Analyzing the periodicity in the sun's magnetism

The magnetic field of the sun is one of the important ways by which the sun influences the space that surrounds it. The solar field determines the behavior of the interstellar plasma, the so-called solar wind, to a distance well beyond the orbit of the earth and possibly to the outermost planets.

Daily observations of the solar field show a pattern that appears very complex compared with the simplicity of the earth's. Magnetism on the earth is overwhelmingly dominated by a dipole field that covers the entire planet—one pole is in the north, the other in the south. But matter on the sun, is in a more fluid state than on the earth, and since most of the fluid is electrically conducting, local conditions can have a greater effect on the over-all field than on the earth. As a result, complicated multipolar configurations are possible. Nevertheless, there now appears to be evidence that an important part of the solar field resembles a kind of rotating dipole.

The evidence is derived from observations of changes in the earth's field. It is reported in the Nov. 19 SCIENCE by John M. Wilcox and Walter Gonzalez, both now of the Institute for Plasma Research at Stanford University.

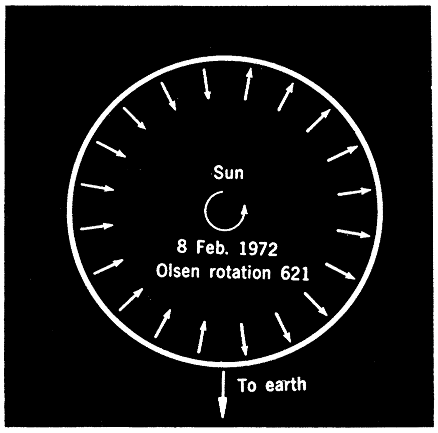
The chain of reasoning begins with an earlier discovery that averaging the records of the strength of the horizontal component of the terrestrial field recorded at Godhavn, Greenland, over four or five years revealed a recurring pattern with a period of 26 and seven-eighths days. The horizontal component is less than average for roughly the first half of the period and greater than average for roughly the second half of the period.

S. M. Mansurov found a connection between this variation of the terrestrial field and the polarity (toward or away from the sun) of the interplanetary field. This connection has been recently confirmed by E. Friis-Christensen, K. Lassen, Wilcox, Gonzalez and D. S. Colburn (SN: 10/16/71, p. 264).

Now Wilcox and Gonzalez have taken the records of the period between 1926 and 1968 and found that the noted periodicity exists through four of the last five sunspot cycles. The exception is the cycle between 1944 and 1954.

The results suggest that the core of the sun or some inner layer rotates every 26 and seven-eighths days and that it possesses a magnetic field that points toward the sun for half the period and away for the other half.

The evidence leads Wilcox and Gonzalez to conclude that a "relatively unchanging magnetic dipole may be lurking within (figuratively or literally) the highly variable sun that we see in day-by-day observations." But Wilcox cautions that the word dipole should be in quotation marks since they do not have a full three-dimensional picture of a dipole field, but only a two-dimensional cross section.



Science

Dipole-like solar magnetic field.

Wilcox points out that "if you take a snapshot of the solar field at any one time," you will not see the dipole. It is only by averaging over several years that it becomes apparent. Wilcox suggests that the dipole-like configuration is subject to distortion by activities of the outer solar layers and that this distortion causes the complexity of the daily observations. Activity of the outer layers could also account for the submergence of the dipole pattern during the anomalous sunspot cycle. □

Inflation's erosion of R&D

The National Science Foundation released statistics this week documenting the extent to which inflation has eroded funds spent on research and development in the nation's universities. They show that price inflation has accounted for a 50 percent increase in the direct costs of academic R&D during the 10 fiscal years ending in June 1971. Most of this rise occurred in the last five years. Salary increases took the biggest share of the toll. In an index with 1967 costs equal to 100.0, personnel costs in 1971 stand at 126.8 and prices of equipment and supplies at 114.4. Based on current dollars academic R&D expenditures have risen 1.7 percent during the last three years. But based on 1967 dollars, they have decreased 3.4 percent.

The statistics clearly document the contention of research administrators that although funding for academic science has increased slightly in recent years the purchasing power of R&D expenditures has actually declined. Congress is sure to be reminded of this at budget time. □

Identifying 26 reversals during early Cretaceous

The time scale of past reversals of the earth's magnetic poles can be established with reasonable accuracy from alternately magnetized bands of oceanic crust. Oceanic basalts become magnetized in the direction of the magnetic field prevailing at the time they are generated at mid-ocean ridges.

Several years ago, J. R. Heirtzler of Lamont-Doherty Geological Observatory and four associates established a chronology for the past 77 million years. The oldest oceanic crust, however, is more than twice that age—as old as 180 million years. Yet a reversal time scale for the period from 77 million to 180 million years ago has been slow in coming.

There are several reasons. The oldest parts of the crust are deeper, covered with thicker sediments, and more densely studded with undersea mountains, making it difficult to distinguish magnetic anomaly patterns. Furthermore, the dated 77 million years occupies two-thirds of the ocean floor, so that some 55 percent of the magnetic reversal record is crammed into only a third of the ocean floor.

The period between 155 million and 180 million years ago is represented by magnetic smooth zones off the continental shelves west of North Africa and east of the United States. These areas have low amplitude lineations that may represent magnetic reversals. If so, there must have been about three reversals every million years, about the same rate evident during the past 42 million years. Recently, a magnetic reversal sequence for between 155 million and 135 million years ago was delineated.

The remaining gap, between 135 million and 77 million years ago, has been one of the least-known parts of the reversal chronology. In the Nov. 5 NATURE, Peter Vogt and G. L. Johnson of the U.S. Naval Oceanographic Office attempt to fill the gap. Ocean crust formed during this period is marred by numerous fracture zones that obscure any magnetic anomaly pattern. Detailed bathymetric surveys have mapped the positions of these fractures, so that the researchers could search for a reversal sequence in an undisturbed area of the western North Atlantic. Closely spaced and carefully navigated traverses were run parallel to and between two fractures in an area of relatively smooth crust. The researchers have identified a long period of normal polarity between about 90 millilon and 80 million years ago and at least 26 reversals between 135 million and 90 million years ago. Even if minor anomalies are interpreted as reversals, the reversal rate was less than one per million years. □