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INTERPLANETARY MAGNETIC SECTOR POLARITY INFERRED FROM POLAR GEOMAGNETIC FIELD OBSERVATIONS.

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Abstract

With the use of a prediction technique it is shown that the polarity (toward or away from the sun) of the interplanetary magnetic field can be reliably inferred from observations of the polar geomagnetic field.

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An influence of the interplanetary magnetic sector polarity on the diurnal variation of the polar geomagnetic field has recently been reported. [1,2] Briefly, for an away (from the sun) polarity interplanetary sector the effect is most prominent as a broad minimum for a few hours near local noon in the vertical component of a station near the northern pole such as Thule (corrected geomagnetic latitude 86.8°N), and as an increase in the horizontal component of a lower latitude station such as Godhavn (corrected geomagnetic latitude 77.5°N). For a toward polarity sector the vertical component at Thule has a corresponding maximum, and the horizontal component at Godhavn is decreased. The effect appears to exist over the entire polar cap, but disappears at latitudes a few degrees below Godhavn. In the southern hemisphere the effects corresponding to a given interplanetary polarity are systematically reversed.

We are collaborating on an investigation of this interesting effect. In order to provide an unambiguous test of the effect the following procedure was arranged. The Danish group undertook to infer the interplanetary magnetic sector polarity from the geomagnetic observations of their stations at Thule and Godhavn for the year 1969. This was done without knowledge of the sector polarity as observed by spacecraft, which was at the same time being analysed by the group in the United States. The sector polarity was inferred by visual inspection of the magnetograms, and no scaling or computing was performed. In the winter months the effect was not so distinct that an objective polarity assignment could be inferred.

The inferred interplanetary sector polarity was sent to the United States for comparison with the observed polarity [3] with the result as shown in Figure 1. The correspondence between the inferred and the observed sector polarities is very close. The positions of the sector boundaries usually agree to within less than a day, and sometimes to within the 3-hour intervals used in the analysis. The inferred field is basically determined for each Universal Time day, but occasionally a sector boundary passing the earth will cause a variation in the geomagnetic field such that a more precise time for the sector boundary can be inferred.

Further investigations of this effect will have two broad objectives: 1) A detailed investigation of the physical processes associated with the influence of the interplanetary sector polarity on the polar geomagnetic fields, and 2) an attempt to infer the interplanetary (and therefore solar) sector polarity patterns over several previous 11-year sunspot cycles, such as to give a broader perspective and understanding of solar and interplanetary sector magnetism.

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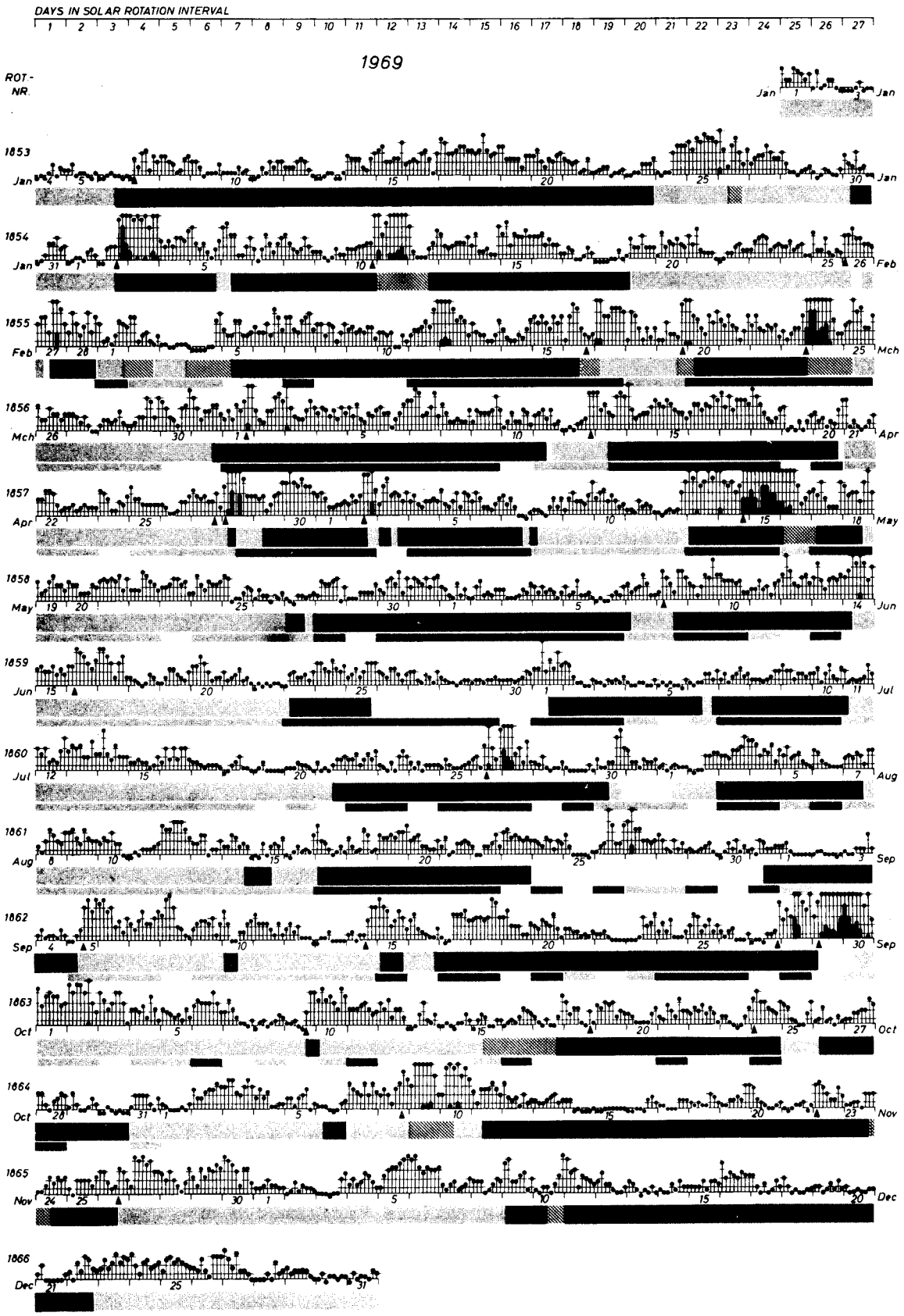
References.

1. Svalgaard, L., Danish Meteorological Institute Geophysical Papers R-6, August 1968.
2. Mansurov, S.M. Geomagnetism and Aeronomy, 9, 622, 1969.
3. Wilcox, J.M. and Colburn, D.S., submitted to J. Geophys. Res.

Figure 1. Interplanetary magnetic field polarity (away from or toward the sun) during 1969 plotted on a chart of planetary magnetic 3-hour range indices Kp (after Bartels). Light shading is field polarity away from the sun, and dark shading is field polarity toward the sun. The top bar on each line represents the interplanetary field polarity observed with the Ames Research Center magnetometer experiments on the spacecraft Explorers 33 and 35, and the bottom (narrower) bar on each line represents the interplanetary field polarity inferred from observations of the polar cap geomagnetic field. The crosshatch represents intervals of ambiguous field polarity.



▲ = sudden commencement

PLANETARY MAGNETIC
THREE-HOUR-RANGE INDICES
Kp 1969

Figure 1