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MAGNETOMETER EXPERIMENT

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Although Mariner IV may have passed near the Earth's magnetic wake last Jan. 28 to Feb. 2, preliminary data indicate that no change in the interplanetary magnetic field was detected by the magnetometer aboard the spacecraft. The spacecraft was 12 million miles from Earth at that time.

Large irregular fields were observed, however, on Feb. 7, two days after the occurrence of a class two, or medium size, solar flare. The sudden jump in the interplanetary field can be correlated with observations made by other instruments aboard the spacecraft.

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The instrument, a new type developed specifically for use on planetary missions, is a triaxial, low-field helium magnetometer with a sensitivity of 0.5 gamma per axis and a dynamic range of ±360 gamma per axis.

No abnormalities in the operation of the magnetometer have occurred during the first half of the eight-month mission, and it is expected that if it continues to operate, the instrument will determine the characteristics of Mars' magnetic field.

In observing the interaction between Earth's magnetic field and interplanetary plasma, the magnetometer detected field intensity and direction changes approximately between 84,000 and 100,000 miles from Earth and again at approximately 140,000 and 152,000 miles from Earth. These regions are tentatively identified as the magnetopause and the outer boundary of the transition region respectively.

An additional change in the character of the magnetic field was observed approximately between 48,000 and 60,000 miles from Earth, well inside the magnetosphere. This change was apparently associated with a transition from a region of the magnetosphere where the magnetic field lines cavitate with the Earth to a region where the Earth's field lines are swept back into the magnetic wake. This transition was observed earlier by satellite particle detectors a few thousand miles closer to Earth.

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The average location of all three transitions, when compared with earlier measurements, is consistent with an outward expansion of the magnetosphere, presumably associated with a lessening in the strength of the solar wind. The magnetic data also suggest that the location of the boundaries can vary rapidly with time and may pass a spacecraft several times as the spacecraft travels away from the Earth.

Also consistent with previous data--Mariner II measurement in 1962--are the following large-scale features of the interplanetary field:

The fields are strongly disordered, probably caused by irregular plasma-field emissions at the Sun, interacting clouds of slowly moving and rapidly moving plasma in space and instabilities that develop in the expanding solar wind.

The interplanetary field tends to lie in, or near, a plane parallel to the solar equatorial plane on the average, but has a high probability of lying out of this plane during any given measurement. (The Earth's solar orbit and the Mariner IV trajectory both are roughly parallel to this plane.) The field tends to be spiralled in planes parallel to these by solar rotation.

There are features in the interplanetary field that re-occur at periodic intervals of approximately 27 days, the period of the Sun's rotation. These features that persist for several solar rotations are probably associated with persistent active regions on the Sun.

HELIUM VECTOR MAGNETOMETER INSTRUMENT

The magnetometer is based on the principle that the amount of light that can pass through helium gas, that has been excited to a higher than normal energy level, is dependent on the angle between the light axis and the direction of the surrounding magnetic field. Measuring the amount of light passed through the helium gives a measurement of the magnetic field in magnitude and direction.

The light source is a helium lamp in the magnetometer. The light, collimated and circularly polarized, passes through a cell containing the excited helium gas and then impinges on an infrared detector that measures the amount of light passed through the helium gas.

The magnetometer is located on the low gain antenna mast to minimize the effect of the spacecraft's magnetic fields. Electronics supporting the experiment are located in a compartment on the spacecraft. The magnetometer weighs 1.25 pounds. The electronics weighs six pounds. The experiment operates on seven watts of power.

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