

or satellites for upper atmospheric studies. The McGill University program of gun-launched vehicles in the Barbados known as HARP (High Altitude Research Program) has been carried on with considerable success. About 90 launchings were made in 1964. Improvements have been made to both the gun and the vehicles and successful measurements have been made of wind shears and atmospheric constituents in the 100-km. region. This program is carried on in collaboration with the U.S. Army.

Much of the foregoing work is shared with Canadian industry. Civilian contractors are producing instruments and space vehicles for both Canadian and foreign experimenters. In some programs, such as the *Alouette* satellite and the development of *Black Brant* rockets, industry is playing a major role. Other work of great importance for the space programs, such as fundamental research on materials and in plasma physics, is also being carried on in industrial laboratories.

Section 4.—Research in Geophysics and Astronomy

Research in the fields of geophysics and astronomy is dealt with briefly in this Section. A more extended treatment of geophysics, appearing in the 1965 Year Book at pp. 45-47, is brought up to date by the following item which shows the progress made in 1964-65. A special article on Astronomy in Canada, appearing in the 1965 edition at pp. 47-55, indicates in some detail the recent advances made in astronomical research and educational facilities; the current item on the subject mentions the highlights only.

Geophysics.*—Geophysics is the study of the earth, including the oceans and atmospheres, by the methods of physics. It embraces a number of fields, each a major science in itself, such as geodesy, seismology, terrestrial magnetism, meteorology, oceanography and hydrology. Work in geophysics in Canada is carried on by a number of Federal Government departments, certain provincial governments, nearly all universities and by companies engaged in geophysical prospecting for oil or minerals.

The year 1965 was marked by further progress in several fields, partly because of Canadian commitments in a number of international programs. In seismology, the number of earthquake recording stations, operated by either the Dominion Observatory or universities, increased to 25. As part of the International Upper Mantle Project, several large-scale studies of the crust were carried out, using waves from artificial explosions. A major investigation of the Hudson Bay area by government and university groups was conducted during the summer of 1965 with the support of the special oceanographic ship *Hudson*.

Measurements of both the gravitational and magnetic fields of the earth were extended, over land areas by the Dominion Observatory and the Geological Survey, and over the oceans by the Bedford Institute of Oceanography. These measurements provide information that is extremely useful in the study of concealed geological structures. Studies of the northern lights, or aurora borealis, and related phenomena involving electromagnetic effects in the upper atmosphere received particular attention from both university and government groups as part of Canada's participation in the International Quiet Sun Year. This study was undertaken at a time of minimum sunspot activity (1964-65) to indicate the contrast with conditions during the International Geophysical Year (1957-58), which was at a time of maximum sunspot activity.

Resources of fresh water continued to be a cause of concern throughout the world, and Canada's hydrologists completed plans to participate in the International Hydrological Decade, a ten-year study of the world's freshwater resources. As these resources include the water contained in glacial ice, the mapping of existing glaciers in the country was extended considerably during the field season.

Meteorology includes not only the routine forecasting carried out principally by the Meteorological Branch of the Department of Transport (see p. 65) but also research in special problems conducted by the Branch and by a growing number of university groups.

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