

# THE CREATION OF THE EARTH'S MAGNETIC FIELD

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*God could have started the earth's magnetic field in a very simple way. He could have created the earth's original atoms with some of their nuclear magnetic moments pointing in the same direction. In one plausible scenario, this would produce a magnetic field of dipole character about eighteen times stronger than the earth's present field. The alignment of nuclei would disappear in a short time, but the field would preserve itself by inducing an electric current in the earth's interior. The field strength would gradually diminish due to resistive losses, as Barnes has calculated. If the field has always decayed at the present rate, it would take about 6,000 years to reach its present strength. In other words, the initial value for the field is consistent with the observed decay rate and the scriptural time scale. It is a striking confirmation of the Biblical creation account.*

## 1. Introduction

The earth's magnetic field has intrigued scientists for nearly half a millenium. Everyone agrees that the source of the field must be a large electric current — billions of amperes — circulating in the core of the earth. But scientists disagree about what causes the current to flow.

Evolutionists believe that the magnetic field has existed for billions of years. So they conjecture that there is some physical process which has maintained the current for all that time, either continuously or in alternating cycles. They theorize that there is some motion of the electrically conductive fluid in the core which maintains the electric current as the fluid moves through the existing magnetic field. The core would resemble an electric generator which produces its own magnetic field. Supporters of such "dynamo" theories have assumed some very complex fluid motions to explain the existing magnetic field. But they have not yet made a firm mathematical connection between the motions and the field. More important, they have not shown that such fluid motions actually occur in the core:

The motions within the earth's core present a dynamical problem of surprising complexity that is *far from being resolved*. . . . Despite the unresolved complexity it is gratifying to understand how several reasonable *assumed* patterns of flow can exhibit dynamo action . . . [Italics mine].<sup>1</sup>

On the other hand, creationists have a simple and mathematically rigorous theory of the earth's magnetic field. It explains the two most important features of the field observed today: its overall "dipole" shape (shown in Figure 1), and the steady decrease of its overall strength. The field has decayed by about seven percent over the last 150 years. The creationists say that there is nothing maintaining the core current except its own electromagnetic inertia. Dr. Thomas Barnes<sup>2,3</sup> showed that the electrical resistance of the core would slowly decrease the current, producing a slowly decaying dipole magnetic field. He showed that a reasonable value of electrical conductivity in the core would produce the observed decay rate.

Evolutionists object to Barnes' theory because of its implications about the earth's age.<sup>4</sup> If there is no "dynamo" maintaining the electric current in the core, the current would only last about ten thousand years.

This would mean that the current — and presumably the earth — was started a lot more recently than the evolutionists would prefer. One of the questions they frequently ask is: How did the electric current get started? In this paper I am proposing one possible answer to that question.

## 2. Magnetic Fields of Nuclei

Many atomic nuclei have a small magnetic field due to their spins. Their magnetic dipole moments (which indicate the source strength) are roughly a thousand times smaller than the magnetic moments of the atomic electrons. In most substances, the magnetic moments of both the electrons and nuclei point in random directions, so that the net magnetic moment is about zero. About five years ago, I noticed that if a sizeable proportion of the earth's nuclei had magnetic moments and were oriented properly, their total magnetic field would be about the same as the earth's. Coincidences of this sort are not common in physics. Since the numbers involved range from infinitesimal to cosmic, a wild guess is usually many orders of magnitude off base. Consequently, I began to wonder if God started the earth's magnetic field by the simple expedient of creating many of its original nuclei in a lined-up state. Once started, the ordinary laws of electricity and magnetism would tend to preserve the field, allowing it to decay slowly to its present value as Barnes has calculated.

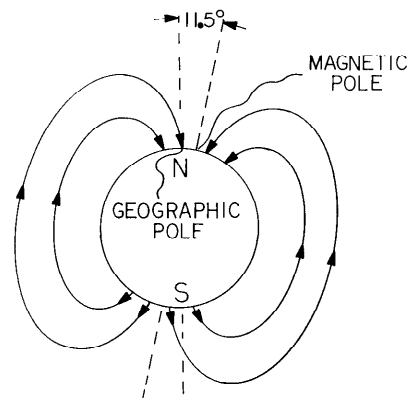


Figure 1. The earth's dipole magnetic field. It will be recalled that the Earth's north magnetic pole is a south-type pole, and vice versa.

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To estimate the strength of the original magnetic field, we need to know the answers to two questions:

- (1) What was the original composition of the earth?
- (2) What proportion of the nuclei did God align?

Fortunately, there is a Biblical answer to the first question, as section 3 will show. Section 4 will show a plausible physical answer to the second question.

### 3. Water: The First Matter

The Bible implies that the earth just after its creation was one hundred percent water. God, through the apostle Peter, says of the event:

For when they maintain this, it escapes their notice that by the word of God the heavens existed long ago and *the earth was formed out of water and by water* (2 Peter 3:5, NASB, italics mine).<sup>5</sup>

The most straightforward understanding of this verse seems to be that God first created the earth as a sphere of pure water. If this were so, He must have soon thereafter transformed many of the hydrogen and oxygen atoms into the silicon, iron, and other atoms of which the present earth consists. The Greek word translated as “formed” in this passage, *sunestosa*, comes from a verb whose primary meaning is “to place together, to set in the same place, to bring or band together.”<sup>6</sup> The American Standard Version of 1901 well translates it as “compact.”<sup>7</sup> The human author, Peter, may not have understood that such compaction would require the banding together of protons, neutrons, and electrons to make new atoms, i.e., nuclear and chemical transformations. However, God certainly knows how atoms and nuclei work, and He nowhere indicates in scripture that His human authors had fully to understand what He was saying through them. In fact, Peter himself points out that the prophets did not completely understand what “the Spirit of Christ within them was indicating as He predicted the sufferings of Christ and the glories to follow” (1 Peter 1:11, NASB). The scriptural teaching on inspiration<sup>8</sup> requires that the true meaning must be within the bounds of the general meaning of the word in Peter’s time. But it does not demand that Peter or his hearers understand the full implications of the compaction process. To require such a restriction would be to filter the rich wisdom of God through the limitations of a single human mind. So we do not need to exclude the possibility that God may have used nuclear and other physical transformations during the creation week.

The second verse of Genesis also implies that the early earth was initially water:

And the earth was formless and void, and darkness was over the surface of the *deep*; and the Spirit of God was moving over the surface of the *waters* (Genesis 1:2, NASB, italics mine).

This view of a completely water planet might help us to understand in what way the earth at that time was “formless and void.” There are not many things more structureless or more devoid of inhabitants than a featureless ball of water. Proponents of the “gap” theory might not like this interpretation, since they want the phrase “formless and void” to imply the result of a catastrophic judgement. However, it should be a help to those who do not see a gap between the

first two verses of Genesis, because it explains how the earth would be formless at that time.

The reader might well ask: “Why would God make the earth all water and then transform it? Wouldn’t it be simpler to just create it in the final form?” A possible answer might be that He did it to provide a picture of some spiritual truths. The New Testament uses the old creation of earth as a picture of the new creation of spiritual life in a believer (2 Corinthians 5:17; 4:6). It also uses water as a picture of the word of God (Ephesians 5:26). Just as the word of God and the spirit of God were prominent in the birth of earth, so also they are essential in the new birth of a man (John 3:5-8, 1 Peter 1:23).

Thus, the concept of an all-water earth in the beginning seems to be the most straightforward interpretation, and it appears to help our understanding of scripture. It also gives a fairly neat answer for the initial value of the earth’s magnetic field, as sections 5 and 6 will show. The concept does not seem to contradict any scripture, as far as I am aware. (Creationists thus far do not seem to have given the idea much attention, although I mentioned it in an earlier paper<sup>9</sup> before I began to follow up its application to the earth’s magnetic field.) So let us pursue the implications of the idea.

### 4. Aligning Nuclei

Water is not usually considered a magnetic substance. Figure 2 shows a water molecule. The ten electrons in the molecule line themselves up in pairs so that their magnetic moments cancel out.<sup>10</sup> The eight protons and eight neutrons of the oxygen nucleus similarly cancel out their own magnetic moments so that the total magnetic moment of the nucleus is zero.<sup>11</sup> That leaves the two hydrogen nuclei, which are single spinning protons. Each proton has a magnetic moment of  $1.41 \times 10^{-26}$  Joules per Tesla.<sup>12</sup>

Figure 3 shows how the two proton spins (and magnetic moments) normally line up with an external magnetic field (even a very slight one) under the laws of quantum mechanics. Theoretically, there are four possible lineups or “states.”<sup>13</sup> At normal (or high) temperatures, the number of molecules in each state is about equal.<sup>14</sup> In other words, about 25 percent of the molecules line up in state (a) with their proton magnetic moments cancelling. A similar thing happens

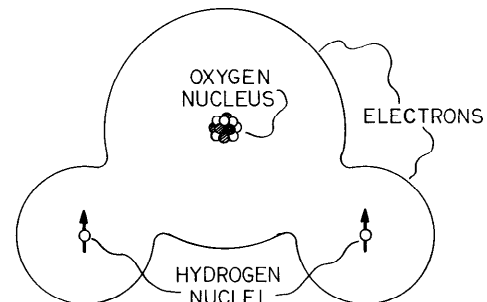


Figure 2. Water molecule. The electrons have no net magnetic moment, nor does the oxygen nucleus. The hydrogen nuclei, however, do have a magnetic moment.

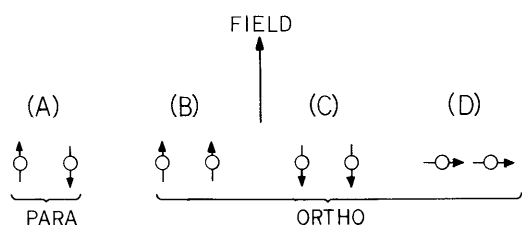


Figure 3. Normal alignment of the hydrogen nuclei in water subjected to a weak magnetic field. Twenty-five percent of the nuclei are in each of the four possible states.

in a hydrogen molecule; the corresponding state is called "parahydrogen."<sup>15</sup> So we could call state (a) "parawater."

States (b), (c), and (d) have the spins of each pair lined up in a noncancelling way. The difference between these three "ortho" states (again borrowing from the hydrogen molecule names) is in how each pair lines up with the external magnetic field. In state (b), the pair is parallel to the field; in state (c), the pair is antiparallel to the field. The spins of state (d) are anywhere in the plane perpendicular to the field. About 25 percent of the molecules would be in each of these states of "orthowater." So there would be about three times more orthowater than parawater at ordinary (or high) temperatures.

The ortho-to-para ratio for hydrogen molecules has been measured and is indeed about three.<sup>16</sup> I have not been able to find any mention of ortho and para forms of water in the literature. However, the theoretical reasoning appears to be exactly the same for any molecule with two similar nuclei.<sup>17</sup> So we should expect water to have the same ratios as molecular hydrogen.

In water under normal conditions, molecules in state (a) have no net magnetic moment. Molecules in state (b) cancel out the effects of those in state (c). Molecules in state (d) have magnetic moments pointing in random directions in the plane perpendicular to the external field, thus cancelling one another. So water normally produces no net magnetic field.

Now let us consider what alignment God could have used to produce the earth's field. Since we have no better information, let us assume that God did it with a minimum of deviation from what was to be the ordinary alignment, and a maximum of orderliness. This would be in accordance with His principle, "Let all things be done properly and in an orderly manner" (I Corinthians 14:40). Figure 4 shows two possibilities. Configuration one only requires that one-eighth of all the hydrogen nuclei have an unusual orientation. The second configuration affects more nuclei, but eliminates the somewhat disorderly state (d) of Figure 3. Either alignment generates 25 percent of the maximum possible field. God could easily have created any proportion of aligned nuclei He might have wanted, but these two possibilities seem more orderly to me. I admit that this is a subjective evaluation, but I know of no better way to make an estimate. So let us postulate this proportion, 25 percent, at least as a starting point.

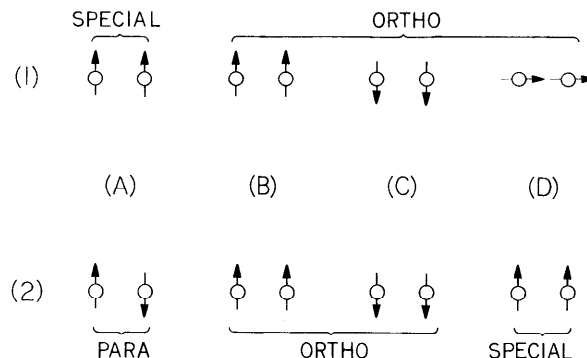


Figure 4. Two possible alignments of water protons at creation. Either configuration would produce 25 percent of the maximum possible magnetic field.

### 5. Initial Strength of the Field

With the information from sections 3 and 4, we can now estimate what the initial value of the earth's magnetic moment would have been if my water/nuclear magnetism hypothesis is true. The magnetic moment at creation would be:

$$M_c = kn\mu_w, \tag{1}$$

where  $\mu_w$  is the magnetic moment of an orthowater molecule (both H nuclei parallel),  $n$  is the total number of water molecules available, and  $k$  is the fraction of water molecules contributing to the field.

From Section 4, we take  $k$  to be 0.25. The magnetic moment of an orthowater molecule should be twice the moment,  $\mu_p$ , of a single proton:

$$\mu_w = 2\mu_p. \tag{2}$$

The number of water molecules is simply the total mass of the earth,  $m_e$ , divided by the mass of a single water molecule,  $m_w$ :

$$n = \frac{m_e}{m_w}. \tag{3}$$

Plugging equations (3) and (2) into equation (1) gives us:

$$M_c = 2k \frac{m_e}{m_w} \mu_p. \tag{4}$$

The mass of the earth is presently  $5.976 \times 10^{24}$  kg.<sup>18</sup> The mass of a water molecule is about 18.02 atomic mass units, or  $2.992 \times 10^{-26}$  kg.<sup>19</sup> Using these values plus the values for  $k$  and the proton magnetic moment mentioned earlier gives the earth's magnetic moment at creation:

$$M_c = 1.41 \times 10^{24} \text{ Joules/Tesla}. \tag{5}$$

This is about eighteen times stronger than the earth's present magnetic moment,  $7.9 \times 10^{22}$  J/T.<sup>20</sup> The next section will show how we can compare the theoretical result in equation (5) with another estimate derived from experiment. The field resulting from this alignment of protons would have a dipole shape,<sup>21</sup> as does most of the earth's field today.

### 6. Decay of the Field

Once the magnetic field was established, thermal collisions of molecules would knock the nuclear orientations into the normal configuration shown in Figure 3. The time required for this "spin-lattice relaxation" in water at normal temperatures is between one and

ten seconds.<sup>22</sup> But as protons began to lose their special orientation they would induce an electric current in the water. The current would tend to maintain the original magnetic field, according to Faraday's law of induction and Lenz's law.<sup>23</sup> Thus, the source of the field would quickly change from oriented protons to an electric current circulating in the watery earth. There would not be much loss of field, provided that the magnetic decay time,  $\tau$ , of the earth at that time was greater than the thermal relaxation time. That is, we must have  $\tau \gg 10$  seconds. The magnetic decay time<sup>24</sup> for a sphere of conductivity  $\sigma$  is:

$$\tau = \frac{\sigma \mu_0 R^2}{\pi^2} \quad (6)$$

Here  $R$  is a characteristic radius in the earth wherein the conductivity of the water is appreciable, and  $\mu_0$  is the magnetic permeability ( $4\pi \times 10^{-7}$  henry per meter). Even pure water is a good electric conductor at the temperatures and pressures characteristic of the earth's interior. Above a pressure of 100 kilobars and a temperature of 500°C, the measured conductivity of water is greater than 10 mhos per meter.<sup>25</sup> Such conditions would be normal below a depth of a thousand kilometers in water.<sup>26</sup> So we can say that  $R$  was probably greater than 5000 km. Using these data in equation (6) gives us a magnetic decay constant of about one year for the earth of Genesis 1:1. This is much longer than the thermal relaxation time. So the electric current induced in the interior would preserve the magnetic field virtually intact.

As God transformed much of the water into other materials (Genesis 1:9) some parts of the earth would probably become less electrically conductive and others more conductive. But the same process of induction would tend to preserve the magnetic field, transferring current from less conductive parts (the crust and upper mantle) into more conductive portions (the lower mantle and fluid core). Since the magnetic decay time of the conductive parts would be longer than the six days of creation, the field would again be preserved efficiently.

After the creation week, the earth's magnetic moment would decay exponentially to its present value of roughly  $7.9 \times 10^{22}$  Joules per Tesla. Figure 5 shows how the measured values of the magnetic moment have steadily decreased over the past 150 years. It includes some new values measured recently. Table 1 shows the data and sources.<sup>27, 28</sup> The scale of this graph is logarithmic so that an exponential decay would appear as a straight line on it. The straight line on the graph is the best least-squares fit to the data points shown. It corresponds to the following exponential decay for the magnetic moment  $M$ :

$$M = M_0 e^{-t/\tau}, \quad (7)$$

where  $t$  is the time in years A.D.,  $\tau$  is the present magnetic decay time, and  $M_0$  is the value the magnetic field would have had in the year zero A.D. (= 1 B.C.) if the decay time has remained constant. The fitted values for  $M_0$  and  $\tau$  are:<sup>29</sup>

$$\tau = (2049 \pm 79) \text{ years}, \quad (8)$$

$$M_0 = (2.088 \pm 0.204) \times 10^{23} \text{ J/T}. \quad (9)$$

If we assume that  $\tau$  has been roughly constant since creation, we can extrapolate  $M$  back to the time of

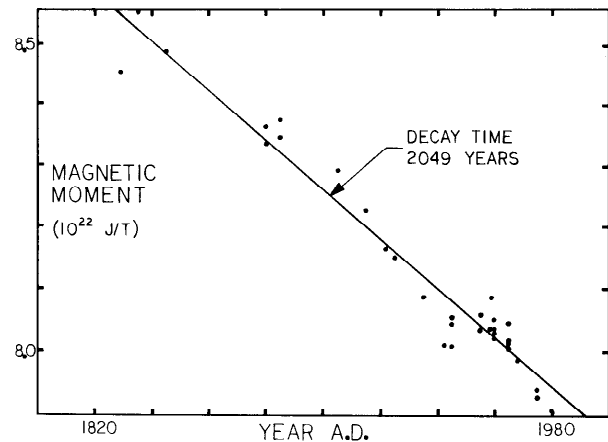


Figure 5. Observed values of the earth's dipole magnetic moment since 1829 A.D. The vertical scale is logarithmic, the horizontal scale is linear. A straight line on this graph implies an exponential decay. The straight line shown is the best (least-squares) fit to the data. Table 1 lists the data and sources.

Table 1. Observed Decay of the Earth's Magnetic Dipole Moment\*

Number	Source	Year	Dipole Moment (Joules/Tesla $\times 10^{22}$ )
1	Erman-Peterson	1829	8.454
2	Gauss	1835	8.558
3	Adams	1845	8.488
4	Adams	1880	8.363
5	Neumayer	1880	8.336
6	Fritsche	1885	8.347
7	Schmidt	1885	8.375
8	Vestine	1905	8.291
9	Vestine	1915	8.225
10	Dyson-Furner	1922	8.165
11	Vestine	1925	8.149
12	Vestine	1935	8.088
13	Jones-Melotte	1942.5	8.009
14	Vestine	1945	8.065
15	Afanasieva	1945	8.010
16	U.S.C. and G.S.	1945	8.066
17	Fanselau-Kautzleben	1945	8.090
18	U.S.C. and G. S.	1955	8.035
19	Finch-Leaton	1955	8.067
20	Nagata-Oguti	1958.5	8.038
21	Cain	1959	8.086
22	Fougere	1960	8.053
23	Adam	1960	8.037
24	Jensen-Cain	1960	8.025
25	Leaton	1965	8.013
26	Hurwitz	1965	8.017
27	Cain	1960	8.028
28	Cain	1960	8.022
29	Malin	1965	8.056
30	Barraclough	1965	8.005
31	POGO	1968	7.985
32	IGS	1975	7.939
33	AWS	1975	7.927
34	Magsat	1980	7.906

\*Sources 1-26 from reference 27. Sources 27-34 from reference 20. Includes eight new points since Barnes' paper (Ref. 2).

creation, as Figure 6 shows. Using a tight chronology from the Hebrew text of the Old Testament gives the time of creation as roughly 4000 B.C.<sup>30</sup> Using a value of -4000 years for  $t$  in equation (7) gives an estimate for the earth's magnetic moment at the time of creation:

$$M_c = (1.47 \pm \frac{1.28}{0.68}) \times 10^{24} \text{ J/T.} \quad (10)$$

This value is derived from experiment and the assumption of exponential decay at a constant rate. The large (one-sigma) error bounds come from extrapolating 150 years of data six millennia into the past.<sup>31</sup>

If the reader compares this experimentally-derived value of equation (10) with the theoretical value of equation (5), he will find that they agree to within 5 percent, well within the error bounds of the experimental value. I find such agreement remarkable and exciting.

### 7. Conclusion

The previous sections show that: (1) we can theoretically estimate the initial strength of the earth's magnetic field, and (2) present measurements of the earth's field and its decay are consistent with that value. This agreement provides supporting evidence for several concepts:

- The field's exponential decay.
- The short Biblical time scale.
- An all-water original earth.
- The scientific reliability of scripture.

If the field did not decay exponentially, the agreement would not exist. For example, a linear decay would predict a field less than one-fourth of the exponentially-derived starting value. If the time scale were much different from 6000 years, no agreement would be possible. That is, if the earth's age were stretched to 10,000 years, the initial value of magnetic moment would exceed the maximum value available from water (for  $k = 1$ ). This not only supports young-earth views, but also the tight-chronology view of scripture.

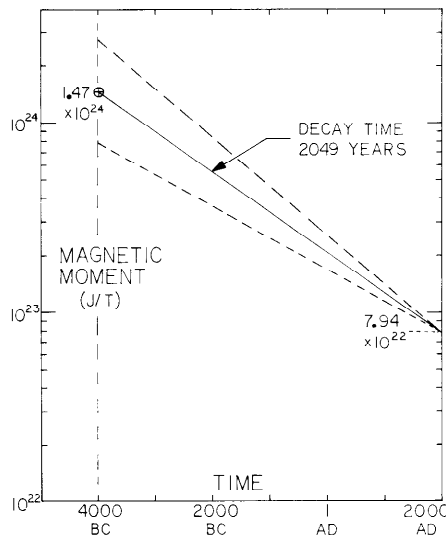


Figure 6. Extrapolation of the earth's dipole magnetic moment back to 4000 B.C. The vertical scale is logarithmic; the horizontal scale is linear. The error bands are statistical (1 - sigma) estimates of accuracy.

If the earth were originally created with the composition it now has instead of water, agreement would be impossible. Most of the earth's present nuclei, (such as silicon, oxygen, magnesium, calcium, and iron) have little or no magnetic moment. The fact that all of these factors—time, composition, exponential decay—must dovetail to produce agreement increases the likelihood that this is a correct explanation for the origin of the earth's field. I admit that my choice for the alignment fraction ( $k = 0.25$ ) is not rigorous but merely plausible. However, even a  $k$  of 1.0 would extend the earth's age by only another 2000 years. The fact that agreement within 5 percent occurs with the tight-chronology age of 6000 years is quite significant.

This paper has moved into an area where creationists have been reluctant to apply the laws of ordinary science: the creation week itself. Much of what happened at that time is clearly miraculous, such as the direct creation of matter out of nothing. In order to tread on such holy ground, the creationist must be careful to use every bit of information available from scripture. He must also be very suspicious of his own speculations — as I am of mine. But at the very least this paper should refute a common charge which evolutionists make: that the Bible suppresses scientific thought by its assertion that God has intervened in this physical universe. Quite to the contrary, I find that scripture stimulates the imagination of any scientist willing to submit to his Creator — Jesus Christ.

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## THE FOSSIL STORY

WILLIAM J. TINKLE\*

When I was a boy I found in the garden something that had the appearance of a burdock root turned to stone; years later it was found to be a solitary coral, such as now are found living in the ocean. It was one of the animals whose presence caused the preserved life of northern Indiana to be called Silurian. The finding of a new type of life, whether living or fossil, gives a mild joy and sometimes leads to wrong conclusions as to what it reveals.

The most useful branch of geology is that which is called "urban" geology, although its value is wider than city industry. Tests are made to see if the substratum will uphold the foundation of a house; if a well in a certain spot will deliver enough water; if a house built on a certain hillside will slide downward with great loss. There is much information which geology gives more ably than the history of the earth.

### What They Tell

Geology is depended on, however, to give such history, and largely through fossils. While relative ages in a small area may be learned by the order of the strata of rocks, if a stratum has different fossils in a part of its length, that part is said to be of a different age.

As we have seen, identification of the position of a bed is based on comparison of its fossil content with worldwide catalogs of fossils.<sup>1</sup>

This statement by K. L. Currie gives the view of the majority of geologists; but there is an active minority who disagree. It is easily seen that this statement reposes much faith in the order in which the

fossils were laid down and that this order is claimed to be the same all over the world. It infers that each species came into being at the same time all over the world and lasted until another certain time, then became extinct at this time, being replaced by another species. As time went on it is claimed that each new species became more complex and that its added structure made it more successful.

### Relative Vigor

Faith in this order of species is one of the chief supports of belief in evolution. But you see that Amoeba and all other very simple animals should have become extinct long ago, which they have not done; and we find that mosses and lichens, simple plants, cling to life in situations where sunflowers would not even make a start.

It has been stated that God writes in two manners, inspiring good books and arranging the order of the rocks; perhaps I have so stated at some time; but we are not justified in calling these acts of the same order. Listen to A. E. Wilder Smith:

How beautiful are the ripples in the sand. . . .  
But if I see my name boldly written in the sand  
or if I see "John loves Mary" an entirely different  
reaction takes place within me.<sup>2</sup>

Let us beware that we do not claim God's intelligence in an assumption of our own. We have no reason to believe that God started each species at a different time rather than placing them together and it is still more presumptuous to credit some man with the knowledge of the time when each one started. Actually a few fossils were studied here and there by a

\*Deceased, 1981.