It reflects radio waves over a wide band of frequencies and has a great practical importance in communications. The underside of the ionosphere has been studied for many years by the technique of sending a short pulse of radio wave up from the ground and measuring the time delay when the reflected pulse is received and the band of frequencies that are reflected. From the results of such studies the diurnal, seasonal and storm effects in the ionosphere are well known and this knowledge is of considerable value in making the maximum use of radio communication channels. However, the satellite *Alouette* was the first attempt to get a continuous sounding of the ionosphere from above. The satellite travels in a nearly circular orbit at about 600 miles above the earth's surface and, on command, will transmit radio pulses of varying frequency to the ionosphere and observe the reflected pulse from the top side of the ionosphere. This type of measurement is often referred to as the topside sounder.

Other experiments carried by the satellite include experiments on radio frequency waves from the sky and very low frequency electromagnetic waves whose propagation is influenced by the earth's magnetic field. Also included are a number of detectors to study cosmic rays, energetic particles in the Van Allen radiation belt and the artificial radiation belts introduced by high altitude nuclear explosions.

The over-all design of the satellite was carried out by the Defence Research Telecommunications Establishment. Some components were developed by Canadian industry and the cosmic ray instruments were the responsibility of the National Research Council. The cost of the launching vehicles, the actual launching and data recovery were undertaken by the United States (NASA) as part of its international co-operation program.

Data are transmitted from the satellite to ground stations. Stations in several countries are receiving them and sending the magnetic tape records to Ottawa for analysis. Most of the ground stations are part of the United States *Minitrack* satellite-tracking organization but three data-recovery stations were built in Canada specifically for *Alouette* and future ionosphere monitoring satellites. These are at Ottawa, Ont., Prince Albert, Sask., and Resolute, N.W.T. The orbit of *Alouette* is almost in a north-south direction, the plane of the orbit being tilted only 10° from the earth's axis.

The satellite, though a striking space experiment, did not represent all of Canadian space activities during 1962. There is an important region of the upper atmosphere that is too low for practical satellite orbits and too high to be reached by balloons or aircraft—the region between heights of about 25 miles and 200 miles. This region is interesting in that it contains the absorbing layer in the lower ionosphere that causes radio blackouts and also includes the lower limit of aurora. While radio propagation through the regions tells a great deal about density of electrons, it gives little information on the chemical constitution of that very tenuous part of the upper atmosphere, or its state of ionization, or about the nature of the radiation or high energy particles that cause the ionosphere. And it is of particular importance to Canadian scientists to study the upper atmosphere at these levels in Northern Canada because the axis of the geomagnetic field is tilted toward Northern Canada and the production of the aurora and ionosphere disturbances that cause radio blackouts is closely associated with magnetic disturbances in polar regions.

To study these, direct measurements are necessary; that is, instruments must be carried up to the regions where the measurements are required and a practical way of doing this is to use rockets that are much smaller and cheaper than those needed for launching satellites. This technique, of course, preceded the launching of satellites and is still of great importance. A series of rockets (*Black Brant*) is being developed in Canada: *Black Brant I*, an experimental rocket, is now obsolete; *Black Brant II* is a 17-inch diameter rocket capable of carrying 150 lb. of payload to over 100 miles; *Black Brant III* is a smaller rocket 10 inches in diameter and has a design capability of carrying 40 lb. to 100 miles; *Black Brant IV* is a tandem combination of *II* and *III*; and *Black Brant V* is an optimum design of *Black Brant II*. *Black Brant II* is being used extensively for scientific measurements and *Black Brant III* and *IV* will be ready during 1963. These rockets were developed for scientific purposes by Canadian industry with some government support.