THE EARTH'S REVERSIBLE MAGNETIC FIELD.
By
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The earth behaves like a giant bar magnet whose axis runs north-south. The northern magnetic pole lies in the Arctic, about 1,600 kilometres from the geographical north pole. The southern magnetic pole lies in the Antarctic, about 2,600 kilometres from the southern geographical pole. The direction of the earth's magnetic field, although relatively steady over long periods of time, completely reverses itself every several hundred thousand years. In other words, what was the northern magnetic pole becomes the southern magnetic pole and vice versa. Geological evidence now tells us that a reversal in direction of the earth's magnetic field is long overdue.

Magnetism is an aspect of the electromagnetic force, which is one of the four fundamental forces in nature. The four fundamental forces are gravity, electromagnetic, the strong nuclear force and the weak nuclear force. Electric and magnetic forces are intimately connected. Electric charges in motion produce a magnetic force. A moving magnet induces an electric current. A magnetic force field organises itself in space between two opposite poles, north and south. The lines of force radiate outwards from the poles. The origin of magnetic force derives from the behaviour of electrons in atoms. Some elements, e.g. iron, display strong magnetic properties, other elements do not.

An existing magnetic field can induce magnetism in a non-magnetised piece of metal; for example if you rub a bar magnet against a thin sliver of iron, the sliver will itself become a bar magnet and, if free to move, will line itself up along the earth's magnetic field, with one end pointing towards the north magnetic pole and the other towards the south magnetic pole - the sliver has become a magnetic compass.

The word 'magnet' comes from the Greek term for magnetite, a strongly magnetic oxide of iron, which occurs naturally in some parts of the world. The Chinese seem to have been the first people to interpret the directional properties of magnets. Around the first century B.C. they were using finely pivoted magnetised spoons in order to predict the future. It was not until the twelfth century that records show they used compass needles as a navigation aid.

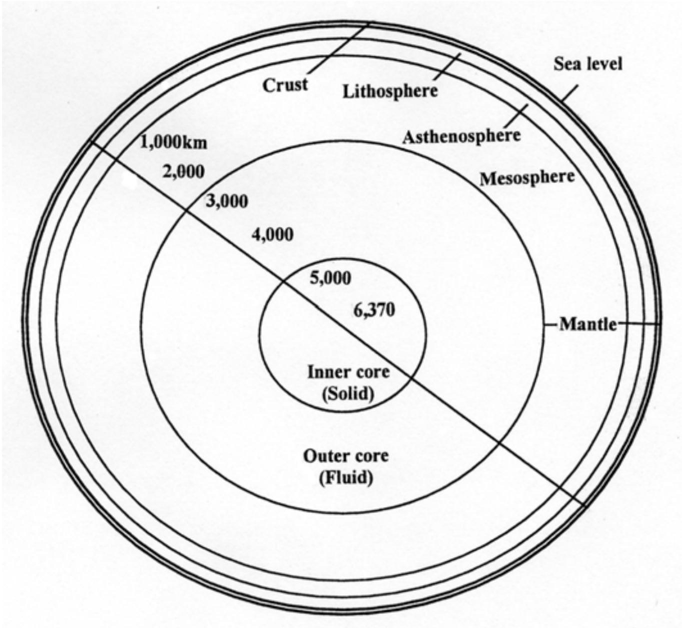
One of the first attempts to explain the unerring tendency of a compass needle to point north-south was the thirteenth century suggestion by Pierre de Maricourt that the behaviour was due to an attractive force exerted by the North Star, which is the only celestial body to remain fixed in the Heavens. Most of his contemporaries, however, thought that the behaviour of the compass was dictated by the presence of strong magnetic mountains in the Arctic region. Critics of this view pointed out that magnetic mountains had been seen by travellers all over the world, but no such mountains had been observed in the Arctic Circle.

It is now known that the earth's magnetic field originates from within the earth itself. If you could section through the earth, passing through the centre, and examine the exposed inside you would find that the earth is built rather like an onion with many layers lying on top of each other. Unlike the onion, the layers are not all of equal thickness. The depth from the surface of the earth to its centre is approximately 6,370 kilometres. On the outside of the earth is the thin crust. Beneath the crust, three layers, down to a depth of almost 3,000 kilometres, are collectively referred to as the mantle. The inner two layers of the earth are called the outer core and the inner core. The outer core is fluid, the inner core is solid. As the earth rotates on its axis, the outer core fluid layer allows the mantle and solid crust to rotate relatively faster than the solid inner core. As a consequence it is claimed that electrons in the core move relative to those in the mantle and crust. This movement creates a natural dynamo and therefore a magnetic field similar in shape to the field of a bar magnet.

There have been several reports over the centuries, from various parts of the world, of compass needles behaving strangely when placed over certain rocks. It was reported that the north pointing end of the compass needle would swing around to point south, and, of course, the previously south pointing end would now point northwards. In 1963, two research groups convinced most geophysicists that such rocks are evidence of a past reversal in the earth's magnetic field, records of a time when the northern magnetic pole resided where the southern pole is today. These volcanic rocks are 'magnetic fossils' recording the intensity and direction of the global magnetic field that prevailed when the rocks cooled and hardened. Rocks from widely scattered parts of the world, but of about the same age, display reverse polarity. The earth's poles have flipped over up to 25 times during the past five million years - on average, once every 200,000 years. The last flip over happened 730,000 years ago, and, therefore, we are now long overdue for another magnetic reversal. Geologists explain the reversals as being caused by eddies and currents in the outer core. When these currents predominantly flow in one direction the magnetic north pole is situated where it is today. When they predominantly flow in the opposite direction, the magnetic north pole will flip over to occupy the present position of the magnetic south pole.

The evidence indicates that the flip-over in the polarity of the earth's magnetic field does not occur all of a sudden but is preceded by a gradual weakening of the field. Some measurements of the present rate of decline of field strength of the earth's magnetic field suggest that a flip over will occur in 2,000 years time. By the time this happens we may well be so forewarned and forearmed that it will cause little disruption to human activities. Of course, if it happened suddenly, the magnetic guidance systems of ships, airplanes, spacecraft and missiles would all go awry. When the flip-over does eventually happen it would seem inevitable that bacteria, insects, fish and birds that use the magnetic field to orient themselves will experience trouble finding their bearings. World climate may also change for the worse. As the earth's magnetic field weakens prior to the flip over, radiation particles from the sun, that previously remained at the outer edge of the earth's magnetic field, may pass through the upper atmosphere providing nuclei for the formation of vast banks of ice clouds that could cause cold rainy weather. The weakened magnetic field will also allow more cosmic radiation to reach the surface of the earth, thereby increasing natural mutation rates.

(See illustration below)



The Layers of the Earth. The Earth is not a perfect sphere, but is flattened somewhat at the poles and bulges somewhat at the equator. This effect is exaggerated in the illustration.

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