WORK EXPERIENCE REPORT
September 1, 1984 to November 15, 1987

Name and address of business:	Institute of Space and Atmospheric Studies University of Saskatchewan 116 Science Place Saskatoon, SK S7N 5E2 tel: (306) 966-6403 fax: (306) 966-6400
Title of position held:	David P. Steele Candidate for M.Sc. degree in Physics
Nature of business:	Upper atmospheric and space research using observations from ground- and space-based observing systems
Name of direct supervisor:	Prof. D. J. McEwen, Ph.D.
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Describe in detail your experience gained during the reporting period, grouped under the following headings:

1. APPLICATION OF THEORY

i. Analysis

- Analyzed photometer observations over passbands covering and adjacent to atmospheric spectral line emissions to determine spectral line surface brightness and background differential brightness. This involved development and solution of a system of linear equations in the measured surface brightnesses, which also involved measured filter center wavelengths, transmission curves, and equivalent passbands.
- Correlated multi-wavelength auroral brightnesses measured along a north-south geomagnetic meridian with simultaneous precipitating electron differential number flux spectra to infer the relationship between the mean energy of the precipitating electrons and the photometric brightness ratio measured in the direction along the local geomagnetic field line. The purpose of the work was to obtain experimental data against which theoretical models of auroral excitation can be checked. The correlation required careful determination of the satellite position relative to the ground observatory.
- Inverted photometric brightnesses from meridian scans across a single auroral arc of known width and geographic position to infer the vertical brightness distribution, for comparison with the expected altitude of maximum emission rate based on the precipitating electron data.
- Synthesized a two-dimensional auroral volume emission rate distribution, and the slant column emission rate distribution across it from a meridian scan, for comparison with actual meridian scan

measurements. The object was to infer the height, width, and peak colume emission rate of the measured emission region from the best fit of the measured data to a synthetic aurora.
- Determined the operating parameters for a 0.5-m Ebert-Fastie spectrometer by analysis of the grating angle at wavelengths of several known atomic line emissions, and application of the grating equation. Applied a similar process to calibrate the wavelength scale of a 1-m spectrometer.
- Investigated the possible effect of changing geomagnetic conditions on the composition of the upper atmosphere, and the resulting optical emission brightnesses.

ii. Design and Synthesis

- None.

iii. Testing Methods

- Developed algorithms for reduction of field calibrations of a meridian scanning photometer, using a standard low-brightness light source and an attenuating neutral-density filter. This entailed careful measurements of the actual attenuation of the nominal ND-1 filter as a function of wavelength.
- Carried out a thorough laboratory calibration of a six-channel meridian scanning photometer, measuring the transmission curves versus wavelength of the six optical interference filters, the rolloff characteristics of the photomultiplier tube at high count rates, and the system sensitivity in counts per rayleigh-second. The filter temperatures had to be monitored for stability and repeatability during the transmission curve tests, and stray light elimination was critical during all phases of the testing.
- Investigated the operating characteristics of a stepper motor for use in driving the grating of a 0.5-m spectrometer, to determine the maximum torque that could be produced without stalling or skipping steps.
- Performed an error propagation calculation throughout the determination of the zenith surface brightness ratio.

iv. Implementation Methods

- None.

2. Practical Experience

i. Visits to existing engineering works

- I visited Cameco's Rabbit Lake uranium mine on three occasions during experimental field work, touring both the B Zone strip mine site and the ore-processing mill. I observed and conformed to required safety practices designed to limit the spread of radioactive material from working to living quarters.

ii. Application of equipment

- I wrote moderate-size programs using VAX FORTRAN to analyze ground photometer data gathered during field work at Rabbit Lake, SK. I also studied extensively, and modified slightly, programs to determine the position and orientation of the U.S.A.F. HILAT satellite. I gained an understanding of the nature and function of satellite limb sensors and 3-axis magnetometers.

iii. Limitations of practical engineering

- None.

iv. Significance of time in engineering processes

- Experimental field work had to be scheduled during the winter, to take advantage of long nights, during periods near new moon when scattered moonlight would not compromise sensitive optical observations.

3. Project Management

i. Planning

- I planned my field expeditions to northern Saskatchewan during the winters of 1984-85 and 1985-86. This included planning and assembling the materials required for safe and effective operation of the observatory. I also planned and carried out a thorough laboratory calibration of a multichannel meridian-scanning photometer.

ii. Scheduling

- I coordinated my course schedule with the observing windows described above in §2.iv above, and with the flight schedule offered by the only carrier serving the northern community where the observatory was located.

iii. Budgeting

- None.

iv. Supervision

- None.

v. Project control

- None.

vi. Risk assessment

- None.

4. Communications Skills

i. Preparation of written work

- I kept a log of research activities and results obtained, as well as a log of operations at the field observatory. I prepared periodic reports of my activities for the College of Graduate Studies and Research, and wrote a comprehensive Master's thesis which subsequently served as a primary reference for all personnel working with the instruments and systems described.

ii. Oral reports

- I prepared and delivered a conference presentation at the 1986 Congress of the Canadian Associations of Physicists. The following year I prepared and presented a poster describing the results of my research at the 1987 Assembly of the International union of Geodesy and Geophysics held in Vancouver, BC.

iii. Public presentations

- None.

5. Social Implications of Engineering

- None.