JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN Vol. 17, SUPPLEMENT A-I, 1962
INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part I

I-4-2. The Geographic Positions of the Stable Red Arcs of October 25 and October 26, 1960

James G. MOORE

Research Department, U.S. Naval Ordinance Test Station
China Lake, California U.S.A.

A stable red arc was observed from Cactus Peak, Calif. shortly after moonset on two successive nights during October 1960. During the night of October 24-25, the arc was observed to form in the direction of the north magnetic pole and to move rapidly southward, opening up so that it lay along an isoclinic line, until it reached a "stable position" at a dip latitude of 52.5°. On the night of October 25-26, the arc lay along an isoclinic at a dip latitude of 50.5° at moonset, and showed slow southerly motions during the night.

§ 1. Introduction

Stable red arcs, due to the forbidden transition $^1D—^3P$ of OI, which were discovered by Barbier (1) at the Haute Provence Observatory, have since been reported by many observers both in the southern and northern hemispheres, (2), (3), (4), (5), (6), (7), (8). From the work of Roach, et al., (1960) and Moore and Odencrantz (1961), the effective height or "opticl center of gravity" of these red arcs has been found to be in the neighborhood of 400 km. Using this information and that obtained from almucantar scans of arcs with a photoelectric photometer at one station, the geographical distribution can be readily obtained. A program for machine computation of the geographic latitude and longitude coordinates, using azimuth, zenith distance and assumed height of the arc as variables, has been devised. If observations are available from two different stations, the height can become a variable and a best fit analysis of the plotted coordinates will also yield the effective height.

§ 2. Observations

Geomagnetic and solar data provided by Lincoln (9) show that a severe magnetic storm, K-index 9, commenced at $14^h\ 53^m$ UT on October 24, 1960, at Sitka, Alaska while at Tucson, Arizona, a moderately severe storm, K-index 7, commenced at $14^h\ 52^m$ UT on the same day. Photometric observations with the 4-color instrument at Cactus Peak were started at 0730 UT the following day (October 25, 1960) shortly after moonset. Table I shows the coordinates of the observing station. These observations were continued until the onset of morning twilight at 1230 UT. Observations were begun again at 0615 UT on October 26, 1960 and continued until 1230 UT. A red arc was observed both nights and its position at various times during the night is shown in Figure 1 for October 25, 1960 and in Figure 2 for October 26, 1960. As seen in Figure 1, the arc was formed in a U-shape at the beginning of the observations (0730 UT) and rapidly fanned out to take a position along the isoclinic lines by 0930 UT. This position was maintained with but a slight southerly motion until the end of observations at 1230 UT. At its southernmost position, the dip latitude of the arc was approximately 51°. For comparison, the geomagnetic latitude at the western end was approximately 51° while at the eastern end it was approximately 49°.

Table I.

Station	Geographic		Geomagnetic latitude	Magnetic isoclinic longitude
	latitude	longitude		
Cactus Peak	36°05′ N	117°49′ W	43.1°	43°

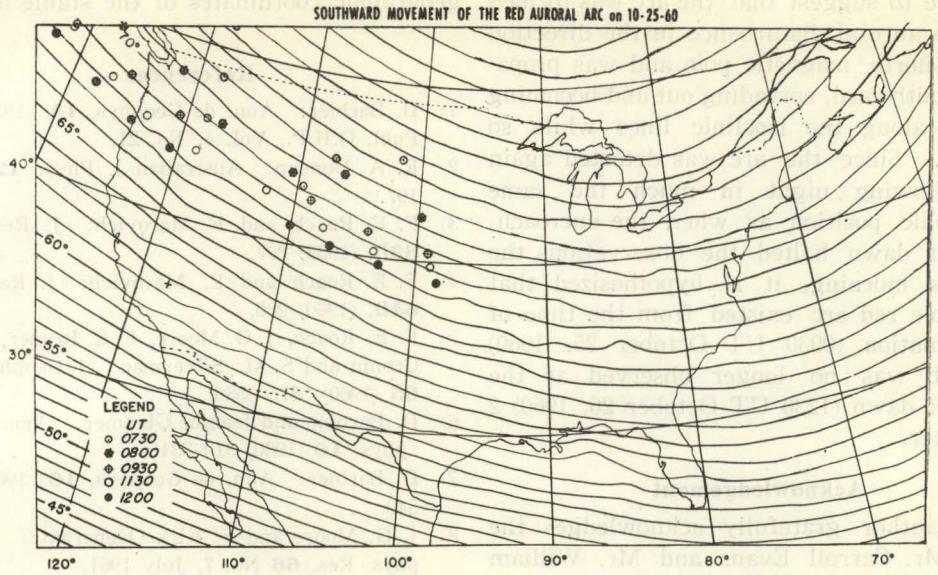

Fig. 1. Southward movement of the stable red arc on 25 October 1960. Geographic latitude and longitude appear on the ordinate and abcissa respectively while the isoclinic lines are identified in the figure. Cactus Peak is indicated by +.

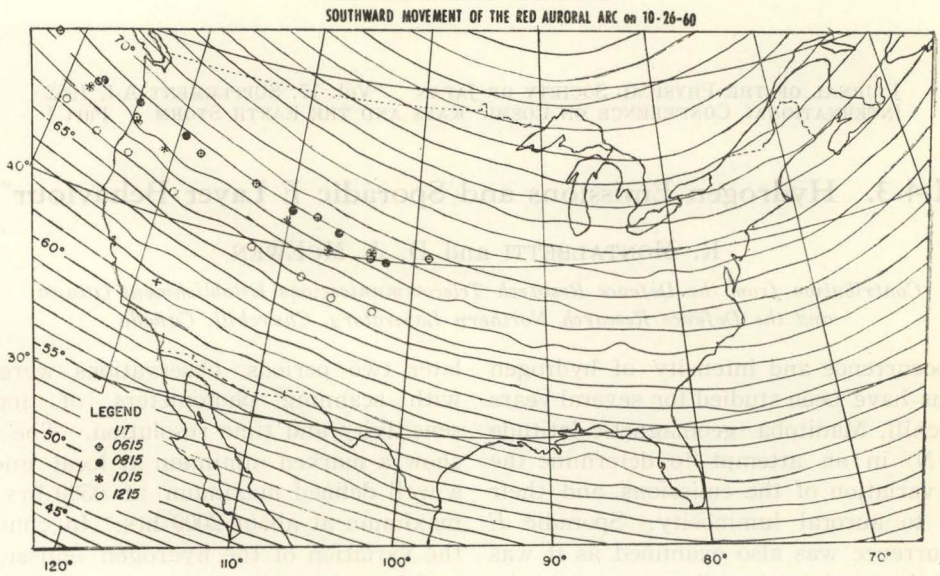

Fig. 2. Southward movement of the stable red arc on 26 October 1960. Geographic latitude and longitude appear on the ordinate and abcissa respectively while the isoclinic lines are identified in the figure. Cactus Peak is indicated by +.

Figure 2 shows the position of the arc for various times the following night. It is seen that the arc again is found along an isoclinic line and shows very little movement for the first 4 hours of observation. The position at this time was at a dip latitude of approximately 51° (which was the southernmost position of the previous night) and then during the next 2 hours it moved southward to a dip latitude of 48°.3.

§ 3. Conclusion

From these observations of a stable red arc on two consecutive nights, it seems

plausible to suggest that the arc was formed from an auroral disturbance in the direction of the north magnetic pole and was propagated southward, spreading out and becoming aligned along the isoclinic lines while so moving. Since the arc was detected again the following night in much the same geographic position as when the encroachment of dawn halted the observations the previous morning, it is hypothesized that the stable red arc existed from the time of its formation (0930 UT October 25, 1960) until it was no longer observed at the onset of dawn (1230 UT October 26, 1960) 2 days later.

Acknowledgement

The author gratefully acknowledges the aid of Mr. Carroll Evans and Mr. William Dale of the Test Department in the programming and machine computation of the geographic coordinates of the stable arc.

References

1) D. Barbier: Ann. de Geophys. **14** (1958) 333, Publ. O.H.P., Vol. 4, No. 21.
2) R. A. Duncan: Australian J. Phys. **12** (1959) 197.
3) F. E. Roach and E. Marovich: J. Res. NBS, **63D**, (1959) 297.
4) F. E. Roach and E. Marovich: J. Res. NBS, **64D**, (1960) 205.
5) F. E. Roach, J. G. Moore, E. C. Bruner, Jr., H. Cronin and S. M. Silverman: J. Geophys. Res. **65** (1960) 3575–3580.
6) D. Barbier and Jeanine Glaumer: Ann. de Geophys. **16** (1960) 319–334.
7) D. Barbier: Ann. de Geophys. **16** (1960) 544–549.
8) J. G. Moore and F. Kirk Odencrantz: J. Geophys. Res. **66** No. 7, July 1961.
9) J. Virginia Lincoln: J. Geophys. Res. **66** No. 7, April 1961.

JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN Vol. 17, SUPPLEMENT A-I, 1962
INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part I

I-4-3. Hydrogen Emissions and Sporadic E Layer Behaviour*

R. MONTALBETTI and D. J. MCEWEN

Contribution from the Defence Research Telecommunications Establishment Ottawa, and the Defence Research Northern Laboratory, Churchill, Canada

The occurrence and intensity of hydrogen emissions have been studied for several years at Churchill, Manitoba (geomagnetic latitude $\varphi=68.8°$N) in an attempt to determine the diurnal variation of the emissions and their relation to auroral luminosity. Sporadic E (E_s) occurrence was also examined as it was felt that the precipitation of protons into the upper atmosphere could be associated with some particular type of E_s.

The diurnal variation of the intensity of hydrogen emissions observed in the zenith at Churchill are shown at the top of Fig. 1. The individual curves refer to the period November-March for three years. Observations for the period 1958/59 were made with a moving plate spectrograph, while in the later two periods, observations were made with scanning photometers of increased sensitivity and time resolution. The curves show a marked minimum at local midnight, a well defined maximum at 0500 hrs. and a maximum at about 2000 hrs. In contrast to the variation of the hydrogen emissions the zenithal auroral intensity as measured by an all sky camera during the December-March 1959/60 period shows a maximum at local midnight. This is given at the bottom of Fig. 1.

The different behaviour points to protons not being associated with normal visible aurora. This view was strengthened by results of a study using a scanning spectrometer to measure the hydrogen emissions arising from various auroral forms. As

* This paper was presented by C. O. Hines.