

Young-Earth Creationism and the Earth's Magnetic Field

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Arkansas Act 590 was passed in 1981 as a result of the Supreme Court decision in *Epperson vs. Arkansas*, which stated that laws prohibiting the teaching evolution were unconstitutional. The Act stated that creation science was to be taught equally alongside the theory of evolution. Section 4 of the act defines creation science as “the scientific evidences for creation and inferences from those scientific evidences”¹. The “scientific evidences for creation” are used to strengthen young earth creationism, “the result of the literal interpretation of the description of creation in Genesis 1”²; as opposed to the universe being billions of years old, which was proposed by old-earth creationists or evolutionists. Young-earth creationists believe that a wide variety of scientific evidence points to the inevitable conclusion that the world was created by God between 6,000 and 10,000 years ago.

Generally, the evidence for this theory is presented in categories of life sciences, geological science, and physical sciences. While many people are probably acquainted with creationists’ objection to the life science aspect of evolutionary theory, many of the “strongest” arguments fall under the physical sciences heading. One of these arguments for a young-earth creation involves the earth’s magnetic field. Many “secular” physicists have been working for decades on the “dynamo” theory, whereas creation physicists have been citing the free-decay theory that was proposed by Dr. Thomas G. Barnes in the 1970s and later developed into the dynamic decay theory of Dr. D. Russell Humphreys.

The dynamo theory of Earth’s magnetic field is a very complicated and not at all completely understood mechanism that attempts to describe the creation and sustainment of the magnetic field. According to this theory, paleomagnetism shows that the magnetic field of the earth has remained constant for about three billion years. However magnetic fields in a conducting body decay ohmically unless sustained by electrical currents. The formula for this time decay is:

$$\tau_{ohm} = \mu_o \sigma L^2$$

According to this formula the decay time for the terrestrial magnetic field should be about 200,000 years. Since this is much shorter than the observed time for the field, something must be maintaining the field and this generally called the dynamo. It is postulated that the electrical currents associated with earth's conducting molten core maintain the field. The magnetic energy lost is replenished by the Lorentz force. If the energy input into the field overcomes the losses due to ohmic heating then it is possible that the field could be sustained for the observed long time period. Another factor that must be considered in the dynamo theory is the reversal that occurs in the magnetic field a few times every million years with the last reversal occurring about 700,000 years ago. Of course, creationists have their own ideas about the magnetic field.³

The use of the magnetic field as evidence for young-earth creation began when Dr. Barnes published *Origin and Destiny of the Earth's Magnetic Field*. It is in this book that Barnes makes the claim that the Earth's magnetic field has been decaying exponentially since the creation of Earth. In order to make this claim the strength of the magnetic dipole, the magnetic moment, was used⁴. As Barnes explains it, the magnetic moment is due to circulating currents that are in the earth's core. Because the currents would have to be very large to produce the earth's magnetic field, and assuming that there is no mechanism to sustain them, the logical conclusion is that the field must be decaying⁴.

The magnetic moment, M, points south, producing a magnetic field that points outward at the south magnetic pole and inward at the north magnetic pole and is symmetrical about its axis. The two components of the field about the axis are represented by:

$$B_{\theta} = \frac{\mu M \sin \theta}{4\pi r^3}$$

$$B_r = \frac{\mu M \cos \theta}{2\pi r^3}$$

Where M is the magnetic moment and μ is the permeability of free space taken as $4\pi \times 10^{-7}$. For these equation the unit of B is the tesla and the unit of M is amp meter². The net magnetic field at the magnetic equator can be derived from B_θ as the $\sin 90^\circ=1$, the earth's radius is $r=6.371 \times 10^6$ meters, and the permeability given above are plugged into the equation:

$$B_o = \frac{\mu M}{4\pi r^3}$$

$$B_o = \frac{4\pi \times 10^{-7} M}{4\pi (6.371 \times 10^6)^3}$$

The equatorial value of B at the surface is then 3.687×10^{-28} M. This shows that if the dipole moment is known, the field can be computed for any point on earth. ⁴

In 1835, Gauss took the first measurement of the magnetic dipole using his invention, the magnetometer. He determined that $M=8.558 \times 10^{22}$ Am². Barnes takes this as the first reference point for determining the decay of the magnetic field. The entirety of his decay argument is based upon data for the magnetic moment taken in the years between 1835 and 1965, and reported in the now infamous U.S. Department of Commerce ESSA publication. Barnes then used the aforementioned equation for B_o to calculate the equatorial field and reported those values in his book ⁴.

From this data Barnes declares, "It is clear...that the magnetic moment and the earth's main magnetic field have been decaying relatively rapidly since 1835" ⁴. He seems to be vindicated by the ESSA report which states, "Since the time of Gauss' measurements the earth's dipole moment had decreased, sensibly linearly, at approximately the rate of 5% per hundred years" ⁴.

Barnes' next step was to calculate the half-life of the earth's field. He plotted both B_0 and M against time and concluding that the decay was indeed exponential he gave the formula:

$$M = M_0 e^{-t/T}$$

Where M_0 is the magnetic moment at the reference time and M is the magnetic moment t years after the reference time ⁴. "The time constant, T , is the time required for the magnetic moment to decay to e^{-1} of its reference value M_0 " ⁴. Barnes then took the natural log of that equation and plugged in the magnetic moment values for 1835 and 1965 with t equaling 130 years. T , the time constant, was calculated to be 2,000 years. To find the half-life with this information Barnes used the equation:

$$\ln 2 = t/2000$$

Rounding, Barnes stated that the value of the half-life of earth's magnetic field is 1400 years. This gave Barnes the ability to predict that in 3373 A.D. the magnetic field will be half of its present strength and will not sufficiently protect us from cosmic radiation ⁴.

Barnes, being a creationist, was much less concerned with the apocalypse and much more concerned with what the decaying of the field could show about the origin of the earth. Using the half-life of 1400 years and the reference value of the field in 1965, Barnes calculated the field backwards in time using the equation:

$$B = 3.1 \times 10^{-5} e^{t/2000}$$

Giving the values of the field at various time in the past, Barnes determined that it was absurd to say that the earth could be even one million years old as the field would have been 3×10^{215} Tesla. If one assumes, such as Barnes does, that the field was created when the earth was created, the earth could not possibly be millions of years old ⁴.

Though Barnes admitted in his book that there is no way of knowing the actual date of creation, it can be predicted by knowing at what date the strength of the magnetic field would be too high. He gave the example that in 20,000 B.C. the field would have been stronger than the field between the poles of the most powerful radar magnets⁴. Naturally the earth must be younger than that. Barnes argued for an even younger earth by assuming that the planet never had a magnetic field that equaled the strength of a magnetic star. Using the data that he calculated from the half-life equation, he determined that the earth must have been created more recently than 8000 B.C.⁴. His conclusion is that the earth is less than 10,000 years old.

It did not take long for even creationists to see a few flaws in Barnes theory. Though they have never questioned the validity of the general idea that the earth's field does indeed decay exponentially, the evidence for field reversal became so overwhelming that creationists had to account for it. Also, Barnes had not given any theory for the origin of the magnetic field. He stated that it was formed by electrical currents in the earth's core and that it must have formed when the earth was created, but no mechanism for this was put forth. These shortcomings in Barnes theories led to a new champion of the magnetic field and young-earth creation, Dr. Humphreys.

Dr. Humphreys has been able to put forth an explanation of the reversals of the earth's magnetic field and a theory on the origin of the magnetic field. The title of his 1986 paper, "Reversals of the Earth's Magnetic Field During the Genesis Flood", is very descriptive. In this paper, Humphreys explains his theory that the reversals of the magnetic field all occurred very rapidly during the year of the flood. Humphreys explains that evolutionists and old-earth creationists believe that the field must have reversed itself over thousands of years and that the decay that has occurred in the field is another reversal in progress⁵. Humphreys never questions that Barnes proved that the field had decayed for the past 150 years, but admits that it does not explain past reversals. However, he is quick to say that

“reversals are possible within a young-earth framework”⁵. The 1986 paper gives the mechanism for all the reversals in the earth’s magnetic field occurring during the flood.

The mechanism is based on simple facts. The reversals are in the fossils strata and therefore must have happened when the strata were being laid down. Young-earth creationists believe that the strata were all laid down during the year of the flood. Humphreys concludes that since there are 50 reversals in the record, and they all occurred in one year, there must have been about one reversal per week. This means that one full cycle, reversal and return, would take about two weeks. It is upon this time period that Humphreys builds his argument. Using mantle and core conductivity, Humphreys determined that the electrical currents and the magnetic flux in the core could not directly produce the rapid reversals in the field on the surface of the earth⁵. He then gave the process; “A relatively thin layer at the top of the core produced a reversing magnetic field which was stronger than the much more slowly changing field contributed by the deeper layers of the core”⁵. The field on the surface of the earth would be the summation of the two, and could reverse rapidly.

Like Barnes, Humphreys also used the magnetic moment of the dipole field to determine the magnetic moments of the top layer of the core and the deeper core. The field is proportional to the current circulating in the layer and the area encircled by the current. The magnetic moment of the top layer was given as:

$$M_s(t) = \frac{2}{3} \pi R^2 I_s(t) A/M^2$$

The magnetic moment of the deeper section of the core would have a freely-decaying current:

$$M_i = 1.080 R^2 I_i A/M^2$$

Adding them gives the field at the earth’s surface:

$$M_{(t)} = M_s(t) + M_i$$

When the equations for the two components are compared, the shell is 1.94 times more efficient at creating a magnetic moment ⁵. This implied that the shell current can rapidly override the interior current. Opposite polarity in the field could be created by a surface current flowing in the opposite direction of the interior current. The earth's present field is produced by a 6 billion ampere current flowing westward in the core, so a surface current of 6 billion amperes would be needed to override it ⁵.

The problem is then getting billions of amperes of current to build up in the surface in a matter of days to fit Humphreys cycle time. He calculates that it would take an electromotive force of a hundred thousand volts using the inductance of the core 1.02H, and the following equations:

$$L = \frac{2}{27} \pi \mu R$$

$$V = L \frac{dI}{dt}$$

In order to have the current and the voltage necessary for Humphrey's reversal mechanism, a hundred trillion watts would be required ⁵. He considered this a small amount when one considers the geological power that was occurring during the flood.

Humphrey's continued to further his model of the history of the earth's magnetic field. He concerned himself with what happened to the field immediately after the flood. He believes that it did not begin an immediate exponential decay. To explain this he used higher modes of decay (beyond dipole). That neither he nor Barnes had used in previous considerations. The high amount of energy that was created in the core due to the flood would not immediately disappear; therefore, higher modes must be considered for the field after the flood ⁵. These multipoles would decay exponentially with their own time constant. Humphreys stated that these multipoles explain the behavior of the field. The field

behavior was that it dropped after the flood and rose to a “broad maximum at about the time of Christ”⁵. Specifically, the quadrupole seems to be important in the rise to the broad maximum. Humphrey’s model for the history of the magnetic field is as pictured⁶:

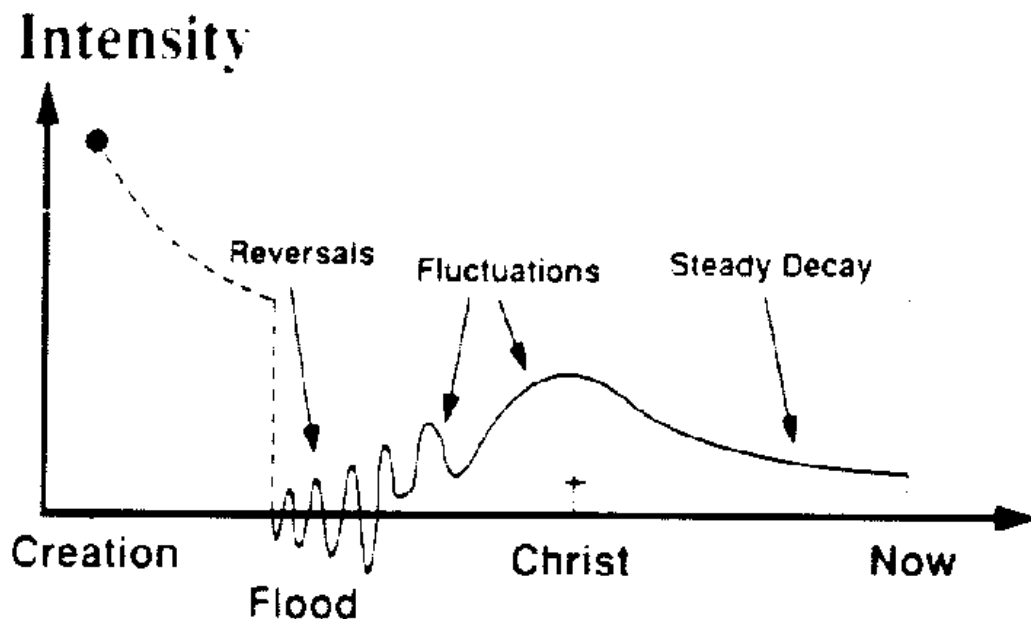


Figure 1. Magnetic field intensity at the earth's surface, from creation to now.

In his conclusion, Humphreys divides this history into five “episodes”:

1. The creation of the field and earth,
2. Steady decay for about 2000 years,
3. Rapid reversals during the year of the flood,
4. Large fluctuations for several thousand years after the flood,
5. Resumption of steady decay from the time of Christ to the present.

His ability to map the history of the magnetic field made Humphreys’ argument the number one explanation for how the magnetic field proves young-earth creationism. As an added bonus, Humphreys had an idea for how the magnetic field, and consequently the earth, was formed.

Humphreys theory of the origin of the earth's magnetic field begins with a verse from Scripture. Peter3:5 states that "...the earth was formed out of water and by water" ⁷. This verse lead Humphreys to develop a theory explaining that God created the earth out of water and then transformed it into the materials that it is made out of today. Considering that the earth was originally created from water, one must examine the magnetic field inside a water molecule. In most molecules the fields are produced by the spinning of electrons ⁷. In water molecules however, the ten electrons spin in opposite directions and cancel each other out. Protons and neutrons also generate magnetic fields that are about a thousand times smaller than electron fields. The only field in a water molecule would come from the single protons in the nuclei of the hydrogen atoms. Normally these would randomly move about, also cancelling the field, but Humphreys' idea hinges on God creating the hydrogen nuclei with all their spins pointing in the same direction ⁷. The sum of all of these tiny magnetic fields would cause a large magnetic field to come into existence as God created the earth.

If the fraction of hydrogen nuclei aligned at creation, $k=0$ to 1 , then it should be possible to determine the magnetic moment, M_0 at the time of creation. Humphreys used the equation:

$$M_0 = k\alpha_0 m$$

where $\alpha_0 = \frac{2\mu_p}{m_w} = 0.9425 \frac{Am^2}{kg}$. The terms are: m_w is the mass of a water molecule, $2.992 \times 10^{-26} kg$, the observed magnetic moment of a proton, $1.41 \times 10^{-26} Am^2$, m is the mass of the earth, $5.979 \times 10^{24} kg$, and α_0 is a constant of the magnetic moment per unit of water with hydrogen nuclei aligned ⁷. This gives that the magnetic moment M_0 equals $k5.6 \times 10^{24} Am^2$. Humphreys then used Barnes exponential decay model to state that 6,000 years ago the earth magnetic moment was $1.5 \times 10^{24} Am^2$. If k is set to 0.25 (25% of the hydrogen nuclei aligned), then the magnetic moment using Humphreys equation is $1.4 \times 10^{24} Am^2$, a very close fit to the Barnes model ⁷. However, Humphreys changed his mind about setting k to 0.25. He began to believe that k should equal one and that that would account for the reversals and

post-flood fluctuations that he had already described. He said, "That gives us one less adjustable parameter, thus tightening up the theory. It is more satisfying for me to imagine God aligning all the hydrogen nuclei He created, not just some of them" ⁷.

Dr. Barnes theory put a 10,000 year limit on the age of the earth. Dr. Humphreys whittled that down to say that the earth was created only 6000 years ago. A diagram of both theories is shown below⁶.

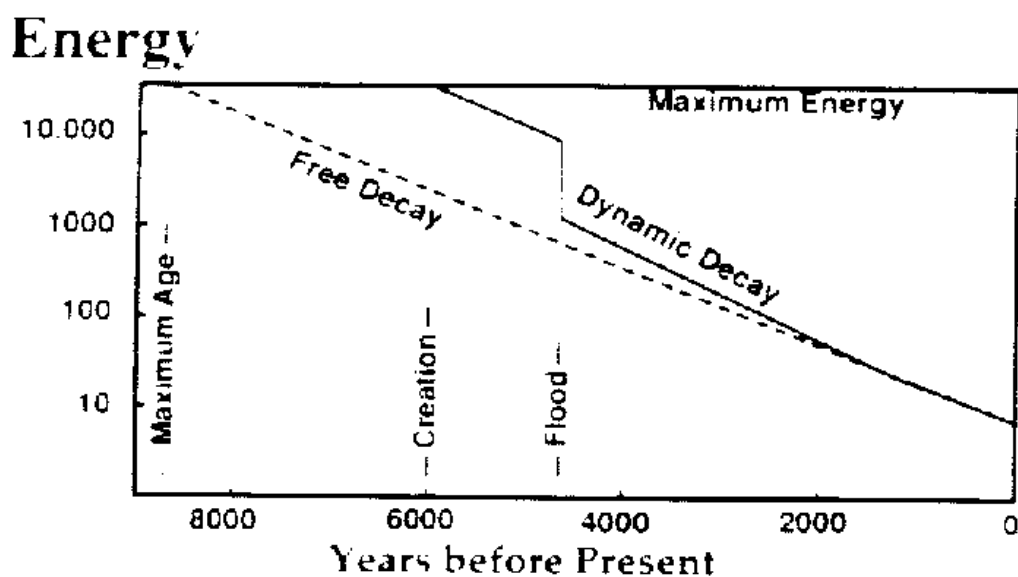


Figure 2. Total energy (in trillions of kilowatt-hours) stored in the earth's magnetic field. Free decay theory gives maximum age of 8700 years.

Naturally, there have been many responses to these theories from evolutionists. Two notable refutations are "One Creation Science and the Alleged Decay of the Earth's Magnetic Field", a paper by Tim Thompson, and a section of the *Counter-Creationism Handbook* by Mark Isaac. Since both creationist arguments rely on the exponential decay of the earth's magnetic field, that is the issue that evolutionists attack. One very simple argument is that an exponential curve can be fit any set of data points, and that in this case a straight line works better ⁸. Another argument is that Barnes used only the dipole moment of the magnetic field to do his calculations, leaving out higher order components ⁹.

Another fatal error for Barnes is that the data from the ESSA report is used without any degrees of uncertainty or percent error⁹. For these reasons, many scientists do not accept Barnes theory of exponential decay.

Despite critiques from evolutionists, young-earth creation scientists believe that they have many types of scientific evidence that shows that the earth is only several thousands, not billions, of years old. When Barnes first published his book on the age of the earth's magnetic field, creationists immediately saw it as yet more proof of a young-earth creation. Later problems with his theory were seemingly rectified by the writings of Humphreys, yet he still depends on Barnes theory of exponential decay, which still depends on the data of the ESSA report. Perhaps if Barnes or Humphreys reworked their theories using new data that accounts for higher order of field components, degrees of uncertainty, and consistent measurements, their idea of predicting the time of creation using the magnetic field could gain better reception in the scientific community.

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