WORK EXPERIENCE REPORT
April 1, 1991 to March 30, 1995

Name and address of business:	Canadian Network for Space Research Department of Physics and Astronomy University of Calgary 2500 University Drive N.W. Calgary, AB T2N 1N4 tel: (403) 220-8651 fax: (403) 282-5016	
Title of position held:	David P. Steele, B.Sc., M.Sc., Ph.D. Research Associate	
Nature of business:	Upper atmospheric and space research using observations from ground- and space-based observing systems; development of ground- and space-based observing systems	
Name of direct supervisor:	Prof. J. S. Murphree	Prof. L. L. Cogger
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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

- I determined the required optical interference filter characteristics in parallel light at normal incidence in order for the filter to center on optical emission features of interest in a converging f/4.6 light beam. I designed passbands for narrowband filters to view branches of the OH 6-2 band near 830 nm, such that changes in filter temperature or atmospheric emission spectrum over the expected rotational temperature range would have negligible impact on the transmission efficiency of the filters.

- I converted raw images of atmospheric emission from atomic oxygen to intensity images, corrected for instrumental characteristics and continuum emission. I projected them from azimuth/zenith angle coordinates to geographic coordinates. I used the motion of the emitting features from one image to the next to determine the drift velocity of the features, using a pattern-matching criterion. I also merged strips of the geographically projected images to form a montage view of the emitting features over a period of 9 hours.

ii. Design and Synthesis

- Using AutoCAD, I designed the mechanical support for the optics chain of a pair of CCD-based all-sky cameras, including 4 simple or compound lenses and a five-position filter wheel. The outer supports had to provide access to the components mounted within the support, and had to ensure sufficient strength to withstand the expected shocks of shipping, while keeping the overall system weight within limits so that each camera could be handled by a single person.

- Again using AutoCAD, I designed the environmental enclosures for the camera system, and the tripod mount for both cameras. This involved a strength analysis of the 1" Al tubing used to fabricate the tripod.

- I designed a jig to hold a standard calibration source (see §1.iii below) in a fixed, known position with respect to the camera objective, and to allow the source to be placed anywhere within the camera field of view, so that the camera sensitivity could be characterized over the entire field of view.

iii. Testing Methods

- I developed a method of ensuring the correct filter geometry in measuring filter passbands prior to installation in the camera system, and performed acceptance testing of our commercially-produced optical interference filters. In the course of this work I determined that three filters failed to meet the specifications, and had to be returned to the manufacturer. I retested these filters on their return from the manufacturer and verified their acceptability.

- I developed a method of measuring the spectral brightness of a standard low-brightness optical source, and tested the stability of its output by repeated measurements over a period of several months.

- I supervised the performance of the measurement of both camera sensitivities at all ten wavelengths, and the development of software to merge the oversampled images to yield an optimal map of the camera sensitivities over the fields of view.

- I performed or supervised the suite of tests required to commission the dual camera system for extended use at high latitudes under Arctic weather conditions. This included extended simulation tests in a refrigerated chamber at -40º C, and four weeks' operational tests in midwinter at a site in northern Saskatchewan.

iv. Implementation Methods

- I was responsible for the determination of a system configuration, and for the selection of an imaging system vendor. I selected the optical filter suppliers after an extensive search for suppliers that could meet our stringent specifications.

2. Practical Experience

i. Visits to existing engineering works

- Thermal testing of the camera system was performed in facilities of the College of Engineering, University of Calgary. I had to gain a thorough familiarity with these facilities in order to use them effectively in this testing.

ii. Application of equipment

- I used a Czerny-Turner monochromator extensively in testing the optical filters, and gained an understanding of the limitations of the device. I also used a Si photodiode in combination with a Keithley electrometer to measure low light levels, and learned how to optimize the experimental setup in order to avoid spurious signals.

iii. Limitations of practical engineering

- In designing and supervising the construction of the camera systems I gained insight into the practical limitations faced in fabricating mechanical components to mate with each other, and in the actual implementation of designs.

iv. Significance of time in engineering processes

- The development of the camera system involved the procurement of components and subsystems, the development of mechanical, electronic, optical, and software subsystems, the integration and testing of subsystems, and the overall testing and verification of the integrated system. I coordinated these activities and adjusted schedules and implementation plans as necessary to ensure timely progress of the project.

3. Project Management

i. Planning

- I evaluated several optional locations for conducting operational tests, on the basis of infrastructure support, likely occurrence of satisfactory weather and auroral conditions, ease of access, and cost.

ii. Scheduling

- I was responsible for keeping the development of the camera system on as tight a schedule as possible. Difficulties in the electronics design, the control software development, and the out-of-house fabrication of two optical filters delayed the overall progress of the project. I arranged extra asupport for the electronics design, contracted a consultant to take over the software development, and monitored the filter fabrication while ensuring that the rest of the project stayed on schedule.

iii. Budgeting

- I was responsible for the completion of the project, including system fabrication, testing, shipment, installation, and operation, within a set budget. This involved allocating budgetary amounts to each of these activities and revising budgets as conditions changed, as well as monitoring the ongoing costs in each activity, and ensuring it was within budget.

iv. Supervision

- I was responsible for building a team of science and technical staff and students, and directing and coordinating their activities toward the successful completion of the project. This involved assigning tasks and monitoring and supporting their performance. In addition I supervised the activities of three summer students engaged in data analysis, software development, and camera testing.

v. Project control

- In §3.ii above I described the actions taken to minimize the effects of delays in parts of the overall camera system development.

vi. Risk assessment

- Risk assessment related to system performance, environmental conditions (including harsh weather during operations, and mistreatment during shipping), and environmental impacts, was an integral part of the planning, design, and fabrication of the camera system.

4. Communications Skills

i. Preparation of written work

- I kept notes of all aspects of the system design and fabrication, as well as detailed drawings of all designs. I prepared quarterly written reports to the leader of the major project of which our camera system was to be a part. I prepared written specifications and requirements for several project activities including optical filter procurement and testing, and control software design.

ii. Oral reports

- I prepared several conference presentations on the progress and goals of the camera system, and presented them at national and international meetings. I presented two scientific seminars on various aspects of my research to the Department of Physics and Astronomy. I made a presentation on the camera system to the CANOPUS All-Sky Imager science team, illustrating the characteristics and successfu performance of the system.

iii. Public presentations

- I gave an interview to a free-lance science writer, which was published in the Calgary Herald. I made a presentation on the aurora to a Grade 10 science class at a Calgary high school.

5. Social Implications of Engineering

- None.