Mercury's magnetic field is fading fast—latest spacecraft data confirm evidence for a young solar system

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Like everything in the heavens, Mercury's magnetic field continues to declare the glory of God. Two NASA spacecraft have visited that planet. The first was *Mariner 10*, which flew by Mercury three times during 1974 and 1975. It took brief magnetic measurements during each flyby. They showed that Mercury has a significant magnetic field, about 1% of the strength of Earth's magnetic field.

That startled uniformitarian (long-age believing) scientists, because they had calculated that Mercury was small enough for its assumed fluid core to cool and solidify during the billions of years they declare that the solar system had existed. A fluid core is essential for the 'dynamo' theory, their unfinished explanation for how a planet might maintain a magnetic field for the alleged billions of years. A few years ago, deep-space radar studies of Mercury's wobbling ('libration') showed that it does indeed have a molten core.[1] But instead of taking that as evidence the planet is young, uniformitarians now conjecture that its core consists of a mixture of materials that has a significantly lower melting point than other planetary cores, low enough to keep it molten for the alleged billions of years. Over the decades, there have been many conjectures about how a magnetic 'dynamo' could be working in the planet.[2]

However, the flyby information *Mariner 10* collected was not enough to determine important details about Mercury's field, such as the location of its magnetic poles and whether the field might be offset from the planet's centre, as is the case for some other planets. Consequently, analysts had to make assumptions about those features in order to make rough estimates of the strength of the source of the planet's magnetic field, a large loop of electric current in the core.

The creation of Mercury's magnetic field

In 1983, eight years after the first Mercury flybys, I published a theory in a creation science journal about how God may have created the magnetic field of the earth.[3] Based on Scriptures that could suggest that God created the earth first as water and then converted the water into its present materials (by nuclear, chemical, and physical transformations), I suggested that He created the water molecules with all their hydrogen nuclei spinning in the same direction. (Not all creationists like this idea; see note below.[4]) That would produce a magnetic field remarkably close to what is needed to explain the earth's magnetic field today after 6,000 years of decay at its observed rate. In the transformations that immediately followed, the spins would cease to be oriented, but the magnetic field would preserve itself (according to the normal laws of electricity and magnetism) by starting an electric current in Earth's core. The electrical resistance of the core would then wear the current down over thousands of years, producing the observed decay of the magnetic field. The theory would not work with different initial materials or an age much different than 6,000 years.

Encouraged by the success of this idea, I published a paper in 1984 applying it to the magnetic fields of the sun, moon, and planets.[5] The theory worked remarkably well for the global magnetic fields that had already been observed by spacecraft (and moon landings) up to that time. Recently I extended the theory to other solar system objects and heavenly bodies outside the solar system. It continued to work well there, too. I published a summary of all the results, from Earth to galaxies, in 2008.[6]

But there were magnetic features and planets not yet closely examined by spacecraft in 1984. So that paper made four scientific predictions about what future spacecraft would measure if the theory were true. Three of the predictions have been verified. The fourth has to do with Mercury. Starting from the initial strength given by my theory, I calculated the decay half-life necessary to decrease during 6,000 years to the strength observed in 1975. Using that half-life, I estimated what Mercury's field would be when future spacecraft might visit the planet again. By 2011, the field would have decreased by 4–6% from its 1975 value.[7]

MESSENGER zooms by Mercury

The second NASA spacecraft to visit Mercury was *MESSENGER*,[8] built and steered by the Jet Propulsion Laboratory and Johns Hopkins University Applied Physics Laboratory. It flew by Mercury three times during 2008–2009 (figure 1), in preparation for its final insertion into close orbit around Mercury early in 2011. Two of the three flybys yielded magnetic data, but as before, not in enough detail to nail down the locations of the magnetic poles or whether the field was offset from the centre. But the rough estimates of the field's strength suggested it was

Photo courtesy of NASA

Figure 1. Image of Caloris basin taken by *MESSENGER* spacecraft flying by Mercury in 2008.

down significantly from 1975, possibly by more than my prediction.[9]

MESSENGER orbits Mercury

A little over a year ago, on 18 March 2011, *MESSENGER* entered a near-polar orbit of Mercury, dipping to as close as 200 km above the north geographic pole and swinging out to 15,000 km above the South Pole. A week later it began gathering magnetic data, and it has been doing so continuously for hundreds of orbits, bringing it over the entire surface of the planet. After six months, an article in the journal *Science* summarized the results.[10] *MESSENGER* confirmed two important features of Mercury's magnetic field:

1. The field's axis lines up with the planet's rotation axis within a few degrees. That means its magnetic poles and its geographic poles essentially coincide.
2. Outside the planet, the field is like that of a tiny but strong bar magnet (a pure 'dipole', having only two magnetic poles) offset north from the planet's centre by 484 (±11) km, 20% of the planet's radius. That indicates the field over the North Pole is considerably stronger than the field over the South Pole.[11]

These discoveries mean the source of the field is a thick, diffuse ring of electric current a few thousand kilometres in diameter, circulating westward (figure 2) in the core. The ring's axis points north, and it is offset north of the centre.[12] Knowing this allowed the authors of the *Science* paper, Anderson *et al.*, to estimate the strength of the source fairly accurately

I could give you the numerical strengths, but what we want to know is how much the source strength changed since 1975. Anderson *et al.* seem reluctant to tell us that clearly. After giving their best estimate for the strength of the offset, non-tilted dipole of today, the authors report that is about 27% lower than the strength from an analysis[13] of the 1975 data that assumed a dipole with no offset and significant tilt. That doesn't give us a direct 'apples to apples' (as opposed to 'apples to oranges') way to compare the results from the two spacecraft. What Anderson and his co-workers should have done was to re-analyze the 1975 data[14] assuming the same tilt (essentially zero) and offset they measured in 2011, since those factors probably haven't changed much in the last four decades.[15] That is what I did, in a simple way,[16] to calculate the degree of change of the field strength. My result: Mercury's dipole is *7.8 (±0.8)% weaker*[17] in 2011 than it was in 1975.

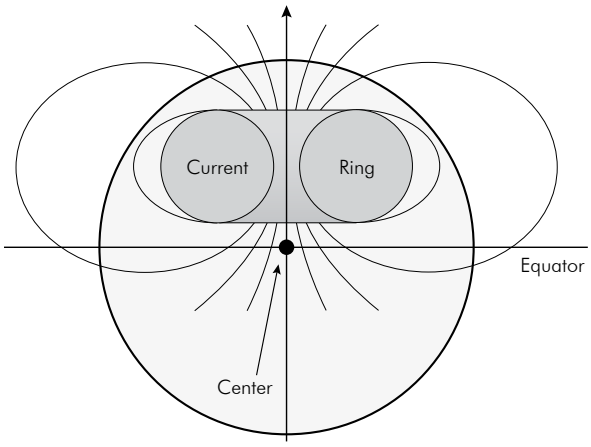

Figure 2. Source of Mercury's magnetic field is an offset (exaggerated here) ring of electric current within its core (crust and mantle not shown).

Grappling with the implications

The decrease is amazing—astonishingly fast for something as big as a planet's magnetic field. For comparison, the decline of Mercury's dipole strength is four times faster than that of the earth. The uniformitarian 'dynamo' theories have as yet offered no clear explanation for the rapid and steady decline in Earth's field, so the theorists should be quadruply troubled by Mercury's fast-fading field. Embarrassment over this near-catastrophic decrease may be the reason the *Science* article (and the *MESSENGER* website article in the same reference) obscures it.

The change is somewhat larger than the 4–6% I was expecting for a simple (constant half-life) exponential decay from my theory's initial value for Mercury's field 6,000 years ago. The additional few percent may be due to an increasing decay rate (non-constant half-life). That could be caused by a slow heating of Mercury's interior since creation, perhaps due to decay of radioactive elements in its core.[18] The heating would increase turbulence, which would destroy magnetic energy more rapidly now than earlier. That would increase the effective resistivity[19] of the core as the millennia passed.

In any case, today's observed high decay rate is in the right 'ball park' for Mercury's likely core size[20] and electrical resistivity.[21] It points strongly to a short-lived field, created only thousands, not billions of years ago. I am convinced God gave Mercury's magnetic field, and the magnetic fields of all the heavenly bodies, as signatures on His handiwork.

References

1. Miller, J., Radar reveals Mercury's molten core, *Physics Today* **60**(7):22, July 2007.
2 Heyner, D. *et al*., Evidence from numerical experiments for a feedback dynamo generating Mercury's magnetic field, *Science* **334**:1690–1693, 23 December 2011. Based on an unproven scaling model for planetary dynamo theories, the authors of this paper assume that Mercury's field should be as strong as that of the earth today. They propose that the solar wind might be suppressing the alleged dynamo so that Mercury's field is much lower than modelled. The references in the paper will give some of the previous history of speculations about the source of Mercury's magnetic field.
3 Humphreys, D.R., The creation of the earth's magnetic field, *Creation Research Society Quarterly* **20**(2):89–94, September 1983.
4. One reviewer of this paper wants readers to know he thinks God lining up all the hydrogen nuclei spins is "an extreme, *ad hoc*, unproven" hypothesis. That's fine with me. There is no way, short of using a time machine, to 'prove' that hypothesis. However, the model resulting from it has now been tested four times (by prediction) and has passed each test. Moreover

the model fits all the other data we have for solar system and cosmic magnetic fields ... remarkably well. The good fit would not be possible without the original material being water, all the hydrogen spins being aligned, and the age of the solar system being close to 6,000 years.

5. Humphreys, D.R., The creation of planetary magnetic fields, *Creation Research Society Quarterly* **21**(3):140–149, December 1984. Archived (with predictions highlighted in red) at: www.creationresearch.org/crsq/articles/21/21_3/21_3.html.
6. Humphreys, D.R., The creation of cosmic magnetic fields; in: Snelling, A.A. (Ed.), *Proceedings of the Sixth International Conference on Creationism*, Creation Science Fellowship, Pittsburgh, PA, and Institute for Creation Research, Dallas, TX, pp. 213–230, 2008. Archived in colour at: www.icr.org/i/pdf/research/ICC08_Cosmic_Magn_%20Fields.pdf.
7. Humphreys, D.R., Mercury's Messenger, *Creation Matters* **9**(4):1,9, July/August 2004. See www.creationresearch.org/creation_matters/pdf/2004/CM09%2004%20low.PDF.
8. MESSENGER is an acronym for 'MErcury Surface, Space ENvironment, GEochemistry, and Ranging' and of course refers to the alleged role of the Roman mythological god Mercury.
9. Humphreys, D.R., Mercury's magnetic field is young! Creation Ministries International feature website article, 26 August 2008, archived at: creation.com/mercurys-magnetic-field-is-young.
10. Anderson, B.J. *et al*., The global magnetic field of Mercury from MESSENGER orbital observations, *Science* **333**:1859–1862, 30 September 2011. Less detailed report, Mercury's Oddly Offset Magnetic Field, 15 February 2012, at messenger.jhuapl.edu/soc/highlights021512.html.
11. For comparison, Earth's dipole magnetic field tilts about 11.5° away from its rotation axis, and the dipole source is offset about 7% of Earth's radius northeastward from the centre.
12. The cause of the offset could be any of a variety of things. One would be an inner core having a higher effective electrical resistance than the outer core. That would cause the decay half-life to be shorter in the inner core, making current in the outer core more likely to persist.
13. Anderson, B.J. *et al*., The magnetic field of Mercury, *Space Science Reviews* **152**:307, 2010. The particular values they used for their comparison are in table 1, Internal model 3.
14. Ness, N.F., The magnetic field of Mercury, *Physics of the Earth and Planetary Interiors* **20**:209–217, 1979. I used the 1975 maximum field Ness reports in the right side of fig. 2, plus the latitude and distance of closest approach in the right side of figure 1.
15. Rikitake, T., *Electromagnetism and the Earth's Interior*, Elsevier Publishing Company, Amsterdam, 1966. On pp. 91 and 102, Rikitake gives information that the earth's dipole is moving at about 2 km/year. A proportional change in the offset of Mercury's dipole would be nearly negligible during a 36-year period.
16. Anderson *et al*., ref. 10, p. 1860, fig. 2. From the graph, I got the maximum total field, plus altitude and latitude at that moment. Then I compared it with similar data from Ness, ref. 14. I kept the ratio of dipole and quadrupole moments the same, setting all other coefficients to zero (as did Anderson *et al*.), and then found the ratio of dipole moments for 1975 and 2011. I ignored the possible effects of external field changes, see next note.
17. Anderson, *et al*. 2011, p. 1861. The most likely cause of error is the external field, which is influenced by the solar wind, possibly different in 1975 than it was in 2011. This article says "From MESSENGER's orbit, the external field contributes more than 20% of the total field only at lower latitudes and higher altitudes." That is why I chose to compare the maximum observed values of total field, recorded at high latitudes (near the North Pole) and at the lowest altitudes. I take half the 20% above as the maximum perturbation from external field, giving me error bounds of ± 0.8%.
18. A reviewer points out that the universe-wide accelerated nuclear decay postulated by the Radioisotopes and The Age of The Earth (RATE) research initiative could have produced a strong pulse of heat in Mercury's interior during the Genesis Flood, and that such heat would still be affecting the core today.
19. Humphreys, D.R., Earth's magnetic field is decaying steadily—with a little rhythm, *Creation Research Society Quarterly* **47**(3): 193–201, Winter 2011. For 'effective resistance' explanation, see "Accounting for Fluid Motion" section on p. 197. Archived at: www.creationresearch.org/crsq/articles/47/47_3/CRSQ%20Winter%202011%20Humphreys.pdf.
20. Smith, D.E. *et al.*, Gravity field and internal structure of Mercury from *MESSENGER*, *Science Express*, 21 March 2012, at www.sciencemag.org/content/early/2012/03/20/science.1218809.full#comments. This late-breaking online article gives new gravity-mapping data from *MESSENGER* indicating that Mercury's fluid core has a radius of 2,030 (± 37) km, a whopping 85% of the planet's radius.
21. Humphreys, ref. 6, pp. 219–221, see eq. (18) and fig. 7. Using the latest core radius (in above reference) in eq. (18) gives an average core conductivity of 28,000 S/m. That is very close to the value of 33,000 S/m for Earth's core I found from the latest data on its dipole decay rate (see Humphreys, ref. 19, p. 200). That would drop the data point for Mercury in fig. 7 of this reference down to the same level as those of Mars and Earth, indicating that the core materials may be the same in all three planets.

Is *Archaeopteryx* a feathered dinosaur?

Michael J. Oard

Practically all paleontologists think of *Archaeopteryx* as the first bird or the missing link between dinosaurs and birds. The fossil is used as a showcase for evolution.

However, Chinese paleontologists now challenge this classification, and instead make a case that *Archaeopteryx* is a feathered theropod dinosaur.[1] This belief is based on the finding of an *Archaeopteryx*-like fossil in China called *Xiaotingia zhengi* (figure 1), the affinity of which is supposedly with the early theropod dinosaurs and feathered dinosaurs. The new fossil is said to resemble theropod dinosaurs and, just like *Archaeopteryx*, it has teeth, claws on its wings, and a vertebrate tail. But the new fossil still has many features of birds, such as: feathers; small size; boomerang-shaped wishbone; and features of enantiornithines, unique fossil birds.

Based on questionable phylogenetic analysis

To back up their claim, the Chinese paleontologists have used numerical phylogenetic analysis, cladistics, that compares anatomical features of many individuals. The idea is that the more similar the fossils, the closer they are related by evolution. But the researchers also admit: "It should be noted that our phylogenetic hypothesis is only weakly supported by the available data."[2] They go on to add that other phylogenetic analyses have demonstrated just the opposite, that *Archaeopteryx* is a basal bird: "Although *Archaeopteryx* is placed within the Avialae [basal brids] by nearly all numerical phylogenetic studies…"[3] In order to attempt to weaken the cladistics data that says *Archaeopteryx* is a bird, the Chinese paleontologists claim that some of the traits used in the cladistics analysis are questionable.