veloped from the scales of reptiles, there has never been any convincing statement in detail as to how it could have happened once. Is one to believe, then, that it happened twice? No, the proper response to a claim that ostrich—or any other—feathers developed from scales is: "Horse feathers!"

As for the argument, on grounds of features of the skeleton, that ostriches descended from dinosaurs, proves nothing. For the mechanical problems encountered in a large bird would not be too different from those encountered by a fairly large dinosaur which walked on two legs. Hence it would not be at all surprising that the Creator solved both problems in similar ways.

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Contributed by Harold Armstrong

QUOTE

. . . Naturalistic evolution can sustain neither the universal nor the permanent dignity of man.

Henry, Carl F. H. 1984. The crisis in modern learning in The Christian vision: man in society, Lynne Morris, editor. The Hillsdale College Press, Hillsdale, MI, p. 9.

The "Missing Mass" Between Galaxies: An Inescapable Problem for an Old Universe

Creationists (for example Slusher[1]) have shown that there is insufficient mass for galaxies to hold gravitationally together over billions of years. Evolutionary astronomers have sought to explain away this difficulty by postulating some hidden sources of mass, but such rationalizations are failures. Rizzo[2] wrote:

> Another mystery concerns the problem of the invisible missing mass in clusters of galaxies. The author evaluates explanations based on black holes, neutrinos, and inaccurate measurements and concludes that *this remains one of the most intriguing mysteries in astronomy.* (Italics added)

The obvious solution is that there really is no hidden mass, galaxies cannot hold together for billions of years, and that galaxies have not been in existence long enough to fly apart.

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2. Rizzo, P. V. 1982. Review of Mysteries of the Universe by Nigel Henbest. *Sky and Telescope,* Aug., p. 150.

Contributed by John Woodmorappe

ICE AGES: THE MYSTERY SOLVED?

PART II: THE MANIPULATION OF DEEP-SEA CORES

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Abstract

This part discusses the basis for the modern revival of the astronomical theory of the ice ages, namely statistical correlations with oxygen isotope fluctuations in deep-sea cores. The analysis of oxygen isotopes and the dating methods for cores are subject to many assumptions, variables, unknowns and problems to objectively relate cores to the astronomical theory.

A) Introduction

Part I of this article presented a brief historical sketch of the astronomical theory of the ice ages. It was shown that long-term orbital variations in radiation are too small to cause ice ages, and that any uniformitarian ice age scheme is practically impossible. Climate simulations supporting the theory actually have many serious problems, namely unrealistic parameterizations that make them highly sensitive to slight changes in radiation. If this is true, then why have most earth scientists accepted it during the past 10 years? The reason is because of statistical relationships with deep-sea cores. During the time when most paleoclimatologists were skeptical of the Milankovitch theory, there were several influential believers trying to prove it by various means. After the Second World War interest in and exploration of the deep sea was intensified, from which came new technology to sample the sediments of the ocean bottom. Thousands of these cores have now been collected and stored at various oceanographic institutions. Downcore time series (the change in a variable with time) of climate sensitive parameters were derived from the cores and then correlated with the astronomical theory. The best parameter employed is the change in the abundance of oxygen isotopes of foraminifera microfossils. However, before oxygen isotopes could be related to the Milankovitch theory, accurate dates for the cores were needed. This was provided mainly by index microfossils, radiocarbon, uranium series disequilibrium, and paleomagnetic stratigraphy. The time series was analyzed for its predominate cycles by power spectrum analysis. However there are too many assumptions, variables, unknowns and problems in the above procedure to objectively relate oxygen isotope fluctuations to the astronomical theory of the ice ages.

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B) Oxygen Isotope Analysis of Deep-Sea Cores

1) THE PROCEDURE

Many geophysical and biological variables have been measured down deep-sea cores. Several of the more important variables are changes in $CaCO_3$, certain microfossil changes, and changes in oxygen isotopes. The first two and others not mentioned are not globally synchronous, a needed condition to establish a link with orbital variations. There are also many problems in attempting to relate them to the Milankovitch mechanism.[1] Referring to variables other than oxygen isotopes, Hays and Morley state:

> On the other hand there is no a priori reason to believe that the frequency distribution of other geochemical or paleontological parameters in widely separated deep-sea cores should have a common frequency distribution. . . These results suggest that the frequency distribution of other geochemical and paleontological parameters may vary regionally, and provide a record of local or regional climatic changes.[2]

Oxygen isotopes have been found to be globally synchronous and to correlate with the astronomical theory of the ice ages.

Oxygen has three stable isotopes with approximate abundances of $^{16}O = 99.76\%$, $^{17}O = 0.04\%$, and $^{18}O = 0.21\%$. The percent of ^{17}O is too low to be practically used. The amount of ^{18}O is very small, and in practice the ratio, $^{18}O/^{16}O$, measured in parts per thousand or per mil ($^0/_{00}$) is used. The ratio, called a delta value is compared to a laboratory standard by the following equation:[3]

$$\delta^{18}O = \left[\frac{^{18}O/^{16}O - {^{18}O/^{16}O}_{\text{Standard}}}{{^{18}O/^{16}O}_{\text{Standard}}}\right] \times 10^3 \ {^0/_{00}} \quad (1)$$

There are many standards that have been developed[4] since Harold Urey and his colleagues at the University of Chicago developed the idea. Negative values of $\delta^{18}O$ mean the sample is enriched in ^{16}O above the standard, while positive values indicate more ^{18}O than the standard.

Oxygen isotopes are measured in the shells or tests of microfossils in deep-sea cores. The main microfossil group is the foraminifera, a one-celled organism commonly found at most depths of the ocean.[5] The shell consists of one or several chambers mostly less than one millimeter across and connected by an opening or two (foramen). Species that live near or on the bottom are called benthonic or benthic foraminifera and have short geographical ranges, which make them less useful for correlating.[6] Those that inhabit the surface (sometimes far from the surface) are called pelagic or planktonic foraminifera. Their shells make up a significant proportion of the sediment on the ocean bottom. Foraminifera are commonly used as index fossils throughout the Phanerozoic. They have been well studied, but there is a "species problem" in their classification because they have been "over-split by zealous taxonomists."[7] After all the study "Little is known about the biology and ecology of the living organisms,"[8] which places severe constraints on the interpretation of oxygen isotopes from their shells. Approximately 30 species of planktonic foraminifera[9] and a lesser number of benthonic species are useful for Pleistocene paleoclimatological analysis.

$\delta^{18}O$ is measured down a deep-sea core usually at 10 cm intervals. The resulting curve is usually sinusoidal in shape with the lower frequencies the most energetic, like many other geophysical time series.[10] Figure 1 is one of the most used $\delta^{18}O$ plots from core V28-238 (the 238th core on the 28th cruise of the Lamont-Doherty Geological Observatory ship Vema).[11, 12]

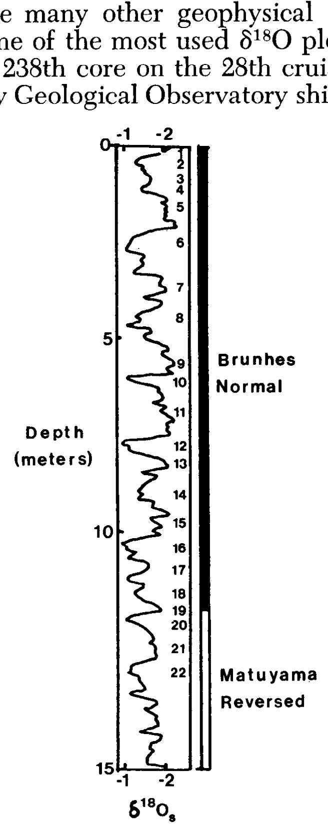

Figure 1. Oxygen isotope variations in core V28-238 from the Solomon Plateau (3120 meters depth), Pacific Ocean. Magnetic declination of core is shown at right.

This core was taken from the Equatorial Western Pacific in 3120 meters of water. The oxygen isotope variations are quite small. Note that the oxygen isotope ratio was multiplied by 1000 in (1). The range of variation in $\delta^{18}O$ during the Pleistocene in Atlantic cores is about 21 $^0/_{00}$, while in Pacific cores, it is about 1.1 $^0/_{00}$.[13, 14] These slight variations are caused by many geophysical and biological variables. From experiments on corals, two main parameters were isolated. The relationship is expressed by the following equation:[15]

$$T = 16.9 - 4.2(\delta^{18}O_s - \delta^{18}O_w) + 0.14(\delta^{18}O_s - \delta^{18}O_w)^2 \quad (2)$$

where T is the temperature in degrees Celsius of the water at which shell secretion occurs, $\delta^{18}O_s$ is the measured delta value of the sample, and $\delta^{18}O_w$ is the delta value of the water.

2) COMPLEX LABORATORY TECHNIQUES

The procedure for measuring $\delta^{18}O_s$ of foraminifera shells in the laboratory is a very complex task with many inter-laboratory variations and much room for error. The sample must first be cleaned of organic matter and other contaminants. Different cleaning methods give slightly different results, which also depend upon the particular sample and the amount of impurities.[16] The sample is crushed lightly and usually only certain sizes are analyzed since different sizes have been found to give different $\delta^{18}O_s$ values, although this may be due to the variable procedures.[17]

In the cleaning process the samples are washed and dried at least twice. Usually the sample is roasted at about 450°C. Then, CO_2 gas must be extracted from the shell. This is usually done with phosphoric acid, but only two-thirds of the oxygen is released. The reaction must take place at low pressure, and the CO_2 must not come in contact with water. The oxygen isotopes in the CO_2 are measured in a mass spectrometer. Care must be taken during this phase to insure that molecules or radicals with the same mass as CO_2 are not formed within the spectrometer chamber.[18] The analytical precision of $\delta^{18}O_s$ measurements is about 0.2 $^0/_{00}$,[19] although this figure has varied. After much trial and error in developing the method (while at the same time $\delta^{18}O_s$ results were being published), a 12 step procedure is normally followed today, the difficulty of which is taken for granted by users.[20]

3) VERY DIFFICULT INTERPRETATION OF $\delta^{18}O_s$

a) Introduction

After $\delta^{18}O_s$ measurements down a core are plotted, the curve needs to be interpreted, which is usually according to (2). However, this is not easy and there are many serious problems of interpretation: ". . . these data are subject to problems of interpretation, which are only gradually being cleared up . . ."[21] Duplessy confirms this: "However a precise interpretation of these fluctuations is still a matter of controversy."[22] In a recent book on marine geology, Kennett repeats: "However, because of the various constraints imposed by the method, a precise interpretation of these fluctuations is still controversial."[23] Most of these constraints, assumptions, and problems will be investigated further in this section. It will be shown that it is very difficult, if not impossible, to know if the $\delta^{18}O_s$ curve accurately records paleoclimatic fluctuations over time which can be related to the astronomical theory of the ice ages.

b) A Missing Relationship

The most obvious problem in the interpretation of $\delta^{18}O_s$ during the Pleistocene is that (2) has two unknowns: the paleotemperature, T, and the $\delta^{18}O_w$ of the ocean water in the past and cannot be solved. Another relationship or equation in the form $T = C(\delta^{18}O_w)$, where C is a constant, is needed in order to accurately decipher the meaning of $\delta^{18}O_s$. Paleoclimatologists have actively searched for the value of C for over 20 years, and considerable controversy has resulted.[24] Recently, a compromise has been worked out. Over 20 years ago, Emiliani believed that C was equal to about three, so that $\delta^{18}O_s$ cycles were primarily due to the paleotemperature of the ocean, which fluctuated during the Pleistocene.[25, 26] However, in the mid and late 1960's many disagreed with him. They believed that C should be about 0.3.[27, 28] They related $\delta^{18}O_w$ to the volume of ice stored in the Pleistocene ice sheets during glacial/interglacial cycles because ^{18}O is heavier and does not evaporate as easily as ^{16}O. Thus the isotopes are fractionated, the amount depending upon the temperature. Consequently, ice will be enriched in ^{16}O at the expense of the ocean, which will have a greater amount of ^{18}O. Based on theoretical assumptions of past ice sheet thickness and the $\delta^{18}O$ of the ice, they were able to convince most scientists that past ocean temperatures contributed little to (2).[29] They drew further support from $\delta^{18}O_s$ measurements on benthonic foraminifera by assuming that the deep ocean has maintained its constant cold temperature throughout the Pleistocene. By relating $\delta^{18}O_s$ to ice volume, they have a more direct relationship to ice age fluctuations and to Milankovitch radiation cycles.

No matter what the value of C, it is based upon shaky uniformitarian assumptions. For instance, the assumption of a known ice sheet thickness for the Pleistocene ice ages is poor because it is really not known or else depends upon analogs from the present ice sheets. In discussing sea level lowering during a glacial phase, which is proportional to ice sheet thickness, Erickson and Wollin state: "The estimates vary because one can only guess how thick ice sheets were . . ."[30] Bloom says: "Unfortunately, few facts about its thickness are known . . . we must turn to analogy and theory . . ."[31] It should not be too surprising that Pleistocene ice sheets are believed to be the same thickness as those existing now. There is a degree of circular reasoning relating sea level lowering to ice sheet thickness, since each has been used to support the other. A recent article in *Science* claims that the sea level data near the maximum of the last ice age is faulty. New measurements on "non-movable" ancient sea level indicators revealed that sea level at that time was 54 percent higher than previous estimates. This implies ". . . that substantially less ice was present from 17,000 to 10,000 years B.P."[32] This new result shows how far off estimates of C can be based on the assumption of past ice sheet thickness. (This also adds support to the author's model of a thinner ice sheet.[33, 34])

The assumption that the $\delta^{18}O$ of past ice sheets can be known from present measurements on mid and high latitude precipitation from polar ice, on carbonate sediments from lakes, etc. is also very poor. There are many complex, interacting variables that intervene. $\delta^{18}O$ of water vapor, which enters into the measurements of all the above quantities, varies considerably with latitude, ranging from -11 $^0/_{00}$ in the warm subtropics to -50 $^0/_{00}$ in the cold polar regions.[35] Water vapor can be transported great distances before condensation, and even clouds can move significant distances before precipitating. Besides, there is a large seasonal difference in the $\delta^{18}O$ of water vapor at high latitude by as much as 25 $^0/_{00}$.[36] Other variables include the distance from open water at high latitude, the temperature and height of vapor condensation, the strength of the wind, and the number of vapor evaporation-condensation cycles. Consequently, the uniformitarian principle indicates that the average $\delta^{18}O$ of the past ice sheets is unknown. Siegenthaler and Oeschger say:

> However, the meteorological processes determining the stable isotopic composition of precipitation are complex and only partly understood, so that a *quantitative interpretation of ancient isotope ratios in precipitation* as recorded in polar ice or in carbonate sediments from lakes, *has not yet been possible.*[37] (emphasis mine)

Even the assumption that the deep ocean has remained at a constant temperature in the past, so that $\delta^{18}O_s$ can be directly related to $\delta^{18}O_w$ in (2), is questionable.[38] The temperature of bottom water depends mostly upon atmospheric conditions at higher latitude, which can change slightly in the present climate, and especially so during or after an ice age climate. A recent measurement of the temperature near the bottom of the North Atlantic showed that it changed 0.15°C in nine years.[39] This is a small but significant change, and surprised oceanographers. If the deep ocean can change this much in a short time, it can possibly change several degrees in a longer time. Even a small change in temperature can greatly affect the oxygen isotope ratio in benthonic foraminifera, since a 1°C temperature change will alter $\delta^{18}O_s$ by about 0.3 $^0/_{00}$.[40] This does not leave much room for error from a constant temperature assumption in view of the small range of $\delta^{18}O_s$ variation during the Pleistocene. Besides, $\delta^{18}O_s$ of benthonic foraminifera are vulnerable to variables other than temperature and $\delta^{18}O_w$:

> Clearly, however, *ice volume cannot be read directly from the benthonic signals* (as has been variously proposed), because of: (1) differences in amplitudes between species; (2) existence of transient events throughout deglaciation and the Holocene; (3) mixing effects; and (4) intra-species variations in $\delta^{18}O$.[41] (emphasis mine)

More will be said on these problems later. Consequently, the assumption that the temperature can be held constant in the deep ocean and that $\delta^{18}O_s$ is related only to $\delta^{18}O_w$ is poor. In summary, the poor assumptions that have determined the value of C make the relationship between paleotemperature and $\delta^{18}O_w$ unknown, so that (2) remains unsolved.

c) Many Other Variables

Some researchers argue that it does not matter what value of C is used because both T and $\delta^{18}O_w$ in equation (2) are sensitive to ice age cycles.[42] Whether this is true or not, modern knowledge of oceanography and marine biology show that many other variables, which are unknown or poorly understood, can influence $\delta^{18}O_s$ in the shells of foraminifera. These variables often are related to $\delta^{18}O_w$ or T or both. Applying the principle of uniformitarianism makes it very difficult to know whether downcore oscillations of $\delta^{18}O_s$ are not just fluctuations of one or more of these variables, unrelated or poorly related to paleoclimate.

One of the main variables affecting the temperature and $\delta^{18}O_w$ at $CaCO_3$ secretion is the paleodepth. In the present tropical and subtropical ocean, the upper layer of water is warm and varies seasonally, but a little below the surface, the temperature decreases markedly with depth. The depth of most rapid decline is called the thermocline and its depth and rate of change vary from place to place. Below the thermocline the temperature falls more gradually to the near-freezing temperature of the deep ocean. Figure 2 shows the thermocline for the Eastern Equatorial Pacific off Panama, which is one of the most shallow and steep in the ocean.[43] The upper 100 meters decreases a total of 15°C, but between 25 and 37.5 meters, the defined thermocline as indicated by dashed lines in Figure 2, the rate of change is 0.5°C/meter.[44] Since the oxygen isotope ratio is very sensitive to temperature, the depth habitat of foraminifera during their life cycle must be known, not only for the present, but also for the past, and both can be different.

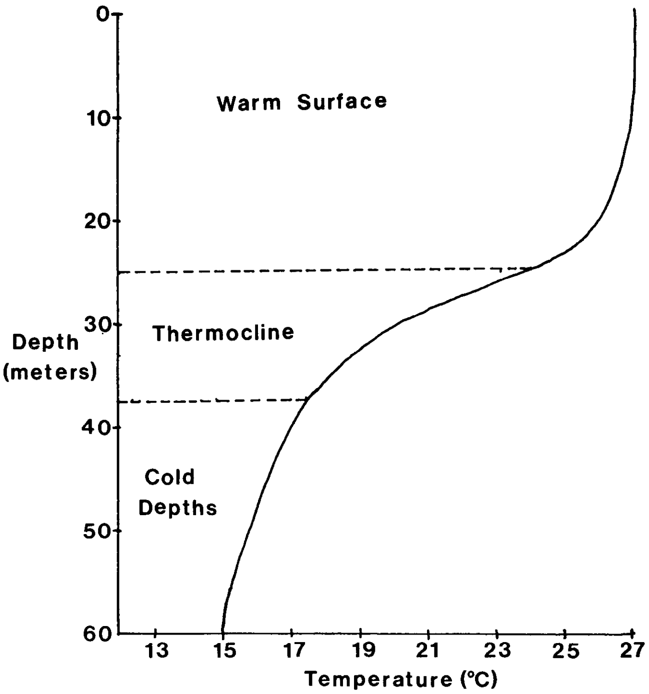

Figure 2. The depth-temperature profile of the Panama Basin in the Eastern Equatorial Pacific.

It has been assumed that each species of foraminifera inhabits a certain average depth and that most $CaCO_3$ secretion occurs within narrow limits in the top 150 meters of water, which is the nutrient-rich zone. This is generally true from plankton tow results. However, there are significant exceptions.[45, 46] Since $\delta^{18}O_s$ is very temperature sensitive and the temperature changes so rapidly with depth within the top 150 meters, very precise knowledge of the depth of shell formation is needed. However, "Very little is known about the vertical distribution and abundance of planktonic foraminifera and how species abundance vary vertically throughout the year and during their life span."[47] It has been found from plankton tows that foraminifera often have large vertical ranges.[48-50] One species of pelagic foraminifera has been observed to range over 2000 meters: "However, living specimens have been found not only near the surface but also as deep as 1500-2000m . . . we cannot be certain of the real depth at which the test was secreted."[51] Another species was observed to descend 170 meters/day for 4 days.[52] At least part of the test secretion for many species takes place in the thermocline.[53] In a study of the Eastern Equatorial Pacific, foraminifera were most abundant in the high nutrient thermocline (Figure 2). A species secreting $CaCO_3$ at the top of this thermocline would have a $\delta^{18}O_s$ 1.8 $^0/_{00}$ lighter than the same species 12.5 meters deeper. Since the range of $\delta^{18}O_s$ variation during the Pleistocene in the Pacific is about 1.1 $^0/_{00}$, and the depth of test secretion is unknown,[54] it is impossible to objectively interpret downcore $\delta^{18}O_s$ fluctuations. Oxygen isotope cycles may only reflect systematic long term changes in the depth habitat of foraminifera.

In addition to the depth habitat problem, there are also seasonal differences in temperature and species abundances in near surface waters of temperate regions. Some species probably migrate vertically with the seasons to maintain a more-or-less constant temperature, but this may be due to salinity or density changes, which are related to surface evaporation/precipitation changes.[55, 56] For those species that do not migrate, the seasonal change in surface water temperatures as well as $\delta^{18}O_w$ will greatly affect the oxygen isotope ratio. For instance, the seasonal change of $\delta^{18}O_s$ of the near-surface foraminifera near Bermuda is 1.6 $^0/_{00}$.[57] Since abundant foraminifera blooms occur at different times of the year, the seasonal temperature change will cause large $\delta^{18}O_s$ variations in different species, or possibly even in the same species.[58, 59] A systematic long term change in the timing of these blooms would cause $\delta^{18}O_s$ oscillations in that species in the sediments below.

There are many other biological or ecological variables that can affect $\delta^{18}O_s$ in foraminifera shells possibly through interaction with the variables already discussed. There is a difference in $\delta^{18}O_s$ of the same species in different oceans.[60, 61] The supply of dissolved oxygen and the nutrients in the water, which vary with time, are important factors. There seems to be a life cycle or age effect on $\delta^{18}O_s$,[62-64] possibly related to depth, although some have not found this relationship.[65] "An important consideration is that planktonic foraminiferal shells reflect a range of hydrographic conditions depending on their life-spans, depth habitat preferences, and vertical migration."[66] These many variables add further constraints to the already difficult interpretation of $\delta^{18}O_s$.

Sensitive thermal observations of the ocean surface by environmental satellites adds another twist to the meaning of $\delta^{18}O_s$ fluctuations in deep-sea cores. Eddies of rapidly circulating water have been observed to break off the edge of the Gulf Stream. These eddies are called warm or cold core rings depending upon the temperature inside the ring compared to the normal water temperature. They can last over a year with a size from 125 to 200 kilometers in diameter, and have temperatures as much as 9°C different than the environmental water.[67] Consequently, organisms that do not normally live in a particular area or do not reflect the normal water temperature thrive for awhile until the ring dissappears. It has been estimated that 50-75 percent of the shells falling on the sea floor of the Northern Sargasso Sea are from cold core rings, which occupy between six and 13 percent of the surface.[68] Rings are found in other strong ocean currents as well. Besides giving a different environmental signal than the normal near-surface water, these rings will cause foraminifera of different $\delta^{18}O_s$ to become mixed together in the sediment, thus adding to the variability of the measurements.

$\delta^{18}O_w$ has generally been assumed constant in the ocean at any one time and to depend mainly on ice volume and the mixing time of the oceans. $\delta^{18}O_w$ of the top layer of water depends upon the evaporation/precipitation ratio, which varies seasonally and possibly over many years due to slow climatic changes. $\delta^{18}O_w$ averages close to zero near the equator, but ranges from +1 $^0/_{00}$ in the tropical and subtropical evaporation belt to −1 $^0/_{00}$ in the higher latitudes. There are also longitudinal differences, especially in the mid latitudes. These differences can cause significant effects on $\delta^{18}O_s$ of foraminifera tests. It is also possible that cyclical changes in $\delta^{18}O_s$ with depth in the sediments are influenced by long term changes in the evaporation/precipitation ratio due to climate change.

In the uniformitarian scheme of repeated ice ages, the top layer of ocean water would be greatly influenced by variable amounts of glacial meltwater. Although, the value of $\delta^{18}O_w$ of this water can never be known, it may be as much as 30 to 50 $^0/_{00}$ lower than the normal ocean water. The greatest difference would be near the mouth of major rivers that drained the melting ice sheets, but its influence may be felt for long distances out in the ocean, depending upon many unknown factors. One of the main variables is the density of the meltwater, which because of its very low salinity may float long distances before mixing. However, if the water is much colder than the normal water, it may be dense enough to sink and mix immediately. The amount of meltwater, which would mainly be added in summer, would depend also upon whether the ice sheet is building or melting. The higher latitudes would be greatly affected while the lower latitudes would be least. Consequently, the unknown effect of glacial meltwater is another possible source of error.

As previously discussed, the deep ocean water is not immune from long term changes. There are factors that can even affect $\delta^{18}O_w$ at this depth which would influence $\delta^{18}O_s$ in benthonic foraminifera. From the uniformitarian viewpoint, Sachs admits that paleotemperature cannot be measured by assuming $\delta^{18}O_w$ constant:

> Given factors like the possible changes in glacial water mass distribution . . . and present uncertainties about glacial climatology and evaporation/precipitation patterns there are more variables than relationships, so that isotopic paleotemperature estimates from benthonic faunas seem premature.[69]

Another variable, over-looked until recently, may significantly affect $\delta^{18}O_w$ with time. Research has shown that ocean water percolates into the earth's crust, is heated and released again into the ocean. In this process there is an exchange of oxygen between the sea water and the crust, which has a much different average $\delta^{18}O$. Some researchers believe this effect is large enough to control the $\delta^{18}O_w$ of the entire ocean with time: ". . . Muehlenbachs believes that the exchange of oxygen between sea water and the crust is so extensive that it controls the oxygen isotope composition of the ocean over geological time."[70] If this is true, or even partially true, it seems that the interpretation of $\delta^{18}O_s$ from (2) for this process alone would be impossible for the past.

d) Disequilibrium and the Vital Effect

In addition to all the above problems, another serious problem has emerged that by itself throws the interpretation of $\delta^{18}O_s$ into confusion. When the three variables in (2) have been measured experimentally or in the present ocean, it was found that the temperature derived from the equation after measuring $\delta^{18}O_s$ and $\delta^{18}O_w$ did not match the actual water temperature:

> However, isotopic temperatures calculated for living planktonic foraminifera that were collected by plankton net tows were *almost always significantly higher than those observed* in the water in which they were collected.[71] (emphasis mine)

The same also applies to most benthonic foraminifera.[72,73] Therefore, foraminifera do not form $CaC0_3$ according to (2) and are said to be out of equilibrium. "These observations conflict with the isotopic equilibrium assumption of the stable-isotope palaeoceanographic method, and can impose severe limitations on the interpretation of stable isotope data."[74]

The amount of disequilibrium varies considerably. Shallow water benthonic foraminifera have been found 2.0-3.0 $^o/_{oo}$ lighter while planktonic foraminifera are commonly 0.5-1.5 $^o/_{oo}$ lighter.[75] Two of the most common planktonic foraminifera used in paleoclimatic research, *Globigerinoides ruber* and G. *sacculifer* are measured 0.6 $^o/_{oo}$ lighter.[76] Some specialists have found evidence that each species deviates from equilibrium by a constant amount, so that a simple correction for each species is all that is needed.[77] However, this species-specific difference in δ18 O_s is "still a fundamental problem in marine geology."[78] The species-specific correction factor likely cannot be objectively applied. Vincent and others state:

> ". . . the ranges of variation within individual species and of isotopic differences between species are the same order of magnitude as isotopic changes commonly recorded in Pleistocene sediments. Thus, *our results impose limits on the significance of downcore isotope records* based on single-species analyses, especially if small samples with few specimens are used.[79] (emphasis mine)

Similar problems occur with mixtures of different species with different average δ^{18} O_s since the results will depend among other things upon the species frequency distribution.[80] Consequently, disequilibrium causes severe difficulties of interpreting δ^{18} O_s measurements.

Scientists are actively searching for the cause of the disequilibrium and several mechanisms have been discovered. Some of the variables already discussed may be part of the problem. Other factors include foraminifera size, fertility differences, ecological stress, and the vital effect.[81,82] The "vital effect" is caused by metabolic oxygen, which is 10 $^o/_{oo}$ lighter,[83] being mixed into the shell. This seems likely, but the mechanism is poorly understood. Photosynthesis from symbiotic algae in the photic zone (the upper 100-150 meters) has been suggested as a good possibility.[84,85] In other cases, symbiotic algae have been ruled out.[86] Besides photosynthesis, food and respiration ". . . may be of equal importance in producing a 'vital effect' on skeletal isotopic composition of organisms . . ."[87] Again, there are too many unknown variables, and whatever the cause, disequilibrium by itself throws doubt on past climatic interpretations of δ^{18} O_s measurements.

4) DEPOSITIONAL AND POST-DEPOSITIONAL PROBLEMS

a) Shell Dissolution

It has been assumed at one time that deep-sea sediments have generally been undisturbed for great periods of time, and the foraminifera shells accurately reflected conditions in the water column above. However, these conditions are rare and nearly impossible to measure. As foraminifera shells sink to the bottom and while resting in the top layer of sediment, dissolution of the shell can occur. In general, the shell begins to dissolve at about 3000 meters and by 5000 meters is usually completely dissolved. However, the dissolution process and its converse the $CaC0_3$ sedimentation process depends upon many other factors besides depth: ". . . carbonate deposition is a complicated process with many controlling factors."[88] Some of the interacting variables responsible for dissolution include the temperature, pressure, carbonate ion content, amount of CO_2 in the water, the amount of water that flows through the sediment, the organic content of the water, the percentage of aragonite ($CaMgCO_3$) in the shell and the supply of non-carbonate material in the water.[89] As a result, there are oceanic and regional differences in the dissolution rate. A recent article indicates that these differences are larger and the dissolution pattern more complicated with depth than previously thought.[90] It was discovered that the rate of dissolution in the Western North Atlantic increased sharply between about 3000 to 4400 meters, which is about 1300 meters more shallow than previously thought.[91] Below 4400 meters the dissolution rate actually decreased; even fragile foraminifera were well preserved, which rules out downslope transport. This pattern was attributed to the different dissolution characteristics of each ocean current.

Most foraminifera shells eventually dissolve in the deep ocean. Those more likely to be preserved in the sediment include large species, benthonic foraminifera, and small species with a more solution-resistent shell. Thus, a species bias is introduced in the sediments right from the start, ". . . with selective preservation posing great difficulty for the interpretation of oxygen isotope data."[92] Another complication arises when $CaCO_3$ with a different δ^{18} O_s sometimes recrystallizes on the shells. Therefore, only well-preserved specimens with no secondary growths must be analyzed.[93] This means each shell must be examined microscopically, which is very time consuming. However, even in well-preserved shells, chemical and mineralogical replacement occurs. Therefore, ". . . it is difficult to prove that the isotopic composition of oxygen has remained unchanged in shells that appear to be unaltered."[94] Since the variables determining dissolution are complicated and poorly known in the present ocean, it is difficult to determine their past effects under uniformitarian principles. Consequently, dissolution causes big problems: ". . . there is controversy about the relative importance of the primary productivity of calcareous microorganisms and their dissolution at depth . . ."[95]

Some authors have found a shell size effect on δ^{18} O_s in sediments. The larger foraminifera are enriched in ^{18}O[96-98] so that dissolution biases the sediment towards higher δ^{18} O_s "The interpretation of oxygen isotope values is further complicated by preferential dissolution on the sea floor of isotopically lighter shells."[99] As previously stated, two of the most widely used foraminifera for paleoclimatic reconstruction are very susceptible to dissolution.[100] In fact, variable or cyclical dissolution rates with time may be responsible for δ^{18} O_s cycles in well-preserved sediments. Kent has shown in a recent article that this is highly likely. He found a strong correlation in deep-sea cores between low $CaCO_3$ content and high $\delta^{18}O_s$.[101] Even though it is claimed by some that dissolution affects the isotopic composition by only 0.2-0.4 $^0/_{00}$ (this may be difficult to determine in the present, as well as the past), $CaCO_3$ cycles have very similiar frequencies to glacial/interglacial cycles, which are determined by $\delta^{18}O_s$ fluctuations.[102] Regardless, there are too many poorly known variables to objectively interpret $\delta^{18}O_s$ measurements in deep-sea cores below about 3000 meters.

b) Bioturbation

Even when a solution-resistant foraminifera becomes incorporated into the top layer of sediment, it does not quietly remain in place for thousands of years. It is common for the top layers of sediments to be mixed by deposit-feeding organisms that ingest the sediment and redeposit it. This is called bioturbation and is very common in the deep sea: ". . . most if not all deep-sea sediment is susceptible to disturbance by marine organisms."[103] The depth of mixing by bioturbation has been variously reported as two to five cm,[104] 15 cm,[105] and 10-60 cm.[106] The latter figure was determined by the redistribution of ash layers, the dispersal of microtectites and the incorporation of radioactive contaminants into the sediments. A recent article indicates that bioturbation may extend deeper than previously thought. Burrows down to more than two meters were actually observed in two cores.[107] The extent of bioturbation of this magnitude is unknown because normal coring operations cause the delicate burrows to close so that they are not detected. Such burrows greatly increase the permeability of the sediment. However, it is claimed that sediment mixing is probably minimal, although three-fourths of the horizontal burrows were filled with sediment. Consequently, this claim seems unjustified. Bioturbation ". . . is not easy to estimate and can be expected to vary from place to place."[108] It can be difficult to detect in carbonate sediments.[109] Therefore, bioturbation presents another complicating factor to the interpretation of $\delta^{18}O_s$ cycles.

c) Reworking

Erosion and subsequent deposition, called reworking, is also a common occurrence in the deep ocean.[110] Besides erosion by bottom currents, several other processes, such as submarine slides, slumps and turbidity currents can greatly disturb the sediment. Erosion causes gaps or hiatuses in the sediment in the erosional area and will mix sediments in the area of deposition. Most cores show evidence of reworking.[111-114] However, it is claimed that reworking is difficult to detect from physical evidence alone: "Unfortunately, the occurrence of local deformations due to slumping, crust loading, mud flows, and so on, even in generally well stratified horizontal beds is common. Such features can be detected in exposures but easily overlooked in cores."[115] Therefore, reworking in cores is detected mainly by their anomalous fossil content and wrong dates.[116] "The distribution of hiatuses, or unconformities, are readily determined by conventional biostratigraphic and paleomagnetic dating of sediment sequences."[117] Thiede says further that reworked fossils are ". . . easily distinguished by not being contemporaneous with the sediments in which they are found."[118] Consequently, many cores and "anomalous" results in one core are discarded because of reworking.[119-121] This is usually done aboard ship after an extensive biostratigraphic examination.[122-124] It is for this reason few cores, which are labeled Quaternary by their fossil content, are extensively analyzed and related to the astronomical theory of the ice ages. Whether reworking in a particular core is genuine or not, it can be a powerful tool to reinforce preconceived ideas.

Modern observations of deep-sea erosion indicate that reworking probably was very extensive in the past. Gardner and Sullivan report large fluctuations in turbidity as a result of erosion near the bottom of the abyssal plain in the Western North Atlantic.[125] The detector was located on a flat rise so that the erosion cannot be due to gravity slides from higher terrain. The results were the largest turbidity readings ever found in the deep sea and were unexpected. Two large fluctuations in bottom water cloudiness were associated with the passage of tropical storms. If the relationship is substantiated with further evidence, oceanographers will have to significantly revise their ideas on the amount of reworking.

5) SUMMARY

In summary, there are too many assumptions and variables that are poorly known and too many problems of interpreting $\delta^{18}O_s$ measurements in deep-sea cores. Consequently, it should be impossible to objectively correlate these fluctuations with the astronomical theory of the ice ages. Even some paleoclimatic researchers have questioned the oxygen isotope result: "If this theory is correct—and we should be aware that it may not be . . . we should always be aware of the underlying assumptions in oxygen-isotope studies . . ."[126] In relating oxygen isotope fluctuations to the Milankovitch mechanism, John cautions:

> But we should ask ourselves whether changes in the Earth's orbital geometry are really the fundamental causes of glacial and interglacial stages. In the first place does the oxygen-isotope record really give a reliable indication of the expansion and contraction of the mid-latitude ice sheets? This is a matter of some dispute . . . If they do not (and this is quite likely), then the 'fundamental cause' of Quaternary glacial stages may not be so fundamental after all.[127]

C) DATING DEEP-SEA CORES

1) INTRODUCTION

Before $\delta^{18}O_s$ fluctuations in deep-sea cores could be related to the astronomical theory of the ice ages, the dates of the $\delta^{18}O_s$ cycles needed to be determined. This introduces many new problems in addition to those already discussed. Dating cores has been a difficult problem: ". . . there has always been some uncertainty in the dating of the geological record and in the accuracy of computed parameters."[128] Some have considered "accurate dating" of deep-sea cores the biggest problem in testing the Milankovitch theory.[129] There are three main dating techniques for cores: 1) radiocarbon dating of the core top in Pleistocene sediments, 2) uranium series disequilibrium method for the late Pleistocene, and 3) paleomagnetic dating of the early and mid Pleistocene.[130] The many assumptions and problems with these dating methods will be discussed further.

2) INDEX FOSSIL DATING

Before a core can be dated by “absolute” methods, it must first be placed into its “proper” position in the geological column. This is done by index fossils, similar to other periods of Phanerozoic time. The Pliocene-Pleistocene boundary has been especially difficult to define, and a number of different methods have been used in the past. Generally, it is the beginning of the Late Cenozoic ice age cycles, but this is not exactly the case today. In cores, it has been defined by the first appearance of the foraminifera *Globorotalia truncatulinoides.* Since the Pleistocene is the last period of geological time, there is usually little difference between the fossils during this time and modern organisms. However, there are a “. . . limited number of faunal extinctions that appear to be synchronous globally . . .“[131] during the Pleistocene which are used for dating, although the dating is rough and there are not enough of them.[132] As previously mentioned, much of the biostratigraphic analysis is done aboard ship soon after the core is collected and before other dating techniques are applied: “Indeed, it is difficult to adequately acknowledge the work that precedes the *selection of a particular core as suitable* for the application of a particular technique.“[133] (emphasis mine) According to the fossils, “Quaternary sediments are absent over extensive areas of the ocean floor.“[134] Of those cores defined as Quaternary, a large majority cannot be used because of “reworking,” variable $CaCO_3$ dissolution and other such processes. Although some of the thousands of cores can be used for a particular research application, few are extensively analyzed. These are the ones that have already met preconceived ideas and are internally consistent; the many others are conspicuous by their absence and indicate the many problems involved in index fossil dating.

For those really not aware of it, index fossil dating is a very rigid system because it is based on the assumption of evolution. An example of the rigidity occurred several years ago when the new results of paleomagnetism contradicted the assumed age of the index fossil *Globorotalia truncatulinoides.* This case is all the more interesting because this fossil is considered “. . . one of palaeontology’s most reliable datum planes.“[135] With the support of another radiolarian index fossil, it was concluded that *G. truncatulinoides* existed 1 to 1.5 million years before its supposed first occurrence at the base of the Pleistocene. Reworking and contamination were considered and ruled out. Needless to say, this result had serious implications because “. . . a great many studies based on the validity of this particular datum plane must surely have led to incorrect conclusions.“[136] Consequently, the author of the contradictory evidence was attacked “. . . with a vehemence that is much less common in science than it was many decades ago.“[137] The author valiantly defended himself and his methods, but in the end, the challenge to the very rigid index fossil dating scheme failed. This is also an example of how specialists can mold various dating techniques into what appears to be a coherent whole.

Modern oceanography indicates that dating cores by extinctions or first appearances of a particular fossil is much too simplified, and the fossil change in the core may actually be due to ecological, biological or physical factors in the waters above. For instance, planktonic organisms, which are more superior for dating than benthonic species, can have geographically restricted ranges. Sometimes there are major faunal boundaries in mid-ocean for no apparent reason. As a result, “. . . biologists still do not understand what determines present limits of geographic distributions of planktonic species.“[138] In addition faunal distributions likely change with time, probably reflecting changing oceanographic conditions. Just the seasonal change alone is considerable: “Physical properties of the world oceans show considerable annual variations.“[139] All the present day unknowns have not been sufficiently emphasized in the past “. . . should be a cause for reflection among those marine paleontologists who infer ocean paleoclimates (essentially temperature) from changes in distributions of species or composition of planktonic assemblages.“[140]

Applying the principle of uniformitarianism should nullify the Pleistocene index fossil schemes, and if for the latest period, what about for the other periods of geological time? The assumption of synchronous world-wide fossil changes has rarely, if ever been proven within the evolutionary framework.[141] Within this system, there are cases where organisms have become extinct at widely different times, and with regard to first appearances, evolutionary scientists can point to a case where a certain species developed in the Quaternary Pacific and Indian Oceans, but not in the Atlantic.[142] Some workers admit that “. . . using fossils to correlate over long distances has been difficult even when planktonic groups are used.“[143] In fact, it was due to simplified concepts of Pleistocene fossils that much paleoclimatic work in the 1960’s was faulted.[144] It is hoped that δ^{18} O_s cycles, which all essentially look the same,[145] will be able to validate the index fossil scheme, although it is this system that has dated δ^{18} O_s fluctuations.

Few people realize that the index fossil dating system, despite its poor assumptions and many problems, is actually the primary dating tool for geological time. Even though “absolute” dating methods have been widely touted to be accurate, this is not the case at all. They have many serious problems:

> One might imagine that direct methods of measuring time would make obsolete all the previous means of estimating age, but these new ‘absolute’ measurements are used more as a supplement to traditional methods than as a substitute. Geologists put more faith in the principles of superposition and faunal succession than they do in numbers that come out of a machine. If the laboratory results contradict the field evidence, the geologists assume that there is something wrong with the machine date. To put it another way, ‘good’ dates are those that agree with the field data.[146]

In other words, radiometric dating methods are actually fit into the geological column, which was set up by fossil dating over 100 years ago. Bowen does not even like the term “absolute”:

> The term *absolute* dating is unsuitable: it implies a degree of achievement hardly consistent with the realities of the majority of dating methods, which, in terms of their present status may be

likened to the top of a gigantic experimental iceberg.[147]

He says further that there is ". . . an unrealistic faith in such dating procedures. So many potential pitfalls and errors are inherent to existing methods . . ."[148] With all the above in mind, let us take a closer look at the main dating methods for Pleistocene deep-sea cores.

3) RADIOCARBON DATING

Radiocarbon dating is used to date the top of a Quaternary deep-sea core when suitable material is available. It is assumed to be valid back to about 30,000 to 50,000 years ago. Creationists have pointed out the poor assumptions and problems with this method. Consequently, it will be discussed only briefly in this paper. As already stated, it was because of C-14 dating of peat, assumed to develop during interglacials, that earth scientists at one time rejected the astronomical theory of the ice ages. A recent article in the *Creation Research Society Quarterly*,[149] which was reprinted from the *Anthropological Journal of Canada*,[150] is a recent exposé of radiocarbon dating.

Contamination seems to be a common problem in radiocarbon dating, and it is likely a convenient excuse to discard dates that do not agree. For instance, a certain layer in several cores of Arctic Ocean sediments was C-14 dated at 12,000 years B.P., 25,000 years B.P. and greater than 30,000 years B.P. However, these variable dates were rejected in favor of a date of 70,000 to 100,000 years ago because the uranium series dates were in better accord with the interpolated date from the last paleomagnetic reversal. The reason for this large discrepancy was ". . . because of reworking and mixing of the sediments by burrowing animals."[151] In a general statement on radiocarbon dating and other dating methods for deep-sea cores, Latham and others state: "The corresponding age data, provided by ^{14}C, uranium series disequilibrium and other methods may also suffer from such errors as bioturbation and migration of radionuclides."[152] Lee provides a good summary statement on radiocarbon dating: ". . . the radiocarbon method is still not capable of yielding accurate and reliable results. There are gross discrepancies, the chronology is *uneven* and *relative*, and the accepted dates are actually *selected* dates."[153]

4) URANIUM SERIES DISEQUILIBRIUM DATING

a) Introduction

A common method for dating deep-sea cores, more in the past than in the present, is the uranium series disequilibrium system. This technique takes advantage of the fact that uranium and its daughters are leached out of the soil and into the ocean. (This is one of the main reasons Creationists reject the uranium-lead method of dating—because it is an open system.) ^{238}U eventually decays to ^{230}Th (ionium, an unstable isotope of thorium), which has a half-life of 75,000 years. ^{235}U decays to ^{231}Pa (protactinium), which has a half-life of 32,000 years. There are actually two main methods in the uranium series system that are especially useful for dating deep-sea sediments.[154] The first is the ionium method, which measures the ratio: $^{230}\mathrm{Th}/^{232}\mathrm{Th}(\mathrm{I_0/Th})$ with time down a core. Thorium-232 is the long lived radioactive isotope of thorium. The second method is the ionium-protactinium method, which measures the ratio: $^{231}\mathrm{Pa}/^{230}\mathrm{Th}$. Both ratios decrease with time, overlapping with C-14 dating in the early stages of decay, and supposedly providing dates back to about 300,000 years. Ionium and protactinium have a residence time of about 300 years in the ocean while uranium remains about 500,000 years. Thus, the daughters become separated from their parents in the water column by being adsorbed onto the surface of detrital mineral grains as they sink to the bottom or by incorporation into authigenic minerals which are formed in place during or after deposition.

The daughters are called "unsupported" for this reason. However, not all the ionium (and probably not all the protractinium) in the ocean is formed by radioactive decay. One-fourth is estimated to arrive directly by rivers or streams along with ^{232}Th.[155]

b) Poor Assumptions

The uranium series disequilibrium system depends upon assumptions inherent in radioactive dating schemes, plus some unique unverifiable assumptions and problems of its own. It is calibrated to the radiocarbon system,[156] a very poor procedure in view of its unreliability. In fact, it is common practice to calibrate dating methods and paleoclimate indicators, such as δ^{18}O, sea level fluctuations, fossil pollen, etc., to each other: "Like sensing systems made by man, each natural paleoclimatic indicator must be calibrated, and each has distinctive performance characteristics that must be understood if the data are to be interpreted correctly."[157] (This quotation indirectly admits that paleoclimate indicators do not match, but each can be manipulated through its distinctive performance characteristics to agree.) Needless to say, this practice takes most of the independence away from dating systems, a problem rarely mentioned in paleoclimatic research.

Four basic assumptions must be applied to account for the ionium and protactinium in the sediments: 1) a constant sedimentation rate for the isotopes during the last several hundred thousand years, 2) ionium, thorium and protactinium have similar geochemical properties, 3) the above isotopes within the mineral grains are excluded from the analysis, and 4) the isotopes do not migrate within the sediments.[158] There are many difficulties with these assumptions, and the analytical method of measuring the various isotopes is complex with much room for error.

The first assumption of a constant sedimentation rate for the isotopes depends upon many factors. One is the uranium content of the water,[159] which is variable and due to the interaction of complex processes. Some of these are the variable input of uranium by rivers, the rate of removal by trapping in near-shore anaerobic basins, the rate of reworking from near-shore basins to open water, and the direct sedimentation of uranium to the ocean floor.[160] A second factor is the variable and complex input of ionium and thorium by rivers, which should change with time. The variability of this input is indicated by present day measurements of $^{230}\mathrm{Th}/^{232}\mathrm{Th}$ at the ocean surface which ranges from 143-158 in the South Pacific to only 1.5-19 in the Atlantic.[161] The amount of ^{230}Th, ^{232}Th, and ^{231}Pa deposited on the ocean bottom ultimately depends on the sedimentation rate of the mineral grains, which likely is not constant.[162] The water depth is another factor which must be considered because a deep water column contains more isotopes than a shallow column, but this should be accounted for by a depth correction factor. The particles that scavenge the isotopes are considered to be very fine. Hence, they are easily erodable, one indication of which is the clouds of sediment often found a few tens of meters above the ocean floor.[163] Consequently, undisturbed sediments are needed to apply the dating method.[164] As previously discussed, cores of this quality are very rare: "Only a minute portion of the deep-sea cores . . . are stratigraphically continuous and undisturbed."[165]

Assumption two may be good for the two isotopes of thorium, but modern research indicates that ionium and protactinium are geochemically different. Ku and Broechker says: "The commonly made assumption that Pa^{231} and Th^{230} are geochemically coherent is not valid."[166] Erroneous dates have even been blamed on the differences between the isotopes.[167]

Assumption three is difficult to monitor. It is hoped that the analytical procedure will measure only the unsupported ionium and protactinium on the mineral surface while leaving those within the grain untouched. The latter isotopes are called uranium "supported" because they are the direct result of radioactive decay of uranium within the grain. Supported isotopes also arise from the decay of uranium contained in the pore water of the sediment. There have been strong disagreements over procedures and results of the uranium series disequilibrium method by various workers. The possibility of contamination by uranium supported isotopes was invoked by Emiliani and Rona to criticize the results from another lab.[168] (Many analytical difficulties also were indicated.) Contamination seems a real problem because a "correction" for supported isotopes is usually invoked. This correction is considered negligible for "young" sediments, but must be applied in an increasing degree the older the sediment is assumed to be.[169] However, if bioturbation down to two meters[170] is common in sediments, the basis for the correction factor is undermined. It seems like the correction factor would be difficult to apply and may actually be a fudge factor.

The fourth assumption ". . . has been the source of some concern."[171] It is believed that ^{230}Th does not migrate through the sediments but that its parent does. Some assume the migration is small, while others say it is often a problem.[172] Regardless, it is difficult to estimate the amount of past migration, which is included as part of the correction factor for supported isotopes. Consequently, the many unknowns and problems behind the assumptions cast grave doubt on the uranium series disequilibrium method.

c) Contradictory Results

It is expected that very few erroneous results or glaring contradictions with other dating methods would ever be published. The few that are published are usually just the tip of the iceberg and can give considerable insight into the method. Broecker hints at many problems when a new dating method is used: "As with all new approaches to earth sciences, valid results are accompanied by numerous erroneous ones."[173] Sometimes, new results will be significantly different from previous research and will be accepted, indicating the plasticity of the dating systems. In regard to the uranium series disequilibrium system, Emiliani used the method to establish a strong relationship between the dominant $\delta^{18}O_s$ cycle in deep-sea cores and the 40,000 year tilt cycle in the astronomical theory of the ice ages.[174-176] The tilt cycle was considered the dominant Milankovitch frequency at that time. He even derived a correlation coefficient of 0.997![177] (+1 or −1 is a perfect fit and 0 shows no relationship). His chronology is now considered erroneous, indicating the dating methods used to support his good results are questionable to say the least. In another case, Rona and Emiliani[178] and Broecker and Ku[179] used the ionium-protactinium method on the same core and calculated a 25 percent difference in dating. In regard to the ionium-protactinium method in particular, Emiliani and Shackleton say: "The universal validity of the $^{230}Th/^{231}Pa$ method remains unproved."[180]

d) Modern Disillusionment

Many paleoclimatic researchers do not use the uranium series disequilibrium method today because of the poor assumptions and divergent results. Shackleton and Matthews say:

> . . . there are difficulties in the analytical methods and acute problems regarding the interpretation of the measurements which are widely acknowledged to exist . . . and interlaboratory comparisons have so far only clouded the issue.[181]

In their landmark paper supposedly establishing the link between $\delta^{18}O_s$ cycles and the Milankovitch mechanism, Hays, Imbrie and Shackleton say: "We have not used estimates based on Io/Th techniques because we believe the intrinsic inaccuracy of these estimates is large."[182] Shackleton says further: "The method can never be precise . . . moreover detailed studies reveal disconcerting gaps in our understanding of ^{230}Th accumulations."[183] In discussing dating methods between 50,000 and 300,000 years ago, Shotton says: "Except for fission track dating, none of these other methods can be yet said to be firmly established as reliable, though uranium series dates are certainly often quoted."[184] His skepticism of this widely used method at that time is evident. Consequently, the uranium series disequilibrium method is not objective enough to date deep-sea cores and many are disillusioned. Without this dating method, there is nothing between C-14 dating and the first paleomagnetic reversal at 730,000 years ago as Gascoyne and others lament: "The lack of age dating methods which can be applied beyond the limit of radiocarbon dating makes the global correlation of continental climatic events and stratigraphic sequences with the continuous palaeoclimate record, obtained by (oxygen) isotopic and faunal analysis of deep-sea sediment cores, a difficult task; often only a relative time scale can be obtained using complex and perhaps tenuous litho- and biostratigraphic data."[185] (parentheses mine)

D) SUMMARY

This part has shown in detail that the interpretation of oxygen isotope fluctuations in deep-sea cores is practically impossible, and therefore cannot be related to the astronomical theory of the ice ages. Very small changes in ^{18}O can result in large changes in $\delta^{18}O$, leaving much room for error. The laboratory procedure for measuring the isotopes in foraminifera is very complex. The equation relating the measurements to paleotemperature and the oxygen isotopic composition of the sea water cannot be solved. In addition, there are many other unknown or poorly understood variables related to $\delta^{18}O$ of the sample. Some of these are paleodepth of the foraminifera, seasonal differences in oceanic parameters and species abundance, and biological variables of foraminifera. There are additional complicating factors introduced by possible secular changes in $\delta^{18}O$ of sea water percolating through the crust, by cold or warm core eddies caused by rapid currents, by shell dissolution with depth, by bioturbation of the sediments and by the reworking of the sediments from common geophysical processes.

Dates for cores are a prerequisite for correlating $\delta^{18}O$ to the Milankovitch theory, but there are too many assumptions, unknowns and problems with the dating methods of cores. The main dating method is index fossils, a very rigid system based on the assumption of evolution. Modern oceanographic and biogeographic variables indicate this dating method is too simplified. Radiocarbon dating of the top of suitable cores is a selective process with contamination a common problem. The uranium series disequilibrium system has been used to date cores back to 300,000 years in supposed geologic time. However, this method is based on many poor assumptions and is so loaded with difficulties many paleoclimatologists do not use it.

Part III of this article will continue discussing dating methods. The new and much used method of paleomagnetic stratigraphy will be explored in depth. Again, too many unknowns and problems exist. Finally, the method of relating deep-sea cores to the astronomical theory will be discussed . It was found that the controlling cycle for ice ages from cores matched the eccentricity cycle in the astronomical theory. This is a big problem because the eccentricity cycle has an exceedingly weak effect on the earth's solar radiation. Throughout this paper, the question naturally arises of how consistent results or order can be generated out of the chaos of problems, unknowns and assumptions. It will be shown in detail with examples how an extreme bias can manipulate data by various means and how the "reinforcement syndrome" keeps the data and researchers consistent.

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CRSQ — Creation Research Society Quarterly
EPSL — Earth and Planetary Science Letters
GSAB — Geological Society of America Bulletin
JG — Journal of Geology
JGR — Journal of Geophysical Research
NAT — Nature
QR — Quaternary Research
RGSP — Reviews of Geophysics and Space Physics
SCI — Science

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THE LEGACY OF DUYVENE DE WIT FOR CREATIONIST BIOLOGY
PART II: THE FOLLY OF MAN AND THE WORKS OF THE LORD

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Abstract

This is part two of a three-part series of articles on the life and work of J. J. Duyvene De Wit, a Dutch biologist, who ascribed to the Creation viewpoint and actively worked against the falsity of evolutionary concepts.

The Unscientific Nature of Evolution

In the previous article I gave a brief glimpse of the life of Dr. J. J. Duyvene de Wit, a tireless fighter against the nearly overwhelming forces of evolution in the academic world.[1]

De Wit had a life-long goal for which he worked till the end. It was that all Christians who accept the creation record, regardless of their other theological differences, would join forces in the battle against evolution.

He felt that it would be much easier to convince undecided and misinformed Christians to do so if they could be shown that *evolution is not a scientific theory but an article of a non-Christian faith.*

We will now examine the contributions he left behind in the ongoing struggle we still must face. I hope to demonstrate that his legacy, which is not widely known among creationists, contains an arsenal of great value in our battle.

Examining Evidences for Evolution

De Wit delivered a lecture entitled "The Paleontological Record and the Origin of Man" to the Scientific Society of the University of the Orange Free State in South Africa on August 28, 1963.

He began with a quote from a speech, given by Dr. Abraham Kuyper in 1899 entitled "Evolution."

> The doctrine of evolution is a newly invented system, a newly conceived doctrine, a newly formed dogma, a new rising belief, which places itself over against the Christian faith, and can only found its temple on the ruins of our Christian confession.[2]

The intervening 64 years have confirmed these prophetic words. De Wit stated that as Copernicus in his day was persecuted for his astrophysical discoveries by scholastic religious doctrinaires, so scientists who have discovered the systemic discontinuities in biology are persecuted and ridiculed by the modern evolutionary doctrinaires with their metaphysical doctrine of a universal continuity of life.

There are non-Christian as well as Christian biologists who recognize how the theory of evolution deviates from the available scientific data, but their minor-

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