PIN: **125522** Family Name **STEELE**

Form 100, Part II

RESEARCH CONTRIBUTIONS

1. List of Research Contributions

Refereed journal publications:

* (a) D. P. Steele, D. J. McEwen, and J. S. Murphree, A comparison of Viking UVI auroral observations and model calculations of camera responses, *J. Geophys. Res., 100*, 3657-3668, 1995.

Articles submitted to refereed journals:

* (b) D. P. Steele and L. L. Cogger, Polar patches and the "tongue of ionization", submitted to Radio Science, June 6, 1995; revised version submitted October 11, 1995.

* (c) Prikryl, P., I. F. Grant, C. W. S. Ziesolleck, J. W. MacDougall, D. P. Steele, G. J. Sofko, and R. A. Greenwald, Observations of polar patches generated by solar-wind-driven Pc5 field line resonances and pulsed magnetic reconnection at the dayside magnetopause, submitted to Journal of Geophysical Research, October 4, 1995.

Non-refereed contributions:

* (d) D. P. Steele, Observations of diffuse auroras at the geomagnetic pole, paper GAA51C-24 presented at XXI General Assembly, International Union of Geodesy and Geophysics, Boulder, CO, July 3-14, 1995.

Refereed journal publications:

(e) D. P. Steele, D. J. McEwen, and J. S. Murphree, On the possibility of auroral remote sensing with the Viking ultraviolet imager, *J. Geophys. Res., 97*, 2845-2862, 1992.

* (f) D. P. Steele and D. J. McEwen, Auroral excitation efficiencies and intensity ratios, *J. Geophys. Res., 95*, 10,321-10,336, 1990.

2. Explanation of Research Contributions

Paper (a) is my most recent publication, and is based on results of my doctoral dissertation, which was the University of Saskatchewan nominee for the NSERC Doctoral Prize in 1991. It is based on a detailed comparison between satellite images of UV auroras and model calculations of the UV brightness expected from simultaneous measurements of precipitating electron (and ion) spectra above the imaged auroras. The auroral excitation calculations were done using the Strickland auroral model, which was run

by Dr. J. H. Hecht at Aerospace Corp., and the radiative transfer calculations for the optically thick OI 130.4 nm and 135.6 nm emissions were done by Dr. G. R. Gladstone (then at U. C. Berkeley) using his 1-d AAPR code (his 2-d code did not exist at the time the calculations were done). The work required a detailed analysis of the Viking UV images, with careful assessment (and correction, where possible) of a number of effects which might compromise the accuracy of the measurements. The disparate spatial resolutions of the imaging and DMSP particle measurements had to be taken into account in performing the modelling, and in comparing the results. The favourable comparison between modelling and observations validated the analytical approach taken, as well as the model inputs (such as the MSIS-86 model atmosphere atomic oxygen concentration profile, required in the absence of measured values, about which there has been controversy) and the particle impact excitation cross-sections for the two OI emissions. This work (together with its companion, paper (e)) provided valuable experience in using a state-of-the-art auroral excitation model, and in interpreting auroral images from space. This experience will be required in the second phase of the proposed research.

Paper (b) is the first manuscript to result from the Polar Camera observations at Eureka. It presents images of optical emission from convecting patches of enhanced ionization in the polar cap, and demonstrates the value of such images in measuring the ionospheric convection velocity from optical observations alone. The convection velocity measurements were confirmed by results from Prof. J. W. MacDougall's CADI at Eureka, which operated simultaneously. The combination of these two instruments provides a very strong capability for characterizing ionospheric phenomena at Eureka. This paper also illustrates the high sensivity of the Polar Camera, which has enabled it to observed the faint diffuse auroral emissions at Eureka. Finally, an innovative technique was used to present a large-scale view of the optical emission from patches, which will be used in subsequent studies with fuller data sets for comparing dayside observations with the resulting plasma distribution at the pole (as imaged by the Polar Camera and, to a lesser extent, the CADI).

Paper (c) reports a wide-ranging study of dayside phenomena including Pc5 magnetic pulsations caused by resonant waves on closed magnetospheric field lines near the magnetopause, flux transfer events (FTEs) at the magnetopause and possibly consequent flow channel events (FCEs) in the dayside cusp caused by IMF B_y oscillations, *E*- and *F*- region backscatter events as seen by VHF and HF radars, and polar cap ionization patches as observed by ionosondes and the Polar Camera. The paper provides evidence that: (a) FTEs manifest themselves in the ionosphere as poleward moving auroral forms (PMAFs) which are associated with enhanced ionization at both *F*- and *E*-region altitudes; (b) field line resonances induced by solar wind and IMF variations can modulate magnetic reconnection between the IMF and the magnetosphere and result in the observed periodicity of FTEs; (c) in some cases polar patches are produced by particle impact ionization equatorward of the cusp (possibly associated with PMAFs) and are enhanced, not created, by cusp precipitation and FCEs. This work synthesizes several phenomena in the dayside ionosphere and magnetosphere into a remarkably coherent picture of the physical processes taking place.

Paper (d) presented a study of five cases of diffuse aurora at Eureka, using Polar Camera images, CADI drift measurements, IMF and solar wind observations from IMP 8 (courtesy of Dr. R. P. Lepping and the IMP data processing team at the Laboratory for Extraterrestrial Physics, Goddard Space Flight Center),

and DMSP particle data (courtesy of E. J. Weber, US Air Force Phillips Laboratory). I established some of the salient characteristics of the diffuse emission regions, and laid the groundwork for further study.

Paper (f) presented new results on auroral excitation efficiencies and optical intensity ratios, for use in ground optical studies of aurora, including remote sensing of electron energy fluxes and characteristic energies. The results have been used in many subsequent studies, and will be used in future work aimed at deepening our understanding of the auroral green line, [OI] 557.7 nm. In particular, the green line excitation efficiency may continue to prove useful as an adjunct measure of precipitating electron energy fluxes at Eureka, as it has done already (Oznovich and McEwen, *J. Geomag. Geoelectr., 46*, 861-871, 1994; Huang *et al.*, *J. Geophys. Res., 99*, 21,353-21,359, 1994).

3. Contributions to the Training of Highly Qualified Personnel

I was informally active in graduate student training at the University of Calgary, as a day-to-day co-supervisor with Prof. Leroy Cogger of a Ph.D. student supported by the CNSR between September, 1991 and December, 1992. This student, Kevin Forrester, subsequently withdrew from the Polar Camera project and entered a joint University-industry collaborative project. I have not been able to ascertain his present position. I have had no formal experience as a co-supervisor of graduate students, having been ineligible until my recent appointment as an Adjunct Professor at the University of Saskatchewan.

I have also provided day-to-day supervision for three undergraduate students at the University of Calgary, including two NSERC Summer Research students (Zeljko Pavic and Todd Oliynyk) nominally working with Prof. J. S. Murphree. These supervision terms were each of four months duration. Results from Zeljko Pavic's NSERC-supported work term added materially to the study presented in paper (e) above. Each of these students subsequently received a B.Sc. (Honours) from the University of Calgary, but their present whereabouts are unknown to me. The non-NSERC student was a University of Calgary Co-op student (David van der Schee) who parlayed the experience gained while working with me into an 8-month work term with Dr. D. J. Kendall at the National Research Council, and is now completing another 8-month term working with Prof. Cogger on a study of WINDII data.

4. Other Evidence of Impact and Contributions

In December 1994 I competed successfully for a CNSR transition contract from the Canadian Space Agency to continue the work with the Polar Camera at Eureka begun under the CNSR's aegis. I was the only Canadian-educated Ph.D. to have been successful in that competition. I elected to hold the contract at the University of Saskatchewan as it provided enhanced opportunities for correlative studies with the other data acquired at Eureka. On the strength of my qualifications the University of Saskatchewan appointed me an Adjunct Professor in the College of Graduate Studies and Research.