THE UNIVERSITY OF MICHIGAN

COLLEGE OF LITERATURE, SCIENCE, AND THE ARTS
Department of Astronomy

Quarterly Reports

UMRI PROJECTS 2451-1 AND 2451-2

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UMRI PROJECT 2451-1

STUDIES OF VARIATIONS IN THE EARTH'S MAGNETIC FIELD DUE TO SOLAR ACTIVITY

APRIL 1 TO JUNE 30, 1960

PERSONNEL

Mr. Frederic Stewart is employed on this project.

INSTRUMENTS:

The APL-5 Mc WWV recorder continues to supply records of interest and value.

STUDIES

In the last several years there has been increasing interest in the terrestrial event called Polar Cap Absorption (PCA) which takes place a small number of hours after the occurrence of certain (usually great) flares and a small number of days prior to the onset of certain (usually great) geomagnetic storms. The observed onset of PCA at high geomagnetic latitudes has been used in the prediction of geomagnetic storms and high-energy-particle phenomena near the earth.

During the months covered by this report we at the McMath-Hulbert Observatory have tried to consider the significance of PCA with respect to the general problem of the occurrence of geomagnetic storms.

According to the data available to us, there have been numerous geomagnetic storms without reports of observation of "prior PCA," even though such observations presumably were in progress—viz. July, 1957, onward. Conversely, although most of the reported instances of PCA were followed by relatively severe geomagnetic storms, this was not always the case—for example, April 10, 1958.

1. Importance and Disk Distribution of "PCA-Flares"

Numerous investigators have tried to identify the flare associated with each observed PCA. The flare so selected generally has been the most important preceding flare or the one with strong radiofrequency emission. "PCA-Flares" identified according to these "rules" constitute a group of flares of very great "importance" as observed in Hα, and with high concentration towards the center of the solar disk. (See Fig. 1a.) Of the 31 flares identified as the "most probable" flares for association with PCA, only 6 were as much as 50° from the central meridian. Eleven of the flares were of importance 3, and 10 of 3+. The remaining flares were of importance 2 or 2+. Thus, the group of flares

thought to be associated with PCA and subsequent geomagnetic storms resemble in importance and disk distribution the 37 "great flares" associated by H. W. Newton in 1943 with geomagnetic storms between 1859 and 1943 (M.N. 103, 244, 1943). (See Fig. 1b.) If this is the case, the study of Polar Cap Absorption, while exceedingly interesting in itself, and helpful in some ways in the prediction of geomagnetic storms, primarily reaffirms ideas well known since 1943 regarding the "geomagnetic significance" of VERY GREAT centrally placed Hα flares, especially if such flares are associated with radiofrequency emission.

2. PCA-Flares and Spots

A number of the flares associated with PCA have had strong concomitant continuous radiation at centimeter and/or meter wavelengths—radiation often referred to as of "Type IV." In the Quarterly Report for this project for October 1 to December 31, 1959, we described our study of three of the PCA-flares, viz. those of February 9, 1958, August 22, 1958, and July 16, 1959, for which Type IV radiation was strong and well established. In each of these cases the intense radiofrequency emission occurred when the Hα flare covered the umbra of a large spot.

We have now searched our photographic records for futher evidence of bright flare emission over spot umbrae for flares associated with Polar Cap Absorption. Of the approximately 30 PCA flares only 13 occurred during hours for which we could possibly have made observations, and for 6 of these clouds prevented photography at the 50 foot solar tower. For each of the 7 PCA-flares for which observations were obtained, the Hα flare occurred directly over the umbra of a spot. It should be remembered that, although many flares occur close to spots or impinge upon the umbrae, it is relatively rare for an Hα flare to occur directly over, or "in," the umbra of a great spot. Thus the evidence is increasing that the covering of the umbra of a large spot by the Hα flare has some bearing upon the occurrence of PCA, of intense centimeter radiation, or both.

Efforts are now being made to learn more about

a. Proximity of Hα flare to large spots at time of occurrence of centimeter radiation,

b. Characteristics of centimeter radiation with flares and Polar Cap Absorption.

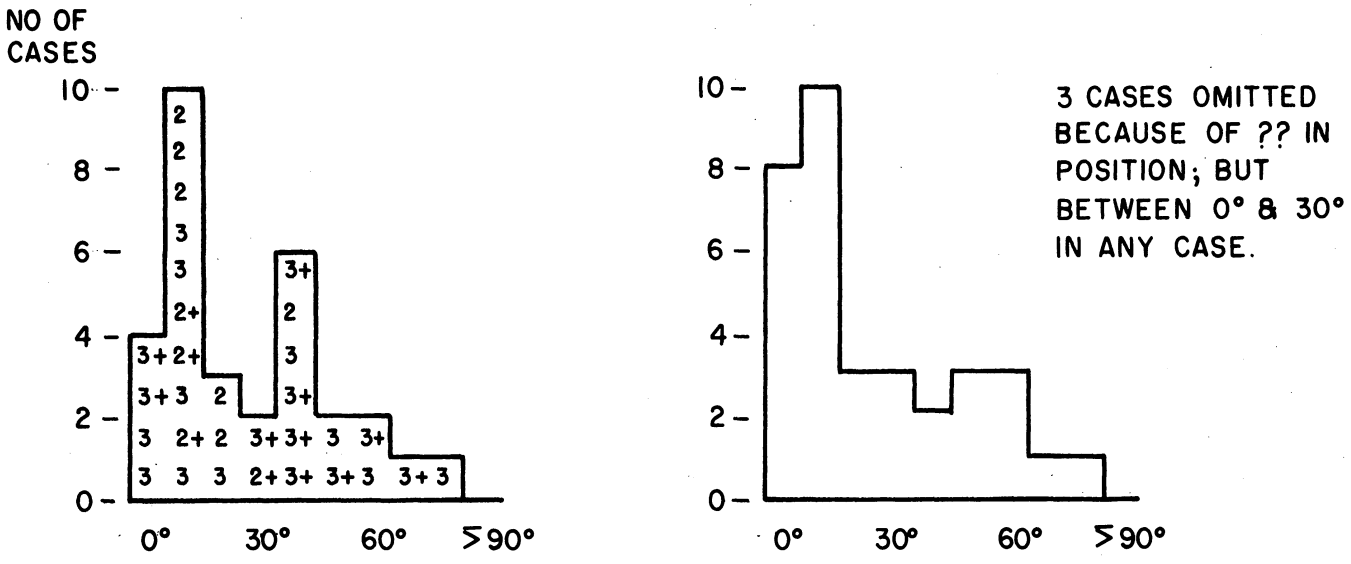

Fig. 1. Comparison of central meridian distance and importance of "Polar-Cap-Absorption" flares with Newton's geomagnetic storm flares (importance 3+?), 1859-1942. (See Monthly Notices, 103, 244, 1943.)

Note: Only 19% of the PCA-flares and 22% of Newton's geomagnetic storm flares were as much as 50° from the central meridian.

UMRI PROJECT 2451-2

JET TASK

JANUARY — JUNE, 1960

A series of repeat tests of single aft side jets on a plain ogive-cylinder body was made, followed by tests of side jets on a body with fins. The results of these tests will be published in a comprehensive report now being prepared. Some of the results are discussed below.

The repeat tests of single aft side jets have been compared with previous results. The main discrepancy seems to result from improper values of the jet force in a vacuum. The latest results are believed to be correct in this respect.

For the body with fins, the interaction force (that is, the force due to jet-induced pressure differences acting on the model exterior) was of the same order of magnitude as the jet internal force increment (the increment in force due to pressures acting inside the jet nozzle). This large interaction force resulted from the lateral constraining action of the fins, which prevented the circumferential spreading of the high pressure interaction region ahead of the jet. Fins having an exposed semi-span of one diameter were found to produce more interaction force than those with a one-half-diameter semi-span. Presumably, the shorter span fins allowed more leakage of the high interaction pressures past their subsonic leading edges. The data for the larger fins were found to agree with extrapolations of data obtained for a side jet issuing from a flat plate (WADD TR 60-329).

In the near future an investigation of the effects of side jets on static stability will be made. Later, the effects on interaction force of various fin parameters and of angle of attack will be investigated.