Section 3.—Space Research in Canada*

Canadian scientific activities in space are limited to the application of new techniques to assist research in fields in which activity has been carried on for years. Canadian capabilities cannot begin to compete with space science activities in countries like the United States and the Union of Soviet Socialist Republics but, on the other hand, there are important things that can be done better in Canada than elsewhere. This is because of the tilt of the earth's magnetic axis toward Northern Canada and the effect of the earth's magnetic field on the interaction of radiation and particles from the sun with the earth's upper atmosphere.

The sun, whose radiations make life on earth possible, discharges streams of particles of matter, sometimes with great energy. These streams of particles are very irregular and occur in bursts associated with disturbances on the surface of the sun. The streams of particles, ultraviolet light and X radiation from the sun cause the outer regions of the earth's atmosphere to be ionized and therefore electrically conducting, forming the well-known conducting layers in the ionosphere. The streams of particles are mostly protons and electrons; their motion is affected by the earth's magnetic field and if intense enough they, in turn, distort the magnetic field.

The study of magnetic variations and magnetic storms is hundreds of years old. Their relation to aurora has been known for a hundred years or more and during the past few decades the electrical nature of the upper atmosphere is gradually becoming understood.

The understanding of the electrical conductivity of the upper atmosphere is of practical importance as well as of academic interest because a wide range of radio communications depend on the reflection of radio waves from the ionosphere. Without the ionosphere, the range of ordinary radio broadcasting and shortwave communication would be limited to a fraction of that used every day. Occasional radio blackouts follow bursts of unusually intense ionizing radiation from the sun. The awe-inspiring phenomenon of the aurora is associated with blackout of some types of radio communication and therefore, for practical reasons, merits study; there is also a natural desire to understand what causes this phenomenon.

The most interesting and important phases of ionosphere and auroral activity occur at heights of from 30 to 100 miles in the atmosphere and the most interesting and important geographic regions for studying the ionosphere and aurora are in what is known as the aurora belt, a diffuse circle about 20 degrees of co-latitude away from the geomagnetic poles. Churchill in northern Manitoba is in the latitude of maximum auroral activity. Because of the tilt of the magnetic axis of the earth in the western hemisphere, the magnetic pole is in Northern Canada and the only place in the world where accessible land stations extend into and across the auroral belt is in Northern Canada.

Canadian scientists have for many years been very active in studying auroral and ionosphere physics. A number of university research groups led by the Department of Physics in the University of Saskatchewan are well known for such studies. The Defence Research Board's Telecommunications Establishment and the National Research Council have conducted research in this field since World War II. In fact, because of Canada's geographic position, it might be said that ionosphere and aurora research is a Canadian scientific birthright with which goes a considerable responsibility to see that the world-wide need for scientific information in this field is satisfied.

Until the present space age, measurements of the upper atmosphere could be taken only by indirect means such as the reflection of radio waves from the ionosphere, spectroscopy of the aurora and night sky and the absorption of cosmic radio noise. Now, the new rocket technique makes it possible to take direct measurements in the interesting region from 30 miles up and it is natural that Canadian scientists should take advantage of this

* Prepared (February 1962) by Dr. D. C. Rose of the National Research Council, Ottawa.