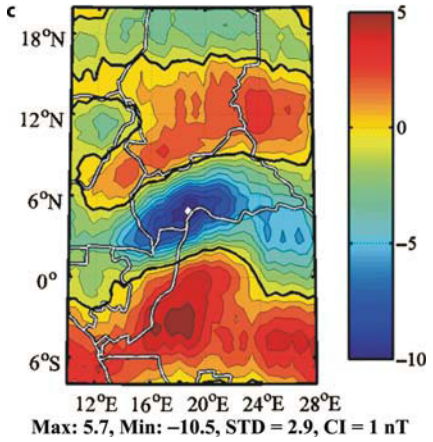

Figure B6/Plate 6c Satellite altitude (400 km) scalar magnetic anomaly map of the Central African Republic region from CHAMP mission data. Anomaly maximum, minimum, standard deviation and contour interval are given on the figure (Hyung Rae Kim, UMBC and NASA/GSFC).

topographic ring some 810 km diameter associated with this feature (Girdler *et al.*, 1992). In Rollin's (1995) recently compiled tectonic/geologic map of the Central African Republic, Late Archean and Early Proterozoic rocks are exposed beneath the central part of the anomaly. Lithologically the area is dominated by granulites and charnockites (a high temperature/pressure granite believed to be part of the lower crust). There are, in addition, significant exposures of greenstone belts and metamorphosed basalts with itabrite (a metamorphosed iron formation). There are several theories for the origin of the anomaly. Regan and Marsh (1982) proposed that a large igneous intrusion into the upper crust became denser on cooling and sank into the lower crust with the resulting flexure producing the overlying large basins of this region (see *Magnetic anomalies for geology and resources*). The intrusion the source of the magnetic anomaly; the sedimentary basin fill the source of the gravity anomaly. Another hypothesis is that it is the result of a large extraterrestrial impact (Green, 1976; Girdler *et al.*, 1992). Ravat *et al.* (2002) applied modified Euler deconvolution techniques to the Magsat data and their analysis supports the impact model of Girdler *et al.* (1992). Unfortunately, it is not possible to discriminate between these theories based solely on geophysical data. However, the key to the solution may lie in the origin of carbonados (microcrystalline diamond aggregates). Carbonados are restricted to the Bahia Province, Brazil and the Central African Republic, with the latter having a greater number. Smith and Dawson (1985) proposed that a meteor impacting into carbon-rich sediment produced these microdiamonds. More recently De *et al.* (1998) and Magee (2001) have failed to confirm this hypothesis. The origin of this large crustal anomaly remains uncertain.

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Aeromagnetic Surveying
CHAMP
Crustal Magnetic Field
Magnetic Anomalies for Geology and Resources
Magnetic Anomalies, Long Wavelength
Magsat

BARLOW, PETER (1776–1862)

A British mathematician and physicist, born at Norwich, England, Peter Barlow is now remembered for his mathematical tables, the Barlow wheel and Barlow lens. His contributions to science in general and magnetism in particular are most impressive. We will concentrate here chiefly on his contributions in direct relation with geomagnetism, which are too often not given the attention they deserve.

Despite lacking formal education, Peter Barlow became assistant mathematical master at the Royal Military Academy in Woolwich in 1801. He was promoted to a professorship in 1806 and worked in Woolwich until retiring in 1847. His first researches were mainly focused on pure mathematics (his "Theory of Numbers" appeared in 1811), but in 1819 he began to work on magnetism. In May 1823, Peter Barlow was elected fellow of the Royal Society. He later also became a member of several of the leading overseas societies (including correspondant of the French Académie des Sciences in 1828). He worked on problems associated with magnetic mesurements and the issue of deviation in ship compasses caused by iron pieces in the hull. In 1825, he was awarded the Royal Society Copley Medal for his method of correcting the deviation by juxtaposing the compass with a suitably shaped piece of iron used as neutralizing plate.

Guided by a suggestion from John Herschel, Peter Barlow conducted experiments on the influence of rotation upon magnetic and non-magnetic bodies. In a letter to Major Colby dated December 20, 1824, he relates:

> *"Having been lately speculating on the probable causes of the earths magnetic polarity. It occured to me that it might possibly be due to the rotation, and if so the same ought to be the case*

with any revolving mas of iron. I therefore fixed one of our 13 inch shells upon one of the turning lathes in the arsenal driven by the steam engine, and the very few trials were most conclusive and satisfactory."

The next year, in the *Philosophical Transactions,* Peter Barlow describes how the experimental mesurements were made extremely difficult because of the disturbing influence of the lathe and other machinery on the needle. After careful investigations, he reports negative conclusions:

"I have certainly found a stronger effect produced by rotation than I anticipated, yet it does not appear to be of a kind to throw any new light upon the difficult subject of terrestrial magnetism. I think there are strong reasons for assuming, that the magnetism of the earth is of that kind which we call induced magnetism; but at present we have no knowledge of the inductive principle, (. . .)"

Years later, *Lord Blackett* (*q.v.*) revisited this possibility with similar conclusions (Blackett, 1952).

Following on Öersted's discovery of the magnetism associated with electrical current (Experimenta circa effectum Conflictus Electrici in Acum Magneticam, 1820), the French physicist André-Marie Ampère proposed (Annales de chimie et de physique, 1820) that electrical currents within the Earth could account for the geomagnetic field (these currents were then assumed to be of galvanic origin). Barlow was the first to test the practicability of Ampère's proposal and designed a remarkable experiment to that end. This experiment is presented in the *Philoposphical Transactions* for 1831. Barlow built a wooden hollow globe 16 in. in diameter and cut grooves in it. A copper wire was placed around the sphere along the grooves in the manner of a solenoid. When this globe is connected to a powerful galvanic battery, current passing through the coils sets up a dipolar magnetic field. Barlow describes how, if one turns

"(. . .) the globe so as to make the pole approach the zenith, the dip will increase, till at the pole itself the needle will become perfectly vertical. Making now this pole recede, the dip will decrease, till at the equator it vanishes, the needle becoming horizontal. (. . .) Nothing can be expected nor desired to represent more exactly on so small a scale all the phenomena of terrestrial magnetism, than does this artificial globe (. . .) I may therefore, I trust, be allowed to say, that I have proved the existence of a force competent to produce all the phenomena of terrestrial magnetism, without the aid of any body usually called magnetic."

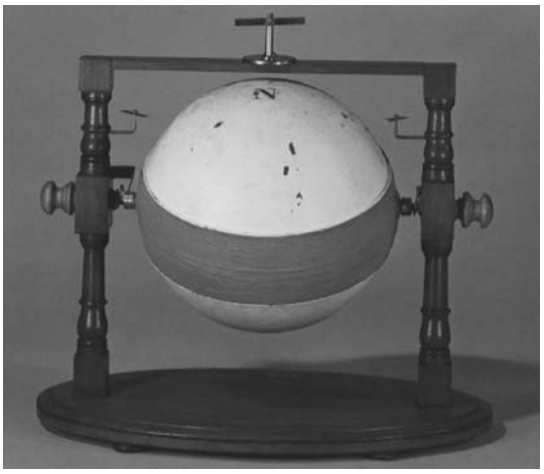

Figure B7 Teaching instrument, based on Barlow's sphere, used to demonstrate how a current passing through a coil produces a dipolar field similar to that of the Earth. [The Physics Museum of the University of Coimbra, CAT. 1851: 25.O.III, 39 × 25.8 × 41, wood, brass, and copper. Photography: João Pessoa-Divisão de Documentação Fotográfica do Instituto Português de Museus].

This interpretation of the principal geomagnetic field clearly represents the premise of present dynamo theory. Barlow's globe was originally constructed in 1824; this experiment yielded a teaching apparatus still preserved in some universities around the world (see Figure B7).

Peter Barlow also did work with geomagnetic observations, in 1833 he constructed a new declination chart (then called "variation" chart) in which he embraced earlier magnetic observations. This chart is illustrated and described in the *Philoposphical Transactions* in 1833. Barlow notes that the lines of equal variation (following the terminology introduced by E. Halley in his original 1701 chart) are very regular, denoting the deep origin of these structures. Barlow also discusses the evolution of these lines in time by comparison to previous charts (i.e., the secular variation).

Barlow concludes his opus by noting that he shall be most happy if this

"labour should furnish the requisite data for either a present or future development of those mysterious laws which govern the magnetism of the terrestrial globe, an object as interesting in philosophy as it is important in navigation."

Peter Barlow died in March 1862 in Kent, England.

Acknowledgments

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Emmanuel Dormy

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Geodynamo
Geomagnetic Secular Variation
Halley, Edmond (1656–1742)