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POSSIBLE CONSEQUENCES OF A DWINDLING GEOMAGNETIC FIELD

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Recently, Facer (1971) has discussed the problem of the dwindling of the geomagnetic field, and estimated that in 810 years (AD 2781) the dipole and non-dipole fields will be roughly equal and that in 1931 years (AD 3902) the dipole field will be essentially zero. Various authors (Crain and Crain, 1970; Cox, 1968; Parker, 1969) have suggested that these conditions are highly favourable for the production of geomagnetic reversals.

What would be the consequences of such a reversal? One of the well-known effects is the loss of the Van Allen radiation belts, which shield the Earth from much of incoming cosmic radiation. Obviously too, radio communication will be severely disrupted by the weak and unsteady state of the magnetic fields. Presumably all but microwave line-of-sight communication would be impossible. Facer (1971) pointed out the simple but important problem of the inoperability of magnetic compasses. These consequences are troublesome enough, but another more deadly possibility has recently appeared.

Various authors have noted a correlation between magnetic reversals and the extinction of micro-faunas in ocean cores (Harrison and Funnell, 1964; Watkins and Goodell, 1969). Long-term comparisons of reversals and extinction patterns show an excellent correlation, (Simpson, 1966; Uffen, 1963; Crain, 1971). So could it be that there is something about a reversal that is rather deadly to terrestrial organisms?

Two obviously dangerous effects are the increased cosmic radiation and severe climatic disruption due to upper atmosphere disturbances. In addition to these two effects is the danger of the low magnetic field itself. In a series of experiments on organisms in low magnetic fields reviewed by Conley (1970) varying effects were noted, which were consistently deleterious. Affected most were motor activity, enzyme production, and any activity which depended on direction finding (such as bird migration). Shortened life span and infertility were noted in relatively short low-field exposures of mice (Van Dyke and Halpern, 1965). There is a frightening correlation between magnetic storms and admissions to mental hospitals (Becker et al, 1961). Experiments on human subjects are not well reported (perhaps classified) but there are indications of disturbing effects even in relatively short experiments (Beischer et al, 1967). The dangerous effects of low magnetic fields would appear to be associated with interactions with the nervous system (Crain, 1971).

Those of the human species who survive the next eight or nine centuries will be faced with the following problems:

1) Ineffective magnetic compasses
2) Difficult radio communications

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3) Severe climatic disruptions
4) Increased cosmic radiation
5) Possible lethal effects of low magnetic fields on humans or related problems due to upsets in animal food-chains.

All these effects may be present even if no reversal takes place, and the field merely drops to a fairly low level as predicted by Facer (1971). If a reversal does occur, however, the field is likely to become even lower for a longer period.

The odds against a reversal in the next 1000 years or so can be evaluated approximately. At the present (the Quaternary) the rate of reversals is very high, about 1 per 25000 years (Crain and Crain, 1970). The Earth's dipole field reaches a period susceptible to reversals about every 3000 years. Thus the odds against a reversal at any one susceptible period are 25000/30000, or about 8:1 (assuming the independence of reversal events). If the system cannot be treated as a Poisson process, then the fact that there have been no reversals for about 700,000 years would enhance the odds in favour of a reversal. Anyone wish to lay a bet?

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