Glacial History and Palaeoecology of Northeastern Nouveau-Québec and Northern Labrador

Between mid-July and mid-August 1975, a reconnaissance was made of a large tract of subarctic and arctic terrain bounded by Schefferville, Fort Chimo and the Torngat Mountains north to latitude 59°35′ N (Fig. 1). A float-plane was used for the purpose. Three main areas received special attention: the southern and central Torngat Mountains between Hebron Fiord and Ryans Bay; the lower George River between Wedge Hill and Port Nouveau Québec, and the Quebec-Newfoundland boundary area north of Schefferville.

This work was designed to provide radiometric dating control for earlier studies in the same region carried out between 1955 and 1965[1,2,3,4]. It was intended to lay a foundation for future detailed investigations of Holocene climatic and ecological history, including fluctuations in the position of the northern treeline, final disappearance of the late-Wisconsin Laurentide Ice Sheet, and the early development of human occupation of the area[5].

Specific objectives included:

1. confirmation that three distinct rock weathering zones, related to discrete glacial stades, were indeed correlative with rock weathering zones recognized in Baffin Island through quantitative studies[6,7,8,9,10];
2. resolution of the questions of the existence of ice-free areas during the Wisconsin Maximum (Saglek Glaciation) and of the earlier total glacial inundation of the Torngat Mountains. The second question hinges on the interpretation of anomalous blocks on high mountain tops as glacial erratics[8,9,11,12];
3. dating of the major glacial lake shorelines in the George River basin (Naskaupi and McLean glacial lakes[4,13,14]) and location of other suspected glacial lake systems;
4. determination of the date of final disappearance of late-Wisconsin ice in the central region of Labrador-Ungava[15,16,17,18];
5. study of the fluctuations in the position of the forest-tundra ecotone over the last 8,000 years and comparison with those in the Districts of Keewatin and Mackenzie, N.W.T.[19,20,21,22];
6. analysis of Holocene climatic and environmental fluctuations affecting plant communities and human occupancy[5].

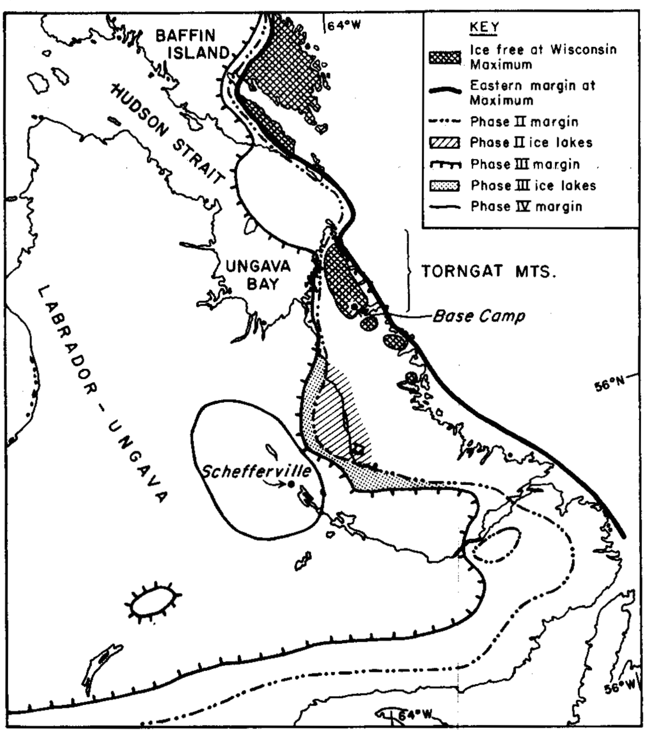

FIG. 1. Schematic retreat phases of the Laurentide Ice Sheet in Labrador-Ungava and southern Baffin Island from its "Classical Wisconsin" maximum to about 6,000 B. P. The maximum position along much of the Labrador coast possibly dates from between 14,000 and 18,000 B.P., but may be as recent as 8,500 B.P. in Baffin Island. Phases II and III probably fall between 8,500 and 7,000 B.P.

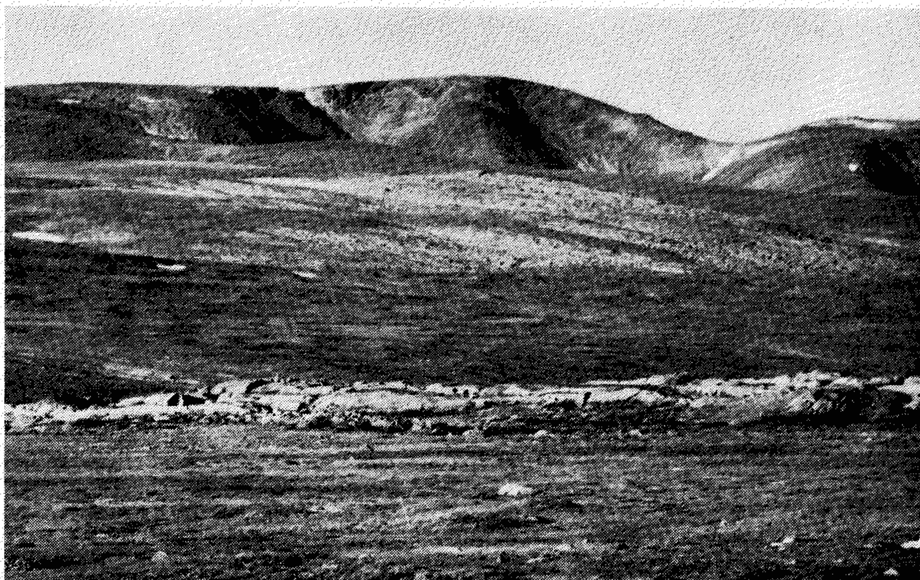

FIG. 2. View from the base camp. The light-toned rough-textured band across the centre represents the Koroksoak Zone. It is bounded by the lower limit of mature mountain-top (Torngat) detritus above, and by the Saglek moraines below.

At the present stage of laboratory and field data analysis only a part of these major problems can be referred to.

Lake sediment cores were taken from ten lakes ranging from Boundary Lake, north of Schefferville, to Miriam Lake in the Four Peaks area of the Torngat Mountains. This material is currently undergoing pollen analysis and selective radiocarbon-dating. Initial field examination of the Torngat Mountain and George River basin cores revealed that the topmost sequence was consistently a layer of coarse sand overlying more organic sediments. This indicates a recent environmental disturbance involving accelerated soil erosion.

Peat monoliths were also collected at scattered localities and a potentially significant sample of marine mollusc shells was collected from the outer coast north of Seven Islands Bay. Tauber static pollen traps were left in place at twelve sites, to be collected later for assessment of the pattern of present-day pollen rain; numerous moss and lichen polsters were also collected to assist this phase of the study. Finally, observations were made on the sites of former snowbanks and on the Neoglacial moraines of the Torngat Mountains cirque glaciers.

From a base camp established on Nakvak Lake in the southern Torngat Mountains, a series of traverses were run from valley bottom to adjacent mountain tops to provide quantitative data on variations in rock weathering with altitude. Weathering characteristics studied included: measurement of rock angularity, extent of projection of quartz veins and phenocrysts above the general rock surface, thickness of weathering rinds and presence and dimensions of weathering pits[6,7,9]; and observations were made on occurrence of mountain-top detritus, tor-like forms, and all indications of former glacial erosion and deposition. From this work it was concluded that the three distinct weathering zones distinguishable by eye (Fig. 2) in the southern Torngat Mountains, and originally named Torngat, Koroksoak and Saglek[8,9], had comparable degrees of weathering to Zones I, II and III respectively, as identified by Boyer and Pheasant[6] in eastern Baffin Island. In the Baffin Island setting, the boundary between Zones III and II is frequently marked by a belt of extensive lateral moraines which have been shown by Pheasant[28] to represent the upper limit of ice during the Wisconsin Stade. A comparable situation exists in the Torngat Mountains since the extensive Saglek moraines mark the transition from the Saglek weathering zone below to the Koroksoak weathering zone above. On this basis a tentative correlation is made between Baffin Island Zone III, Labrador Saglek Zone, and the maximum extent of Wisconsin ice in the eastern Canadian Arctic. The Koroksoak Zone bears numerous signs of former glacial activity and presumably

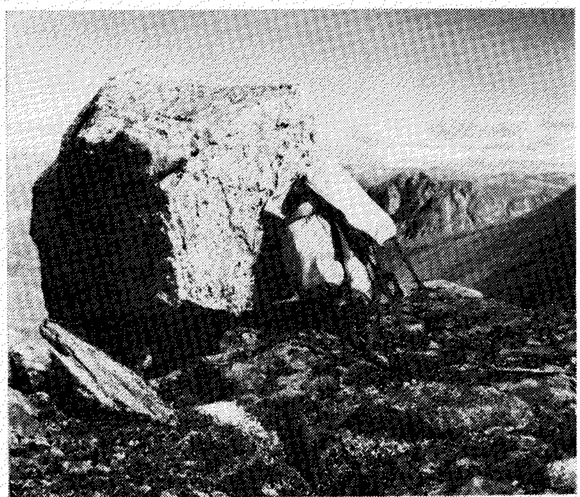

FIG. 3A. Glacial erratic at over 4,000 ft. (1,200 m) on a mountain top overlooking the head of Saglek Fiord.

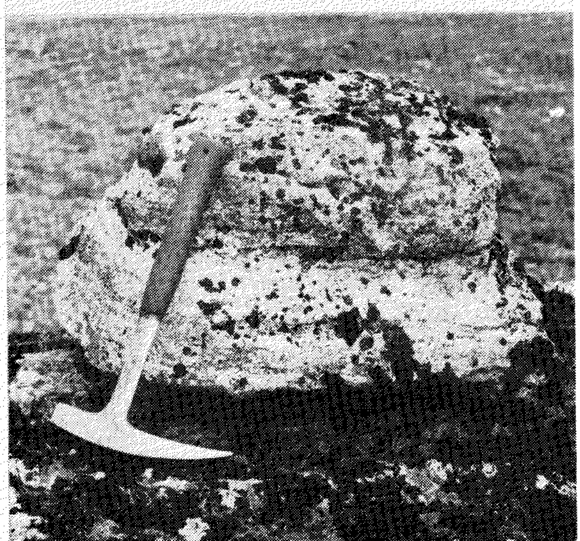

FIG. 3B. Glacial erratic of pink and white banded granite gneiss on a hill top in the Torngat Zone north of Nakvak Lake.

FIG. 3C. Detail to location of erratic shown illustrated in Fig. 3B.

can be related to a pre-Wisconsin glaciation, or glaciations. It is hoped that analysis of sediment cores collected from lakes dammed up by the Saglek moraines will strengthen these chronological designations.

The significance of the Torngat Weathering Zone has remained a topic of considerable controversy for many years, associated, in particular, with the interpretation of anomalous summit blocks as glacial erratics or erosion residuals[10,11]. During the 1975 field season is was possible to ascend a large number of summit areas. Many more anomalous blocks were located than hitherto and an analysis of their rock type in relation to that of the underlying bedrock, and their general disposition, leads to the definite conclusion that most of them are glacial erratics. A typical glacial erratic is illustrated in Fig. 3A, while in Figs. 3B and 3C is shown an erratic resting on top of a tor-like form. The age of such erratics remains a major problem. They may have been emplaced during the Koroksoak Glaciation when thinner ice over the summit areas was cold-based and hence protected the underlying tor-like forms and related weathering phenomena, whilst thicker, more rapidly moving, and hence, warm-based ice in the through-troughs scoured the Koroksoak surface; or they may have been emplaced during a much earlier glaciation.

Field work in 1973 in the George River basin by Dr. William Fitzhugh, whose Smithsonian Institution party included Short, facilitated a first attempt to date the Naskaupi Glacial Lake shorelines. Six lake sediment cores have been completely pollen-analysed by Short, and two critical radiocarbon dates from basal sediments have been provided by Dr. Robert Stuckenrath of the Smithsonian Radiocarbon Laboratory. These dates relate to the highest Naskaupi shoreline and indicate that the lake system began to form sometime after 8,700 B.P. and that the major drainage had occurred prior to 6,800 B.P. During the 1975 field work, additional lake sediment cores were collected and progress was made in more clearly defining the northern limits of the former lake system which was dammed by ice over the lower George River and southern Ungava Bay. Previously-unmapped systems of former ice-dammed lakes were located by airborne reconnaissance between the northern limits of the Naskaupi Glacial Lakes and the Torngat Mountain height-of-land.

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REFERENCES

[1]Ives, J. D. 1960. The deglaciation of Labrador-Ungava: an outline. *Cahiers de Géographie de Québec*, 4 (3): 323-43.

[2]Andrews, J. T. and Matthew, E.M. 1961. Geomorphological studies in northeastern Labrador-Ungava. *Canada, Department of Energy, Mines and Resources, Geographical Paper* no. 29.

[3]Løken, O. 1962. Late-glacial and postglacial emergence and the deglaciation of northernmost Labrador. *Geographical Bulletin*, 17: 23-56.

[4]Barnett, D. M. and Peterson, J. A. 1964. The significance of Glacial Lake Naskaupi 2 in the deglaciation of Labrador-Ungava. *Canadian Geographer*, 8 (4): 173-81.

[5]Fitzhugh, W. W. 1972. *Environmental Archeology and Cultural Systems in Hamilton Inlet, Labrador*. Washington, D.C.: Smithsonian Institution (Contributions to Anthropology no. 16).

[6]Boyer, S. J. and Pheasant, D. R. 1974. Delimitation of weathering zones in the fiord area of eastern Baffin Island, Canada. *Geological Society of America Bulletin*, 35 (5): 805-10.

[7]Pheasant, D. R. and Andrews, J. T. 1972. The Quaternary history of northern Cum-

berland Peninsula, Baffin Island, N. W. T., part VIII: chronology of Narpaing and Quajon fiords during the past 120,000 years. *Proceedings, 24th International Geological Congress, Montreal, 1972,* section 12, pp. 81-88 (Available from International Geological Union).

[8]Ives, J. D. 1958. Glacial geomorphology of the Torngat Mountains, northern Labrador. *Geographical Bulletin,* 12: 47-75.

[9]————. 1974. Biological refugia and the nunatak hypothesis. In: Ives, J. D. and Barry, R. G. (eds.), *Arctic and Alpine Environments 1974,* London: Methuen, pp. 605-36.

[10]————. 1975. Delimitation of surface weathering zones in eastern Baffin Island, Northern Labrador and arctic Norway: a discussion. *Geological Society of America Bulletin,* 86: 1096-100.

[11]Løken, O. 1962. On the vertical extent of glaciation in northeastern Labrador-Ungava. *Canadian Geographer,* 6 (3-4):106-19.

[12]————. 1966. Baffin Island refugia older than 54,000 years. *Science,* 153 (3742): 1378-80.

[13]Ives, J. D. 1960. Former ice-dammed lakes and deglaciation of the middle reaches of the George River, Labrador-Ungava. *Geographical Bulletin,* 14: 44-70.

[14]Andrews, J. T. and Barnett, D. M. 1972. Analysis of strandline tilt directions in relation to ice centers and postglacial crustal deformation, Laurentide ice-sheet. *Geografiska Annaler,* 54A (1): 1-11.

[15]Ives, J. D. 1960. Glaciation and deglaciation of the Helluva Lake area, central Labrador-Ungava. *Geographical Bulletin,* 15: 46-64.

[16]Grayson, J. A. 1956. The postglacial history of vegetation and climate in the Labrador-Quebec region as determined by palynology (Unpublished Ph.D. thesis, University of Michigan, Ann Arbor, Michigan).

[17]Bryson, R. A., Wendland, W. M., Ives, J. D. and Andrews, J. T. 1969. Radiocarbon isochrones on the disintegration of the Laurentide ice-sheet. *Arctic and Alpine Research,* 1 (1):1-14.

[18]Morrison, A. 1970. Pollen diagrams from interior Labrador. *Canadian Journal of Botany,* 48 (11): 1957-75.

[19]Nichols, H. 1972. A summary of the palynological evidence for late-Quaternary vegetational and climatic change in the central and eastern Canadian Arctic. In: Vasari, Y., Hyvärinen, H. and Hicks, S. (eds.), *Climatic Changes in Arctic Areas during the Last Ten Thousand Years,* Oulu, Finland: Oulu University (Acta Univ. Oulu., A, III, 1, pp. 309-39).

[20]Nichols, H. 1974. Arctic North American palaeoecology: the recent history of vegetation and climate deduced from pollen analysis. In: Ives, J. D. and Barry, R. G. (eds.), *Arctic and Alpine Environments 1974,* London: Methuen, pp. 637-67.

[21]————. 1975. *Palynological and Paleoclimatic Study of the Late Quaternary Displacements of the Boreal Forest-Tundra Ecotone in Keewatin and Mackenzie, N.W.T., Canada.* Boulder, Colorado: University of Colorado, Institute of Arctic and Alpine Research (Occasional Paper no. 15).

[22]Larsen, J. A. 1974. Ecology of the northern continental forest border. In: Ives, J. D. and Barry, R. G. (eds.), *Arctic and Alpine Environments 1974,* London: Methuen, pp. 341-69.

[23]Pheasant, D. R. 1971. Glacial chronology and glacio-isostasy of the Narpaing/Quajon Fiord area, Cumberland Peninsula, Baffin Island. (Unpublished Ph.D. thesis, University of Colorado, Boulder).