

Section 3.—Space Research in Canada*

The interests of Canadian scientists engaged in space research continue to be mainly in the field of aeronomy with particular, though not exclusive, emphasis on the high-latitude atmospheric and magnetospheric phenomena which are now generally believed to be related to the various disturbances on the sun. Canada, with its large land mass extending on both sides of the auroral zone, is ideally located for studies of medium- and high-latitude atmospheric phenomena and Canadian scientists have long been active in this exciting field. While many of the older programs of ground-based observations are still of great importance and are being carried out, the new measurements from satellites and rockets are making a significant contribution to knowledge of solar-terrestrial relations and in the next few years the importance of these studies using the new space techniques will increase.

The satellite program of the Defence Research Board, carried on in collaboration with the United States National Aeronautics and Space Administration (NASA), continues to form a major part of the Canadian space activities. The Canadian satellite 1962 Beta Alpha (*Alouette*), which was launched on Sept. 29, 1962, is still in orbit. Its instruments are functioning satisfactorily and there is every indication that it will continue to operate and send back scientific data for many months to come. The satellite carries a number of experiments but its main objective is the sounding of the ionosphere from above. The ionosphere is the diffuse layer of highly conducting gas lying between heights of about 60 to 300 miles. It reflects radio waves over a wide band of frequencies and is of great practical importance for communications. The underside of the ionosphere has been studied for many years by the technique of sending a short pulse of radio waves up from the ground and examining this pulse after it had been reflected back from the ionized regions. The satellite *Alouette*, however, was the first spacecraft to provide scientists with a continuous sounding of the ionosphere from above.

Other instruments carried by the satellite enable studies to be made of radio waves from outer space and very low frequency electromagnetic waves whose propagation is influenced by the earth's magnetic field. There are also a number of detectors to study cosmic rays, energetic particles in the Van Allen radiation belts and the artificial radiation introduced by high-altitude nuclear explosions. Data are transmitted from the satellite to the ground stations in several countries around the world and the magnetic tape records are sent to Ottawa for analysis. Scientific results to date have been most gratifying and the satellite measurements have added greatly to knowledge of the earth's upper atmosphere.

The over-all design and construction of the spacecraft were carried out by the Defence Research Telecommunications Establishment. Some components were made by Canadian industry and the cosmic ray instruments were the responsibility of the National Research Council. The cost of the launching vehicle, the actual launching and much of the data recovery were undertaken by the NASA as part of its international co-operative program. This joint Canadian-United States program is continuing. On Nov. 29, 1965 the second Canadian satellite *Alouette II* was successfully launched by NASA from the Western Test Range in California. This spacecraft carries instruments similar to but more sophisticated than *Alouette I*. Its elliptical near-polar orbit has an apogee of 3,000 km., allowing measurements to be made over a much greater height range than previously. *Alouette II* is the first of four satellites to be built in Canada for the International Satellites for Ionospheric Studies (ISIS) series. These vehicles will be launched at about two-year intervals during the next five or six years.

The rocket-launching facility at Fort Churchill, Man., located almost under the belt of maximum auroral activity, has been very active; 17 Canadian rockets carrying scientific instruments have been launched since January 1964 as well as many United States rockets. The range has four launchers capable of handling the following rockets: *Arcas*, *Nike*, *Cajun*, *Nike Apache*, *Astrobee*, *Aerobee*, *Argo D-4* (*Javelin*) and the Canadian *Black Brant*

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