THE CLIMATE OF THE CANADIAN ARCTIC*

Early exploration of the Canadian Arctic yielded only limited information on the climate of the region. Although some of the meteorological observations were made by well-equipped scientific groups, the climatic descriptions too often publicized were by those explorers who tended to stress the dark, rigorous aspects of the environment. As a result, in the early decades of the present century the popular concept of the Arctic was a land of perpetual snow, usually stormy and always very cold. The atmospheric processes that shape its climate were often assumed to be unique to the area and independent of those affecting other parts of the hemisphere.

The groundwork for a better understanding of the climate of the Canadian Arctic was laid just prior to 1930 when several weather reporting stations were established on the shores of Hudson Bay, on Baffin Island and along the mainland Arctic Coast. Most of these are considered to be Arctic locations since they are generally north of the tree-line, a limit that is frequently used to define the boundary of the Arctic. North of this well-marked natural boundary line, which runs southeastward from the Mackenzie Delta to the shore of Hudson Bay near Churchill and then eastward over northern Ungava–Labrador, the growing season is too short and too cold to permit tree growth.

Reports from these southern Arctic sites emphasized the dependence of weather in middle latitudes on conditions in the Arctic. The full extent of this relationship could not be investigated, however, until the late 1940s, when weather stations, reporting both surface and upper-air observations, were established in the polar basin on five of the Queen Elizabeth Islands. The weather picture was further clarified after 1955 when regular reports became available from two or three scientific stations on ice islands located in the Arctic Ocean and at the Distant Early Warning Line of radar stations extending along the Arctic Coast from Alaska to Baffin Island. As a result of continuous observations from this expanding network of stations, there has been a great increase in knowledge of the climate of the Arctic and the atmospheric processes that control it. The more important features are discussed below and climatic tables for many of the individual stations are added to facilitate comparison over a standard ten-year period (1951-60). For purposes of climatic comparison it would be advantageous to divide the Canadian Arctic into a number of regions, each with homogeneous climatic features, but the wide spacing of weather reporting stations and their predominantly coastal locations preclude such an approach at this time.

Climatic Controls

To understand the climate of the Canadian Arctic one must consider to what extent the basic controls of temperate zone climate, such as distance from the equator, the major features of the atmospheric circulation, continental and maritime influences, and the nature of the land surface apply to the Arctic regions. Of these, the far north location is of prime importance, since it is responsible not only for the extreme annual range of daylight but also for the low angle at which the sun's rays strike the earth. The absence of incoming radiation from the sun during the long Arctic night results in sustained cooling of the snow and ice surfaces of the region. After a period of two or three months when the sun rises and sets in a normal 24-hour cycle, there is a period of continuous daylight. At this time, the amount of solar radiation reaching the atmosphere over the Arctic tundra and ice-filled seas is greater than that in southern latitudes but owing to the high reflectivity of the surface only a small percentage of the heat energy remains to heat the earth and the Arctic atmosphere. Snow and ice surfaces and cloud layers, for example, reflect more than 50 p.c. of the incident radiation. Thus, not only is there an extremely large annual range of incoming radiation from the sun but the solar energy received in the course of the year is much less than at lower latitudes. The Arctic regions in fact lose more heat to space than is received from the sun.

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