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Reports

A Series of Raised Pleistocene Deltas; Halls Bay, Newfoundland*

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Previous Research

A number of raised Pleistocene deltas are situated at various localities around Halls Bay, from Springdale in the north, to South Brook and West Bottom at the head of Halls Bay (Fig. 1). The deltas have been described by Lundqvist (1965) who proposes a general scheme for construction of the system following the Jenness (1960) theory of inner-outer drift zones. Jenness argues that the inner-outer drift zones in northeast Newfoundland resulted by either a still-stand at a position of discontinuous end moraine or a final major advance from further inland. He identifies an outer drift zone (coastal side) of ground moraine and an inner drift zone of "slightly younger eskers, kames and ground moraine" (p. 161). Supposedly, final melting produced the glaciofluvial deposits that radiate coastward to form deltas.

Despite the Jenness argument, Lundqvist mentions that no end moraine could be distinguished at the inner-outer zone boundary in west-central Newfoundland. He identifies the boundary on the basis of thick, almost continuous, inner drift and thin outer drift where --"... bedrock structure is clearly visible through the thin overburden, even where bedrock is not exposed" (p. 299), and hypothesized that individual ice lobes protruded from an inland ice sheet and filled the valleys which feed into Halls Bay. The deltas at Springdale and South Brook, as well as Kings Point and Botwood (the latter two being located outside the field area) are interpreted by Lundqvist as being contemporaneous and part of the boundary between inner and outer drift, since such a halt would allow the deposition of much thicker glaciofluvial sediments that would a continuous recession of the ice. The possibility of the deltas being deposited in ice dammed water-bodies as suggested by Jenness is continued by Lundqvist.

A glacial study completed by Damman (in Wilton (1957)) portrays the Halls Bay delta deposits as being similar in origin to those of St. Georges Bay

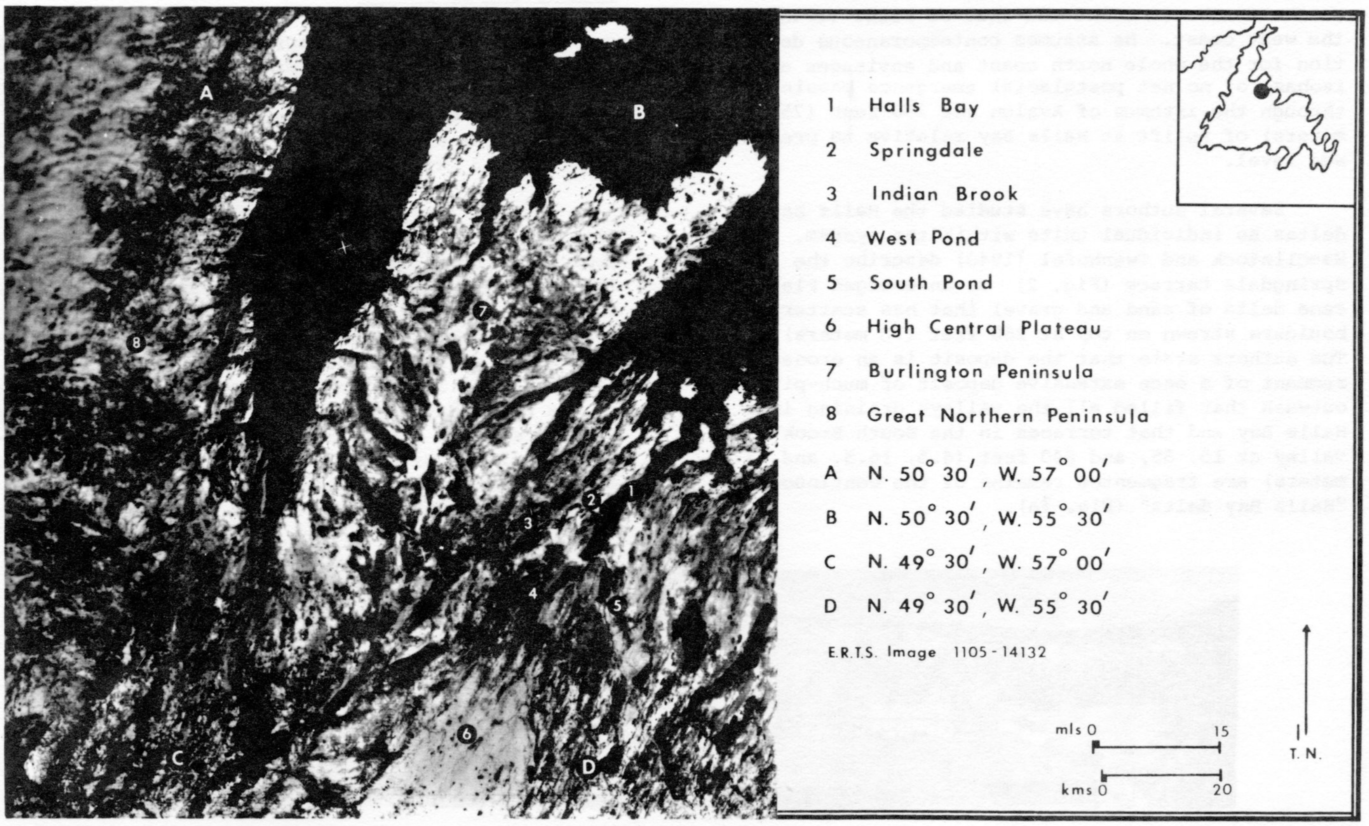

Fig. 1. West-Central Newfoundland.

*Manuscript received May 10, 1974
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TABLE 1

Elevations of terraces and raised shoreline features on the Halls Bay delta system

Springdale	Burnt Berry Brook	Dock Point	White Point	West Pond	Sugarloaf	South Brook
252' (75.6 m) (U.M.L.)*	250' (75 m) (U.M.L.)	250' (75 m) (U.M.L.)	250' (75 m) (U.M.L.)	250' (75 m) (U.M.L.)	245' (73.5 m) (U.M.L.)	249' (74.7 m) (U.M.L.)
220' (66 m)			220' (66 m)			218' (65.4 m)
210' (63 m)				200' (60 m)	212' (63.6 m)	
180' (54.3 m)	180' (54.3 m)			178' (53.4 m)		
50' (15 m)		50' (15 m)	54' (16.2 m)	53' (15.9 m)	49' (14.7 m)	58' (17.4 m)
			20' (6 m)			29' (8.7 m)

*U.M.L. - Approximate upper marine limit.

(MacClintock and Twenhofel (1940) and Brookes (1969)). The process as presented in the Wilton report would have an extensive glaciofluvial period with a re-advance of ice depositing till 1-2 feet (.3-.6 meters) thick on top of the deltas. Damman continues by hypothesizing a gradual isostatic rise of the land which resulted in rivers flowing into Halls Bay cutting their way through old deltaic deposits, leaving some parts of the deltas as high terraces.

Jenness proposes a series of isobases from elevations of former marine levels, based on his work on the northeast coast and that of Flint (1940) for the west coast. He assumes contemporaneous deglaciation for the whole north coast and envisages a zero isobase of no net postglacial emergence passing through the isthmus of Avalon and 250 feet (75 meters) of uplift at Halls Bay relative to present sea level.

Several authors have studied the Halls Bay deltas as individual units within the system. MacClintock and Twenhofel (1940) describe the Springdale terrace (Fig. 2) as an emerged Pleistocene delta of sand and gravel that has scattered boulders strewn on top at 260 feet (78 meters) a.s.l. The authors state that the deposit is an eroded remnant of a once extensive deposit of much-pitted outwash that filled all the valleys draining into Halls Bay and that terraces in the South Brook valley at 15, 55, and 240 feet (4.5, 16.5, and 72 meters) are fragmented remains of the continuous "Halls Bay delta" (Fig. 3A).

The Springdale delta is also described by Lundqvist (1965). He suggests that it was formed, particularly in its eastern section, by melt-water flowing south, noting that the beds dip slightly away from the hills northwest of the town. Similarly, bedding in other deposits in the area slopes outward form local centers. Unlike MacClintock and Twenhofel, Lundqvist visualised the 240-foot (72 meters) terrace at South Brook as being an isolated unit formed in front of West Brook Valley.

Present Study Results

Since the various theories of construction and previous morphological information for the Halls Bay deposits conflict, an attempt was made to quantify and qualify the characteristics of the delta systems and to present some conclusions as to their method of formation.

Various ^{14}C dates (Dyck and Fyles (1963)) confirm that shortly before 12,000 BP ice retreated from Halls Bay. In early summer 1972, D.R. Grant (1974) recovered a sample of *Balanus* which was subsequently dated at 12,000 $\pm$ 220 BP (G.S.C. - 1733). The shells were located 55 feet (17.5 meters) a.s.l. in a stony pelite at the front of the Sugarloaf terrace (Fig. 3B). Two shell samples were collected in the Halls Bay area by the writer. Sample 72-1SS, *Mytilus edulis*, was located in a sand lens in foreset gravels on Riverhead Brook 29 feet (8.7 meters) a.s.l. Sample 72-2SS contained perfect specimens of *Hiatella arctica*. The sample was removed from

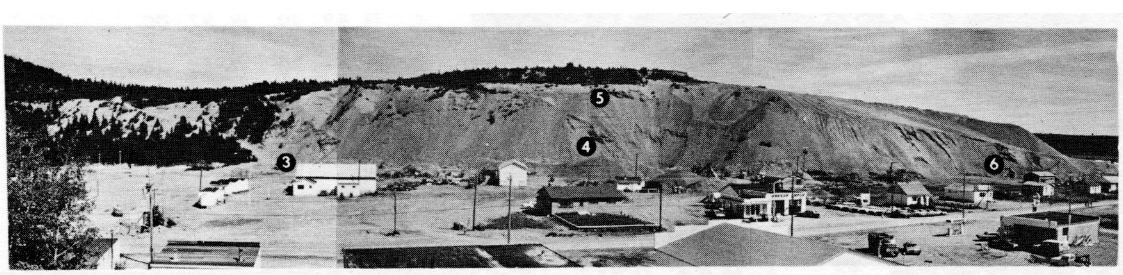

Fig. 2. The Springdale delta, southwest scarp. Data points are duplicated on Figure 4.

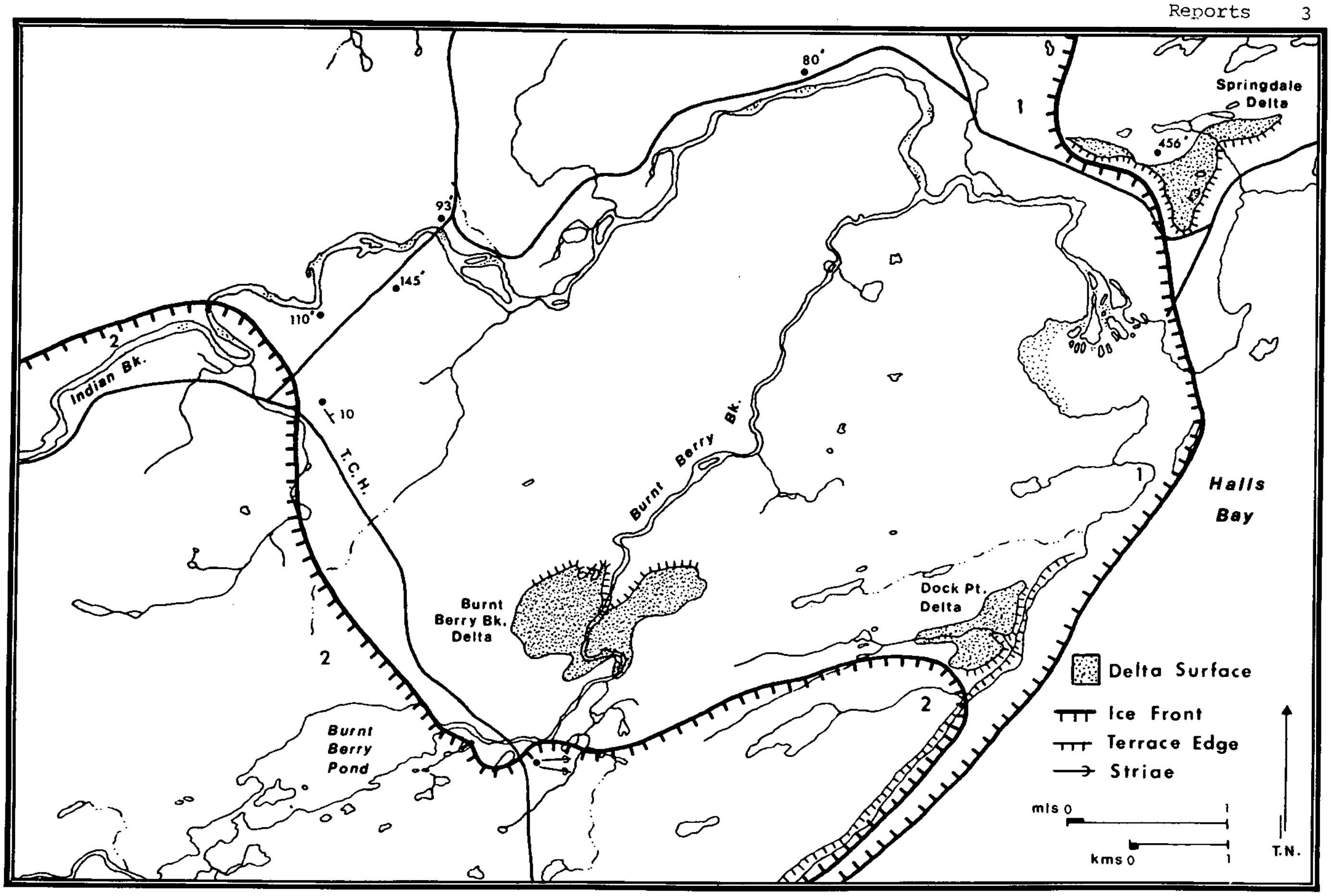

Fig. 3A. West Halls Bay - Deltas and ice fronts.

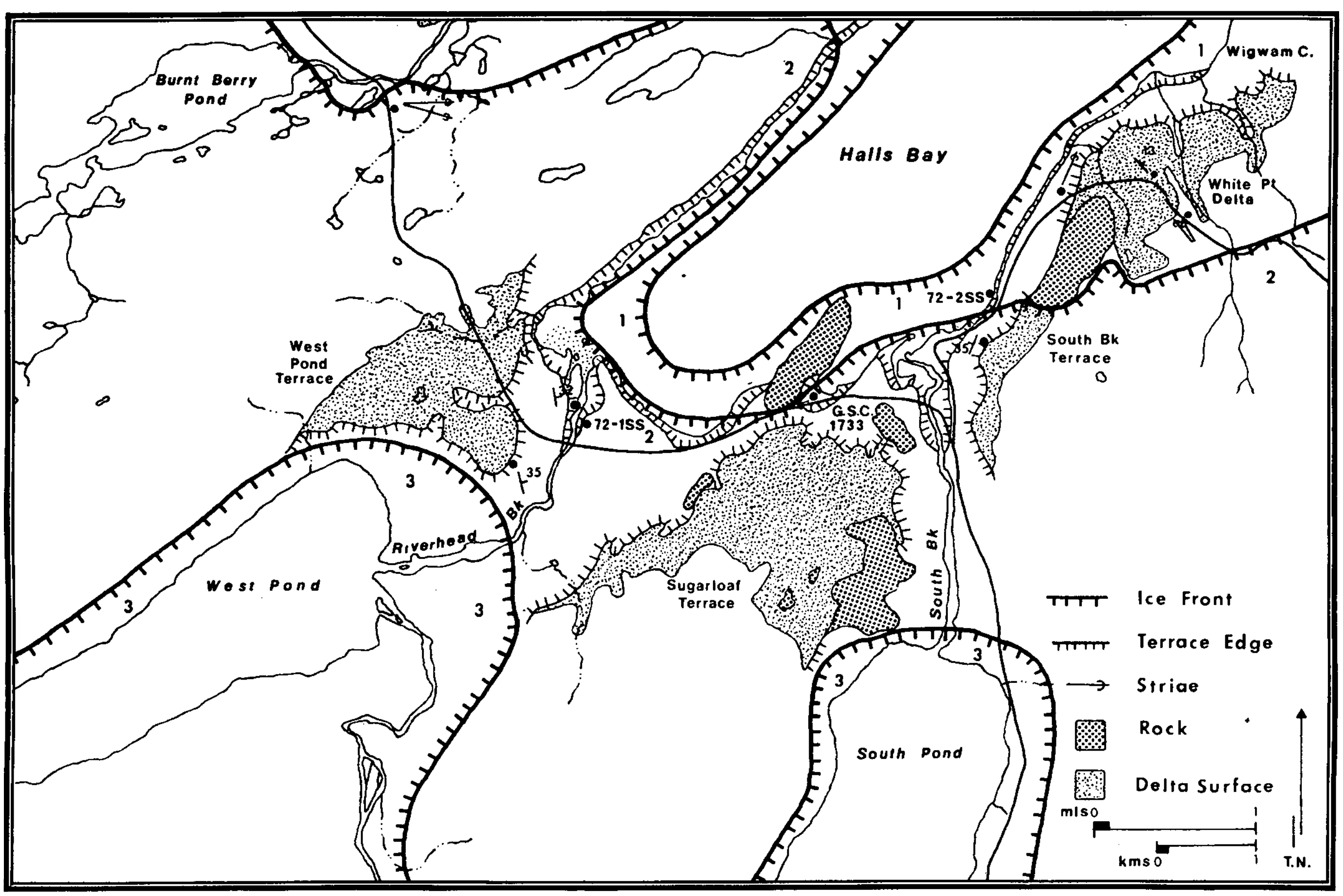

Fig. 3B. Lower Halls Bay - Deltas and ice fronts.

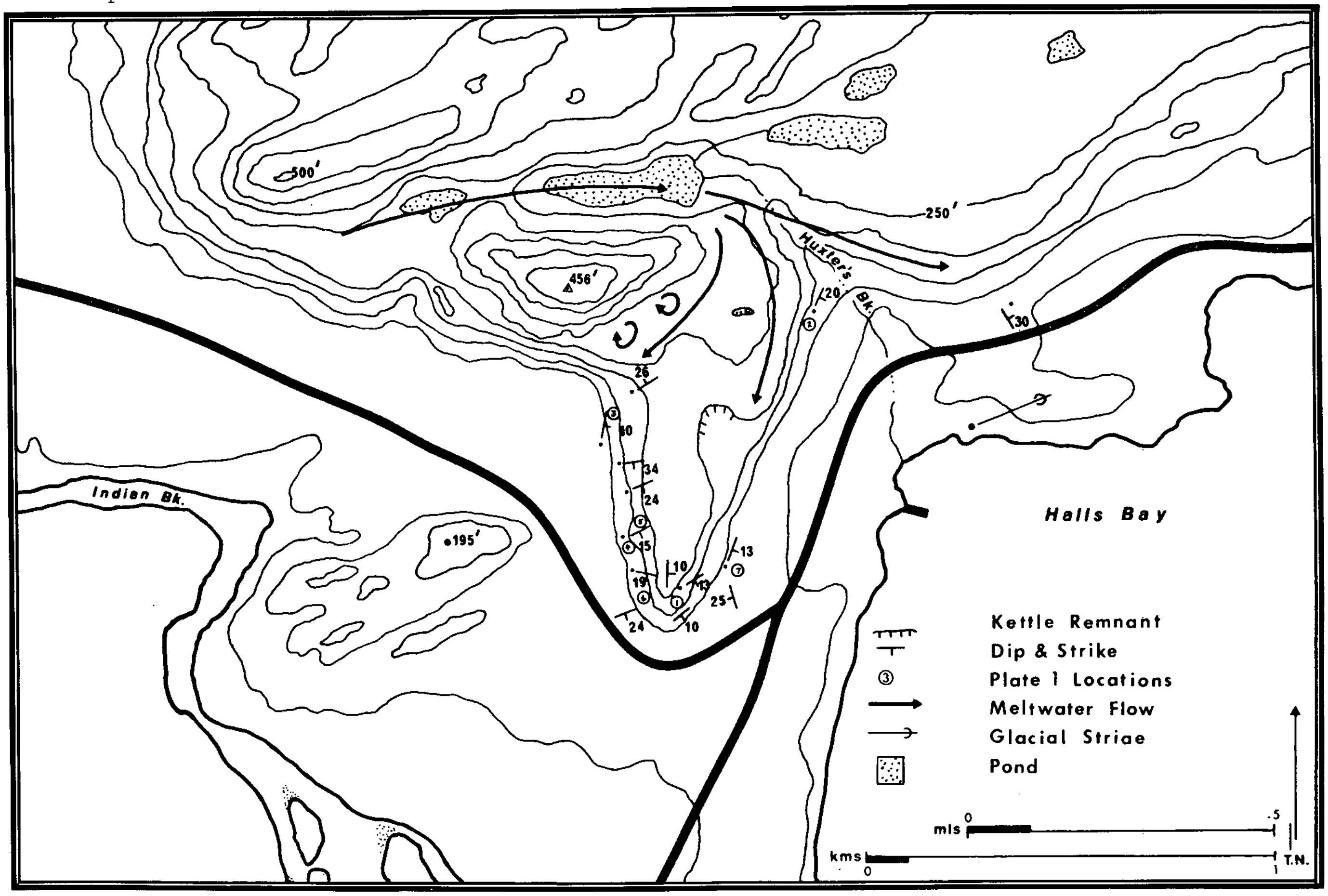

Fig. 4. Springdale Delta.

a cut in stony pelite 15 feet (4.5 meters) a.s.l. at Spring Cove near the eastern end of Halls Bay (Fig. 3B). Since both these samples were located in delta bottomsets, they are estimated to be similar in age to G.S.C.-1733 and are significant in that they date the innermost series of glacio-marine deltas on the northeast coast of the island and that the deltas were not, as suggested by Jenness (1960) and Lundqvist (1965), deposited in ice dammed lakes.

A calving ice front rapidly deglaciated Halls Bay until it became land fast in Indian Brook and in the valleys to the south, where it remained while delta deposition took place. Bottomsets of the deltas fronting on Halls Bay are equivalent in time and were deposited at ice-recessional position 1 (Fig. 3A and B).

Construction of the Springdale delta occurred from lateral meltwater in Indian Brook valley. Final deposition was from meltwater flowing through the designated route (Fig. 4) along what is now Huxter's Brook. The modified kettle hole on the eastern edge of the delta and the bedrock meltwater channel suggest that ice was close to the western face of the delta. Recorded dips and strikes signify that while initial flow was down the north side of Indian Brook valley, meltwater involved in delta deposition also flowed to the east-northeast and deposits wrapped around the massive outcrops.

Volumes of meltwater varied considerably during delta deposition. The mass of bouldery material at location 4 (Fig. 2) , is evidence of a period of high discharge. Further deposition of large amounts of fines on the boulder fraction signify a substantial slowing of meltwater flow.

At no time was the delta much more extensive than it is now. British Admiralty Chart No. 4591 does not indicate deposition of large quantities of sediment outside Indian Brook Arm, rather the 100 fathom (180 meters) threshold is close to shore at this point. Tides and currents in the bay modified the delta and elongated its southern tip into the spit-like shape shown in Figure 4.

As ice retreat continued, major marine delta deposition took place at Burnt Berry Brook, Dock Point and White Point, with continued minor deposition at the head of Halls Bay (position 2, Fig. 3A and B). Although there is little remaining to confirm the idea, it is possible to speculate that at position 2, a 250-foot (75 meters) terrace was constructed just southeast of the Trans Canada Highway - Springdale highway intersection. This would have paralleled the existing terraces at Burnt Berry Brook, Dock Point and White Point.

Finally, meltwater from ice located in West Pond and South Pond valleys (position 3, Fig. 3B) was responsible for the larger proportion of West

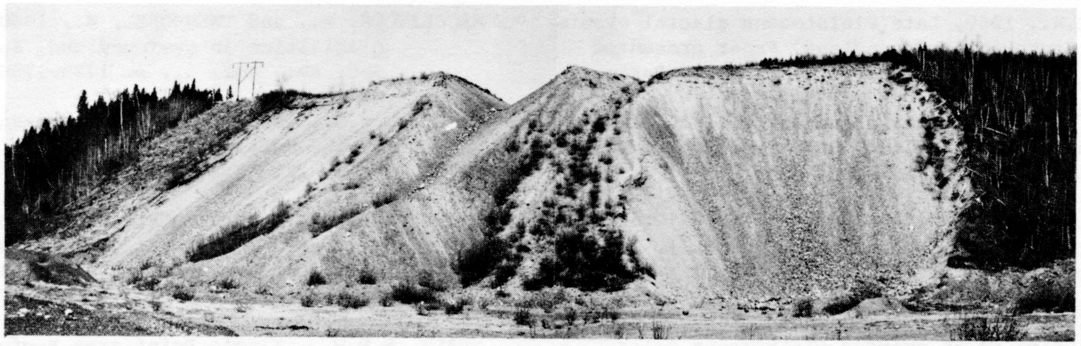

Fig. 5. The West Pond terrace showing the 250-ft. (75m) level and 53-ft. (15.9 m) erosional terrace.

Pond, (Fig. 5) Sugarloaf and South Brook terrace construction. Greatest amounts of ice recession between positions 1 and 3 took place on interfluves with relatively slow retreat in the valleys. Kettle holes and hummocky moraine on the highlands around the deposits indicate that ice fronts were near the deltas during their construction.

From recorded dip and strike measurements (Fig. 3A and B) and textural information, it is also concluded that the delta system at the head of Halls Bay, which includes the West Pond, Sugarloaf and South Brook terraces, completely filled the lower perimeter of the bay, (Fig. 6). Continued glaciofluvial and postglacial erosion removed large portions of the delta from the two valleys. Admiralty Charts show depth soundings of 30-40 fathoms (54-72 meters) in lower Halls Bay with a sudden drop to 103-120 fathoms (185-216 meters) immediately north of Dock Point. This suggests major fjord infilling by the eroded delta c mater al.

During and after the process of ice removal from the field area, isostatic rebound caused the terrain to be uplifted. Recorded elevations of the Halls Bay deltas, set the marine limit of postglacila emergence relative to present sea level at 250 feet (75 meters). Various sources cite sea level for 12,000 BP as being C. 172-224 feet (52-68 meters) below present levels. From the approximate eustatic data, it may be that C. 440 feet (133 meters) of isostatic uplift has taken place since 12,000 BP of which 190 feet (57 meters) has been obscured by a eustatic rise in sea level during the same postglacial interval.

Erosional terraces occur at 220, 200, 180, 50 and 30 feet (66, 60, 54, 15 and 9 meters) (Table 1). All except the 50-foot (15 meters) level are poorly defined and do not appear on all deposits in Halls Bay. The 50-foot (15 meters) terrace is continuous throughout the area and represents a major stillstand. This is not to suggest that other stillstands were not important but that evidence for them is scanty having been removed by later marine erosion or mass wasting of unconsolidated material.

The Halls Bay delta system amy be assumed outer drift zone boundary outlined by Lindqvist (1965). The writer feels, however, that if a coastal area is deglaciated quickly by calving ice fronts in the major bays and fjords with ice remaining just in-

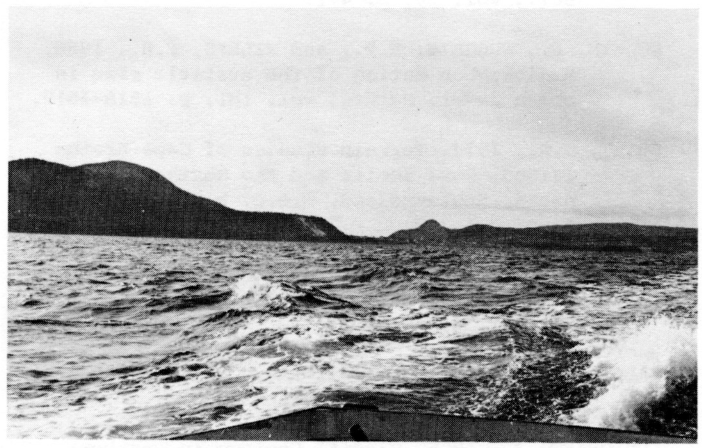

Fig. 6. The lower Halls Bay delta system; left centre South Brook terrace, right centre, Sugarloaf terrace and Sugarloaf. Photographed facing south.

land, deltas would obviously demarcate the ice margin. This does not imply inner-outer drift zones but rather describes ice retreat sub-parelleling a land-sea margin.

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