ELECTROMAGNETICS AND THE APPEARANCE OF AGE

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Received 31 March, 1981

Creationists have discussed how the light from distant stars, created only a few thousand years ago, could be reaching us. An analogous question is why no radioactive isotopes with half-lives less than many millions of years exist naturally; apparently if any ever existed they have decayed.

Again, while it is no doubt true that there are many sources of error in radiometric dating, yet there seems to be a certain consistency in giving long ages. Creationists need to investigate all of these matters carefully.

In this article it is proposed that a change in the electrical forces associated with elementary particles, possibly at the time of the Flood, may provide a Creationist explanation for all of these points.

The problem of the appearance of age has vexed creationists ever since secular science accepted the old age of the earth. The accepted explanation for apparent age in creationist circles is given by Whitcomb and Morris[1]. They argue correctly that since plants needed a soil in which to grow, the earth would appear to be as old as the soil appears to be in spite of the fact that the earth was only a few days old. Following this same line of reasoning necessitates that Adam and Eve were created fully-grown since they would have to take care of themselves. This view could be called age by necessity, since surely God would not create plants with no soil to plant them in.

Age by necessity seems not to be applicable to all indicators of age. There is little apparent necessity for creating radioisotopes with the appearance of age. Neither is there any apparent necessity for the ratios of parent to daughter isotopes in radioactive elements to appear old. In the dating processes, there is a trend for the determined age to get older as the expected age gets older. This systematic portion of the dating process has never received an explanation by a creationist to my knowledge.

Another problem area for the creationist is the apparent age of the universe based upon how long it takes for the light from distant stars to reach the earth. This too needs a consistent creationist explanation. Although Akridge's brilliantly argued case for the creation of the light everywhere in the universe may be correct[2], it is this author's opinion that a change in the speed of light might be more satisfactory.

Therefore this article will examine the problem of age and how it is affected by a change in the permittivity of free space, the constant which relates electrical force to electrical charge.

Three areas will be examined: the appearance of age in the natural existence of radioisotopes, the radioactive dates and the light from distant stars.

The Missing Isotopes

One of the rules of thumb for radioactive dating is that the method is unusable after the isotope has gone through approximately ten half lives. After an object to be dated is that old less than one atom in a thousand of the original supply of the isotope involved is still in existence. This makes the measurement of the ratio of the parent-daughter nuclides very difficult and thus the date arrived at very uncertain. After twenty half lives less than one-millionth of the original atoms is present, making even the detection of the original element very difficult.

Creationists believe that the earth is relatively young as compared to the approximate 4.5 billion year age held by the uniformitarianists. Assuming for the moment that the earth is young, say 7000 years old, and assuming that after 10 half lives a radioisotope becomes undetectable by present day instruments, then creationists should expect that isotopes whose half lives are greater than 700 years would still exist, if God created them. On the other hand, uniformitarianists should expect that no isotopes with half lives less than 450 million years exist. After this amount of time those isotopes should be extinct.

Of the approximately 1400 radioisotopes, only about 75 have half lives longer than 700 years. Some of these are continuously being formed by the nuclear decay of other longer-lived elements, such as Radium 226 which is formed by the decay of uranium 238. Carbon 14 is continually being manufactured by nuclear processes in the atmosphere. Isotopes like these will not be considered in this paper since there are always new additions to the population of atoms.

In this author's opinion one of the strongest evidences which uniformitarianists have for their belief a 4.5 billion year old earth can be seen in Table 1. Listed in increasing length of the half life are all of the isotopes with half-lives greater than 700 years which are not being formed by natural processes today. Also listed is the type of decay and the percentage of natural occurrence. As can be seen no isotope exists with less than a 450 million year half-life while *all* isotopes exist above this half life. If plutonium-244 existed at the time of the earth's formation then it should still exist if that formation was only a few thousand years ago. On the other hand if the earth were 4.5 billion years old then plutonium-244 would have gone through 50 half lives leaving only 1 atom out of every 6 quintillion atoms originally created. This would be totally undetectable by present instruments. Thus, on this point uniformitarian theory fits the facts better than creationist theory as currently formulated.

A Creationist is left with only three possibilities if he wishes to retain the idea of a young earth. First, one can assume that God didn't create these isotopes which are missing. This would seem to strain credibility, in light of the fact that every isotope over 450 million years does indeed exist. One could attempt to explain this

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Table 1. Radioactive isotopes with half-lives greater than 650 years. β^- indicates beta decay, β^+ positron decay, and EC electron capture, all of which are somewhat similar. Likewise alpha decay, indicated by α, and spontaneous fission, indicated by SF, are somewhat similar.

The per cents for uranium 235 and 238 are from the *Handbook of Chemistry and Physics*, 47th edition, The Chemical Rubber Co., 1966; while that for lanthanum is from the 60th edition. That for thorium is from Semat, H., 1954. *Introduction to Atomic and Nuclear Physics*, Rinehart and Co., New York, p. 528. Other data are from the 58th edition of the *Handbook of Chemistry and Physics*.

I have not been able to find any information about the type of decay of zirconium 96.

Isotope	Half-life Years	Decay-type	% natural Occurrence
Si^{32}	6.5×10^{2}	β^-	0
Cf^{251}	8×10^{2}	α	0
Ho^{163}	1×10^{3}	EC	0
Tb^{158}	1.2×10^{3}	EC, β^-	0
Bk^{247}	1.4×10^{3}	α	0
Cm^{246}	5.5×10^{3}	α, SF	0
Pu^{240}	6.5×10^{3}	A, SF	0
Th^{229}	7.3×10^{3}	α	0
Am^{243}	7.3×10^{3}	α	0
Cm^{245}	9.3×10^{3}	α	0
Cm^{250}	1.7×10^{4}	SF	0
Nb^{94}	2×10^{4}	β^-	0
Pu^{239}	2.4×10^{4}	α, SF	0
La^{137}	6×10^{4}	EC	0
Se^{79}	6.5×10^{4}	β^-	0
Ni^{59}	8×10^{4}	EC	0
Ca^{41}	8×10^{4}	EC	0
Sn^{126}	1×10^{5}	B^-	0
U^{233}	1.6×10^{5}	α	0
Kr^{81}	2.1×10^{5}	EC	0
Tc^{99}	2.1×10^{5}	β^-	0
Fe^{60}	3×10^{5}	β^-	0
Pb^{202}	3×10^{5}	EC	0
Cl^{36}	3.1×10^{5}	β^-, B^+, EC	0
Bi^{208}	3.7×10^{5}	EC	0
Pu^{242}	3.8×10^{5}	α	0
Cm^{248}	4.7×10^{5}	α, SF	0
Al^{26}	7.4×10^{5}	B^+EC	0
Dy^{154}	1×10^{6}	α	0
Zr^{93}	1.5×10^{6}	β^-	0
Tc^{98}	1.5×10^{6}	B^-0	
Mn^{53}	2×10^{6}	EC	0
Gd^{150}	2.1×10^{6}	α	0
Np^{237}	2.1×10^{6}	α	0
Be^{10}	2.5×10^{6}	β^-	0
Tc^{97}	2.6×10^{6}	EC	0
Pd^{107}	7×10^{6}	B^-	0
Hf^{182}	9×10^{6}	β^-	0
Cm^{247}	1.6×10^{7}	α	0
I^{129}	1.7×10^{7}	β^-	0
U^{236}	2.4×10^{7}	αSF	0
Pb^{205}	3×10^{7}	EC	0
Sm^{146}	7×10^{7}	α	0
Pu^{244}	8×10^{7}	α, SF	0
U^{235}	7.1×10^{8}	α	.72
K^{40}	1.3×10^{9}	B^-, β^+, EC	.118
U^{238}	4.5×10^{9}	α	99
Th^{232}	1.4×10^{10}	α	100
Lu^{176}	3×10^{10}	β^-	2.6
Re^{187}	7×10^{10}	β^-	62.5
Sm^{147}	1×10^{11}	α	15
La^{138}	1×10^{11}	EC, β^+	.089
Rb^{87}	$t\times10^{11}$	β^-	28
Pt^{190}	6×10^{11}	α	.0127
Ta^{180}	1×10^{13}	EC, β^-	.0123
Sm^{148}	1.2×10^{13}	α	11
Te^{123}	1.2×10^{13}	EC	.87
Gd^{152}	1.1×10^{14}	α	.2
Sm^{149}	4×10^{14}	α14	
Pt^{192}	1×10^{15}	α.78	
Hf^{174}	2×10^{15}	α	.18
Nd^{144}	5×10^{15}	α	24
V^{50}	6×10^{15}	EC	.24
Zr^{96}	$>3.6\times10^{17}$	—	2.8

teleologically by saying that God didn't think these isotopes would be helpful, but this is merely putting thoughts into God's mind which are not revealed to us in scripture. Why would God create the isotopes so that a young earth would have the appearance of great age and if He did this would it not be possible to charge God with being deliberately deceptive?

The second possibility is to find an independent cause for each isotope which would change the half-lives. This would require many different causes, one for each isotope, and this would also strain credibility since the longer lived isotopes all exist.

The final possibility is that there was in the past a systematic change in all half lives so that the half lives we now use are not at all applicable. For instance, if the rates of *all* radioactive decay was faster in the past, then using the present rates of decay everything would appear older than it really is. Whatever this cause for the change in the rate of decay was, it must be able to affect not only alpha-decay but also beta-decay. Alpha-decay is basically caused by the fact that the electrostatic repulsion of the protons in the nucleus of larger atoms is great enough to be nearly equal to the strong force which holds the nucleus together. If either the permittivity of free space was smaller before the flood or the electric charges of elementary particles were greater at that time, then the force of repulsion within the nucleus would have been greater than it is today since the force depends inversely in the permittivity and the probability of alpha decay correspondingly greater. This would mean that the half life of all alpha emitters would have been shorter, explaining the missing alpha-emitters.

Beta-decay and electron capture are related types of decays. In beta emission, the nucleus spontaneously expels an electron from a neutron. The neutron is changed

into a proton, which changes the atom into another element. Positron decay is similar to beta decay except that the particle emitted is a positively charged electron, an anti-electron. Electron capture occurs when an electron falls into the nucleus and a proton is changed into a neutron. All three of these processes are governed by the weak force. As is shown in the Appendix, the decay constant is related to the permittivity by $\lambda \propto 1/\epsilon_0^2$ where λ is the decay constant and ϵ_0 is the permittivity.

Therefore if the permittivity had been smaller in the past then the decay rates would have been faster meaning that many short-lived isotopes would have become extinct in a very short time.

Radioactive Dating

The usual approach to the dating problem is to examine the assumptions which go into the radioactive dating methods and explain why the method won't work. Others scan the literature and find cases where radioactivity fails to yield a proper age, contending that these show the failure of the method. Neither of these approaches is entirely satisfactory in explaining all of the facets of the dating problem. These approaches do not explain why the radioactive dates generally get older with increasing depth in stratigraphic position.

Figure 1 is a graph produced from data listed in a recent article about radioactive dating. The author specifically edited his literature search to include only those dates which approached being 20% wrong. Woodmorappe says:

> "Many other dates could have been listed, but Table 1 is limited to dates which approach 20% discrepancy: being either 20% 'too young' or 'too old' for their biostratigraphic positions."[3]

The data in Figure 1 are the values given by Woodmorappe; except that where he gives several values for the same object, they are averaged to obtain one value. As can be seen there is a general trend in the scatter of value in which the radioactive age gets older as the expected age gets older.

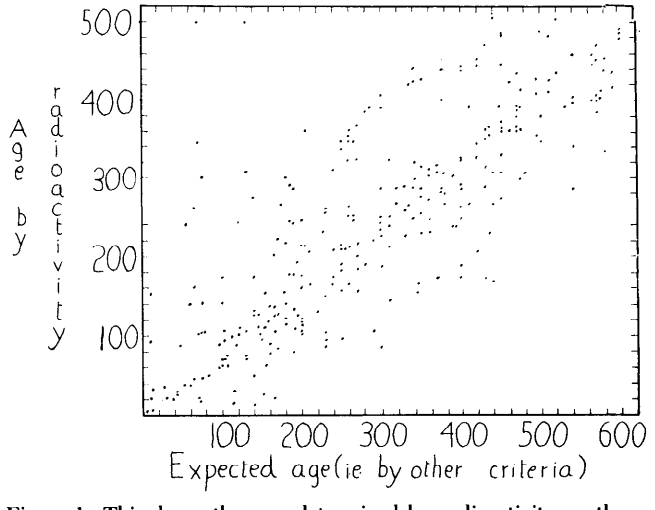

Figure 1. This shows the ages determined by radioactivity vs. those expected on other grounds e.g. from stratigraphy, for many samples. Both ages are in millions of years. There seems to be a certain correlation.

The scatter which is seen in Figure 1 is generally used by creationists to illustrate how poorly the dating processes work. However, the scatter is generally believed by uniformitarianists to be caused by poorly met initial conditions. For instance, the potassium-argon method assumes that all the argon escapes from the molten rock before it cools. If some is trapped, then the rock dates older. If some escapes after the rock cools, due to weathering or fracturing, then it will date younger. These are perfectly logical events which should be expected to occur under natural conditions. Similar scenarios are applicable to other dating techniques. Thus the scatter in the data is to be expected since nearly nothing in nature is as simple as the theories of man would make it. Because of this, creationist attempts to discredit the dating techniques, based upon the normal *expected* scatter in the data, carry little weight with our uniformitarian colleagues familiar with the dating processes. *Time* magazine attacks creationists on this point. They say,

> "The creationist argument is a bit like claiming that because some trains are canceled or run way off schedule, the basic timetable is totally inaccurate."[4]

In some sense they are correct. Therefore it is the broad trend illustrated in Figure 1 which must be explained.

If the sediments are the result of a world-wide flood, then the lava flows which were intermixed with the sediments, dated and then listed by Woodmorappe, were also deposited during a historically brief period of time. If this is so then why do the radioactive ages correlate with the expected age? Or to pose the question from a creationist position, why do the radioactive ages of lava beds laid down within a few weeks of each other differ by millions of year?

If, as already suggested, the permittivity and the decay constants gradually changed in value, then the correlation may have a creationist explanation. If the decay constant were changing linearly, a proper alteration to the exponential law of decay would be (see Appendix 2), $N = N_0\ exp\ (-\lambda_i t - \lambda_0 t^2/2)$ where λ_i is the initial decay constant before the permittivity began to change, λ_0 is the time rate of change of the decay constant, t is the time since the bed was laid down and is therefore the true age of the bed, N_0 is the number of atoms of the parent isotope initially and N is the number left after time t. An ideal initial condition is $N = N_0$ when $t = 0$.

As shown in the previous section, in order to explain the isotope distribution one must assume that the rates of decay were faster in the past than they are now. Taking an hypothetical isotope with a current half-life of 450 million years as the shortest lived isotope which could exist, then the decay constant would be[5] $\lambda_f = 0.693/T = 4.884 \times 10^{-17}$. where λ_f is the current decay constant and T is 450 million years measured in seconds.

If we assume that the ten half-lives had to be accomplished within the 1656 years between the creation and the flood and recalling that ten half-lives is our existence cutoff point then, one half-life is 165.6 years;

and the relation stated above gives $\lambda_1 = 1.327 \times 10^{-10}$/sec. The preflood decay constant for our hypothetical isotope would be seven order of magnitude greater than its post-flood value.* $\lambda_0 = (\lambda_f - \lambda_1)/\Delta t$ where Δt is the time over which the change occurred.

Substituting the above determined decay constants into the above relation and assuming that all of the change occurred over 420 years, then $\lambda_0 = 1.003 \times 10^{-20}$/sec^2.

Consider two lava flows, one of which occurred the day the earth was created and the other the day the flood began. We will assume that the chemical fractionation processes worked perfectly so that the daughter atoms were removed from the lava prior to the flow. This means that $N = N_0$ at $t = 0$. At the end of the period over which the permittivity changed, the first bed would contain only 4 ten thousandths of the original atoms while the second bed would still retain 42% of the parent atoms. The uniformitarianist who knows nothing about catastrophes, would use the present post-flood decay rates when he dates these two beds. Under that assumption, the uniformitarianist would date the first bed as being 5.07 billion years old and the second bed would date at 570 million years old. The true difference in age is 1656 years.

The fascinating feature of these two dates is that the amount of change in the decay rate, which was determined strictly from the isotope distribution, can be used to determine two dates which correspond to the uniformitarian age of the earth *and* the uniformitarian age of the Cambrian-Precambrian unconformity. This unconformity is a worldwide break in the deposition of sedimentary rocks. This author believes that this worldwide erosional period seen in the geologic record represents the onset of the flood. 570 million years is the currently accepted age of this unconformity. The presently accepted age of the earth is of the order of 4.75 billion years, which is very close to the 5.07 billion derived here.

Table 2 illustrates the chronology which this view would require. In the first column are the years since creation for the births of various individuals, as calculated from the Genesis account. The true age is given in column 3 and it assumes that the Flood occurred 4330 years before present *and* that Arpachshad was born three years after the *start* of the Flood. The radioactive age is the age which a uniformitarianist would calculate using the assumptions which he would normally use.

The novel and probably the most controversial part of this dating scheme and its involvement with the Flood is that the "Flood" would have had to have lasted longer than 1 year. Noah would have been off of the ark before the entire Cambrian was deposited; Peleg would have lived in "Devonian" times while Terah would have walked in both the "Cretaceous" and the "Tertiary".

Table 2: A suggested chronology for the early chapters of Genesis, which, for the most part, follows, or is close to, Ussher's.

The true ages were calculated on the assumption that the flood occurred in 2349 B.C., and that Arpachshad was born two years after the *end* of the flood.

In the column of radioactive ages, "B" indicates "billons"; "M", "millions".

Time Since Creation	Birth of	True Age Before Present	Radioactive age
0	Adam	5986	5.07 B
130	Seth	5856	4.71 B
235	Enosh	5751	4.43 B
325	Kenan	5661	4.18 B
395	Mahalalel	5591	3.99 B
460	Jared	5525	3.81 B
622	Enoch	5364	3.38 B
687	Methuselah	5299	3.20 B
874	Lamech	5112	2.69 B
1056	Noah	4930	2.20 B
1556	Shem, Ham, Japheth	4430	841 M
1656	(The Flood)	4330	570 M
1659	Arpachshad	4327	561 M
1694	Shelah	4292	471 M
1724	Eber	4262	400 M
1758	Peleg	4228	326 M
1788	Reu	4198	268 M
1820	Serug	4166	211 M
1850	Nahor	4136	164 M
1879	Terah	4107	158 M
1949	Abram	4037	52 M
2049	Isaac	3937	2 M

Is this view reasonable? There are several facts which favor it. First, it would explain why at Glen Rose, Texas, human footprints are found with dinosaurs. Both seismic studies and oil wells show that there are several thousand feet of sediments under the Glen Rose site which would have had to have been deposited by the Flood before this man took his walk. If these sediments had been deposited within the previous few months, how did this man survive the Flood's onslaught? How did he get food to eat at a time when everything outside the ark was supposedly covered with water?

If this man represented one of the first pioneers in Texas after the flood, then the problem of where he lived for the first few monthsof the flood can be avoided.

This chronology can also explain why we find successive beds in the geologic records which contain large numbers of mollusks. (See Figure 2) If all of the sediments were simply dumped onto the ocean bottom then all of the ocean bottom creatures should occur within one well defined zone. Deposits like the one illustrated in figure two seem to indicate that there was

*The question has been raised, whether this would not have meant a fatal level of radioactivity from the surroundings. I suggest that it could have been mitigated by two circumstances: in the first place that the surface was shielded by great depths of loose soil, which many believe, on other grounds, existed before the Flood; and in the second place that the difference in the permittivity made chemical bonds stronger, and less vulnerable to radiation.

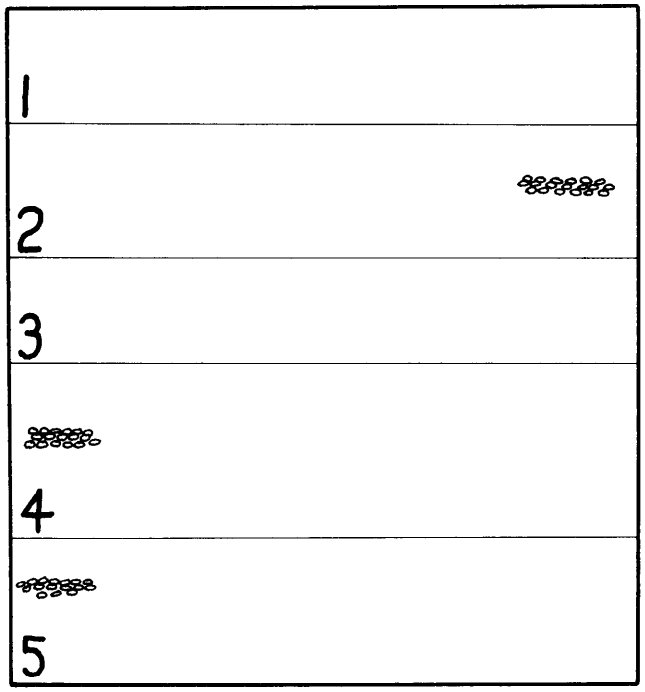

Figure 2. This shows a rather common situation where strata contain beds of fossils. Many fossils. e.g. hundreds of thousands of oysters, may be found in one stratum, and then more of the same species in a different stratum, and several miles (which the horizontal extent of the Figure indicates) away. The numbers indicate the different strata.

If the Flood lasted only one year, why should so many oysters of the same species be found in successive (or even more widely separated) beds? Surely in one year they could not have reproduced to such an extent.

enough time for the population to be replenished before more sediment was rained down on the area.

If the majority of the sediments were deposited after Noah left the ark, it would explain why the fossil animals and plants get more modern in younger strata. Percentage-wise there are more extant species fossilized in younger strata and this percentage gets larger the younger the sediment is. The earth during this time would still be undergoing earthquakes, tsunamis etc. and plants and animals living near the sea shore would be likely to get entombed in the sediments of some postflood catastrophe of local extent.

The mammoth frozen in Siberia could also be understandable. They too are only shallowly buried; but they are underlain by several thousand feet of sediments. If they were a preflood phenomena, where did they live during the first part of the flood while the underlying sediments were being deposited?

This chronology makes it seem likely that Noah and his decendants lived in highland areas during the period in which the flood waters gradually abated. Occasionally, local catastrophes would entomb an individual, or preserve evidence of human existence, e.g. footprints. In time the earth settled down to the relatively peaceful place in which we live. This is interpreted in what follows to mean that the permittivity stopped changing.

No claim is made that the linear variation is the only one which could be suggested or used. But certainly the general trend of the data shown in Figure 1 needs explaining rather than being explained away.

Light and the Appearance of Age

Creationists have long puzzled over how the light from distant stars and galaxies has reached the earth within the few thousand years given in most Christian cosmologies. One of the implications of a change in the permittivity of free space is that the speed of light would have been considerably faster before the flood. This is because $c = (\epsilon_0\mu_0)^{-1/2}$ where c is the speed of light, ϵ_0 is the permittivity and μ_0 is the permeability. Since $\lambda \propto 1/\epsilon_0^2$ as is shown in the Appendix, $\lambda_f/\lambda_i = (\epsilon_{01}/\epsilon_{0f})^2$. Here λ_1 is the preflood decay constant, λ_f is the postflood decay constant, ϵ_{01} is the preflood permittivity and ϵ_{of} is the postflood value.

Substituting the values of the decay constants derived above and the present value of the permittivity, 8.85418×10^{-12}, into the above equation we find that the preflood value of the permittivity was 5.3715×10^{-15}. Assuming that only the permittivity changed, then the velocity of light before the Flood would have been 40.6 times the present. If the earth were about 6,000 years old, light from about 77,000 light years away would have had time to reach the earth since creation.

Although this author does not wish to add any further assumptions to the theoretical framework outlined here and in other articles, it is interesting to note that if one assumed that both the permeability and permittivity changed by a similar amount the distance that light could travel within the few thousand years of creation becomes enormous. Light from a galaxy 3.08 million light years away would have had time to reach the earth.

Conclusions

The hypothesis of a change in the permittivity will effectively explain the appearance of age in the three problems discussed. Should this hypothesis ultimately fail the test of time, other solutions to these problems should be sought. Creationists can no longer afford either to ignore our own problems or to simply explain away the evidence which supports the evolutionists' position. We must provide positive explanations of the phenomena observed on the earth which at the same time preserve the Biblical record in its entirety. These explanations must be as quantitative as they can be. Qualitative explanations should be minimized. By formulating a quantitative theory of the flood creationists can compete with the uniformitarianist on a firmer scientific base.

The results outlined above have implications which are applicable to a creationist form of radiometric dating. The assumption which this author has made, namely that the decay constant has changed with time, is no better nor worse than the uniformitarianist assumption that they have remained unchanged. By utilizing this assumption creationists can radiometrically date any object desired and the object will always fit into a creationist time-frame.

Appendix 1: on the Rate of Radioactive Decay

While some theory exists, particularly for beta decay[6], the subject is an involved one. Here dimensional analysis can be used to find the dependence on ϵ_0, which is all that is needed.

It appears that, of the various atomic constants, λ, the coefficient, might depend on ϵ_0, and also on Planck's constant h, m the electronic mass, and q the elemental charge. It can be shown to depend in the form $\epsilon_0^a h^b q^c m^d$, the exponents being integers.

In terms of the four fundamental dimensions (temperature is not involved here): length, mass, time, and charge: L, M, T, and Q respectively, ϵ_0 has the dimensions $L^{-3}M^{-1}T^2Q^2$, while h has L^2MT^{-1}. Of course, q and m give just Q and M, respectively.

So the dimensions take on the form: $(L^{-3}M^{-1}T^2Q^2)^a (L^2MT^{-1})^b Q^cM^d$. And this is to give λ, which has dimensions of inverse time: T^{-1}. So clearing the brackets and equating the exponents on the two sides gives:

$$-3a+2b=0$$
$$-a+b+d=0$$
$$2a-b=-1$$
$$2a+c=0$$

These equations are solved easily; and they give, in particular, $a=-2$. So λ is proportional to $1/\epsilon_0^2$.

The author will be glad to provide a copy of a more detailed treatment of beta decay to anyone interested.

Appendix 2: the Equation of Decay

In the equation of decay, $dN/dt=-\lambda N$, a solution is still possible if λ varies with time. Dividing through by N and integrating both sides gives $N=N_0\ \exp(-\int\lambda dt)$.

If one sets $\int\lambda dt=\Lambda T$, then $N=N_0\ exp(-\Lambda T)$. Here Λ is an average constant of decay over the time involved, and T the total time.

In every case N_0 represents the original amount of radioactive material, N the amount undecayed at the end of the time concerned.

If the linear case be considered, so that $\lambda=\lambda_1-\lambda_0 t$, then $\Lambda T=\lambda_1 T-\lambda_0 T^2/2=[1/2]\ [\lambda_1+(\lambda_1-\lambda_0 T)]\ T$; so Λ is the (arithmetical) average of λ at the beginning and at the end of the time concerned.

For the isotopes considered here, decay in the time from the end of the period of change until the present would be negligible. So times subsequent to that, i.e. roughly the last 4,000 years, need not be taken into account.

As for material originating a time t', say, before the change began, $\Lambda T=\lambda_1 t'+\lambda_1 t-\lambda_0 t^2/2$. So again Λ is the time average of λ over the time concerned. Again, as a practical matter that time need be only up to the end of the period of change.

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PANORAMA OF SCIENCE

Mother's Milk

Currently there is a popular impression that "milk is milk"; but that is a false assumption. Nor is it true that artificial formulas provide all the important ingredients in human milk. Indeed, cows' milk, so often given to babies, contains about twice as much protein as human milk. That is necessary; for a newborn calf which will double its birth weight in about 50 days; whereas a human baby takes approximately 180 days. Humans do not need to add bulk the way a cow does; but they have different needs, especially concerning growth of the brain. The myelin which is necessary to surround nerve axons would be supplied by the relatively high lipid content of human milk. This fat also can provide energy and produce insulation.

Interestingly, mothers who give birth to preterm babies produce milk having higher protein and lipids than the milk of mothers whose babies were full term. (Incidentally, how could this have evolved? What selection value would it have for the species as a whole?)

Various substances in a mother's milk are important in the baby's growth and development. For instance, breast-fed babies receive antibodies from the mother and have fewer gastrointestinal tract infections than formula-fed babies; also hormones carried in milk can play an important role in cell growth and differentiation. Epidermal growth factor (EGF), found in milk, is a small protein (53 residues) which appears to stimulate growth of the skin and gastrointestinal tract, maturation of digestive enzymes, and development of lung epithelium. Additionally, it appears to protect against excess gastric acid and aid in healing of wounds. Interestingly, urine has a high amount of EGF, and in the past it has been utilized to encourage healing, particulary in war situations.

The above information was taken primarily from Carpenter[1] who presents a good case for mothers to nurse their babies. Also Carpenter follows the rather popular procedure of recognizing that "nature" possesses wisdom in solving its various problems; and this wisdom is thought to have been derived during a long period of evolution and as a result of natural selection. The credit often accorded "nature" for ability to maximize utility of its products historically has inspired observers to recognize such ingenuity as the handiwork of a designer, as for instance Paley indicated.[2] This posi-