turtles. *Nature* 349:324-326.

Summary. *Owenetta* is a procolophonid reptile (Order Cotylosauria, Suborder Procolophonia, Family Nyctiphuretidae) from the Upper Permian and Lower Triassic of South Africa. *Owenetta* shares several derived features with turtles, and the authors suggest that the procolophonids are the sister group to turtles, and that turtles may have arisen in the Late Permian. The alternative sister group for turtles is the Captorhinidae (Order Cotylosauria, Suborder Captorhinomropha), which first appear in the Lower Permian of North America. Turtles first appear in the Middle or Upper Triassic, with no obvious links to any other group. This paper represents an attempt to resolve the puzzle of the origin of turtles.

Shubin NH, Crompton AW, Sues HD, Olsen PE. 1991. New fossil evidence on the sister-group of mammals and Early Mesozoic faunal distributions. *Science* 251:1063-1065.

Summary. Newly discovered fossil material from the Lower Jurassic of Nova Scotia, Canada reveals the presence of a fossil mammal-like reptile from the family Tritheledontidae. This is the first definite record of this family in North America. The material appears to be from the same genus and species (*Pachygenelus monus*) as

previously found in South Africa. Other material from the same formation in Nova Scotia is similar or indistinguishable from material from other Lower Jurassic formations in Africa, Europe or Asia. Several synapomorphies form the basis for considering the tritheledontids to be the sister group of mammals. One of these is a jaw joint between the dentary and squamosal.

The nearly worldwide distribution of Lower Jurassic species, after the initiation of Pangean fragmentation, is of interest biogeographically. The first fossil mammals are found in the Upper Triassic, stratigraphically lower than the Nova Scotian reptiles.

POPULATION GENETICS

Fleischer RC, Conant S, Morin MP. 1991. Genetic variation in native and translocated populations of the Laysan finch (*Telespiza cantans*). *Heredity* 66:125-130.

Summary. Much theoretical work has been done on the concept of genetic bottlenecks and founder effects, but little actual field evidence is available. This paper reports genetic differences among populations of Laysan finches on four islands. Contrary to expectations, population bottlenecks did not result in reduced levels of genetic variation. In fact, genetic variation appears possibly to have increased after the bottleneck. The differences are relatively minor, but occurred in less than twenty years.

Comment. This result is contrary to the conventional wisdom, and may have important implications for models of speciation.

PUNCTUATED EQUILIBRIA OR INCOMPLETE SAMPLING?

Cuffey RJ, Pachut JF. 1991. Clinal morphological variation along a depth gradient in the living scleractinian reef coral *Favia pallida*: effects on perceived evolutionary tempos in the fossil record. *Palaios* 5:580-589.

Summary. Coral from the Pacific island of Enewetak was used in this study. Samples were taken of a reef coral at depth intervals of about 4.5 m, and measured for corallite diameter and growth rate. Coral samples showed a clinal gradation from shallow to deep water. Samples from different depths were statistically different. If sampling were incomplete, they would form a stepwise “punctuated” pattern, while more complete sampling would reveal a clinal “graduated” pattern.

The possible existence of environmental gradients should be considered in efforts to understand trends in the fossil record.

LITERATURE REVIEWS

Readers are invited to submit reviews of current literature relating to origins. Mailing address: ORIGINS, Geoscience Research Institute, 11060 Campus St., Loma Linda, California 92350 USA. The Institute does not distribute the publications reviewed; please contact the publisher directly.

NEO-DARWINISM IS NOT DEAD

ARGUMENTS ON EVOLUTION: A PALEONTOLOGIST'S PERSPECTIVE. 1989. Antoni Hoffman. NY and Oxford: Oxford University Press. xiii + 274 p. Cloth, \$29.95.

Reviewed by L. J. Gibson, Geoscience Research Institute

This book is written as a critical analysis of certain recent evolutionary concepts proposed as alternatives to Neo-Darwinism. Hoffman is a well-known European paleontologist, and his thesis is that Neo-Darwinism is much better off than some of its detractors seem to believe.

The first five chapters act as an introduction and provide a background for the next seven chapters, which contain the real argument of the book. After dismissing creationism and puzzling over transformed cladism in Chapter 1, Hoffman briefly describes some of the challenges to orthodox Neo-Darwinism in Chapter 2. These include controversies over the relative importance of natural selection, the role of ontogenetic patterns, the decoupling of microevolution and macroevolution, and the neutral theory of evolution. Chapter 3 contains a brief summary of modern Neo-Darwinian evolutionary theory. The value of the fossil record is discussed in Chapter 4. Particular applications include paleoecology, hypotheses concerning phylogeny, and establishing time correlations. This chapter ends with the statement that uncertainties in the fossil record do not make it worthless, but it must not be taken at face value. This is a surprising statement to hear from a paleontologist. In Chapter 5, Hoffman discusses some philosophical aspects of the difficulty of reconstructing historical events. Two points of interest here are the difficulty of disproving any hypothesis, and the danger that one's view of nature may determine one's approach to inquiry.

The next four chapters are grouped under the heading "Macroevolution." Chapter 6 concentrates on an unhelpful effort to give a

suitable Neo-Darwinian definition to the term macroevolution. Punctuated equilibrium is dissected in Chapter 7, after which the pieces are discarded one by one. Whether species should be treated as individuals or as classes is a philosophical question discussed but not answered in Chapter 8. In Chapter 9, Hoffman characterizes the concept of species selection as an explanation in search of phenomena; in other words, a concept built on imagination rather than data.

Chapters 10 through 12 discuss various aspects of “megaevolution,” which Hoffman considers (Chapter 10) to mean the largest-scale supra-specific patterns in space and time. Mass extinction is the subject of Chapter 11. The periodicity of mass extinction is dismissed and even the reality of mass extinctions as worldwide or instantaneous events is challenged. Supposed diversity patterns through the Phanerozoic are discounted in Chapter 12, with the conclusion that so-called mega-evolutionary phenomena are merely aggregations of microevolutionary phenomena. In Chapter 13, the concluding chapter, Hoffman emphasizes the individualistic nature of living organisms and processes affecting them.

Throughout the book, Hoffman admirably maintains a posture of open-mindedness to new data. Although he does successfully point out weaknesses in the arguments he attacks, I did not find answers to the problems pointed out by these alternatives. Nevertheless, Hoffman has shown that Neo-Darwinism is not ready to give up yet.

LITERATURE REVIEWS

Readers are invited to submit reviews of current literature relating to origins. Mailing address: ORIGINS, Geoscience Research Institute, 11060 Campus St., Loma Linda, California 92350 USA. The Institute does not distribute the publications reviewed; please contact the publisher directly.

MUST CREATION-SCIENCE BE EITHER UNBIBLICAL OR UNSCIENTIFIC?

PORTRAITS OF CREATION: BIBLICAL AND SCIENTIFIC PERSPECTIVES ON THE WORLD'S FORMATION. 1990. Howard J. Van Till, Robert E. Snow, John H. Stek, & Davis A. Young. Grand Rapids, MI: Wm. B. Eerdmans Publishing Company. 285 p. Paper, \$14.95.

Reviewed by R. H. Brown, Yucaipa, California

Portraits of Creation was evidently prepared to be a definitive treatment of the tension between science and theology over the origin and development of the physical universe. The treatment focuses on the evidence provided by geology, astronomy, and the first chapter of the book of Genesis, and includes intensive philosophical consideration of the nature of natural science and the nature of the Genesis account of creation. A critique of modern creation-science precedes the analysis of biblical considerations.

This book is skillfully written. Some parts are worth reading for their literary quality alone. Extensive footnotes, conveniently located on the page where noted, give clear definitions of technical terminology, elaboration of the authors' thoughts, and a generous bibliography for the reader who wishes to investigate a topic more extensively. The authors have achieved a high degree of excellence in serving the purposes for which the book was written.

After the introductory chapter there is an excellent brief treatment on the history of human thought concerning the nature of physical reality. The discerning reader will note that this material is skillfully presented to provide a foundation for lack of confidence in the first chapters of Genesis as a straightforward account of real events and historical sequence. Extraordinary skill toward this objective is demonstrated throughout the following chapters. The book will be welcomed by anyone who *wants* to be freed from a simplistic, literal understanding of the first eleven chapters of Genesis. It will provide convenient access to valuable insights and useful references for many individuals who are concerned for the establishment of faith in biblical testimony.

On p 24, “nature’s properties, behavior, and formative history” are implied as being equally discernible by means of experimental science, thus improperly transferring to speculations concerning the unobservable past the confidence generated from success in discovering properties and behavior subject to controlled experimentation. Only in the latter part of the book is there passing recognition of the need for placing speculative, experimentally unverifiable science in a category separate from hard science (conclusions concerning nature’s properties and behavior) that utilizes repeated and controlled observation. On p 25, in an evident allusion to some products of the modern creation-science movement, Robert Snow says:

... we need to take to heart Augustine’s caution that ‘it is deplorable and mischievous and a thing especially to be guarded against that [an unbeliever] should hear a Christian speaking of [scientific] matters in accordance with Christian writings and uttering such nonsense that, knowing him to be as wide of the mark as ... east is from west, the unbeliever can scarcely restrain himself from laughing.’

In Chapter 3 there is a review of some bizarre explanations that have been developed by creationists, both ancient and modern, in their attempts to account for geologic features. I must agree with Davis Young’s assessment that “no consensus has emerged about how the geological sequence of events is to be linked with the biblical sequence of events” (p 59); that “there are many *conflicting* concordisms, and not one of them does an adequate job of dealing with the diversity of questions raised by the evidence uncovered by biblical and scientific scholarship” (p 60). The examples in the latter part of this chapter are presented so as to give the reader the impression that the long-age uniformitarian model accounts for all geologic features with complete satisfaction. It is unfortunate that the reader is not given a balanced exposure to geologic features that are much better explained with a short-time-frame diluvial model. A fully satisfactory treatment of geologic features awaits a better understanding of geology and a broader perception of processes associated with the flood than are presently available.

Howard Van Till’s treatment of data provided by astronomy leads to a penetrating discussion of the creation *ex nihilo* concept that he concludes by saying: “A big-bang beginning and creation *ex nihilo* cannot be equated. In no way do they offer answers to the same question” (p 114).

What the authors are endeavoring to promote as the *standard model* comes to clear expression on p 118:

Finally, to say that the ordinary patterns for material behavior have been followed continuously throughout cosmic history is

to exclude from cosmological models the introduction of arbitrary discontinuities. It is becoming increasingly evident that the interpretation of the physical record of cosmic and terrestrial history does not require a reliance on any special events that interrupt or contravene the ordinary patterns of proximate causality.... That part of cosmic history accessible to scientific investigation appears to be composed of a continuous flow of phenomena that conform to the ordinary patterns for the behavior of physical systems.

In the first four pages of the chapter entitled “The Characteristics of Contemporary Natural Science,” Howard Van Till gives a clear statement of the difference between science and scientism, a distinction that is crucial to an understanding of science-versus-the-Bible issues. But the reader is prepared for unsound conclusions by the statement on the next page (p 130) that “*physical properties, physical behavior, and formative history...these three aspects of the physical universe are empirically accessible to us....*” Historical questions cannot be studied by repeated observation under controlled circumstances, and belong in a distinct category: Speculative Natural Science. Success in the discovery of physical properties and physical behavior is improperly used as an assurance that scientific speculations concerning history are correct.

According to my assessment, the creationist literature would be much more effective than it is today if all contributors had worked in accordance with the maxim expressed by Dr. Van Till on p 131: “both theists and non-theists...must resist the temptation to coerce science into warranting (in the sense of proving) their particular religious beliefs.” There can be a critical difference between presenting some scientific material as “proof” for a religion-derived viewpoint, or attempting to show how this material might be explained from that viewpoint. The discussion of the relationship between religious viewpoints and scientific evidence on p 147-151 provides a valuable perspective, but does not give recognition to the advantages that may be enjoyed in research conducted with insights obtained from reliable testimony such as the Bible.

Chapter 6 gives a description of modern creation-science as it appears to the members of the scientific and intellectual community who are not constrained by the biblical testimony. All individuals who are active in promoting creationism on a scientific basis should read this chapter. In concluding the chapter, Robert Snow says:

Without realizing what they have done, many of the leaders of the creation science movement have betrayed the trust placed

in them by their lay followers. The pervasive lack of critical judgment that characterizes the creation science literature is due to its role as a folk science intended primarily to offer 'comfort and reassurance to believers' rather than to make a contribution to our deeper understanding of the created world (p 202).

We must not allow criticism of the creation-science literature, however justified that criticism may be, to denigrate the sincerity and dedication of the contributors to this literature, or to determine our confidence in the Hebrew-Christian scriptures. There is need for recognition that much creation-science literature is of excellent scientific quality.

In Chapter 7, John Stek gives a summary of the textual criticism arguments against a straightforward literal reading of Genesis 1:1-2:3. He relies on anthropological and archaeological scholarship, in preference to the testimony of Genesis 1-11, for a reconstruction of human history, and considers the 7-day creation week account to be a metaphorical narration written for the *exclusively religious* (his italics) purpose of proclaiming knowledge of God, His manifestation in created works, and His relationship to mankind. Dr. Stek's exhaustive treatment of the meanings of the Hebrew verbs associated with the "creation" concept should be welcome to any biblical creationist.

The characteristic thrust of this book is clearly stated on p 242:

To read Genesis 1:1-2.3 as a piece of divinely revealed 'historiography' disclosed to humanity's first pair and transmitted by tradition to the author of Genesis will no longer do.... While Genesis 2:4 ff. ["ff." presumably designating the entire remainder of the Bible] presents an account of God's ways with humankind in the arena of human history, the grand overture that precedes [sic] it presents not historical or scientific data but the fundamental theological...context of that drama.

If Genesis 1 is to be treated in this manner, what about Chapters 7 and 8 (the flood account)? (In Chapter 3, entitled "The Discovery of Terrestrial History," the authors treat Genesis 7 and 8 as legend/myth, rather than reliable historical data concerning a universal flood of brief duration.) What about Genesis 19 (the destruction of Sodom and Gomorrah)? What about the events reported in the Gospels of the New Testament? Once one starts mythologizing portions of Scriptures that were endorsed by subsequent Bible writers, where does one stop?

Under the heading "The Creation as God's Kingdom" (p 253-255), Dr. Stek concludes that the physical universe is a distinct, intelligible, integrated, composite system, separate from God, but pervasively contingent on

the free will of the Creator, yet subject to misconstrual and exploitation. This succinct statement gives a comprehensive base from which to evaluate any cosmology.

A statement on p 262 that was obviously directed toward creation-science can *just as well* apply to uniformitarian science:

... the creation contains no inner deceptions. Humans can misread the phenomena, misinterpret their experience of the world, introduce distortions in their gathering of data, pursue misguided research, and employ wrongheaded principles of explanation, but the creation itself does not mislead. As God's appointed stewards over God's creation, we can trust the integrity of compelling evidence to lead us into a valid understanding of the creation. The Creator is not a deceiver...

Yes, God is not a deceiver. He has given us the revelation of Genesis 1-11 to preserve us from incorrect conclusions; when we disregard His revelations we cannot claim divine assurance for the accuracy of our conclusion!

Another significant statement on p 262 is: "... human understanding of the Bible is as subject to fault as human understanding of the creation." Then why not have faith to search for an understanding of both the Bible and the natural world that does not degrade Genesis 1:1-2:3 as is so commonly done in modern Christendom? Why not work from an understanding of the creation account in Genesis 1:1-2:3 that is based on the definitions God has included in Genesis 1:8,10, rather than on concepts which have become attached to the terms "heaven" and "earth" over the last 3000 years? If we do this, the astronomical evidence does not compel the convoluted treatment of Genesis 1 featured in this book. (Since radioisotope age characteristics may be preserved, completely or partially, in a relocation by a geologic process, the same can be said concerning the nuclear isotope evidence which the authors give only passing reference.)

Portraits of Creation gives a good presentation of the pattern on which the Bible has been interpreted in conformity with modern uniformitarian science, and which provides a basis for a religion that is apparently Bible-based, yet places the generally accepted views among scientists in the position of ultimate authority. It gives no recognition to the possibilities for interpreting the observations in the various sciences in a manner that is both logically sound and consistent with the specifications in the Bible.

GENERAL SCIENCE NOTES

QUANTUM MECHANICS: THE STRANGE WORLD AT SMALL DIMENSIONS

By B. L. Clausen, Geoscience Research Institute

Science usually uses some kind of model as it tries to make the natural world understandable. It uses the known to model the unknown. This is a standard and useful method, but caution is required when it is necessary to extrapolate from the familiar and understood to the unfamiliar and extreme. Geological and evolutionary models attempt to describe what happened in the distant past history of the earth. Special relativity describes what happens to particles traveling at high speeds close to that of light. General relativity describes the effects of strong gravitational fields. Quantum mechanics describes nature at the extremely small sizes of the atom or nucleus. To demonstrate some of the cautions necessary in developing a model for extreme conditions, it is useful to examine this last model describing small-scale phenomena.¹

MODELS OF THE INFINITESIMAL

The essence of nature at very small sizes was first discussed by the Greek philosophers Leucippus and Democritus. They believed that discrete, indivisible “atoms” that moved in a void served as the building blocks for matter. The observable world arose from the relation between atoms in the same way that a book arises from the letters that make it up.² At one time scientists thought the chemical elements were these fundamental building blocks, then later it was electrons, protons, and neutrons. Now quarks are generally accepted as the particles that make up protons, neutrons, and other exotic particles. This particle nature of matter was extended by Newton to describe light as well. Light as a stream of particles was the accepted model during the 18th century.

On the other hand, Aristotle’s physics was the study of nature and its processes on the basis of form and motion.³ The essence of nature was the action, not the material substance. A medium was needed to initiate and preserve the motion, thus ruling out the possibility of a vacuum. Ocean waves are the action, in contrast to the material substance of the water medium in which they travel. Sound waves are the action in

contrast to their medium of air. During the 19th century, the accepted model of light was also a wave model. As a result physicists spent a great deal of time trying to observe the medium in which it traveled and determine its properties. This postulated ethereal substance was called “aether.”

In the early 20th century, science developed the quantum-mechanical model to describe the essence of nature at small dimensions that encompasses both the wave and particle concepts. Quantum mechanics has an impressive ability to explain and quantify small-scale phenomena. It was used in developing and explaining such well-known components of our technological society as the television screen, the radio transistor, the computer chip, the grocery-store laser, and the credit-card hologram. Quantum mechanics is the basis for understanding chemistry at the atomic level and for the development of atomic bombs and nuclear power. It has the ability to make exceedingly accurate calculations of the fundamental quantities of nature. According to quantum mechanics, an electron that behaves something like a little magnet should have a magnetic moment that includes a factor of 1.001159655. The experimentally measured value is 1.001159658. This accuracy is equivalent to measuring the distance from Los Angeles to New York to within the width of a blade of grass.⁴

With all its successes, quantum mechanics does not try to answer the question of whether the essence of nature is wave-like or particulate. As a result, it has introduced philosophical issues that have been debated for 60 years.⁵ The consequences of the quantum-mechanics revolution have changed the very core of physics and the philosophy of science and are so “shattering as to be almost beyond belief — even to the scientific revolutionaries themselves.”⁶

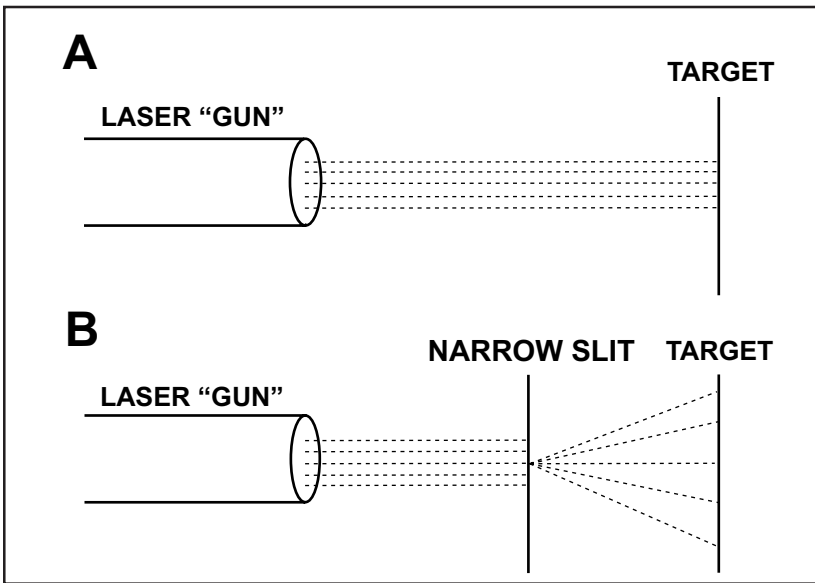
THE BEHAVIOR OF LIGHT AS WAVE OR PARTICLE

Light appears to exhibit both wave and particle properties. The *wave* aspects are evident when light is transmitted from one place to another without losing energy. The wave property of interference accounts for the colors seen in oil slicks, soap bubbles, and peacock wings. The wave property of diffraction accounts for the spreading of light when it passes through a narrow slit. This same wave property explains why water waves can spread around a turn in a river and sound waves can be heard around corners. The *particle* aspects are important when light interacts with matter during emission and absorption.

The model of light as particles or photons is used to explain why light bulbs do not emit ultraviolet radiation and X-rays, why photocells for turning on street lights at night might be more sensitive to blue light than to red light, and why neon and mercury vapor lamps only emit certain colors of light. The particle aspects and the wave aspects of light seem to be important at different times.⁷

Since 1930, quantum mechanics has reconciled these apparently contradictory properties observed for light, but at the expense of introducing some philosophical problems. A laser beam can be used to illustrate the apparent contradictions. The particle model of light must be used to describe the emission of light by the laser. Once the laser “gun” is aimed and the “bullet” particles fired, one should be able to predict where each particle of light will hit the “target” (Figure 1A). It might be expected that a more accurate prediction could be made by passing the beam through a very narrow slit, removing particles at the periphery of the beam. However, after the beam passes the slit it spreads out (Figure 1B), making predictions about any particle less, rather than more, accurate.

FIGURE 1. A laser beam used to demonstrate particle properties (A) and wave properties (B) of light.



This spreading of the beam is not at all what would be expected for particles, but is best described by the diffraction property of waves.⁸

The complementary particle and wave properties of the laser beam demonstrate four philosophical issues introduced by quantum mechanics: (1) One tenet of quantum mechanics, the Heisenberg *uncertainty principle*, informs us that the more accurately the velocity of the particles aimed at the target is known, the less accurately the position where they hit the target can be known. This is no lack in our physical ability to measure accurately, but is an underlying uncertainty inherent in the natural world. (2) For these small particles, we have *lost determinism*. The effect (the location where the individual light “particle” hits the target) is no longer completely determined by the cause (the direction the laser-beam “gun” is aimed). (3) The path of any individual particle cannot be predicted. Only a *statistical probability* can be assigned to each of the many paths possible. The wave diffraction pattern can be described accurately only for a large number of “particles.” (4) The *experiment determines what will be observed* about the behavior of light. Depending on the nature of the experiment, light will behave as a beam of particles traveling in a straight line, or as a wave that spreads after passing an obstacle.

THE BEHAVIOR OF ELECTRONS AS WAVES OR PARTICLES

Like light, the electron sometimes appears to be a particle, and sometimes a wave. It behaves as a particle when it strikes the fluorescent screen of a television picture tube and a small flash of light is produced. However, it can also be diffracted like a wave. In 1907 J. J. Thomson received the Nobel prize for his experimental proof of the particle nature of the electron. In 1937 his son, G. P. Thomson shared the Nobel prize with C. J. Davisson for demonstrating the wave nature of the electron. Father and son demonstrated these two opposite, but complementary, aspects of the nature of matter.⁹

Louis de Broglie was the first to suggest that electrons may exhibit wave as well as particle properties in the same way that light does. Erwin Schrödinger described the motion of the electron in an atom in terms of a wave equation. The complementary particle and wave properties of electrons demonstrate the same philosophical issues as the laser beam: (1) Max Born interpreted atomic electrons as waves by assuming the waves were not real physical oscillations, but probability waves. The size of the wave at any given point in space was related to the probability

of finding the electron there. The electron orbit is not a sharply defined circle or ellipse but rather a “cloud of *probability density*.” (2) This interpretation was at the price of certain knowledge: both the location and the speed of the electron could not be described exactly. The relation between these two quantities is expressed in Heisenberg’s *uncertainty principle*. The better known the position of the electron, the more poorly known the velocity and vice versa. (3) The only consistent way to interpret the principle is to assume that the position and speed of an electron is *indefinite until an experiment is performed*. (4) The uncertainty about present measurements extends to an uncertainty in determining the future. This *destroys strict cause-and-effect* relations for small-scale phenomena.

At the beginning of the 19th century, Pierre Simon de Laplace argued from the spectacular astronomical successes of Newtonian mechanics that with a knowledge of the total mechanical state of the Universe at any moment of time the entire future would be certain.¹⁰ The uncertainty principle does away with this determinism and strict causality. It only allows the calculation of statistical probabilities for the outcome of any individual small-scale interaction. Only for a large number of atoms or electrons is it possible to make accurate predictions describing their average behavior.

FURTHER CONSEQUENCES OF QUANTUM MECHANICS

According to quantum mechanics, small-scale phenomena include an inherent uncertainty in their measurement, are described by statistical probabilities, are affected by the observer, and are not governed by strict cause-and-effect relationships. Radioactive decay is one of these small-scale phenomena. Quantum mechanics cannot predict exactly when an individual radioactive atom will decay; it can only calculate a probability that the atom will decay in some given amount of time, or calculate an average lifetime for a large number of atoms.

Radioactive decay is affected by being observed. Both the decayed and undecayed state of the atom are inherent until the atom is actually observed. In 1935 Erwin Schrödinger illustrated the situation by a now-famous thought experiment involving a cat.¹¹ The cat is placed in a box with the following “diabolical device.” A small bit of radioactive material is placed in a Geiger counter which, if activated by decay of an atom, will trigger a hammer which shatters a small flask of hydrocyanic acid, killing the cat. According to the rules of quantum mechanics, the total system includes both a live and a dead cat “until someone peeps into the

box to check on it, at which point it is either projected into full vitality or else instantly dispatched!”¹² The affect of the observer is still being intensely researched and debated. A recent article entitled “Schrödinger’s cat ensnared” describes a 1990 workshop concerned with ways in which quantum-mechanical effects can manifest themselves on a macroscopic scale.¹³

The quantum-mechanical theory of radioactive decay, where the disintegration of any individual atom is random, is in sharp contrast to usual scientific theories that are based directly on cause-and-effect relationships. No two atoms of a radioactive material are the same, because one will decay at one time and another at a different time. It has been suggested in one speculative hypothesis that there may be a cause for the difference. Perhaps the “individual atoms have, in a sense, a memory.”¹⁴

It is well known that, beginning in the 1920s, Albert Einstein broke with the whole of the physics community by refusing to accept quantum mechanics as more than a “provisional” account of nature. He objected to the absence of classical causality and determinism, the introduction of probability as the foundation for physical events, and the consequent incomplete description of nature. Einstein summarized his dislike of these consequences of quantum mechanics in his famous statement, “God does not play dice with the universe.” He made numerous attempts to refute the uncertainty principle or to find examples where it would lead to obvious error or paradox.¹⁵ In his most powerful attack on quantum mechanics, Einstein with two other physicists developed a thought experiment now called the Einstein-Podolsky-Rosen (EPR) paradox to show how ludicrous are the consequences of the uncertainty principle.¹⁶

The EPR paradox has to do with how the act of measurement affects what is observed. Suppose that a particle with no angular momentum decays into two photons. By conservation laws, both photons must have the same polarization. This can be confirmed by placing measuring devices called polarizers perpendicular to the paths of the two photons. If both polarizers are oriented in the same direction (‘up’ for example) and one photon passes through the polarizer in its path, the other photon will pass through the polarizer in its path, i.e., complete correlation. If the polarizers are arranged perpendicular to each other and one photon passes through the polarizer in its path, the other photon will be blocked by the polarizer in its path, i.e., complete anti-correlation. If the two polarizers are oriented obliquely to each other, the result is intermediate between complete correlation and complete anti-correlation.¹⁷

According to quantum mechanics, each photon has a combination of potential polarizations after it is emitted. Which potential possibility becomes the reality for each photon has to await a definite measurement or observation, but it takes the measurement of only one particle to effect the reality for both. The problem arises in trying to understand how the well-separated photons can communicate with each other. In particular, if both photons are observed simultaneously, there is simply no time for any signal to propagate between them. Einstein insisted that this result is paradoxical, unless the photons have a distinct polarization at the instant that they separate.

In the 1960s, the physicist John Bell studied the theoretical limits on the extent to which such measurements can be correlated.¹⁸ Bell proved that the degree of correlation between the two photons cannot exceed a certain definite maximum, if one assumes as Einstein did that the photons have a definite polarization before they are observed. In contrast, quantum mechanics predicts that this limit can be exceeded. Several experiments were performed to check Bell's inequality, the most notable of which was carried out by Alain Aspect and colleagues at the University of Paris in 1982.¹⁹ The amount of correlation between photons exceeded the maximum that Einstein would have predicted. The strange consequences of quantum mechanics were demonstrated to be correct in contrast to Einstein's "more sensible" interpretations.²⁰

The interest is not abating in these philosophical topics of determinism and of the interaction between the observer and the observed. A recent "always-vs-never refutation" of Einstein, Podolsky, and Rosen was described in a 1990 editorial of *Physics Today*.²¹ The topic was addressed by Eugen Merzbacher at an invited talk on "The Raw Nerve of Quantum Physics" in the same year.²²

CONCLUSIONS

Quantum mechanics is able to account for small-scale phenomena, but only by changing the questions to be asked. The question no longer has to do with whether the actual substance of nature is wave or particle, but with how it is observed to behave. The question has changed from Why does nature behave the way it does? to How does nature behave? Niels Bohr, one of those who worked on developing quantum mechanics, replaced ontological questions such as 'what is light' by phenomenological ones such as 'how does light behave under specified conditions?' Feynman said he could describe how Nature works, but nobody understands

why Nature works that way. One can describe the radioactive decay of nuclei, but cannot give a precise cause-and-effect explanation; in contrast to all other areas of science where such changes are precisely what ordinarily would require explanation. The Copenhagen interpretation of quantum events rejects the notion that all changes require explanation.²³

Basic to the problem is the fact that this theory that applies to the extremes of small size appears to violate common sense. No ordinary objects that we can visualize behave as both particles and waves. Therefore, no large-scale physical phenomena (a) have intrinsic uncertainties in measuring them, (b) disregard cause-and-effect relationships, (c) can only be described in terms of probabilities, or (d) are affected by how they are observed. Niels Bohr resolved the wave/particle contradiction by his complementarity principle. An electron is both a wave and a particle, not a hybrid. Although waves and particles are contradictory concepts for large-scale phenomena, there is no contradiction for small-scale phenomena where the two concepts are complementary. There is no contradiction when it is realized that small-scale phenomena for which we have only indirect evidence cannot be modeled after large-scale phenomena that can be visualized, that are familiar in normal experience, and upon which common sense is based. It is not surprising that no intuitively satisfying model of the small-scale phenomena is possible, because it cannot be based on large-scale phenomena with which we are familiar.

ENDNOTES

1. Gamow G. 1966. *Thirty years that shook physics*. NY: Dover Publications.
2. De Santillana G. 1961. *The origins of scientific thought: from Anaximander to Proclus, 600 B.C. to A.D. 500*. NY: New American Library, p 141-146.
3. Bynum WF, Brown EJ, Porter R, editors. 1985. *Dictionary of the history of science*. NJ: Princeton University Press, p 25.
4. (a) Feynman RP. 1985. *QED: the strange theory of light and matter*. NJ: Princeton University Press, p 7; (b) see also Halzen F, Martin AD. 1984. *Quarks and leptons*. NY: John Wiley, p 162.
5. Cushing JT, McMullin E, editors. 1989. *Philosophical consequences of quantum theory: reflections on Bell's Theorem*. Indiana: University of Notre Dame Press.
6. Cohen IB. 1985. *Revolution in science*. Cambridge: Harvard University Press, p 420.
7. Spielberg N, Anderson BD. 1987. *Seven ideas that shook the universe*. NY: John Wiley, p 184-206.
8. Feynman, p 54-56 (Note 4a).
9. Gamow G. 1988. *The great physicists from Galileo to Einstein*. NY: Dover Publications.

10. Hawking SW. 1988. A brief history of time: from the big bang to black holes. NY: Bantam Books, p 53.
11. DeWitt BS. 1970. Quantum mechanics and reality. *Physics Today* 23(9):30-35.
12. Davies PCW, Brown JR, editors. 1989. The ghost in the atom. NY: Cambridge University Press, p 28-30.
13. Ball P. 1990. Schrödinger's cat ensnared. *Nature* 347:330-331.
14. Oliver J. 1991. Solid earth science during the 21st century. *Transactions of the American Geophysical Union*, EOS 72:121-126.
15. Mermin ND. 1985. Is the moon there when nobody looks? Reality and the quantum theory. *Physics Today* 38(4):38-47.
16. Einstein A, Podolsky B, Rosen N. 1935. Can quantum-mechanical description of physical reality be considered complete? *Physical Review* 47:777-780.
17. (a) Davies P. 1983. *God and the new physics*. NY: Simon & Schuster, p 104-106; (b) see also Davies & Brown, p 16 (Note 12).
18. Bell JS. 1964. On the Einstein-Podolsky-Rosen paradox. *Physics* 1:195-200.
19. Aspect A, Dalibard J, Roger G. 1982. Experimental test of Bell's inequalities using time-varying analyzers. *Physical Review Letters* 49:1804-1807.
20. d'Espagnat B. 1979. The quantum theory and reality. *Scientific American* 241(5):158-181.
21. Mermin ND. 1990. What's wrong with these elements of reality? *Physics Today* 43(6):9-11.
22. Merzbacher E. 1990. The raw nerve of quantum physics. *Bulletin of the American Physical Society* 35:2357.
23. Bynum, Brown & Porter, p 55 (Note 3).

EDITORIAL

CREATION HOLDING ITS OWN

A recent Gallup Poll has affirmed significant acceptance of creation. Conducted in 1991, the survey of over 1000 representative adults in the United States also showed that the general “scientific” evolutionary model does not have strong preference. Individuals were given four choices:

1. Man has developed over millions of years from less advanced forms. God had no part in the process.
2. Man has developed over millions of years from less-advanced forms of life, but God guided the process, including man’s creation.
- 3 God created man pretty much in his present form at one time within the last 10,000 years.
4. I don’t know.

Results indicate that only 9% believe in the purely evolutionary model (Choice 1), 40% believed that God was active in a combination of creation and evolution (Choice 2); 47% believed that God created man in the last 10,000 years, as believed by creationists (Choice 3), and 4% did not know.

It is surprising that 143 years after the publication of the *Origin of Species* by Charles Darwin and persistent efforts on the part of evolutionists to promote their views, only 9% of the general population believe them. This is all the more surprising in view of the very broad endorsement of evolution by the powerful scientific community. Unfortunately, Choice 3 about man’s recent creation, which was selected by 47%, did not involve a statement about the rest of creation and may not fully represent the standard biblical creation stance, but it is the closest choice to it.

A very similar Gallup Poll conducted nine years earlier gave about the same percentages: 9% for evolution, 38% for a combination of creation and evolution, 44% for man’s recent creation, and 9% did not know. It does not appear that there is any significant change in this nine-year period. The 3% increase in 1991 noted for a recent creation of man (Choice 3) may not be statistically significant.

One interesting result of the 1991 survey is the effect of education on beliefs about origins: 16% of college graduates believed in the evolutionary view (Choice 1), while for those below a high-school diploma level, only 5% did. Only 25% of college graduates believed in a recent creation (Choice 3), while 65% of those below the high-school diploma level did. One might be tempted to suggest that knowledge steers one away from

myths such as creation. On the other hand, the effect of a basically secular education may just as well be the reason for this. One cannot be exposed to years of evolutionary teaching without its having some effect. Creation, which is sometimes defined as a religion, is not often promulgated or even allowed in many public schools. Both the contemporary secular philosophy in academia and the rejection of religious concepts in public education favor evolution.

One may wonder why more than five times (47% versus 9%) as many believe in some form of recent creation as in naturalistic evolution, or why more college graduates (25% versus 16%) favor the recent-creation-of-man model. Such questions are difficult to answer, but I would suggest the following:

1. It is difficult for us to think that the working universe, including an Earth that accommodates delicate life, just happened.
2. It is even more difficult for us to think that life, which even in its simplest independent form has hundreds of thousands of nucleotide bases in its genetic repertoire, just came about by itself.
3. How could advanced integrated physiological systems that have complex feedback systems, such as the nervous or endocrine systems, develop without some kind of design?
4. If evolution ever occurred, why are there such pronounced gaps (missing links) in the fossil record? These missing representatives are especially conspicuous between the major group of plants and animals.
5. How did the phenomena of mind ever develop? Our consciousness, sense of purpose, love, and meaning all speak of a reality above mechanistic evolutionary concepts.

Until these questions can be adequately answered by the evolutionary community we should not expect overwhelming support for their model.

Ariel A. Roth

ARTICLES

PROGRESSIVE CREATION AND BIBLICAL REVELATION: SOME THEOLOGICAL IMPLICATIONS

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WHAT THIS ARTICLE IS ABOUT

The biblical description of the creation process seems to conflict with the common scientific understanding that life and death on Earth have existed for hundreds of millions of years. “Progressive creation” is a theory that has been proposed in an attempt to harmonize the Bible with science. Progressive creation proposes that God has created various creatures at various times over hundreds of millions of years, with mankind appearing in a relatively recent creation. In this theory death is seen as part of God’s will before sin entered Earth. This paper examines progressive creation, some biblical statements about death especially in Romans, and explores eight theological implications of the proposal that death existed before sin entered the world. Despite the intentions of the proponents of progressive creation, the theory does not offer a satisfactory solution to the tension between the Bible and science.

The purpose of this essay is to examine the intellectual roots and the current status of the discussion concerning progressive creation, and to identify and evaluate eight theological implications of affirming the presence of death for millions of years prior to the appearance of *Homo sapiens* in the geologic record as required by progressive creation. This piece can be methodologically likened, in the language of a fine-arts painter, to a limited palette endeavor, i.e., the article is an academic account informed by the presuppositions of a high view of Scripture (*sola scriptura*) and Christ’s death understood in a forensic substitutionary sense.¹ However, as an objective theological, reflective exercise, the author hopes that the work will reach a wide academic audience, including readers holding alternative theological presuppositions.²

Progressive creation, popularized in 1954 by Bernard Ramm in his book *The Christian View of Science and Scripture*, is a form of broad concordism between the biblical creation texts and science. It invokes God's intervention to accomplish macroevolution over a period of approximately six hundred million years.³ This investigation concerning the historical roots and current status of the discussion about progressive creation is best introduced by considering God's momentous objective expressed in Exodus 25:8: "Let them make me a sanctuary that I may dwell among them."⁴ The Hebrew word *shakan*, translated "to dwell," means that contrary to Aristotle's unmoved mover who does not concern himself with human affairs,⁵ the true God wishes to dwell permanently in nearness and closeness⁶ with His created beings. God's desire is reaffirmed through His faithful, forgiving, loving acts in the Old Testament, the exodus, the cultic system, the atonement, the gospel commission, and the Second Advent of Christ.

Jesus amplifies this same desire in the famous discourse recorded in John 14, notably in verse 3: "I will come back and take you to be with me that you also may be where I am." Through these words Christ presents a truth of personal destiny upon which Christians, as it were, "hang their souls." However, connected with this truth about destiny is the biblical teaching about origins. In the following words God outlines the method employed in the creation of humanity: "For in six days, the Lord made heaven and earth...and all that is in them" (Exodus 20:11). Christians eagerly accept the truth of Christ's destiny statements; however, statements from the same source concerning origins are not accepted with equal readiness. Does a faulty origin statement impact upon the certainty of the destiny statement? For example, if science falsifies the divine claim about origins, on what basis does the Christian rely upon Jesus' statement about destiny? In other words, can the Christian scholar legitimately accept the destiny statement in a literal sense while at the same time discounting the truthfulness of the origin statement in a literal sense? The implication seems to be that the truthfulness of Jesus' destiny statement interpreted in a literal sense stands or falls upon the truthfulness of the origin statement. Thus, the basic underlying issue of biblical authority is at stake in the discussion of both progressive creation and the theological and philosophical implications stemming from its claims.

Leading contemporary liberal and evangelical theologians respond similarly to the underlying issue of this paper. Historically, their work forms the intellectual basis upon which the concepts of progressive creation are grounded. For example, perceiving the serious implication of the

eschatological claims of Jesus noted above, Rudolph Bultmann introduced his epoch-making demythologizing method. In what may be the most theologically influential forty-some pages written in this century — the famous 1941 address “New Testament and Mythology: The Problem of Demythologizing the New Testament Message”⁷ — Bultmann deals precisely with biblical elements which he believes to be falsified by science. As a consequence, in order to ascertain what he considered to be authentic human existence “exhibited by the text,”⁸ Bultmann uses helpful existential concepts derived from “phenomenology, into which my colleague and friend, Heidegger introduced me.”⁹

The result of applying this method is well-known. For Bultmann and other liberal scholars and theologians, the literal, historical fall of Adam, the entrance of sin interpreted according to a literal reading of Genesis, the literal return of Christ, and so on, are no longer tenable. Here are Bultmann’s challenging words regarding the last point: “We can no longer look for the return of the Son of Man on the clouds of heaven or hope that the faithful will meet him in the air.”¹⁰

The current status of the discussion about progressive creation is in flux. Because of convictions concerning origins analyzed above, not only liberal scholars — e.g., John Polkinghorne¹¹ and Arthur Peacocke —, but even leading evangelical thinkers such as J. I. Packer, Clark Pinnock, and Davis A. Young are advancing beyond progressive creationism.¹² These thinkers do so because they already agree with Polkinghorne’s recent claim that at the popular level the concept of the “God-of-the-gaps” as employed in progressive creation is dead.¹³ Consequently, these scientists, scholars, and theologians are now championing non-concordist, theistic evolution.¹⁴ Nevertheless, both theistic evolution and progressive creation require the constant operation of the death-and-life cycle for over six hundred million years prior to the appearance of *Homo sapiens* in the geologic record, i.e., before the appearance of the biblical Adam. What are some of the theological implications of affirming the existence of death prior to Adam? What is the theological price of adopting either progressive creation or theistic evolution? We turn to this task in the discussion below.

The following reflections are divided into two parts. First, space permits only a summary of Paul’s discussion in Romans concerning the origin of death, and a brief analysis of selected treatments of this Pauline material by contemporary scholars. Second, I shall explore eight significant theological implications of the idea that death necessarily existed for approximately six hundred million years prior to Adam — an inherent aspect of progressive creation.

Important Pauline passages which treat the origin of death are located in Romans 5 and 8. In brief outline, one can say that the former chapter links the appearance of death to human sin while the latter chapter causally links human sin to the phenomenon of death within the brute animal kingdom. Paul states in Romans 5:12 that “sin entered the world through one man, and death through sin, and in this way death came to all men.” In this passage Paul makes the crucially important causal linkage between the original appearance of sin and the first entrance of death. Death here is placed in an unqualified perspective, hence suggestive of a universal, all-encompassing meaning of the term. However, the most important theological point to notice is the relationship between human sin and death, because it is upon this connection that the atonement is based.

What about the origin of the life-and-death process in the lower animal kingdom? Does Paul in some sense link the origin of death in this portion of the animal kingdom to the sin of Adam? Romans 5:14 states that death reigned from Adam, not from a time long before Adam. Again, does this beginning of the reign of death at the time of Adam include death in the lower animal kingdom as well? If Paul’s words can properly be viewed as responding in the affirmative to this question, then he is in effect establishing the affinity between human beings and the natural world, contrary to the essential dualism prevalent in the Hellenistic world.¹⁵ Romans 8:20 suggests a positive response to this query by stating that “the creation was subject to frustration, not by its own choice, but by the will of the one who subjected it.” Moreover, the creation is subjected not only to frustration but to decay (v. 21, *phthora*), i.e., to that which implies death. In this context the “creation” which is subjected to decay or death refers to the lower animals and not to human beings, because in Romans 8:22-23 Paul contrasts the said “whole creation” that groans for liberation from subjection to decay and death with himself, or with those in the human race who also groan for liberation from the bondage to death. John Murray underscores this point by stating that the scope of the term “creation” in v. 21 is limited to the non-rational creation, and that the subjection within this realm means the “mortality of the body”¹⁶ (i.e., the death of lower animals). Thus two domains — the human race and the lower brute creation — comprise a single unified totality of God’s creation groaning for liberation from death stemming from the sin of Adam.¹⁷

Furthermore, Paul’s position concerning the entrance of biological death in the lower animal kingdom because of the sin of the first human beings is consistent with important biological inferences from a prelaps-

arian (“before the fall”) philosophy of nature gained by a literal reading of Genesis 1:30. In this creation text God states that “to all the beasts of the earth and all the birds of the air and all the creatures that move on the ground — everything that has the breath of life in it — I have given every green plant for food.” These important words, giving the nature of the diet of some land and air creatures, carry significant biological implications. They suggest that the uncursed first dominion was a predation-free habitat, i.e., free of the life-and-death cycle for the creatures noted. In other words, Paul may be understood to view *all* forms of death as phenomena which are ultimately foreign elements, something which a loving God must have temporarily superimposed because of sinful action by the human overseer of the lower animal kingdom.

Understandably, not all scholars share the same interpretation of the meaning of death in Paul’s discussion. Some evangelical scholars interpret what they consider to be Paul’s own understanding and meaning of the word “death” as not conflicting with modern evolutionary biology. Hugh Ross, for example, believes that Paul himself limits the meaning of the term “death” in Romans 5 and 8 to human spiritual death, thereby excluding the concept of biological death either of humans or of the lower animals from the meaning of the term “death.”¹⁸ In this fashion he harmonizes the Bible and science by interpreting Paul’s original intent and meaning in a way which accedes to the claims of science. In other words, he believes that Paul’s own, original meaning in Romans 5 and 8 does not conflict with a progressive-creationist point of view requiring physical death prior to Adam.

By contrast, with nothing theologically to fear, one liberal theologian understands that Paul’s own, original meaning in Romans 5-8 dashes with the claims of progressive creationism. Aiming for harmony with modern science, he simply reinterprets what he sees as Paul’s original meaning of the connection between sin and death as stated in Romans 6:23. Thus, Arthur Peacocke, eminent Oxford scholar and author of many recent, influential books on science and religion,¹⁹ makes the following assumption when discussing death in relation to Christian anthropology:

*Biological death was present on the earth long before human beings arrived. It is the prerequisite of our coming into existence through the creative processes of biology which God himself has installed in the world.... God had already made biological death the means of his creating new forms of life. This has to be accepted, difficult though it may be for some theologies.*²⁰

I appreciate Peacocke's honesty in perceiving and admitting the potential theological difficulties of his evolutionary assumption about the presence of death prior to Adam, who for Paul is "a historic personage and not just the mythological personification of every human being."²¹

However, notice how Peacocke reinterprets Paul's corollary message (to Romans 5:12) in Romans 6:23 about the wages (or "the soldier's pay"²²) in light of what he has written above: So when St. Paul says that 'the wages of sin is death,' that cannot possibly mean for us, now, *biological* death.... [I]n that phrase St. Paul can only, for us, mean 'death' in some figurative sense of, [perhaps], the death of our relationship to God as the consequence of sin."²³ Peacocke's words "for us, now," and "for us" indicate his understanding that Paul in Romans 6:23 is speaking literally about the causal linkage between sin and death of all kinds, perhaps even about the origin of death of all kinds; and that Paul is, therefore, saying something in Romans 6:23 which is unacceptable to modern theology. Above all, Peacocke's words "for us, now," and "for us" indicate that he is deliberately reinterpreting Paul's original meaning to conform with modern anthropology. This illustrates that in some cases, though not in all instances, a liberal scholar may ascertain the original intended meaning of a biblical writer more adequately than some evangelical scholars do, even though the scholar who employs higher criticism may not consider the original meaning normative for contemporary theology.

With this summary of Paul's discussion in Romans concerning the origin of death and an analysis of some contemporary response to Paul's position, we turn now to a brief consideration of eight theological implications of the claim by both progressive creation and theistic evolution that death existed for long ages prior to Adam.

First, the claim impacts upon the literal and historical trustworthiness of the Bible in general. One can, for example, trust neither the historicity of the fall of Adam nor the actuality of a universal deluge if the literal biblical statements about these events are countered by the claim that death existed prior to Adam.

Second, to assert the ongoing cycle of life and death prior to Adam for millions of years deeply affects our perception of the character of God in at least two important ways. On the one hand it necessarily leads to the conclusion that the God who purportedly notices when a sparrow falls (Matthew 10:29) countenanced and intended the suffering and death of animals for millions of years prior to Adam. Thus, the merciful character of God is compromised.

On the other hand, the claim of death before sin destroys the integrity of God's character. If indeed millions of years of death existed before Adam, then God, knowing this fact, articulates in the fourth commandment of Exodus 20 a creation methodology in direct opposition to the truth. The irony of this conclusion is that in the original presentation of the ten commandments as recorded in Exodus 20, the ninth of which prohibits the bearing of false witness, God Himself is made to tell a lie in the fourth commandment, thereby Himself sinning by transgressing His own law. Of course, this action clearly contradicts the honesty of God acclaimed both in the Old and New Testaments. God inspired Balaam with the following words, "God is not a man, that He should lie" (Numbers 23:24). Paul praises the God "who cannot lie" (Titus 1:2), while in Hebrews 6:18 we find these famous words, "It is impossible for God to lie."

Third, and above all, if death existed before Adam for millions of years, then the crucial causal linkage between sin and death is broken. If the connection between sin and death is severed, then the basis for Christ's atonement is also destroyed. For example, if death is not related to sin, then the wages of sin is not death. Consequently, Christ's death as a wage for sin loses its power to save the believer from death.²⁴ Thus, a most serious implication of this aspect of progressive creation is that it thwarts the purpose of the saving, atoning blood of Christ, i.e., the cross. In light of this implication, a passage in Hebrews is notably relevant in warning all investigators against lessening in any way the value of the blood of Christ: "How much more severely do you think a man deserves to be punished who has trampled the Son of God underfoot, who has treated as an unholy thing the blood of the covenant that sanctified him, and who has insulted the Spirit of grace?" (Hebrews 10:29).

Fourth, the claims of progressive creationism require a reinterpretation of some of Jesus' teachings. The believer who does not experience complete confidence in all the teachings of his Lord and Saviour will be restricted in his ability to accept the full Lordship of Christ. For instance, an exegete would need to reinterpret Jesus' own understanding of the historical truthfulness of Cain's murder of Abel:

Therefore this generation will be held responsible for the blood of all the prophets that has been shed since the beginning of the world, from the blood of Abel to the blood of Zechariah, who was killed between the altar and the sanctuary (Luke 11:50-51).

These words indicate that Jesus regarded the account of the murder of Abel to be a reliable historical fact. Because the account of Abel's death is

recorded in Genesis 3, there is clear implication that Jesus regarded this chapter to be a dependable record of historical facts. Abel had a very famous father, whose historical existence is implied by these words of Jesus. However, progressive creation requires Jesus' own understanding in this case to be modified according to the views of modern science.

Moreover, these claims force the Christian scholar to reinterpret the original monogamous nature of marriage as described by Jesus in the following language: "Moses permitted you to divorce your wives because your hearts were hard. But it was not this way from the beginning" (Matthew 19:8). The statement, "it was not this way from the beginning," indicates that Jesus accepted the historical reliability of the creation account recorded in Genesis 2. There the ideal character of marriage is indicated to be monogamous, as illustrated by the first pair of human beings to exist on Earth. By requiring a radical reinterpretation of these teachings of Jesus, the claims of progressive creation undermine total confidence in His instructions.

Fifth, the claim of progressive creation negatively impact the theology of worship in sabbatarian Christian communions. Recent scholarly discussions of the theological meaning of the Sabbath for contemporary Christians include works by Jürgen Moltmann,²⁵ Niels-Erik Andreasen,²⁶ and James B. Ashbrook.²⁷ Ashbrook concludes that the "Sabbath rest-and-reorganization are built into our very being. The basic cycle of rest/synthesis/activity is the means we have for the making of meaning, and meaning-making is the making of soul."²⁸

These general studies indirectly raise a corollary issue of the divine will regarding the identity of a contemporary Sabbath day of rest and worship, which is negatively impacted by the tenets of progressive creation. If death existed before Adam, including millions of years of evolution, the concept of a literal six-day creation as the basis for a seventh-day Sabbath is untenable. Thus, a contemporary believer who understands the New Testament to teach that the seventh-day Sabbath remains unchanged from Old Testament practice could not base her or his selection of a day of worship upon the Genesis creation texts or the fourth commandment. This demonstrates how progressive creation can impact contemporary worship.²⁹

Sixth, if it existed before Adam, death is a divinely intended part of life. This significant conclusion raises the following question: If death is part of the divinely instituted economy of life, how can death be properly viewed as the last enemy to be destroyed, as Paul suggests in 1 Corinthe-

ans 15:26? In the view of progressive creation, death is an aspect of life that would not be changed or removed in some future new creation in which “there shall no longer be death” (Revelation 21:4).

Thus, how does the concept of the integral part of death in the life processes of natural world impact on the *parousia*? Viewing death in this perspective, are we to conclude that the early Christians mistakenly expected a Second Advent of Christ to put an end to death and suffering as outlined in Revelation 21 and 22? It would seem so. However, a literal reading of Scripture shows that these early Christians correctly looked for the *parousia*, enjoying a strong biblical basis for their hope in the elimination of death at the return of their Lord. Thus, Christians today who adopt progressive creation differ from the early Christians.

Seventh, the notion of the existence of death, especially of higher organisms, before Adam impacts on the conflict between Christ and Satan over the final salvation of humanity. If death existed before Adam, then Christ ultimately redeems no one from a fate that was not a feature of life before Adam’s sin. In what way, then, has Adam’s sin *introduced* Christ’s great longing to dwell with His people? Here is another aspect of the way in which progressive creation helps Satan to achieve his goal of preventing reconciliation between God and His people.

Eighth and last, even if a return of Christ were possible in view of the six-hundred-million-year development of life claimed by progressive creation, there is serious confusion concerning God’s promise in Isaiah 65:17 to create a new heaven and a new Earth. For example, what length of time will be required to accomplish this new creation? In creating this new Earth, will God need another six hundred million years, as He allegedly needed to guide the evolution of the first Earth to completion according to the claims of progressive creation? Are the meek to be kept waiting in the New Jerusalem for six hundred million years while their promised inheritance, the new Earth, evolves into a habitable place as it did the first time? Such concepts, of course, mock the creative power of the God portrayed in the Bible.³⁰

In conclusion, these eight evaluations show a few of the important theological implications of affirming death prior to Adam and his transgression. From the perspective of this paper, the Christian scholarly community stands before two mutually exclusive alternatives. Although reluctant to cast positions into either/or terms, the author discovers no tenable intermediate position in this instance. On the one hand, the scholar may accept the complete canonical witness in a fashion similar to the way in

which Jesus viewed the authority of the Old Testament, namely, as authoritative, reliable, propositional revelation. On the other hand, if the Christian scholar accepts the six hundred million years of death prior to Adam, then this individual may well take her or his stand with Bultmann's methodology and conclusions in order to remain consistent. However, in the ongoing scholarly discussions of these and related issues, those involved need to exercise continually the utmost respect, genuine love and courtesy to one another, and an openness to new ideas lest we deny our caring Christ, the author of all interpersonal relationships worthy of His name.

Considered in the light of the reflections presented in this essay, the admonition of Hebrews 10:35-37 is appropriate for all Christian scholars, theologians, and scientists. In these verses, individuals are encouraged not to cast away a believer's confidence which has great recompense of reward, because, as v. 37 promises, "yet a little while, He that shall come will come." This hope means that John 14:1-3 has yet to be fully realized, that Christ will indeed take human beings to Himself, thereby achieving His deepest desire.

ENDNOTES

1. A high view of Scripture is here assumed to mean one which accepts the unity, reliability and authority of the entire Bible as divinely revealed, propositional revelation. In this view, for instance, chapters 1-11 of Genesis are assumed to be straightforward, factual accounts of historical events concerning the way in which God created this world as a life-sustaining habitat, the entrance of sin and death into the world, and the catastrophic modification of the original habitat.
2. David Tracy distinguishes three kinds of theology: fundamental, systematic, and practical (1981. *The analogical imagination*. NY: Crossroad, Ch. 1 and 2). Concerning these distinctions, Robert Neville observes that practical theologies are those associated with movements of social change, and their audience is the participants in these movements. Fundamental theologies are those that ask the basic questions in a wholly pluralistic, perhaps even secular, context with little or no regard for communities of faith, and their audience is mainly the academy. Systematic theologies are those oriented to the self-understanding and guidance of "communities of faith" (1991. *A theological primer*. Albany: State University of New York Press, p xiv). The current essay addresses the audiences Tracy calls systematic and fundamental.
3. Ramm B. 1954. *The Christian view of science and Scripture*. Grand Rapids, MI: Wm. B. Eerdmans; reprinted in 1984. See particularly the section called "Progressive Creation" (p 76-79), and above all, Ramm's comments on p 191 about the limits of the natural biological process with respect to horizontal and vertical radiation of species within the paradigm of progressive creation.
4. Scripture quotations are taken from the New International Version.
5. *Metaphysics*, Bk XII: Ch 9.
6. Harris RL, editor. 1980. *Theological workbook of the Old Testament*, Vol. 2. Chicago: Moody Press, p 925.
7. See: Kümmel WG. 1972. *The New Testament: the history of the investigation of its problems*. Nashville, TN: Abingdon Press, p 456, n 466.

8. Ibid., p 457, n 468.
9. Ibid.
10. Bultmann R. 1952. New Testament and mythology. In: Bartsch HW, editor. *Kerygma and Myth*. Fuller RH, translator. London: S.P.C.K., p 4.
11. Polkinghorne J. 1991. God's action in the world. *Cross Currents* 41(3):293-307.
12. (a) Packer JI. 1988. The challenge of biblical interpretation: creation. In: *The Proceedings of the Conference on Biblical Interpretation 1988*. Nashville: Broadmann Press, p 21-33; (b) Pinnock C. 1989. Climbing out of a swamp: the evangelical struggle to understand the creation texts. *Interpretation* 43(1):145; (c) Young DA. 1987. Scripture in the hands of geologists, Part II. *Westminster Theological Journal* 49:303.
13. (a) Polkinghorne, p 295 (Note 11); (b) cf. Malone NM. 1991. The silence speaks. *Cross Currents* 41(3):291. In basic support of this concept, Daniel L. Migliore of Princeton Seminary states that because the grammar used by science and theology are two different languages and because the stories of Genesis 1 and 2 are not scientific descriptions, "the purposive activity of the creator and the purposefulness of the world cannot be directly 'read off' what we perceive and experience. It is an affirmation of faith, not an empirical observation" [1991. The ecological crisis and the doctrine of creation. *Princeton Seminary Bulletin* n.s. 22(3):275].
14. The current scholarly drive toward accepting either non-concordist, theistic evolution, or a broad concordist progressive creationism seems to be unnecessary. The endeavor is unwarranted because recent paleontological, biological, geological, philosophical, and geochemical evidence can be correctly interpreted as strongly consistent with a faith position which accepts as true the Scripture's assertions of an origin *de novo* of biological forms by some causality other than random causes and an origin occurring within a relatively recent time. But these assertions are topics for other papers with extensive evidentiary documentation.

However, anyone interested in an introduction to some of the more recent studies presenting evidence in support of these claims may consult the following sources: (a) Brown RH. 1979. The interpretation of C-14 dates. *Origins* 6(1):30-44; (b) Coffin HG. 1983. *Origin by design*. Washington DC: Review & Herald Publishing Assn.; (c) Denton M. 1986. *Evolution: a theory in crisis*. Bethesda, MD: Adler & Adler; (d) Hasel GF. 1980. Genesis 5 and 11: chronogenealogies in the biblical history of beginnings. *Origins* 7(1):23-37; (e) Hoyle F, Wickramasinghe C. 1982. *Why Neo-Darwinism does not work*. Wales: University College Cardiff Press; (f) Johnson PE. 1991. *Darwin on trial*. Downers Grove, IL: InterVarsity Press; (g) Oard MJ. 1990. Evidence for only one ice age. In: Walsh RE, editor. *Proceedings of the Second International Conference on Creationism 1990, Vol. II: Technical Symposium Sessions and Additional Topics*. Pittsburgh: Creation Science Fellowship, p 191-200; (h) Polanyi M. 1958. *Personal knowledge*. Chicago: University of Chicago Press, p 381-405; (i) Roth AA. 1988. Those gaps in the sedimentary layers. *Origins* 15 (2):75-92; (j) Wilder-Smith AE. 1987. *The scientific alternative to Neo-Darwinian evolutionary theory: information sources & structures*. Costa Mesa, CA: TWFT Publishers; (k) Snow GE, Javor GT. 1979. Atmospheric oxygen rules out biochemical evolution. In: Van Dolson LR, editor. *Our Real Roots: Scientific Support for Creationism*, Washington DC: Review & Herald Publishing Assn., p 155-161; (l) Shea WH. 1984. A comparison of narrative elements in ancient Mesopotamian creation flood stories with Genesis 1-9. *Origins* 11(1):9-29; (m) Wise KP. 1990. Baraminology: a young-Earth creation biosystematic method. In: Walsh RE, editor. *Proceedings of the Second International Conference on Creationism 1990, Vol. II: Technical Symposium Sessions and Additional Topics*, pp. 345-360. Pittsburgh: Creation Science Fellowship, p 345-360.

- For a useful treatment of the implications of theistic evolution for Christians, see: Gibson LJ. 1992. Theistic evolution: is it for Adventists? *Ministry* 65(1):22-25.
15. For comments concerning such forms of dualism in the Hellenistic world, see: Meyer PW. 1988. Romans. In: Mays JL, editor. *Harper's Bible Commentary*. San Francisco: Harper & Row, p 1153.
 16. Murray J. 1968. The epistle to the Romans. Grand Rapids, MI: Wm. B. Eerdmans, p 304.
 17. It should be noted that a recently published dissertation focusing on these passages of Romans 8 takes an alternative point of view arguing that Paul does not have Genesis 3 and the fall of Adam in mind in this context, but rather the Genesis flood-tradition. See: Christoffersson O. 1990. The earnest expectation of the creature: the flood-tradition as matrix of Romans 8:18-27. Stockholm: Almquist & Wiksell International.
 18. Ross H. 1989. The fingerprint of God. Orange, CA: Promise Publishing Co., p 154.
 19. See the following works by Arthur Peacocke: (a) 1971. *Science and the Christian experiment*. London: Oxford University Press; (b) 1979. *Creation and the world of science: the Bampton Lectures, 1978*. Oxford: Oxford University Press.
 20. Peacocke A. 1989. The challenge of science to theology and the church. In: Mangum JM, editor. *The New Faith-Science Debate*. Minneapolis: Fortress Press, p 16.
 21. Käsemann E. 1980. Commentary on Romans. Grand Rapids, MI: Wm. B. Eerdmans, p 142.
 22. *Ibid.*, p 185.
 23. Peacocke, p 16 (Note 20).
 24. A similar point is made in a 1990 article by John D. Morris entitled "Evolution and the Wages of Sin" [Impact Series 209. *Acts & Facts* 19(11):i-iv. El Cajon, CA: Institute for Creation Research.].
 25. Moltmann J. 1985. The Sabbath: the feast of creation. Chapter 10 in: *God in Creation: A New Theology of Creation and the Spirit of God*. San Francisco: Harper & Row, p 276-296. This work comprises Moltmann's Gifford Lectures, 1984-1985.
 26. Andreasen N-E. 1978. Rest and redemption: a study of the biblical Sabbath. Berrien Springs, MI: Andrews University Press.
 27. Ashbrook JB. 1992. Making sense of soul and Sabbath: brain processes and the making of meaning. *Zygon* 27(1):31-49.
 28. *Ibid.*, p 46.
 29. The thrust of this article is not to determine the divine will concerning the proper day of worship for contemporary Christians. However, the seriousness of implication number five above is, of course, particularly significant for Christians taking seriously the creation account as the basis for a selection of a worship day.

Readers may be interested in a brief outline indicating the basis upon which some Christians understand the New Testament teaching concerning a day of worship in contemporary times. According to Hebrews 8:7-13 and 10:15-18, it is the privilege of Christians living in the gospel period to participate, by means of the Holy Spirit, in the new covenant experience.

That the seventh-day Sabbath forms part of the new covenant terms is strikingly demonstrated by the fact of Jesus' death for sin (Romans 6:23; 1 Corinthians 15:3; Matthew 26:39-45; and Matthew 27:50) as follows. If it were possible that the definition of sin [the ten commandments (1 John 3:4), which are the same thing as the terms of the new covenant (Hebrews 10:16; Romans 13:8-10)] could be changed in any sense, then God would have done so in order to do away with sin in order that His Son would not have had to die, because the Scripture states that Christ died precisely because sin existed (1 Corinthians 15:3). The Son in effect asked God the

Father whether that kind of change in the law was possible (Matthew 26:39-45) while at the same time saving humanity. If the law could have been changed, the cup (the cross) could have passed from the lips of Jesus as He requested. That in the mind of God the Father the law could not be changed in any respect is shown by the subsequent death of Jesus. For this reason some Christians believe that the costly fact alone of Jesus' death establishes the perpetuity of the seventh-day Sabbath.

Moreover, in Romans 3:31, Paul suggests the perpetuity of the law. In addition, our Lord says that the Sabbath was not given to the Jews but to mankind universally (Mark 2:27; Genesis 2:2-3). Finally, the women who wished to anoint the body of Jesus kept the Sabbath "according to the commandment" after the burial of Jesus, thus showing that the author of the gospel of Luke believed that the death of Jesus did not abolish this beautiful term of the new covenant (Luke 23:55-56). For a fuller exposition of this issue, see: 1988. *The Sabbath*. In: *Seventh-day Adventists Believe Ministerial Association, General Conference of Seventh-day Adventists*. Hagerstown, MD: Review & Herald Publishing Association, p 248-267.

30. From a confessional perspective, one might conjecture whether God will create the new Earth within a time frame analogous to the original creation of the first Earth, viz., in one week. In any case and by God's grace, it will be a high privilege for Christians to witness the creation of the new Earth in whatever fashion the event occurs.

ARTICLES

INTERPRETATION OF RADIOCARBON AND AMINO ACID AGE DATA

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WHAT THIS ARTICLE IS ABOUT

*The spontaneous decomposition of amino acids under natural circumstances does not proceed as should be expected if radiocarbon age is actually a measure of real time. This disagreement compounds the uncertainty in using amino acid isomer ratios for age determination, and also brings radiocarbon ages beyond 4000 B. P. into question. By using a radiocarbon age conversion previously published in *Origins* (17:56-65, 1990), the authors obtain a reasonably good correlation between amino acid isomer ratios and estimated real time. This correlation permits significant conclusions regarding environmental conditions and climatic changes to be drawn from amino acid data on land snail shells from sediments in the Negev.*

INTRODUCTION

Individuals who accept the historical and literary evidence for the accuracy of the specifications given in the first eleven chapters of the book of Genesis are open to the possibilities for scientifically sound interpretations for the data utilized in the organic radioisotope and biochemical age-dating techniques that have been developed within the last fifty years. Radioisotope data for inorganic material that has replaced plant or animal tissue, or which is associated with the burial of organic material, can be dealt with as a characteristic of inorganic material that originated in creative activity not described in the first chapter of Genesis (Brown 1986). But radiocarbon-age data for ancient organic material must be explained within the time frame for the existence of plant and animal life on this planet. The ratio of right-handed to left-handed amino acids in ancient material must also be explained within the same constraint.

RADIOCARBON AGE

Some aspects of the harmonization of radiocarbon age data with biblical time constraints have been reviewed in a recent issue of *Origins* (Brown 1990). In that treatment a mathematical relationship is derived for converting carbon-14 (C-14) dates into real-time ages on a basis that incorporates fully established age data from secular history together with the chronological constraints in the eleventh chapter of Genesis. According to this relationship, a musk ox frozen in Alaskan muck (Stuckenrath & Mielke 1970) had a reasonable life span in the vicinity of fifty years, and perished about 4900 years ago. A one-to-one representation of real time by radiocarbon ages indicates an unreasonable life span in the range between 5000 and 9000 years and death about 17,000 years ago.

Further indication of the soundness of this conversion relationship is provided by recently published amino acid data for land snail shells (Goodfriend 1991a).

AMINO ACID AGE

The proteins in living organisms are made of amino acids in the left-handed (L) form of the two possible asymmetric (chiral) structures. After death these proteins progressively disintegrate, and in the disintegration process, molecules of amino acids in the right-handed (D) form are produced. As the concentration of proteins diminishes, the ratio of D to L forms of the amino acids increases, approaching an equilibrium ratio at which the rate of D to L conversions equals the rate of L to D conversions. Consequently the D/L ratio of any particular amino acid in a specimen of organic remains is related to the age (time since death) of that specimen. Dating by means of amino acid D/L ratios was reviewed in *Origins* 12:8-25 (Brown 1985). That review should be read as a background for the present treatment.

In the conclusion of the above-cited review, it is stated that

... there is a dominant trend for the effective racemization [conversion between L and D forms] rate constant to decrease with putative fossil age. This relationship, together with the demonstrated survival of amino acids in fossils from the Paleozoic era, raises a question concerning the accuracy with which radioisotope age data have been used to represent the real-time history of fossils.

The land snail shell data reviewed here support this conclusion and strongly indicate that C-14 ages specify real time only when interpreted

in accord with constraints such as those provided by the chronological data in the Bible.

LAND SNAIL SHELL AMINO ACID CHARACTERISTICS

A large amount of data for D/L ratios of 7 amino acids in 38 samples of land snail shells from rodent burrow middens and stream sediments in the Negev Desert of southern Israel has recently become available (Goodfriend 1991a). These data cover C-14 ages from zero to 10,400 years, and represent a major effort on the part of Dr. Goodfriend and the Ministry of Energy and Infrastructure of Israel.

It has been observed that amino acid D/L ratios do not relate as satisfactorily with C-14 age as they should if C-14 ages directly represent real time (Brown 1985). Goodfriend's best results were obtained with D/L data plotted against the square root of C-14 age. A square-root relationship is justified by empirical results, but is not expected from basic theoretical considerations. It is described by Goodfriend as "apparent parabolic kinetics" (see Mitterer & Kriausakul. 1989). Since a plot of D/L against time is asymptotic to 1/1, or to 1.25/1 for the amino acids which have two carbon atom sites of asymmetry (chirality), some function other than the square root of C-14 age might be more effective in producing a satisfactory treatment of amino acid D/L ratios in ancient materials. These observations suggested our investigation of a treatment based on a biblically consistent conversion from C-14 age data to real time.

LAND SNAIL D/L RATIOS IN PRESUMED REAL TIME

Table 1 reproduces Goodfriend's data for Negev Desert land snail shells, together with the presumed real-time age BP (t) obtained from C-14 age (R) according to Equation 9 from Brown (1990).

$$(1) R = t + 8300 \ln [1 - e^{-2.996(5000 - t)/1000}]^{-1}$$

(This equation, reproduced as No. 1 above, is based on the Flood at 5000 BP, a negligible biosphere C-14/C-12 ratio at the time of the Flood, and an upper biosphere C-14/C-12 at 4000 BP equal to 95% of the average C-14/C-12 ratio that has been characteristic over the past 3500 years.)

Also given in Table 1 are the corresponding racemization/epimerization rate coefficients (k) based on simple first-order kinetics with negligible D/L ratio at $t = 0$. For the amino acids which have only one carbon atom site of asymmetry, the characteristic rate coefficient k for conversion from the L form to the D form (racemization) is given by

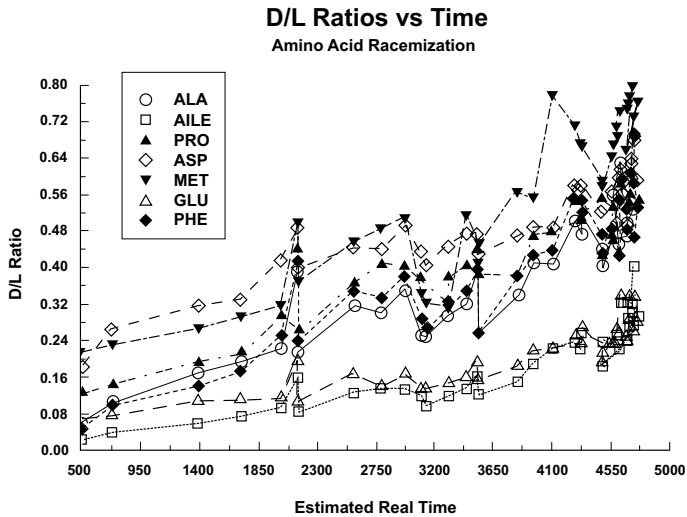


Figure 1. Ratio of right-handed (D) to left-handed (L) residual amino acid molecules in land snail shells versus presumed real-time shell age.

Figure 2. Ratio of right-handed (D) to left-handed (L) residual amino acid molecules in land snail shells versus the square root of presumed real-time shell age.

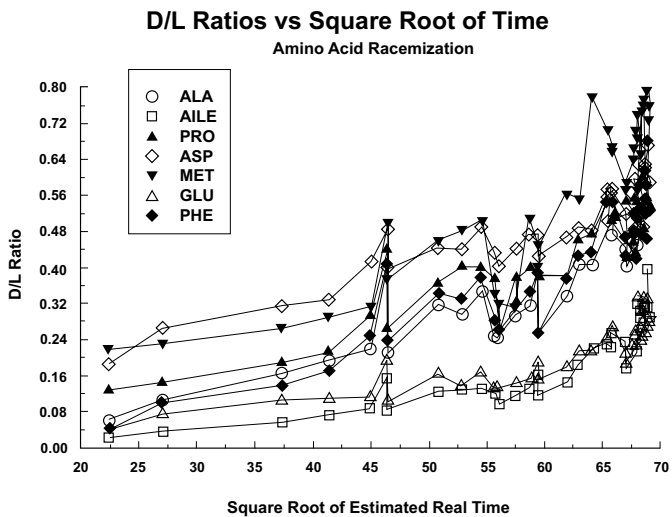


Table 1.
Land Snail Shell Amino Acid Data. K expressed in units of 10⁻⁵ per year.

C-14 TIME	TIME	ALANINE		ALLOISOLEUCINE/ ISOLEUCINE		PROLINE	
		D/L	K	D/L	K	D/L	K
500.00	500.00	0.06	12.22	0.02	4.12	0.13	25.80
730.00	730.00	0.11	14.85	0.04	5.19	0.15	20.14
1390.00	1390.00	0.17	12.05	0.06	4.15	0.19	14.14
1710.00	1710.00	0.19	11.43	0.07	4.13	0.22	12.83
2020.00	2020.00	0.22	11.02	0.09	4.38	0.30	15.11
2150.00	2150.00	0.39	19.04	0.15	7.10	0.44	22.08
2150.00	2150.00	0.21	10.01	0.08	3.74	0.27	12.73
2580.00	2580.00	0.32	12.68	0.12	4.76	0.37	14.92
2790.00	790.00	0.30	11.02	0.13	4.79	0.40	15.36
2970.00	2970.00	0.35	12.23	0.13	4.41	0.40	14.42
3130.00	3100.00	0.25	8.24	0.12	3.84	0.38	12.91
3170.00	3140.00	0.25	8.00	0.09	3.00	0.28	8.99
3370.00	3310.00	0.29	9.15	0.12	3.48	0.38	12.16
3530.00	3450.00	0.32	9.48	0.13	3.78	0.40	12.42
3630.00	3530.00	0.39	11.73	0.16	4.49	0.44	13.52
3640.00	3540.00	0.26	7.40	0.12	3.33	0.39	11.50
3990.00	3840.00	0.34	9.13	0.15	3.76	0.39	10.66
4330.00	3960.00	0.41	10.97	0.19	4.65	0.47	12.75
4690.00	4105.00	0.41	10.49	0.22	5.31	0.48	12.68
5270.00	4275.00	0.50	12.91	0.23	5.38	0.55	14.33
5500.00	4325.00	0.47	11.85	0.22	5.02	0.50	12.82
5520.00	4330.00	0.52	13.25	0.25	5.80	0.52	13.44
6470.00	4483.00	0.44	10.51	0.24	5.22	0.55	13.83
6520.00	4490.00	0.40	9.49	0.18	3.99	0.43	10.13
7110.00	4560.00	0.47	11.10	0.23	5.00	0.53	12.88
7220.00	4570.00	0.48	11.42	0.23	4.99	0.46	10.83
7600.00	4600.00	0.50	11.80	0.25	5.43	0.55	13.32
7620.00	4610.00	0.45	10.49	0.22	4.69	0.44	10.14
7750.00	4615.00	0.54	13.00	0.25	5.33	0.55	13.49
7980.00	4630.00	0.63	16.01	0.32	3.93	0.58	14.41
8650.00	4675.00	0.47	10.80	0.24	5.09	0.53	12.50
8760.00	4685.00	0.49	11.53	0.29	6.09	0.54	13.02
8900.00	4690.00	0.52	12.44	0.26	5.61	0.55	13.06
9000.00	4700.00	0.63	15.70	0.32	6.82	0.56	13.53
9540.00	4725.00	0.58	14.05	0.32	6.66	0.53	12.49
9600.00	4730.00	0.46	10.51	0.27	5.71	0.53	12.54
9700.00	4735.00	0.68	17.59	0.40	8.43	0.70	18.15
10400.00	4765.00	0.53	12.39	0.29	6.03	0.55	12.95

Table 1 (continued)

ASPARTIC ACID		METHIONINE		GLUTAMIC ACID		PHENYLALANINE	
D/L	K	D/L	K	D/L	K	D/L	K
0.18	37.22	0.22	43.00	0.05	9.41	0.04	8.81
0.26	37.04	0.23	31.79	0.08	10.71	0.10	13.61
0.31	23.46	0.26	19.45	0.11	7.80	0.14	9.99
0.33	19.92	0.29	17.33	0.11	6.58	0.17	10.04
0.41	21.68	0.31	15.98	0.12	5.77	0.25	12.54
0.48	24.57	0.50	25.30	0.20	9.33	0.41	20.26
0.40	19.59	0.37	17.96	0.11	4.95	0.24	11.24
0.44	18.50	0.45	18.98	0.17	6.57	0.34	13.90
0.44	16.93	0.48	18.84	0.14	5.09	0.33	12.29
0.49	18.14	0.50	18.68	0.17	5.78	0.38	13.35
0.43	14.95	0.34	11.42	0.14	4.41	0.28	9.46
0.40	13.53	0.32	10.51	0.14	4.36	0.26	8.65
0.44	14.42	0.31	9.62	0.15	4.47	0.32	10.09
0.47	14.90	0.51	16.31	0.16	4.68	0.35	10.46
0.47	14.56	0.40	12.00	0.19	5.57	0.39	11.77
0.43	12.85	0.45	13.66	0.15	4.39	0.25	7.34
0.47	13.18	0.56	16.56	0.18	4.85	0.38	10.30
0.49	13.40	0.55	15.62	0.22	5.59	0.43	11.46
0.48	12.80	0.77	25.16	0.22	5.40	0.44	11.38
0.58	15.36	0.71	20.57	0.25	6.00	0.55	14.40
0.57	14.90	0.67	18.75	0.24	5.68	0.51	12.95
0.58	15.16	0.66	18.35	0.27	6.39	0.55	14.15
0.52	12.86	0.57	14.58	0.21	4.80	0.47	11.35
0.52	12.78	0.59	15.02	0.19	4.31	0.43	10.13
0.56	14.04	0.64	16.63	0.23	5.18	0.47	11.21
0.55	13.63	0.67	17.62	0.24	5.26	0.48	11.50
0.60	15.00	0.70	19.03	0.26	5.90	0.55	13.47
0.54	12.95	0.69	18.19	0.23	5.10	0.42	9.82
0.57	14.06	0.68	18.05	0.26	5.79	0.55	13.24
0.61	15.31	0.74	20.48	0.34	7.55	0.59	14.57
0.55	13.11	0.65	16.70	0.24	5.33	0.48	11.21
0.54	12.93	0.75	20.53	0.25	5.41	0.53	12.63
0.57	13.74	0.76	21.17	0.29	6.32	0.53	12.58
0.63	15.95	0.77	21.81	0.34	7.49	0.61	14.91
0.62	15.45	0.79	22.90	0.32	7.04	0.58	14.18
0.52	12.30	0.68	17.53	0.26	5.63	0.46	10.54
0.68	17.35	0.73	19.48	0.34	7.41	0.68	17.67
0.59	14.16	0.76	20.86	0.28	6.11	0.53	12.44

$$(2) k = \{ \ln[(1+D/L) / (1-D/L)] \} / 2t .$$

For amino acids such as alloisoleucine/isoleucine which have two sites of asymmetry, the corresponding characteristic rate coefficient for conversion (epimerization) is given approximately by

$$(3) k = \{ \ln[(1+D/L) / (1-0.8D/L)] \} / 1.80t .$$

[The theoretical basis for these equations is discussed in Brown (1985).]

In Figure 1 the D/L ratios from Table 1 are plotted against presumed real time as determined from Equation 1. In Figure 2 these ratios are plotted against the square root of the time values in Figure 1. Because of the asymptotic approach of D/L to a constant value, the data presentation in Figure 2 should follow straight lines more closely than the presentation in Figure 1, as demonstrated by Goodfriend (1991a) and Mitterer and Kriausakul (1989). Goodfriend's plots are not the same as those in Figure 2, because he did not use a conversion from C-14 age to presumed real time.

To obtain a more sensitive treatment of the factors involved, we have plotted the racemization/epimerization coefficients, rather than D/L ratios, against presumed real time in Figure 3. If t was at all points a correct representation of real time, and if both the physical and chemical environment were the same for each sample and also unchanged throughout the time range involved, the data points in Figure 3 should describe straight, horizontal lines (constant k) within the range of experimental error involved. The normalized racemization/epimerization coefficient trends are represented in Figure 4. In the construction of the plot in Figure 4, the data set for each of the seven amino acids was multiplied by a normalization constant that makes the line pass through 1.0 at $t = 2000$ (neglecting the higher of the two values for $t = 2150$ — Sample No. 6). The average of the normalized data for all seven amino acids at each value of t in Table 1 was then plotted to obtain Figure 5. Recognizing that due to the Standard Deviation of the C-14 measurement the experimental uncertainty is nearly $\pm 50\%$ for the first group of data points at $t = 500$, and nearly $\pm 30\%$ for the second group of data points at $t = 730$, the extent to which the ideal expected constant relationship is demonstrated over a twenty-to-one radiocarbon time range is remarkable. (The uncertainty attributable to C-14 measurement has dropped to $\pm 15\%$ at the third set of data points for $t = 1390$, and diminishes to $\pm 4\%$ by the end of the plots.)

Racemization Coefficients vs Time

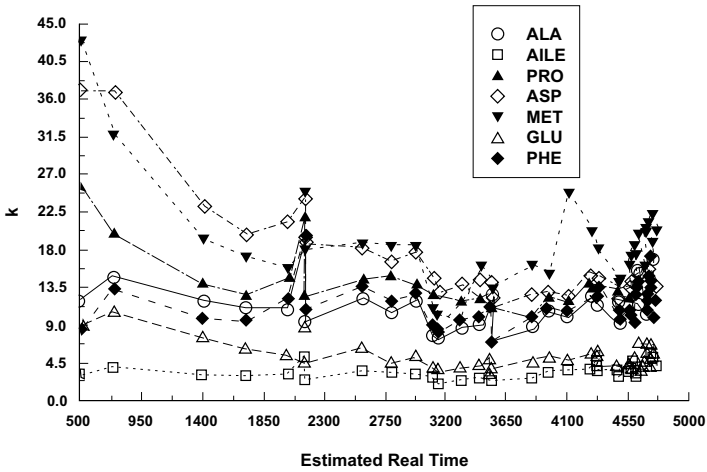
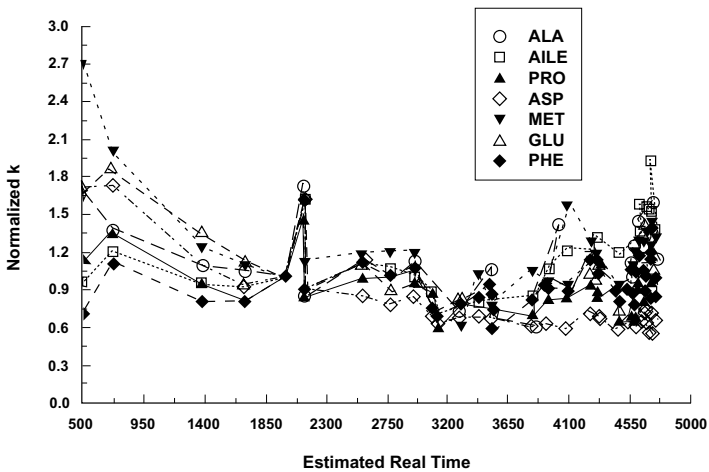


Figure 3. Amino acid racemization/epimerization coefficients versus presumed real-time snail shell age.

Figure 4. Amino acid racemization/epimerization coefficients, normalized to unity at age 2000 years BP, versus presumed real-time snail shell age.

Normalized Coefficients vs Time



The uncertainty in the values for k that is attributable to uncertainties in the measurement of the D/L ratio can be estimated from the scatter of the data points about a smoothed progression line, if this scatter is greater than what would be expected from uncertainty of t in Equation 2 or 3. But particular consideration should be given to the D/L values for $t = 0$ reported by Dr. Goodfriend (see Table 2). Notice that the D/L ratios are greater than 0 for $t = 0$. These values may be representative of uncertainty in any D/L measurement, or may be an indication of error that would result from an unjustified simplistic presumption that D/L = 0 at $t = 0$. The corresponding uncertainties in k for $t = 730$ are given in Table 2, as estimated from a linear extrapolation for Equation 2 or 3 from the $t = 730$ point. For only two amino acids (alloisoleucine/isoleucine and glutamic acid) are these uncertainties in k as great as those due to the uncertainty in t at 730 years (30%). Therefore, t is the greater source of uncertainty. The possible significance of uncertainty due to the $t = 0$ values diminishes as D/L increases. (Compare alloisoleucine/isoleucine with proline and glutamic acid with methionine in Table 2.)

Table 2. Relation of Uncertainty in k to Uncertainty in D/L

AMINO ACID	D/L at $t = 0$	D/L at $t = 730$	Q
Alanine	0.022	0.108	20
Alloisoleucine/isoleucine	0.014	0.038	33
Proline	0.014	0.146	10
Aspartic Acid	0.051	0.264	21
Methionine	0.020	0.228	10
Glutamic Acid	0.022	0.078	29
Phenylalanine	0.013	0.099	13

Q = % uncertainty in k at $t = 730$ due to a variation of D/L equal to value of D/L at $t = 0$. See text.

From these considerations of the possible consequences of uncertainties in the determination of t and D/L, it is evident that the hazard of drawing unwarranted conclusions from the data patterns in Figures 1 and 2 may be minimized by avoiding any judgment that is influenced by data for $t = 500$ and $t = 730$.

Racemization/epimerization rates are dependent on a number of environmental factors (Brown 1985, p 18), the most critical of which is temperature. The differences between samples No. 6, from 17 cm below ground level, and No. 7, from 78 cm below ground level, each with $t = 2150$, clearly indicate the influence of environmental factors. Sample No. 6

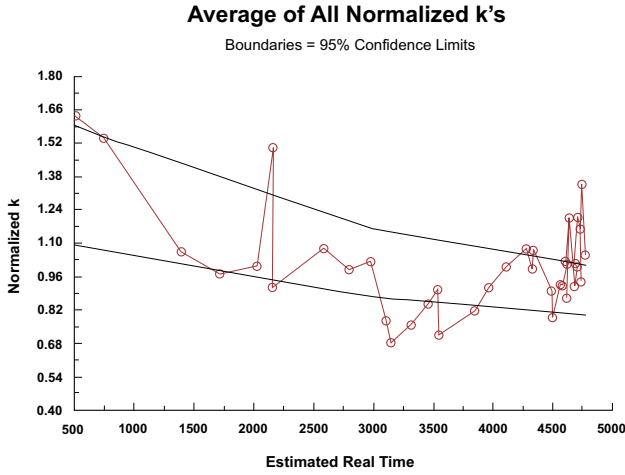
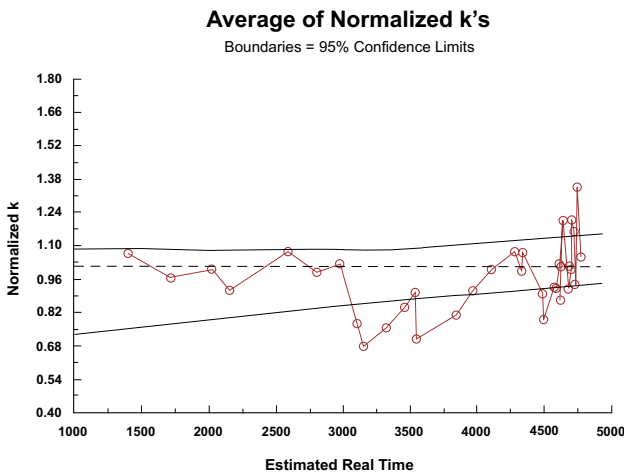


Figure 5. Average of data from Figure 4, with $\pm 95\%$ confidence boundaries.

evidently had a higher effective average temperature than sample No. 7. In each case for the data from Table 1 in which a sample from less than 20 cm below ground level is followed (higher C-14 age) by a sample from greater than 75 cm depth (there are four such cases in Goodfriend

Figure 6. Average of data from Figure 4 with $\pm 95\%$ confidence boundaries, but with data for $t = 500$, $t = 750$, and the upper values for $t = 2150$ (samples 1, 2 and 6) omitted to make long-term trends more apparent.



1991a), the D/L ratios decrease, indicating a lower average temperature for the most deeply buried specimens.

Figure 6 was obtained by omitting samples No. 1 ($\pm 50\%$ uncertainty), No. 2 ($\pm 30\%$ uncertainty), and No. 6 (higher storage temperature than for other samples in the $t = 2150$ -year vicinity). This provides a better basis for judging long-term trends than does Figure 5. The 95% confidence boundaries are indicated on Figures 5 and 6. The noticeable dip at $t = 4500$ in Figures 5 and 6 correlates with at least four of the six samples in this region coming from depths greater than 75 cm and evidently having a lower mean storage temperature than those slightly younger or slightly older. (Two of these six samples are not specified with respect to depth, but have D/L ratios closely similar to the other four.) Any factor that influenced the long-term average temperature — such as depth of burial, slope of overlying surface toward the sun, or type of vegetation cover — could cause variation from the smooth plot of D/L ratio against time (constant k) that would be expected if all samples came from the same location.

The trends evident in Figures 4, 5, and 6 have an enhanced significance, because each rate coefficient plotted is an average over the time between the present and the lifetime of the shell growth of the snails it represents. The racemization/epimerization rate that characterizes a sample at any time will be strongly dependent on the current temperature, and also dependent on temperature-dependent changes in the chemical bond relationships that have developed over preceding time (Kimber & Hare 1992). For a continuous trend of change, the difference between the most ancient and the recent rate coefficients would be greater than the corresponding difference between a time average and the recent value. The most likely interpretation of the trends evident in Figures 4, 5, and 6 is as an indication of three major temperature epochs. Samples with ages greater than 4200 appear to have experienced an initial warm environment that made their effective temperature greater than the effective average temperature for samples with ages in the 2800-4200 range. The 2800-4200 year range can be identified with the period of continental glaciation (Oard 1990a,b). Glaciation may have been well developed in some high latitude areas before there was a marked change of climate in southern Palestine, so these amino acid data do not provide a basis for estimating a time for the beginning of glaciation. A universal postglaciation warming trend since around 2900 BP has apparently resulted in samples with ages less than 2500 having a higher average

temperature than that which characterizes samples in the 2800-4200 year age range.

While commenting on glaciation and ice ages, it is worth noting that among the snail shells treated in this study, those with C-14 age in the 5200-5800 range (real time range 4200-4650, according to the conversion used in this paper) have oxygen isotope ratios which indicate that during this time the average of the temperatures at the sources of water for the food supply was higher than it was subsequently, or previously (Goodfriend 1991b). This has been interpreted to indicate an era of differing weather patterns, during which a higher portion of the annual rainfall in the Negev came with southwest winds out of Africa.

The plot in Figure 6 emphasizes the need for a conversion from C-14 age to real time. If C-14 ages are used, the right end of this plot extends to 10,400, rather than 4765, with ordinate values clustering around 0.46 instead of 1.0. It would be unreasonable for racemization/epimerization coefficients of fossil material to progressively increase with time sufficiently to produce over 10,000 years a two-fold increase in the values indicated by Equations 2 and 3. These equations are based on the assumption of a constant racemization/epimerization rate. If the rate has actually been increasing, the rate at the beginning of a time period would be less than the “average” given by these equations. Accordingly the rates 10,000 years ago would have to be considerably less than one-half their recent value.

The slight upward trend of the 95% confidence band in Figure 6 indicates that presumed real time as given by Equation 1 is too small. Placing the date for the Flood in Equation 1 at 5350 BP, as supported by the Septuagint (see Brown 1990), rather than 5000 BP, produces the horizontal 95% confidence band that would be expected for constant racemization/epimerization rates.

CONCLUSIONS

The data treated in this discussion provide support for the following significant conclusions:

1. Radiocarbon ages give a better representation of real time when interpreted in accord with the chronological guidelines given in the Hebrew scriptures (Nichol et al. 1953, 1978), than when taken as directly equivalent to real time, or when interpreted according to the currently popular dendro-

chronological model that requires radiocarbon ages to be increasingly less than equivalent real time.

2. Amino acid racemization/epimerization coefficients have been to a first approximation essentially constant, with small variations that may be accounted for as a result of temperature differences, as expected from simple theoretical considerations.
3. Based on the trends in Figure 6, mean temperatures in the Palestine area were relatively warm for a few hundred years after the Flood, prior to the development of polar climate zones and continental glaciation; and then became cooler over a span of about 1500 years before the end of continental glaciation and the establishment of a warming trend that has continued over the past 2500 years.

ACKNOWLEDGEMENT

We thank L. J. Gibson for assistance in manuscript preparation.

LITERATURE CITED

- Brown RH. 1985. Amino acid dating. *Origins* 12(1):8-25.
- Brown RH. 1986. Radiometric dating from the perspective of biblical chronology. In: Walsh RE, et al., editors. *Proceedings of the First International Conference on Creationism*. Pittsburgh, PA: Creation Science Fellowship, p 31-57.
- Brown RH. 1990. Correlation of C-14 age with the biblical time scale. *Origins* 17(2):56-65.
- Goodfriend GA. 1991a. Patterns of racemization and epimerization of amino acids in land snail shells over the course of the Holocene. *Geochimica et Cosmochimica Acta* 55(1):293-302.
- Goodfriend GA. 1991b. Holocene trends on O¹⁸ in land snail shells from the Negev Desert and their implications for changes in rainfall source areas. *Quaternary Research* 35:417-426.
- Kimber RWL, Hare PE. 1992. Wide range of racemization of amino acids in peptides from human fossil bone and its implications for amino acid racemization dating. *Geochimica et Cosmochimica Acta* 56:739-743.
- Mitterer RM, Kriausakul N. 1989. Calculation of amino acid racemization ages based on apparent parabolic kinetics. *Quaternary Science Reviews* 8:353-357.
- Nichol FD, et al., editors. 1953, 1978. *Seventh-day Adventist Bible Commentary*, Vol. 1. Washington DC: Review and Herald Publishing Association, p 174-196.
- Oard MJ. 1990a. A post-Flood ice-age model can account for Quaternary features. *Origins* 17(1):8-26.
- Oard MJ. 1990b. *An ice age caused by the Genesis Flood*. ICR Technical Monograph. El Cajon, CA: Institute for Creation Research.
- Stuckenrath R, Jr., Mielke JE. 1970. Smithsonian Institution radiocarbon measurements VI. *Radiocarbon* 12:192-204.

ANNOTATIONS FROM THE LITERATURE

BIBLICAL CHRONOLOGY

Gould SJ. 1991. Fall in the house of Ussher. *Natural History* 12(11):12-19.

Summary. Bishop James Ussher is well-known for establishing the time scale often found in Bibles and Bible commentaries, in which creation is set at 4004 B.C. Actually, the Bishop was more precise, setting the time of creation at midday, 23 October 4004 B.C. Gould gives an interesting thumbnail sketch of Ussher's life and the method he used to arrive at his date for creation. Although completely rejecting Ussher's conclusions, Gould argues that too many scientists today tend to judge the Bishop unfairly. Given the information available at the time, Ussher actually used good methods of scholarship to make his calculations.

Comment. Despite Gould's assurance that Ussher's chronology was hopelessly wrong, the sympathetic treatment of Ussher makes this paper interesting reading, even to those who believe Ussher's chronology to be more accurate than the one accepted by Gould.

END-CRETACEOUS IMPACT

Florentin J-M, Maurrasse R, Sen G. 1991. Impacts, tsunamis, and the Haitian Cretaceous-Tertiary boundary layer. *Science* 252:1690-1693.

Summary. The Cretaceous-Tertiary (K/T) boundary in southern Haiti is located in the Beloc Formation. A marker bed within this formation has the thickest ejecta layer and the largest microtektites yet found. Shocked quartz grains and high concentrations of iridium are also found in the bed. These features are interpreted as evidence of a nearby extraterrestrial impact.

Hildebrand AR, Penfield GT, Kring DA, Pilkington M, Camargo Z A, Jacobsen SB, Boynton WV. 1991. Chicxulub Crater: a possible Cretaceous/Tertiary boundary impact crater on the Yucatan Peninsula, Mexico. *Geology* 19:867-871.

Summary. A buried circular structure on the Yucatan Peninsula of Mexico may be a K/T impact crater. The structure's diameter is about 180 km, and was identified by gravity-field and magnetic-field

anomalies. Oil-well drilling cores from within and without this putative crater reveal limestone and broken-up rocks containing Cretaceous fossils. Andesitic igneous rocks are also present, but only within the crater. Shocked quartz grains have been found in drill core material. The K/T boundary within the structure appears to be depressed about 1000 m below its level in a well just outside the structure.

The geologic age of Chicxulub Crater is not precisely known, but the evidence is consistent with a Cretaceous-Tertiary boundary event. The crater is located in continental crust, apparently on a shallow water platform. The maximum excavation depth is calculated as 15 km. The crater is located geographically about midway between deposits of K/T boundary ejecta found in Haiti and northeastern Mexico. The authors suggest the Chicxulub Crater may have been formed by the impact of an extraterrestrial object, which may have contributed to the forces causing the end-K extinction.

GEOLOGY: TRENDS IN DEPOSITION

Jablonski, D. and D. J. Bottjer. 1991. Environmental patterns in the origins of higher taxa: the post-Paleozoic fossil record. *Science* 252:1831-1833.

Summary. Twenty-six orders of benthic marine invertebrates with good fossil records have first appearances in the Mesozoic and Cenozoic. The inferred energy levels of the depositional environments for the first appearances of each of these 26 orders were compared. Evidences of high-energy deposition were interpreted as indicating onshore environments, above normal storm wave base. Low-energy deposition systems were interpreted as indicating offshore environments, below normal storm wave base. Although many of these orders are today restricted to offshore environments, the authors report that 20 of the 26 orders have first appearances in onshore (high energy) environments. The high proportion of first appearances of benthic marine orders in high-energy deposits may indicate the general importance of catastrophes in fossilization.

MOLECULAR EVE?

Gyllensten U, Wharton D, Josefsson A, Wilson AC. 1991. Paternal inheritance of mitochondrial DNA in mice. *Nature* 352:255-257.

Summary. Most of the DNA is located in the nucleus of the cell, but mitochondria also contain some DNA. Conventional wisdom has

held that mitochondrial DNA (mtDNA) is passed on only by the mother, since the ovum has many mitochondria, and the sperm does not contribute mitochondria to the fertilized egg. At fertilization, the sperm nucleus enters the ovum, leaving the paternal mitochondria behind. This paper reports that paternal mitochondria may not be entirely left behind. Traces of paternal mtDNA were detected in an experiment using mice. The frequency of paternal mtDNA was only 0.001 as compared to maternal mtDNA. This shows that mtDNA may not be exclusively transmitted by the maternal line. An interesting sidelight is that this result reduces the proposed time since the divergence of human races from a postulated “mitochondrial Eve” in Africa.

Hasegawa M, Horai S. 1991. Time of the deepest root for polymorphism in human mitochondrial DNA. *Journal of Molecular Evolution* 32:37-42.

Summary. By comparing mitochondrial DNA sequences in humans, an evolutionary “gene tree” has been produced that indicates all humans share a common ancestry from a woman who supposedly lived at a time variously estimated as 100,000-300,000 years ago. This woman has been dubbed “Eve” in the press. This hypothesis has stirred a great deal of controversy, especially from anthropologists who believe some human fossils to be more than one million years old. The “Eve” hypothesis implies that these older fossil humans are evolutionary side branches rather than ancestors of modern humans.

The original study used DNA restriction fragments for comparison. Other studies have used the actual nucleotide sequences of non-coding mitochondrial DNA. This study reports a comparison of nucleotide sequences from previous studies, using a newer statistical method. The conclusion is that all humans share an ancestral “Eve” who lived about 280,000 years ago. This is essentially in agreement with the original estimate based on restriction fragments.

Vigilant L, Stoneking M, Harpending H, Hawkes K, Wilson AC. 1991. African populations and the evolution of human mitochondrial DNA. *Science* 253:1503-1507.

Summary. Sequences of two segments of mitochondrial DNA from 189 people were compared. Sequences were identical within populations, but different among populations. A phylogenetic tree showed the deepest branches leading to African sequences. A molecular clock calibrated to the supposed divergence of humans and chimpanzees placed the age of the ancestor of modern humans between 169,000

and 249,000 years ago. This supports the controversial hypothesis that all modern humans share a recent common ancestor.

Wolpoff M, Thorne A. 1991. The case against Eve. *New Scientist* 130(1774, 22 June):37-41.

Summary. The “Eve hypothesis” states that all modern humans descended from a single African female that lived some 200-300 Ka ago. This lineage supposedly spread over the world, replacing previous populations rather than mixing with them. The “Eve hypothesis” is based on comparisons of mtDNA sequences in various human populations. Wolpoff uses fossil evidence to oppose the “Eve hypothesis.” According to Wolpoff, differences among modern populations can be seen in fossil skulls in the same respective geographical regions, indicating that the modern populations in each region are locally derived. Since the fossils are dated at older than the date for “Eve,” Wolpoff concludes that present populations cannot be derived from Africa so recently.

Comment. Wolpoff’s argument hinges critically on the accuracy of dating of fossils. The “Eve hypothesis” depends critically on the validity of a mtDNA molecular clock. Although neither argument is compelling, the debate is interesting, particularly the point that all human populations seem much more closely related than expected if the human lineage were millions of years old.

MOLECULAR PHYLOGENY

Bulmer M, Wolfe KH, Sharp PM. 1991. Synonymous nucleotide substitution rates in mammalian genes: implications for the molecular clock and the relationship of mammalian orders. *Proceedings of the National Academy of Sciences (USA)* 88:5974-5978.

Summary. The molecular-clock hypothesis postulates that the rate of mutation is essentially constant when averaged over geologic time. If true, groups that diverged from each other at a particular time should show the same degree of difference when compared among themselves or to another group. The most reliable molecular clocks should involve mutations that have no phenotypic effect, such as those affecting the third base position in a codon. These are known as silent substitutions, and are used to make comparisons in this paper.

Bulmer et al. report on comparisons of DNA differences at third codon positions for 58 genes among primates (humans), artiodactyls

(cattle) and rodents, with some lagomorphs (rabbits) and carnivores (dogs) also included. Each of these orders is believed by evolutionists to have diverged at approximately the same time. The results of this study indicate that the differences between primates and artiodactyls are much less than between either of these groups and rodents, even for similar types of substitutions. This conclusion violates the assumptions of the molecular clock.

Comment. An alternative interpretation of the data, not considered by the authors, is that each of these groups has a separate ancestry, and is not related to the others by a common ancestry.

Gorr T, Kleinschmidt T, Fricke H. 1991. Close tetrapod relationships of the coelacanth *Latimeria* indicated by haemoglobin sequences. *Nature* 351:394-397.

Summary. Evolutionists have debated which group of fish makes the best ancestor for tetrapods. Much of the debate has focused on the lungfishes and the group including the coelacanth, with the ray-finned fishes also mentioned at times. This paper reports a comparison of amino-acid sequences for alpha and beta hemoglobin chains for the coelacanth and several other species pertinent to the debate. For alpha globin, the coelacanth sequence was more similar to amphibian sequences, and the lungfish was least similar. For beta globin, the ray-finned fishes were more similar to amphibians, and the lungfish was least similar. All matchings were less than 60%. The coelacanth had the greatest number of unique similarities with amphibians. The authors conclude that the coelacanth is the closest living relative of tetrapods.

PALEOECOLOGY

Russell MP. 1991. Modern death assemblages and Pleistocene fossil assemblages in open coast high energy environments, San Nicolas Island, California. *Palaios* 6:179-191.

Summary. Four fossil assemblages and four death assemblages of subtidal molluscs were compared on San Nicolas Island. Two habitats were represented: sandy bottom and rocky bottom. Habitat type could not be inferred merely from presence or absence of species, but could from the relative frequencies of the species. Death assemblages did not form on the sandy substrate, but formed in sediment traps around boulders.

PALEONTOLOGY

Bardack D. 1991. First fossil hagfish (Myxinoidea): a record from the Pennsylvanian of Illinois. *Science* 254:701-703.

Summary. A fossil hagfish has been discovered in the Francis Creek Shale of the Carbondale Formation of Will County, Illinois. This formation is classified as Pennsylvanian (Upper Carboniferous). This is the first fossil record of a hagfish to be discovered. The single specimen has features suggesting it may be a juvenile. The fossil differs from living hagfish enough for it to be placed in a new genus. It is considered to be basically modern in its characteristics. The newly discovered hagfish does not show any characteristics of lampreys or other groups, showing that the hagfish group was separate and distinct at the time the organism was living.

Gribin J. 1991. Rocks reveal world's oldest mollusc. *New Scientist* 132(1800/1801, 21-28 December 21):10.

Summary. Chitons are flat, oval-shaped, soft-bodied animals with a shell of eight overlapping plates. They are commonly found attached to rocks in the ocean. A chiton has been found in lower Cambrian deposits on the Yorke Peninsula of South America. This earliest known fossil mollusc extends the record of chitons back from the upper Cambrian.

Ramskold L, Xianguang H. 1991. New early Cambrian animal and onychophoran affinities of enigmatic metazoans. *Nature* 351:225-228.

Summary. A Cambrian worm-like fossil has been discovered in Yunann Province of China. The fossil is about 6 cm long, with 11 pairs of legs. The authors interpret the structure of this fossil to suggest similarities with certain problematic Cambrian fossils such as *Microdictyon* and *Hallucigenia*. Referred to as "lobopods," these fossils are placed by the authors in the phylum Onychophora.

Thwaites T. 1991. Duck-billed platypus had a South American cousin. *New Scientist* 131(1783, 24 August):13.

Summary. The duck-billed platypus is found only in Australia and its origins are unknown. No platypus fossils have been found outside of Australia. Recently, an upper-right platypus molar has been found in Patagonia. The fossil was found in lower Tertiary (Paleocene) sediments.

Comment. This discovery strengthens the case for paleofaunal similarity between Australia and South America, but does little to solve the riddle of the origin of the platypus or its possible relationships.

LITERATURE REVIEWS

Readers are invited to submit reviews of current literature relating to origins. Mailing address: ORIGINS, Geoscience Research Institute, 11060 Campus St., Loma Linda, California 92350 USA. The Institute does not distribute the publications reviewed; please contact the publisher directly.

DARWINIAN MORALITY?

CREATED FROM ANIMALS: THE MORAL IMPLICATIONS OF DARWINISM. 1990. James Rachels. NY and Oxford: Oxford University Press. 245 p. Cloth, \$19.95.

*Reviewed by Earl M. J. Aagaard,
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This is a closely reasoned, relentlessly logical case for removing humanity from the unique moral position which it has occupied in Western thought. It is not an overstatement to say that this is a frightening book, precisely because Rachels does such a good job at the task he has set for himself.

The book begins with an Introduction in which the author sketches the problem and lays out his thesis: Darwinism undermines and removes all traditional Christian support for the idea of human dignity. “Man” is not special. While this may seem unremarkable to some, it is a hotly debated idea. Its attackers may be Christians (in particular, theistic evolutionists) or non-Christians. Some hold that Darwinism does *not* have moral implications — that it is in a separate realm, the realm of science. Others concede that there are indeed moral implications to the idea that man is a product of evolution from primitive ancestors, but that Rachels is nevertheless wrong, and man *can* occupy a special place in the moral calculus.

Chapter 1 is a historical review of Darwin’s life and the era in which he lived. Chapter 2 examines earlier attempts to relate (or deny relationship between) ethics and evolution. Chapter 3 asks and answers the question: “Must a Darwinian Be Sceptical?” The conclusion is that even if theism can coexist with Darwinism, it will be so different from the traditional view that it no longer supports the doctrine of human dignity. Chapter 4 addresses the question of “How Different are Humans from Other Animals?” and concludes that they are different only in

degree, not in kind. Chapter 5 explores the possibility of “Morality Without the Idea that Humans are Special.” Rachels’ “basic idea is that how an individual may be treated is to be determined, not by considering his group memberships, but by considering his own particular characteristics” (p 173).

Rachels’ replacement for the traditional view of man can be termed “moral individualism.” The characteristics of any individual animal (and only those characteristics relevant to the specific question at hand) determine how that individual will be treated. Mere membership in the human race affords no special treatment. This leads to *apparently* anomalous results. Damaged humans with few apparent future possibilities may be sacrificed for the welfare of non-humans — mainly higher mammals, in Rachels’ view. He makes it plain that, under Darwinism, these results are not anomalous, but are reasonable and to be expected.

Rachels’ biases are revealed here and there throughout his book. In Chapter 2 (p 88) he examines the traditional sanctity of innocent human life. After listing suicide, euthanasia, and infanticide as violations of the principle, he says: “Suicide will serve as a convenient example (although euthanasia or infanticide would do just as well).” I am struck that, perhaps purely by chance(?), he chose as his example the (currently) *least* controversial of his choices, and the only one not involving aggression against another human being. Would the argument that follows be so convincing to his readers if he were defending the acceptability of infanticide? I think not.

Also, with few exceptions, when evaluating the case for man’s privileged position in the animal, Rachels expresses that concept in its extreme form — that *any* of man’s interests take precedence over *all* interests of other forms of life. While he does mention that some Christians see their role on earth as stewards rather than owners, his examples of traditional views all involve the exploiters. While these do make much better stories for Rachels’ purpose, a less-anthropocentric understanding of God’s creation can accomplish many of the good things that he espouses — vegetarianism, anti-vivisection, etc. — without leaving human beings subject to the inhumanity of their peers.

Perhaps a good philosopher can make a convincing case that Rachels is wrong; that Darwinism and a Christian worldview are compatible. But the consequences of widespread acceptance of the doctrine taught in this book frighten me. Rachels is saying that *THERE*

IS NO OUTSIDE STANDARD. We are free (indeed, compelled) to develop our own standards of right and wrong. History is full of examples (slavery, genocide, wife-burning are just a few) of what happens when man abandons God's Law and invents his own. Rachels appears at his most naive when he implicitly assumes that emphasizing the continuity between man and animals will result in bringing our treating animals according to traditional human norms. He does not deal with the probability that some humans will simply begin treating other humans as badly as animals are currently treated. To accept a doctrine whose success depends on a fundamental change in human nature is a recipe for disaster, one that we see looming over us even now in the abortion and euthanasia movements.

This book is a challenge to every Christian who thinks about ethics. Is Rachels correct when he says that the Bible teaches the dignity of man and the sanctity of innocent human life? If so, then a Christian view of the fundamental moral questions will be different than a materialist's view. If our decisions on these issues are essentially similar to the Darwinists', the task is to show that Rachels is incorrect in his arguments about the moral implications of Darwinism. Otherwise we risk being Christian in name only, denying Christ by our actions.

GENERAL SCIENCE NOTES

FRESH BREAD; OLD FOSSILS

By R.H. Brown, Yucaipa, California

INTRODUCTION

Homemade bread fresh out of the oven has a unique taste that for many of us is among our treasured memories. All too soon, subtle chemical changes produce markedly inferior, stale bread. The duration of choice flavor can be prolonged by keeping the bread in a refrigerator, and greatly extended by storage in a freezer. But eventually the breakdown of complex molecules converts the best bread into undesirable food. Statements such as “Better if used before (date)” or “Discard (date)” are commonly found on packages containing food or medicine.

ORGANIC MOLECULE DEGRADATION

The degradation of organic material is a familiar experience. Organic molecules are high energy configurations of carbon, hydrogen, and oxygen atoms. These configurations may also contain nitrogen and a small proportion of other elements such as sodium, phosphorous, sulfur, potassium, calcium, and iron. The atoms in these molecules tend to reorganize into arrangements that have a lower energy, and eventually break down into water, carbon dioxide, and relatively simple compounds of carbon and the other elements. Organisms such as bacteria derive energy from the more complex organic molecules by enzymes that vastly increase the rate of breakdown (digestion).

An allusion to this breakdown process may have been included in the statement “dust thou art, and unto dust shalt thou return” (Genesis 3:19). If all life (the ability to produce high energy organic molecules from simple ingredients) were to become extinct, in an ordinary chemical environment the more complex organic molecules such as DNA would eventually disappear.

DNA RESIDUE IN FOSSILS

The superficial tissue of an Egyptian mummy with a carbon-14 age of 2430 years has been determined to have 20 micrograms of DNA per gram of dried tissue (Pääbo 1985), about 5% of the amount of DNA

expected from fresh human tissue. A 95% decrease in 2430 years is represented by a 562 year half-life (reduction by $\frac{1}{2}$ every 562 years), if the process proceeds at a uniform rate. The inner tissue of this mummy is less well preserved, and has even less than the 5% level of DNA. The DNA sequences there are more broken up than are those from the skin. These differences have been explained as due to relatively more rapid dehydration of superficial tissues in the mummification process, making the effective time for hydrolytic processes relatively shorter there than in the interior tissue (Pääbo 1985). In his 1985 report Pääbo states that "most mummy samples are seen to be devoid of nucleic acid." The rate of DNA degradation is critically dependent on the chemical environment.

DNA at a concentration level of one microgram per gram of dried tissue has been extracted from a Ground Sloth carcass which has a 13,000 year carbon-14 age (Pääbo 1989). On the basis of the 562 year half-life representation for the 2430 year old Egyptian mummy, the DNA in this Ground Sloth carcass would be expected to be only about $\frac{1}{100,000}$ of one percent of the level in a living organism, whereas in fact it is $\frac{1}{10,000}$ of one percent. At such a relatively infinitesimal concentration level, there would still be sufficient DNA molecules to be detectable by sensitive modern techniques.

The oldest DNA reported so far is from leaves in a Miocene lake deposit of northern Idaho (Golenberg et al. 1990). From laboratory estimates of hydrolysis rates, no initial DNA sequence is expected to remain intact in the natural environment much beyond 10,000 years (Sykes 1991), about $\frac{1}{2000\text{th}}$ the presumed 17-20 million year age of the leaves. Yet the DNA sequences in fossil magnolia leaves from this deposit are sufficiently preserved to permit identification and comparison with modern species of magnolia (Golenberg et al. 1990).

AMINO ACID RESIDUE IN FOSSILS

One does not need to be biased by chronological specifications in the Bible to have these observations regarding residual DNA produce doubt concerning the conventional geological and radiometric time scale. Similar evidence from the amino acid residue in fossil material has been treated in an earlier issue of *Origins* (Brown 1985). In that treatment attention was called to graptolites from a Silurian formation (presumed age in the 400-440 million years range) that contain residual amino acid,

contrary to expectation based on the rates of decomposition of amino acids observed over historically defined time spans.

The principal difficulties presented by the data on DNA and amino acid content in fossil material are removed when fossil deposits are treated as having been formed during, or since, a universal reformation of planet Earth's surface about 5000 solar years ago, according to the data in chapters 6-11 of the book of Genesis.

CARBON-14 RESIDUE IN FOSSILS

The observed upper limit in the 40,000 carbon-14 year range for supposedly infinite age (undetectable carbon-14) samples of anthracite, bone, calcite, shell, and wood is also readily explainable on the same basis (Brown 1988a, 1988b; Brown & Webster 1991).

SIGNIFICANCE OF RESIDUAL DNA, AMINO ACID, AND CARBON-14

Individuals who have confidence in the historical validity of the data/specifications in the first eleven chapters of Genesis may be widely ridiculed within the scientific community, but these individuals can offer a better *scientific* explanation for the DNA, amino acid, and carbon-14 data on ancient and fossil organic material than can be constructed in accordance with the prevailing dogma concerning the history of planet Earth. There is an increasingly broad basis for confidence that a correct interpretation of the first eleven chapters of Genesis and of the data from investigations in natural science will be mutually supportive.

ACKNOWLEDGEMENT

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REFERENCES

- Brown RH. 1985. Amino acid dating. *Origins* 12:8-25.
- Brown RH. 1988a. Implications of C-14 age vs depth profile characteristics. *Origins* 15:19-29.
- Brown RH. 1988b. The upper limit of C-14 age? *Origins* 15:39-43.
- Brown RH, Webster CL. 1991. Interpretation of radiocarbon and amino-acid age data. *Origins* 18:66-78.

- Golenberg EM, Giannasi DE, Clegg MT, Smiley CJ, Durbin M, Henderson D, Zurawski G. 1990. Chloroplast DNA sequence from a Miocene *Magnolia* species. *Nature* 344:656-658.
- Pääbo S. 1985. Molecular cloning of ancient Egyptian DNA. *Nature* 314:644-645.
- Pääbo S. 1989. Ancient DNA extraction, characterization, molecular cloning and enzymatic amplification. *Proceedings of the National Academy of Sciences (USA)* 86(3):1939-1943.
- Sykes B. 1991. The past comes alive. *Nature* 352:381-382.