than is required for the operations schedule of 5.7 hours per day. When the sunlit portion of the orbit periodically decreases to 65 per cent, the schedule is trimmed to 4.7 hours of operation per day.

"During the first year of operation, the satellite orbited the earth 4,981 times and in doing so, travelled 144,000,000 miles. It executed 12,900 commands and provided 2,060 hours of telemetry transmissions, which resulted in 2,700 miles of magnetic tape containing scientific data recordings – the equivalent of the mileage between Toronto and Vancouver. This information is sufficient to make 423,000 ionograms. During *Alouette's* first year, the spin rate decreased from 1.4 to 0.9 revolutions per minute.

"Long-range plans are now being made for the second year of the satellite's operation. Solar-cell efficiency should not vary by more than a few per cent during the next year; hence, it is planned to maintain the present schedule of operation which averages 5.0 hours per day."

The satellite was launched into orbit from a rocket-pad at Vandenberg Air Force Base in California as the Canadian payload on a two-stage *Thor Agena* "B" rocket provided by NASA. The project represents a classic example of international co-operation in a joint scientific venture by two countries.

AIM OF OPERATION

DRB embarked on the project because of its long-time interest in the vagaries, caused by disturbances in the upper atmosphere, that beset radio communication in and over Canadian territory. During its upper atmospheric investigations, the Board has examined the lower and mid regions of the ionosphere with ground-based scientific "sounders" and with instrumented rocket nose-cones.

The 320-pound *Allouette* satellite, however, with its inboard "sounder", examines in detail the top side of the ionosphere, telemetering scientific information to 13 ground stations in various parts of the world, including four in Canada. The data so collected are forwarded to DRTE, where ionograms or taped records are prepared and studied.

Other *Alouette* experiments, including one carried out by Canada's National Research Council, count the number of solar particles near the satellite, observe the electrical noise from cosmic sources, determine the atmospheric noise from distant storms at low radio frequencies and observe the sighing sounds called "whistlers" which originate as lightning strokes and which follow the earth's magnetic field. Indirectly, whistlers provide information about many other facets of geophysical phenomena associated with the earth's atmospheric environment.

PRACTICAL RESULTS OF PROGRAMME

Already, nearly a score of scientific discoveries have resulted from the *Alouette* experiments. Some have been acclaimed by the international scientific community as major advances, rather than mere academic curiosities.

The satellite is providing information from which the characteristics and distribution of the earth's ionosphere can be charted in much greater detail than was hitherto possible. Eventually, this should benefit radio communication in all parts of the world.

NEW INFORMATION ABOUT EQUATOR

Alouette data have shown, for example, that ridges and troughs in the ionosphere exist along the magnetic equator close to, but not precisely parallel with, the earth's geographical equator as shown in ordinary atlases. In some respects, this is similar to the recent discovery that there is a pronounced mound along the equator at the bottom of the Pacific Ocean. Data analysis has also yielded significant information relative to the mapping of the earth's magnetic field.

As the spacecraft cruises silently on its passages about the earth, it observes cosmic and solar noises. These are telemetered to ground stations, increasing extensively man's knowledge of the cosmic and solar radiations that are unable to penetrate the ionosphere and cannot, therefore, be studied from the ground.

The solar and cosmic information received is also providing a means of predicting the arrival of the clouds of particles spasmodically expelled from the sun's surface. These particles cause magnetic and ionospheric storms and frequently affect communications adversely.

Recent *Alouette* observations in the same research area give evidence of electromagnetic radiations from the planet Jupiter. This information has resulted in visits to DRTE by scientists from other agencies particularly interested in studying this evidence.

The satellite's external temperature varies widely because of its changing positions with respect to the sun. The solar cells, batteries and other components were designed specifically to withstand such temperature variations.

Alouette's 6,500 solar cells provide power to charge its batteries. Although solar-cell performance has decreased as expected to 58 per cent because of encounters with space radiation and atmospheric dust or micrometeorities, sufficient reserve power was provided in the design for continuing operation despite further slow deterioration of the cells.

METEORITE HAZARD

The scientists calculated that during its first year of space whirlings, *Alouette's* chances of not colliding with a meteorite large enough to penetrate its electronics mechanisms would be about 90 per cent. The spacecraft appears so far to be unharmed by meteorites. DRTE forecasts a 72-percent probability that *Alouette* will continue to escape meteorite damage during the next 12-month period.

The satellite should continue to revolve about the earth for from 200 to 2,000 years. Uncertainty in forecasting its life span stems from lack of knowledge of possible space hazards likely to be encountered in future years.

Alouette's usefulness in providing new information about the upper atmosphere has given rise to an invitation from NASA for the design

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