23. GLACIAL SCULPTURE ALONG THE EAST-CENTRAL COAST OF ELLESMERE ISLAND, ARCTIC ARCHIPELAGO

Project 750063

W. Blake, Jr.
Terrain Sciences Division

Part of the 1977 field season was devoted to investigating glacial features in the vicinity of Cape Herschel and Pim Island, on the east-central coast of Ellesmere Island (Figs. 23.1, 23.2). The Cape Herschel station of the "North Water Project" (Müller et al., 1975) was utilized for the duration of our stay, and a period of exceptionally good weather between July 15th and 25th facilitated field observations and travel.

Cape Herschel is the easternmost promontory of Johan Peninsula, and together with Pim Island, which is separated from Johan Peninsula by Rice Strait, it juts out into Smith Sound at the entrance to Kane Basin. The eastern side of Pim Island is only 40 km from the nearest point on the Greenland coast. The highest points on Cape Herschel and Pim Island are approximately 285 m and 550 m a.s.l., respectively. Both areas consist for the most part of massive red granite, gneissic in places (Christie, 1962) and physiographically they are plateaus with undulating surfaces surrounded by steep slopes or cliffs to the sea. Holocene marine deposits were not discovered above approximately 85 to 90 m a.s.l. in the vicinity of Cape Herschel or in the valley south of the abandoned R.C.M.P. Post at Alexandra Fiord.

The most striking feature of Cape Herschel and Pim Island is that they have been overridden and deeply sculptured by glacier ice flowing from north to south. Roches moutonnées abound, their polished, striated, and grooved north sides and plucked south sides showing clearly the direction in which the ice moved. In fact, the highest points on both Cape Herschel and Pim Island are fine examples of this type of landform. Figures 23.3 to 23.8 illustrate some of the well developed features which have resulted from glacial sculpturing. On a larger scale, steep yet rounded slopes are present on the northeast side of Cape Herschel for instance, but the southeast side, overlooking Herschel Bay, is dominated by cliffs. Striae with the same orientation are displayed near Cape Herschel on Christie's (1962) map, however, the sense of ice movement is not indicated. On the "Glacial Map of Canada" the direction of ice flow is given as northward by a striae symbol on Pim Island (Prest et al., 1968), but in view of the observations made in 1977 this must be modified.

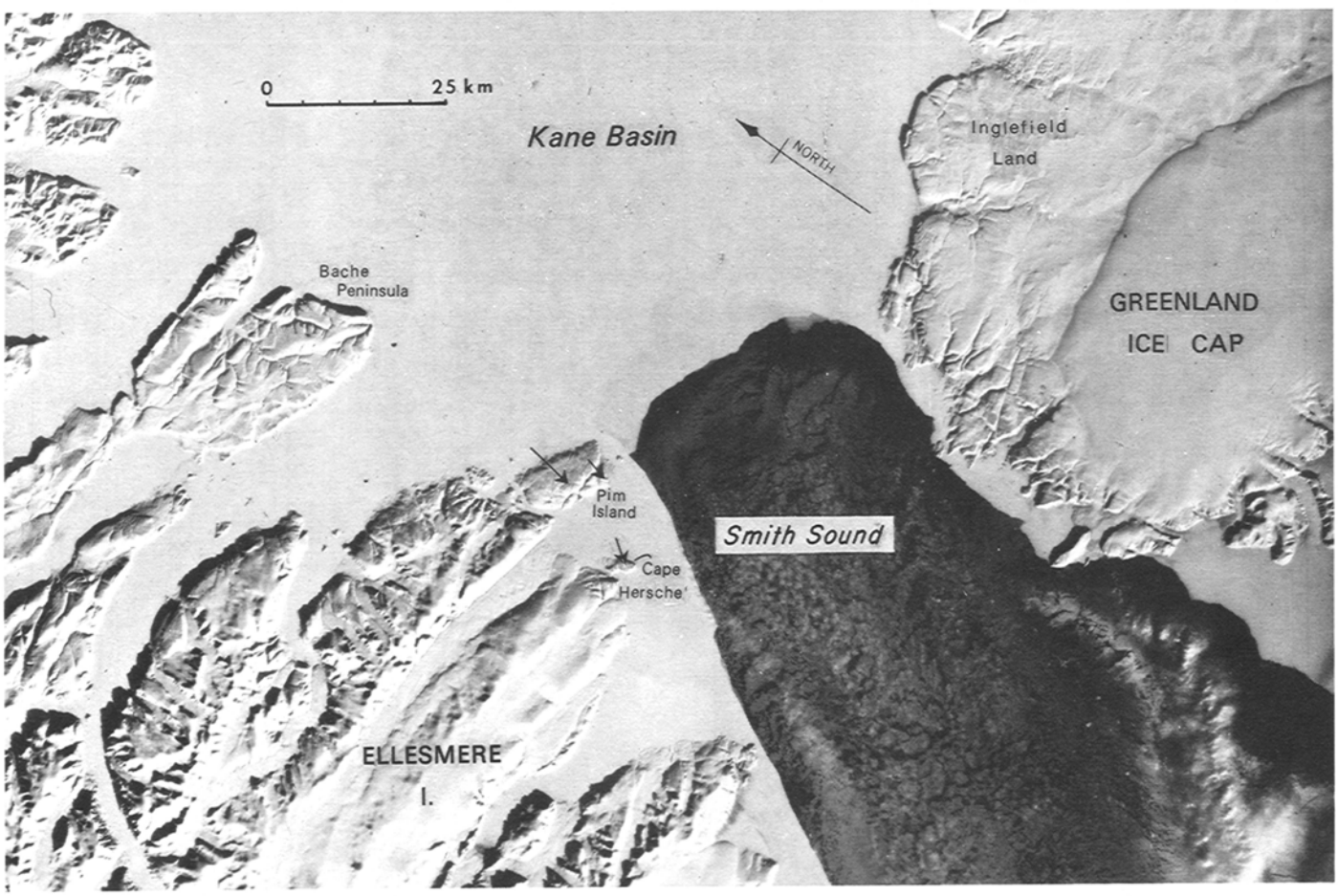

Figure 23.1. LANDSAT image showing Smith Sound and southern Kane Basin. Black arrows indicate direction of ice flow across Pim Island and Cape Herschel. Note the development of the North Water on April 4, 1973 (image E-10255-18054, spectral band 7).

From: Report of Activities, Part C; Geol. Surv. Can., Paper 77-1C (1977).

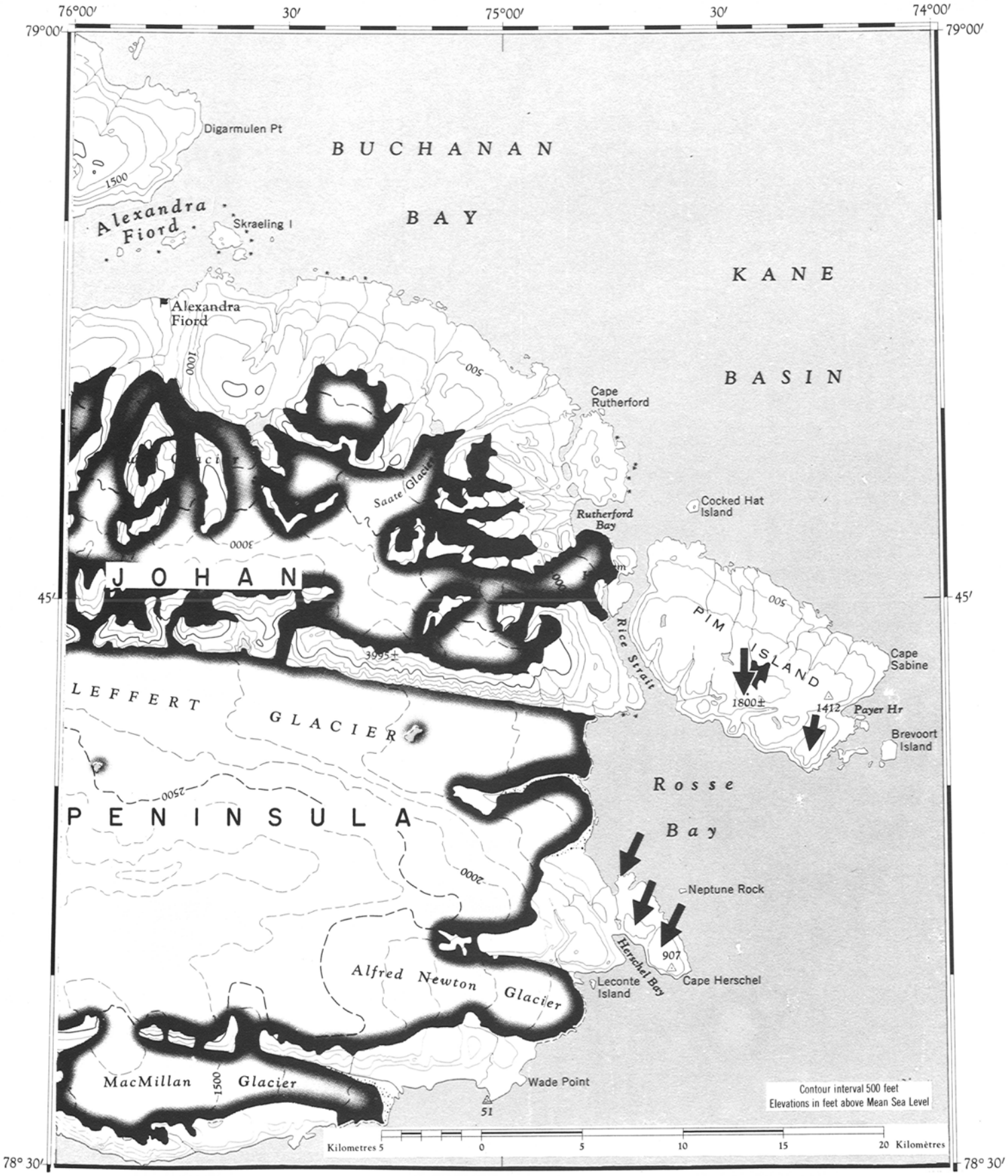

Figure 23.2. Location map of features and sites referred to in the text. Black arrows indicate how the ice, which formerly flowed out of Kane Basin, moved across Pim Island and Cape Herschel at right angles to the present-day direction of flow of Leffert and Alfred Newton glaciers. Base map is 1:250 000 NTS map-sheet 39F and 39E, Ekblaw Glacier (1967).

Figure 23.3.

Glacially sculptured and polished granite below the limit of postglacial marine submergence near Cape Herschel base. Note the rounded contours of the rock surface on the left (northeast) and the plucked lee side to the right (southwest), the direction in which the ice was flowing. Reproduced with permission from a drawing by John Leaning, July 20, 1977.

Figure 23.4. Striated granite surface on the side of a through-valley on the plateau near Cape Herschel, at an elevation of approximately 180 m a.s.l. Ice motion was toward the south-southwest, from right to left in the photograph. July 17, 1977 (GSC-203240).

Figure 23.5. Striated and polished granite outcrop on the summit of the plateau above Cape Herschel, at an elevation of approximately 280 m. View toward the northwest. Note the plucked lee side side toward the south-southwest (left), the direction in which the ice moved across this plateau. July 17, 1977 (GSC-203238).

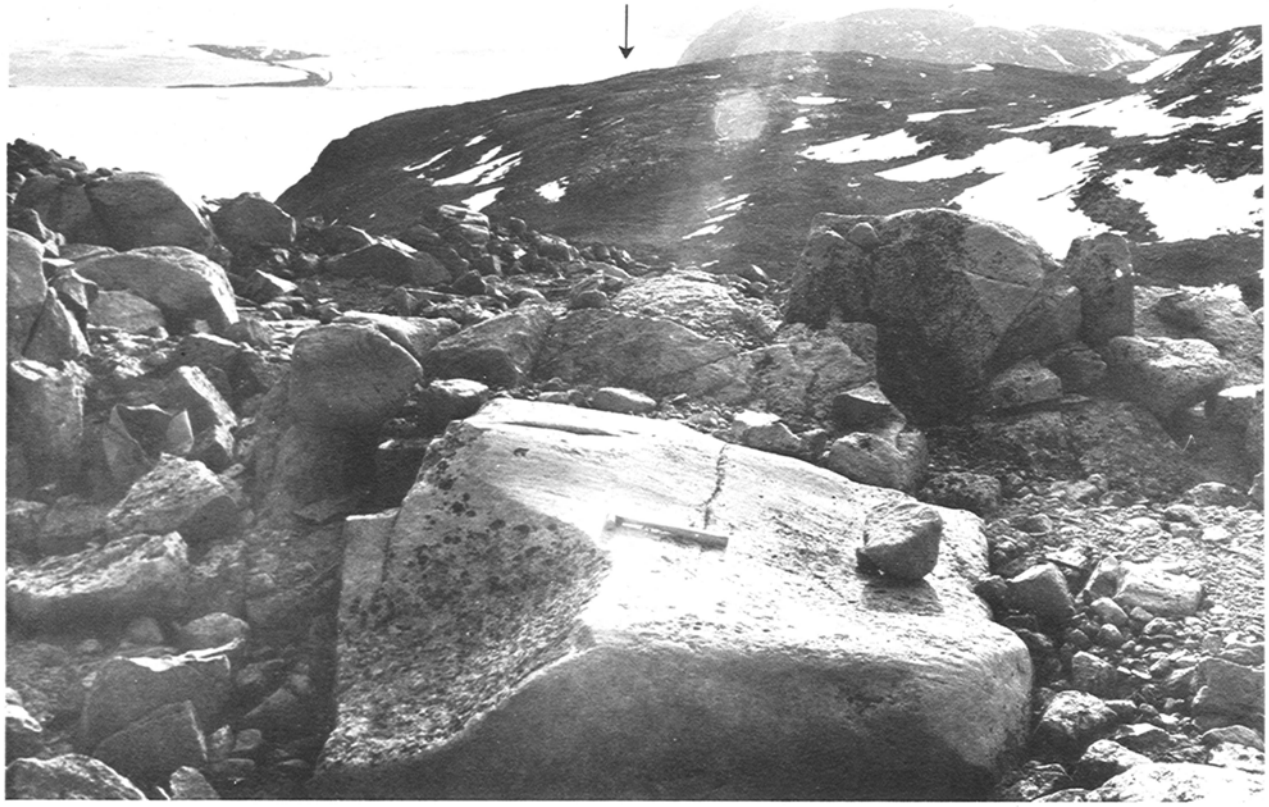

Figure 23.6. View west at a glacially sculptured bedrock knob, with a perched boulder, on the plateau of Pim Island near its southeast corner, elevation circa 440 m a.s.l. This striated granite outcrop displays the typical rounded stoss side (to the right) and plucking on the lee side (left). Ice formerly flowed across the plateau of Pim Island from north to south, precisely at right angles to the present day direction of flow of Leffert Glacier (arrow), seen in the distance across Rosse Bay. July 21, 1977 (GSC-203241).

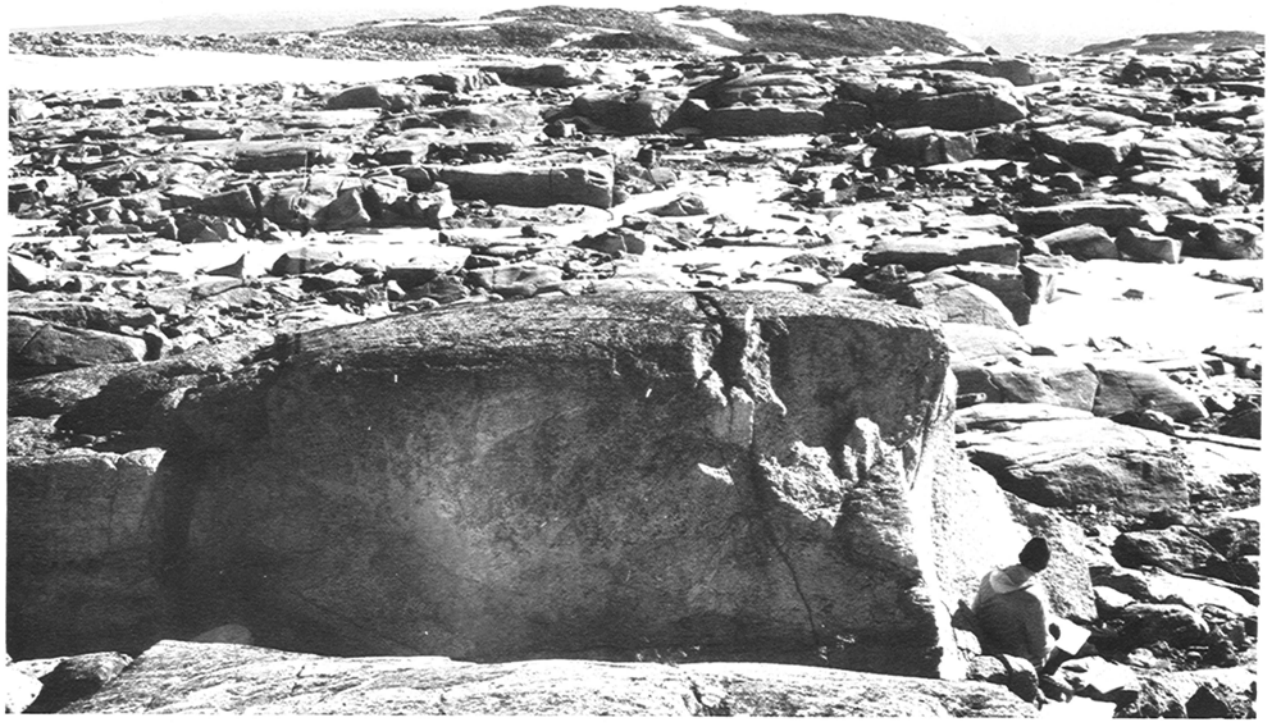

Figure 23.7. View east across the summit plateau of Pim Island, from the highest point at approximately 550 m a.s.l. Note the smoothed rock boss in the foreground. The plucked lee side to the right (south), the direction in which the ice flowed, is over 3 m high. July 22, 1977 (GSC-203242).

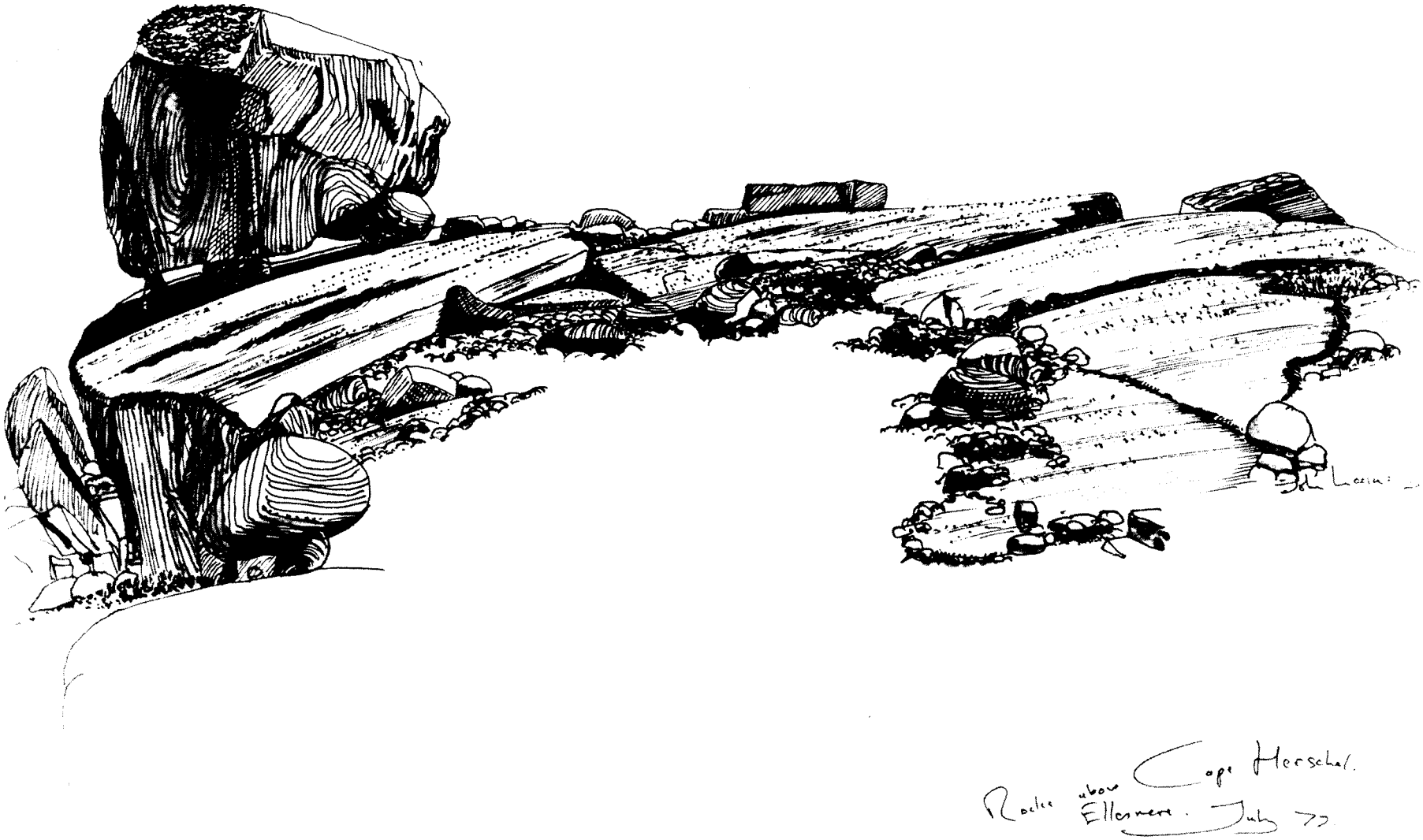

Figure 23.8.

Striated granite and perched boulders on the Cape Herschel plateau, elevation circa 200 m.
Ice flowed from left to right, toward the south-southwest.
Reproduced with permission from a drawing by John Leaning, July 21, 1977.

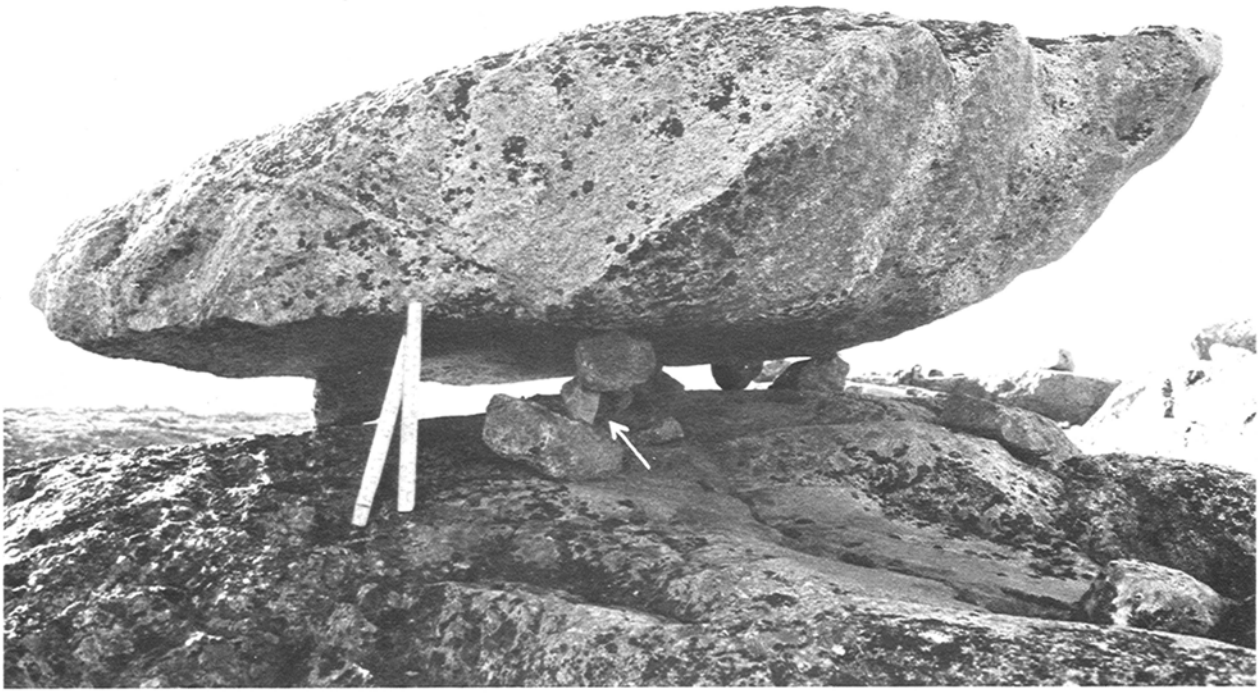

Figure 23.9. Perched boulder of grey granite on red granite bedrock, Cape Herschel plateau. This erratic measures 145 x 180 cm and is 25 to 40 cm thick (the length of the vertical rule is 22 cm). It is balanced on five supports, and at the corner nearest the observer the support is a stack of three angular cobbles, the middle one of which (arrow) is grey limestone-dolomite. July 17, 1977 (GSC-203239).

Figure 23.10. Detail of striated and polished granite surface near the highest point of Pim Island. The direction of ice flow is away from the observer (toward the south). Note the absence of differential weathering at the contacts with the aplite dyke. July 22, 1977 (GSC-203243).

In addition to the features carved in bedrock the landscape on the Cape Herschel and Pim Island plateaus is characterized everywhere by the presence of till, including thousands of erratic boulders. Many of the boulders are perched, and examples are shown in Figures 23.8 and 23.9. The erratics are predominantly sedimentary rocks which do not outcrop nearer than Alexandra Fiord, about 30 km to the northwest of Pim Island, or on Bache Peninsula, approximately the same distance to the north. Rock types present include all of those grouped by Christie (1962) under the Proterozoic and Lower Paleozoic category – dolomite (in part stromatolitic), limestone, limestone-dolomite breccia, sandstone, and conglomerate – as well as a considerable variety of igneous and metamorphic rocks. In addition, fragments of marine mollusc shells were found in till at high elevations on the summit plateaus of Cape Herschel and Pim Island. These shell fragments are also a type of erratic, like those Christie (1967) described from Bache Peninsula at elevations of up to approximately 460 m.

The fact that Pim Island and Cape Herschel have been overridden by southward-flowing ice is of considerable importance to a proper understanding of the glacial history of the entire region (cf. recent reviews by Andrews and Miller, 1976; Weidick, 1976a, b; Paterson, 1977; Paterson et al., 1977). Flow toward the south, and in the case of Cape Herschel toward the south-southwest, could not have been accomplished unless Smith Sound were filled by an outlet glacier draining from Kane Basin. This relatively shallow body of water, in which depths over 500 m are common only near its junction with Smith Sound[1], must have been filled completely with ice which originated from both the Greenland Ice Sheet and the Innuitian Ice Sheet (cf. Blake, 1970). Presumably the Humboldt Gletscher, which is today about 90 km wide at its snout (over twice the width of Smith Sound at Pim Island) and is the sole outlet glacier entering the eastern side of Kane Basin, was the main drainageway for Greenland ice. To the west, valley glaciers in the numerous fiords which indent the Ellesmere Island coast funnelled ice into Kane Basin from the Innuitian Ice Sheet. The volume of ice flowing southward was apparently such that it could impinge on, and inundate, Pim Island and Cape Herschel. Although Pim Island rises close to 1200 m above the deepest parts of Smith Sound, because of the constricted width of the Sound as compared to Kane Basin (40 km as opposed to approximately 100 km), there was no place for the ice to escape except over the adjacent landmasses. In fact, the force of the ice flowing out of Kane Basin was sufficiently great to deflect the ice streams entering from the Ellesmere side, hence the south-southwestward direction of flow across Cape Herschel.

Not only is the wealth of glacial sculpture on Cape Herschel and Pim Island impressive, but the freshness of all features the incredible array of perched boulders (Figs. 23.8, 23.9), and the lack of differential weathering along the contacts between rocks of different grain size (Fig. 23.10) provide convincing evidence that the ice which eroded and polished these rocks flowed out of Kane Basin in late Wisconsin time. If the carving of these textbook glacial features had been accomplished during an earlier glaciation, say during early Wisconsin time (> 50 000 years ago?) then it would be reasonable to expect destruction of fine striae and polished surfaces, the development of weathering pits, and the toppling over of precariously perched boulders; however, none of this has happened.

Relatively little is known of the absolute chronology of glacial events around Kane Basin. A number of radiocarbon age determinations from Inglefield Land, Greenland, have been published by Nichols (1969) and Tedrow (1970). The oldest Holocene materials – both peat and marine shells – reported by Nichols (1969) are 7800 ± 200 years old (L-1091A and L-1091E, respectively). On the Ellesmere side of Kane Basin the only radiocarbon date available for raised marine features is one on marine pelecypods collected in 1968 near the former Alexandra Fiord R.C.M.P. Post by R.L. Christie; its age is 6220 ± 140 years (GSC-1348; Lowdon and Blake, 1973). A new collection of **Macoma calcarea** shells from the distal side of the moraine forming the head of Herschel Bay is in the order of 9000 years old (GSC-2516). This is the first radiocarbon age determination obtained from the shores of Smith Sound. Additional dates will help to fill in details of the pattern of ice retreat. However, the distribution of moraines suggests that ice still was flowing into the low-lying pass between Cape Herschel peninsula and the higher land of Johan Peninsula to the west some 9000 years ago. Much of the Cape Herschel plateau, including features such as those illustrated in Figures 23.4, 23.5, 23.8 and 23.9 probably has been ice-free for approximately the same length of time.

Acknowledgments

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[1] See Pelletier (1966), who described Kane Basin as a drowned watershed from which ice flowed both north and south. Also Chart 896, "Arctic Bathymetry north of 72°, 0° to 90° West", Canadian Hydrographic Service, 1967.

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