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Hugo Greiner

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Reports

Geomorphology of the Fundy National Park, New Brunswick

HUGO GREINER
Geology Department, University of New Brunswick, Saint John, N.B.

Introduction

This study, undertaken for the National Parks Branch, had as its objective the investigation of the geomorphology of this area as background material in the redevelopment of the Park. The surgicial features and bedrock geology of Fundy National Park were examined along the coast, and on roads and major trails during the 1970 field season and in early spring of 1971. The underlying bedrock as well as the nature of the overlying soil were also investigated along roads and trails and by pace-and-compass traverses in heavily wooded or less accessible areas. Cores of bottom sediment were obtained from McLaren Pond for study; Dr. J. Terasmae of Brock University has kindly permitted publication of his data from this and related areas. Unpublished M.Sc. theses in the University of New Brunswick Geology Department were examined, and information obtained by S.I. Ali has been incorporated, with his permission. Stereoscopic examination of aerial photographs provided additional information.

It is a pleasure to acknowledge the friendly help of Park personnel, in particular that of Superintendent T.R. Heggie, Mr. Roger Roy, Park Naturalist, and Mr. Gordon MacLean. Miss Ruth Jackson proved to be an excellent field assistant.

General and Bedrock Geology

Fundy Park lies entirely within the Southern or Caledonian Highlands of New Brunswick (Howie and Cumming, 1963), and comprises some 80 square miles. The upland is a maturely dissected peneplain which has been modified by glaciation during the Pleistocene.

Perhaps the most important factors controlling the surface features of an area are the kind and structure of its bedrock. Most of the following summary of the bedrock geology has been taken from the map with marginal notes of Kindle (1962).

Except for a wedge of Carboniferous sedimentary strata along the Bay at the southern edge, Fundy National Park is entirely underlain by crystalline rocks of presumed Precambrian age (Fig. 1). The first of the two oldest units comprises predominantly mafic rocks such as andesites, basalts and dacites, together with interbeds of metasedimentaries--feldspathic quartzites and conglomerates and slates. These have been grouped together on the accompanying map. The second unit is more felsic, and consists mainly of rhyolites (in places, banded rhyolites), dacite, tuff and sericite schist.

These two series of volcanic and altered sedimentary rocks have been intruded by granitic and granodioritic plutons, dykes and sills. Granite, granodiorite, quartz diorite, diorite, alaskite and quarts and feldspar porphyry are all present.

The Carboniferous rocks are entirely sedimentary. Those of the Hopewell Group are reddish conglomerates, sandstones and shales, whereas those of the Boss Point Formation are mainly grey and red sandstone, conglomerate and shale, with thin coal seams. Plant fossils such as *Calamites*, *Lepidodendron* and *Sigillaria*, as well as such primary sedimentary structures as cross-bedding and ripple marks may be found in the Boss Point Formation.

Precambrian(?) bedrock in the Park has been metamorphosed, intruded, and folded and faulted most complexly, but that of Carboniferous age is mainly only gently folded. The Point Wolfe-Alma Fault separates the two, and has been downthrown on the south some 1,000 feet.

Two old copper showings occur in the Park: one on the south side of Barrett Brook 800 feet east of Broad River, and another north of the Point Wolfe Road west of the Golf course.

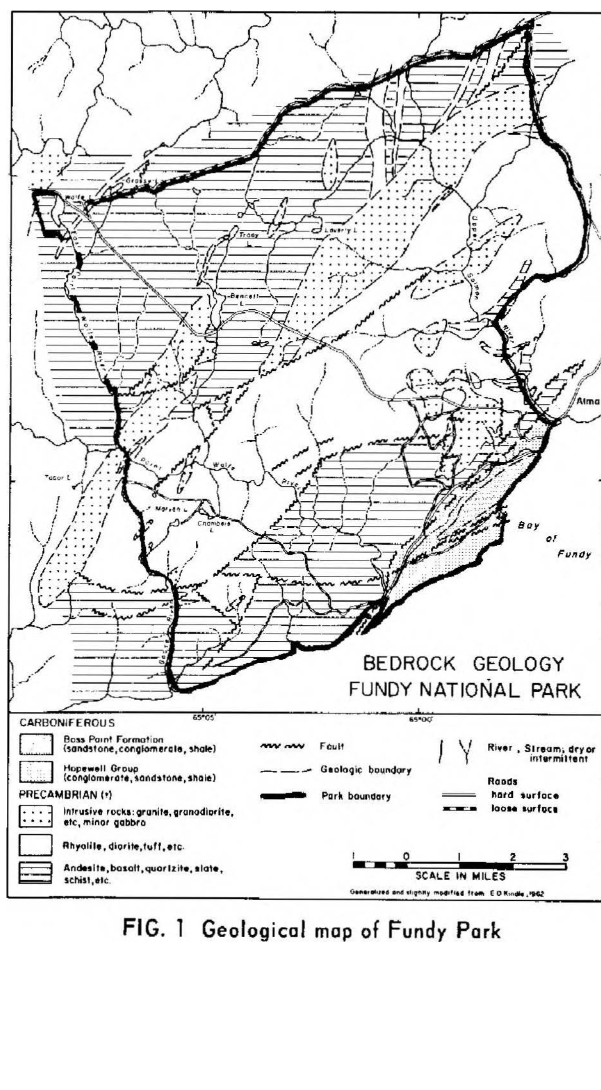

FIG. 1 Geological map of Fundy Park

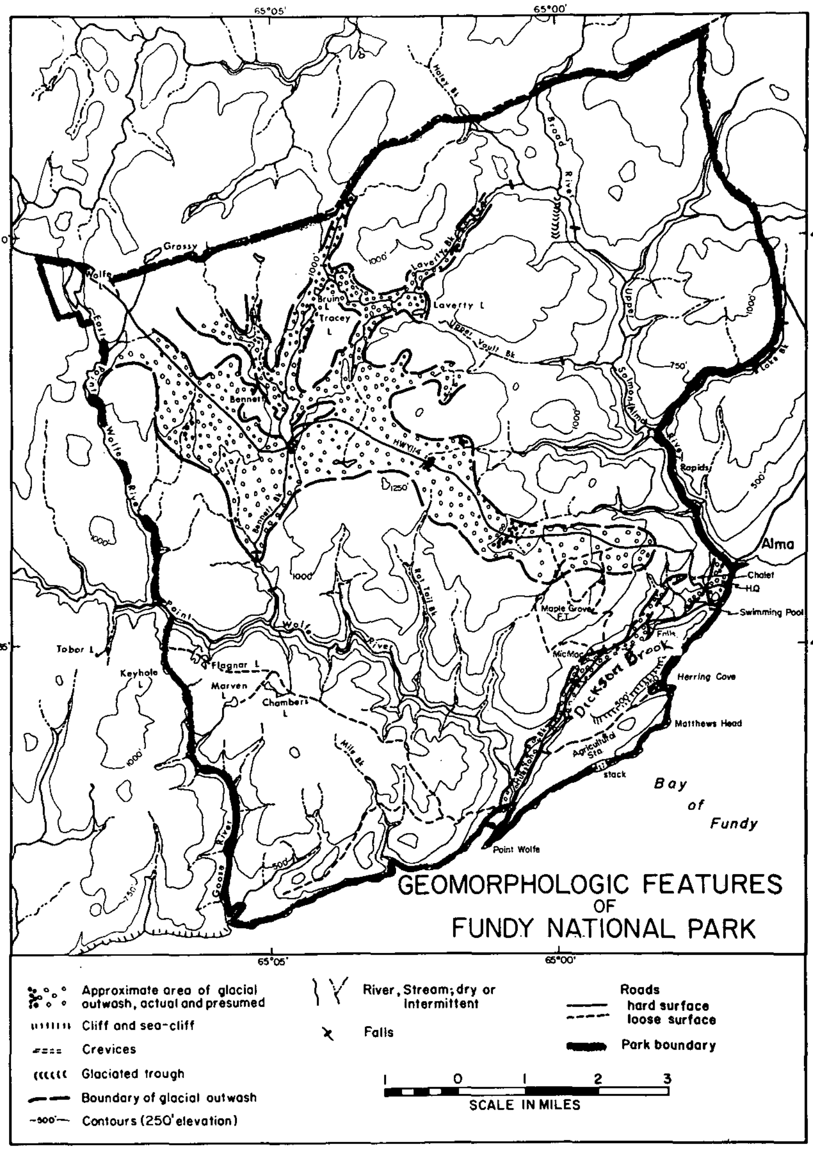

FIG. 2 Geomorphological map of Fundy Park

Geomorphology

In general, topography in the area has been largely determined by the bedrock; glacial drift is too thin to influence it much, in most places.

The effects of the nature and structure of the bedrock on the landscape of Fundy National Park are seen in many ways. The resistant, crystalline rocks produce and maintain the upland generally. The Point Wolfe-Alma Fault has created a zone of weakness along which the Dickson Brook valley has been eroded. Less obvious, on Figure 1, are the north-northeast-trending lineaments and belts in the northwest quarter of the Park produced by bands of rock of varying hardnesses. The more easily eroded units have been deepened by glacial ice action, and etched out by glacial runoff and present-day streams. The Bennett Brook and Laverty Brook drainages follow this formational trend.

Two falls on Bennett Brook, 1.5 and 2 miles south of Bennett Lake respectively, occur where faults cut across the stream course. It is noteworthy that erosion in the hills above Herring Cove tends to follow the bedding planes, forming crevices. Aside from these instances, however, the surface upland in particular has reacted to erosion in a remarkably homogeneous fashion. Other than the two mentioned, for example, no falls or rapids can be seen to be directly attributable to faults or differential erosion of rocks of varying competencies.

(a) Drainage

The principal drainage direction is southeast into the Bay of Fundy. This consequent flowage is followed by the Alma River on the east, and by the

Point Wolfe River and its tributaries in the south and west. Bennett Brook and Laverty Brook, where they have been developed upon belts of weak rock, as well as Dickson and Hueston Brooks, which follow a weak zone of faulted rock, are subsequent streams.

The general pattern of the drainage, especially on the upland surface, is typically deranged due to glacial and post-glacial deposition and blockage. A persistent trellis pattern, probably inherited from pre-glacial times, can be seen on tributaries of Laverty and Bennett Brooks.

(b) Glacial Geology

Like all of eastern Canada, and as far south as Long Island, the Caledonian or Southern Highlands of New Brunswick were covered with continental ice, and the earth's crust itself was depressed below sea-level, in the Pleistocene Epoch (Flint, 1957). Deglaciation beginning about 20,000 years ago (Prest, 1963) was discontinuous, and marked by periods of stillstand, or even of readvance of the ice, as the climate fluctuated. Raised beaches at Saint John, N.B., in which post-glacial marine shells have been radiocarbon-dated at 13,325 ± 500 BP (Lee, 1960), suggest one interval of deglaciation not far from the Park. During the Climatic Optimum for the region about 3,000 to 5,000 years ago, there was a general rise in sea-level along the Atlantic Coast, reaching its present level about 6,000 to 7,000 years ago.

The presence of an "end moraine" reported by Lougee (1954) southwest of Saint John is seriously questioned by the writer because the belt of submarine topography suggestive of (terminal?) moraine does not seem to enter the Bay of Fundy, according to the Bathymetric Chart of the Canadian Hydrographic Service, Bay of Fundy to Gulf of St. Lawrence, 1969.

Quite obviously glacial erosional features must have dominated in the Quaternary history of the Park area, for this is a conspicuous highland, exposed to weathering and transport of the fragmented rocks. Nevertheless, erosional types of landscape features are scarce: only the valleys of the Braod River and Haley Brook appear to have been rounded by moving glacial ice. Likewise--with one exception to be discussed later--no prominent glacial gouging of the bedrock is noticeable in serial photographs. Crevices and ancient sea-cliffs are recognizable along the coast, however. Only one glacial striation on *in situ* bedrock has been seen.

In contrast, glacial depositional features, in particular stratified drift, are common in the Park; till of any thickness is not. These glacial deposits were probably laid down during the period of final deglaciation of the area. Kame terraces, kames, valley trains and a widespread, thin mantle of bouldery ground "moraine" are the main features to be found in Fundy National Park. No pronounced morainal topography, drumlins nor eskers are present.

Areas of relatively thick outwash (greater than 10 feet) occur along the west bank of Alma River, in the vicinity of the MicMac campsite, and in a 2,000-foot-wide belt south of Kinnie Brook. Thicknesses decrease away from these zones, but occasional patches and depression-fillings occur locally.

Swamps and boggy areas occupy natural basins. They result from the uneven deposition of drift damming-up outlets from bedrock depressions. The muskeg in the vicinity of the Maple Grove Fire Tower seems to be an example of this.

Kame terraces are present at two levels in the Headquarters area. The highest, at an elevation of 350 to 400 feet, extends westward from just south of the Chalets to the Lookout Point about 1.5 miles upstream from the mouth of Dickson Brook. Several hundred feet of poorly bedded outwash sand and gravel with boulders up to 3 feet in diameter are present. These sediments are easily accessible in a gravel pit near the Lookout Point mentioned. On aerial photographs the surface of the kame terrace appears to be quite level, except for several depressions, probably kettle-holes. The ground surface is irregular and hummocky, and stratification of the deposits is poor. Elevations of 360 and 340 feet respectively were obtained from the eastern and western ends of this kame terrace.

Triangular facetting is observable on aerial photographs on the hillside above the west end of the terrace. It may be the result of marine erosion, glacial-ice erosion, or perhaps even faulting in the bedrock.

The second kame terrace (Baird, 1960, p. 9) is at a level of 100 to 150 feet, and its main belt extends from near the mouth of Dickson Brook up the Alma River to the top of the Headquarters campsite. Its present smooth surface is in part the result of initial park development, however. The terrace is bounded on the west side by the thick belt of hummocky, eskeroid, coarse outwash, and on the east by the river. It has McLaren Pond on its surface. Remnants of this terrace may be found on the north side of Dickson Brook in the golf course area as well as at Herring Cove and Point Wolfe Cove. On the headland south of Matthews Cove a similar terrace is very well developed, and apparently is associated with what were once offshore stacks and cliffside beaches, with some crevicing on the cliff face above.

The materials comprising this lower kame terrace appear to be less coarse-textured than those in the high-level one, and stratification is better. In the gravel-pit 0.25 miles west of the Headquarters Building, for example, a cross-bedded layer of coarse sand 2 feet thick lying between unsorted gravel beds with boulders up to 0.5 foot in diameter can be seen.

Inland sites of deposition of stratified drift of significant thickness appear to be limited to kame and valley train deposits along stream courses and in low-lying areas. However a belt of more-or less continuous outwash occupies much of the northwest quarter of the Park. None of these deposits are of large size nor spectacular proportions. Their limits have been approximated on Figure 2. Many hilltops appear to be free of drift.

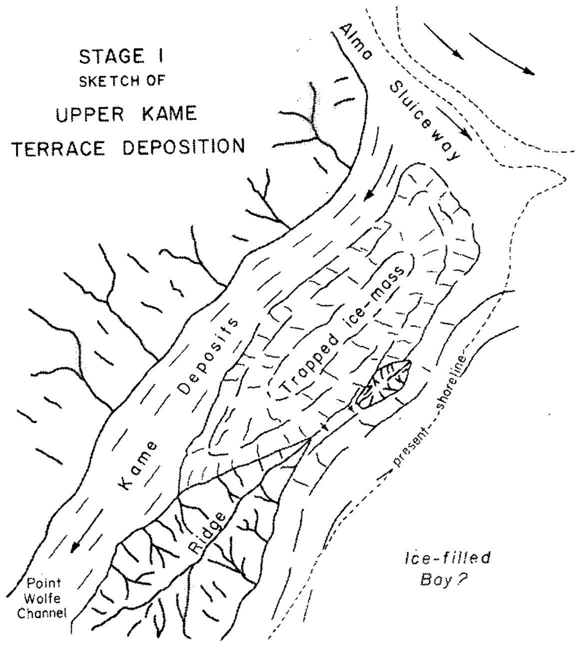

FIG. 3 Late glacial and Recent history of Fundy Park – Stage 1.

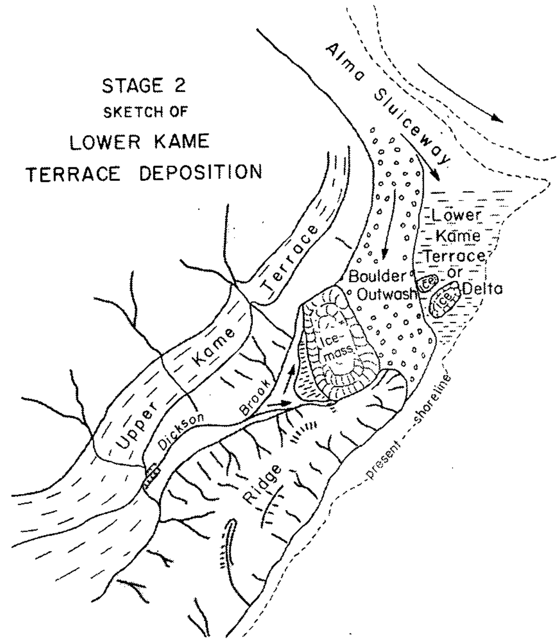

FIG. 4 Late glacial and Recent history of Fundy Park – Stage 2.

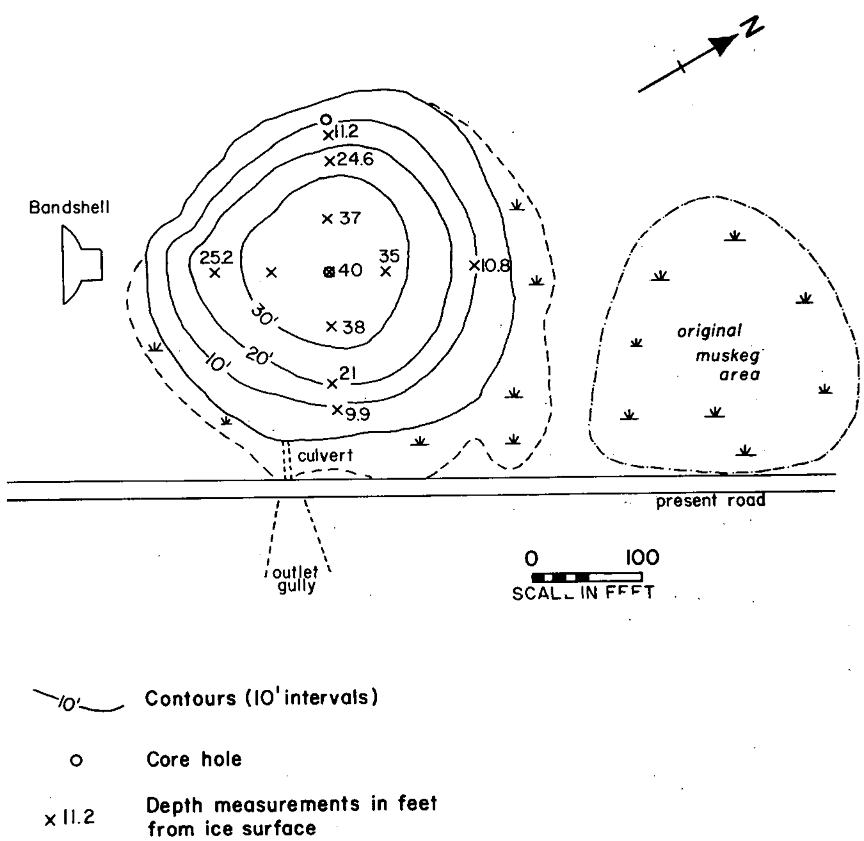

FIG. 5 McLaren Pond, Fundy National Park (Sketch map after Christie, D.S., Internal Park Report, 1968).

An example of a patchy valley train occurring 1500 feet downstream from the bridge on Laverty Brook was examined in some detail. At that place, medium to coarse-grained cross-laminated, lithic sand, composed of about 50% sub-angular fragments of fine-textured igneous rocks and schists, plus micas, feldspars, etc., is there overlain by a capping of bouldery outwash about 4 feet in thickness.

(c) Deglaciation and Interpretation

The history of the drainage systems, of the stratified drift and of most of the erosional features described is one of deglaciation and of stagnating ice-masses during times of crustal depression and higher sea-levels.

Glacial ice is likely to form stagnant patches and isolated masses when downwasting lowers the ice surface below drainage divides. Absence of moraines and abundance of ice-contact stratified drift deposits with long esker systems are generally thought to be evidence for stagnant ice conditions.

Three stages in the late glacial and Recent history of the area are conceived:

Stage 1 (Fig. 3). A large body of stagnating ice became trapped in Dickson Valley between the Caledonian massif to the northwest and the Carboniferous ridge next to the Bay. Meltwater and abundant rock material carried with it down the Alma River sluiceway overflowed, in part, between this ice-mass and the upland, depositing rock material of heterogeneous composition and size to form the high-level kame terrace. Thence, drainage proceeded down the valley of Hueston Creek to Point Wolfe Cove to the southwest.

Contemporaneously, the sea-level was much higher than at present, conceivably near that of the deposited kame, as evidenced by the base-level of the crevices and sea-cliffs north of Herring Cove and again west of the Chalets.

Some of the drainage from the stagnant ice-mass apparently took place in a col channel over the Carboniferous ridge, as a saddle and raised sea-cliff above the shore one mile northeast of Herring Cove seem to attest.

Stage 2 (Fig. 4). Wastage of the trapped ice, and probably crustal uplift (or sea-level fall) proceeded until only about half the length of Dickson Valley was occupied by the ice. A new base-level was reached about 100 to 150 feet above the present sea-level. At that time, the loaded river, jammed with outwash debris and large blocks of glacial ice, effectively blocked the Dickson Valley exit toward the Alma River mouth with a thick mass of hummocky, eskeroid material. The former front of the captive ice-mass can be traced northwards along the hillside just west of Highway 114 where a sharp line marks the edge of the Alma River outwash belt: west of the contact occurs crevassed and gullied bedrock; east of it, bouldery outwash.

Next, a new kame terrace built up behind the ice in Dickson Valley, and along the river east of the bouldery outwash just mentioned another kame or possibly an outwash delta formed. Several blocks of glacial ice were caught and buried there beneath outwash at this stage, to melt later, and the overlying outwash caved-in to form depressions. This is believed to be the origin of McLaren Pond and several smaller depressions just to the north of it. One such depression has apparently been filled during development of the Playground area.

Further evidence for this second stage is to be found in the odd configuration of one of the principal streams entering Dickson Brook from the north. On entering the main valley, it swings toward the head of the main stream to join it at an obtuse angle, thus going around a portion of the low-level kame terrace which, therefore, must have been built up in contact with the upstream side of the main valley ice-mass.

Stage 3. Unable to exit near the Alma River mouth, in the third stage following renewed and final uplift, Dickson Brook by necessity began to carve a new channel through bedrock to its present mouth near the swimming pool. From the vantage point of the small bridge the stream can be seen eroding its channel through bedrock at the present time. The lower end of the valley probably contained a small lake, as evidenced by the flat surface thereabouts.

The unblocking of Dickson Valley, together with further crustal rebound since final deglaciation of the area, accounts for the youthful nature of Dickson Brook and its tributaries. These have not only greatly dissected, and cut through the high-level kame terrace, but have incised steep gorges for themselves. Dickson Falls and its gorge provide a good example of this rapid downcutting; even little McLaren Pond has carved an outlet into the Bay.

Perhaps, in the final stages of deglaciation, a local ice-cap occupied a dwindling area on the highest hills in the central and northwestern area of the Park.

A relatively limited amount of glacial materials occurs on the Upland. Haley Brook and Broad River both have fairly abundant outwash along their valleys with braided channels and, for part of their courses, both flow in broad, rounded, glacial troughs.

(d) Post-glacial and Recent Topographic Development

1. McLaren Pond (Fig. 5). Originally somewhat elongate in shape, and with a bog to the northeast about the size of the present pond (Christie, 1968), this small lake has been infilled and dredged to a subcircular form during early Park development. Hence the bottom configuration has been considerably modified. However, the evidence obtained seems to support the theory of its origin as a kettle. It is a round-bottomed lake some 40 feet deep at the centre.

Several cores were obtained from the lake-bottom by the Muskeg Research Institute, Fredericton, New Brunswick. One from mid-lake measured 19 metres (60 feet), but was proven to be worthless due to mixing of the bottom sediment. Another from near the west bank, where no dredging nor modification had been done, measured 7 metres (24 feet), of which 187 cm

TABLE 1

Pollen Counts

A - Per cent of Total Arboreal Pollen								
cm. from water-sediment interface	2	51	72	112	147	167	182	186
Pine	12.4	29.4	29.3	44.0	22.3	12.7	52.2	29.7
Spruce	8.5	2.4	1.3	3.5	1.4	1.9	2.2	4.1
Fir		3.2	2.0	2.5			2.0	2.0
Hemlock	.6	.4		2.0		1.9		.5
Larch		2.8	.6		.9			1.0
Birch	38.9	36.7	32.2	26.5	63.0	69.8	29.0	35.4
Alder	3.9	.4		1.0		.9	1.6	1.0
Hornbeam	25.7	6.4	13.3	13.5	.5	2.8	6.6	12.3
Hazel	1.0	1.6	.7				1.1	3.6
Beech	1.6	15.3	14.0	4.5	7.1	1.9	1.4	6.1
Oak	.6	.8	.7	1.5	2.8	1.9	1.6	2.0
Elm				.5	.5	1.4		
Maple			1.3		.5			.5
Sycamore?	5.9			.5		4.2		
Ash	1.0	.4	2.8				1.6	
Willow			1.3		.5	.5	.6	1.0
Hickory					.5			
Walnut	.3							.5
Total A.P.	307	248	143	200	211	212	362	195
B - Actual Counts per sample (approximately 200 per sample)								
Ericaceae		3	6				5	4
Gramineae	6	1		1		6	1	4
Compositae	19			1		4	1	1
Rosacea	28	2	3	1			x	x
Ilex			2				5	4
Nymphaceae		1						
Nuphar							1	1
Myrica	1							
Typha	16			4			2	

(6 feet) were usable. Boulders or logs prevented deeper penetration in both cases. Coring attempts were also made in a small depression 400 feet west-northwest of McLaren Pond as well, but the bouldery overburden was impenetrable.

Pollen analysis of the core obtained was done by Dr. Jaan Terasmae, Geology Department, Brock University. The writer is most grateful for permission to publish this data, so kindly given by Dr. Terasmae. The latter is of the opinion that the coring did not reach the oldest postglacial deposits, and hence the pollen sequence is incomplete at the base. However, the remainder of the sequence compares reasonably well with pollen diagnosis from New Brunswick. Dr. Terasmae's pollen data are presented in Table 1. Figure 6 is a copy of his Grand Falls pollen diagram as an example of a representative postglacial pollen sequence for the northern part of New Brunswick.

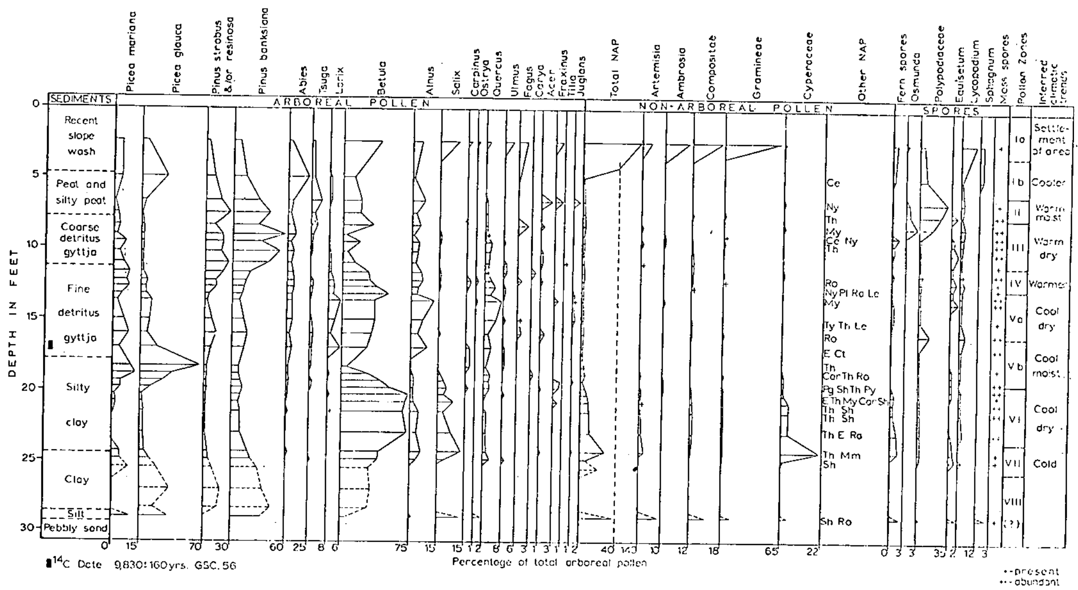

FIG. 6 Grand Falls, N.B. Pollen diagram (Pers. Comm. after J. Terasme, Brock Univ. St. Catherine's, Ontario)

ABBREVIATIONS

						Cy	Cyperaceae		Py	Polygonaceae
Am	*Ambrosia*		Mm	*Myriophyllum*		E	Ericaceae		Ra	Ranunculaceae
Ar	*Artemisia*		My	*Myrica*		El	*Elaeagnus*		Ro	Rosaceae
Car	Caryophyllaceae		Ne	*Nemopanthus*		Ep	*Epilobium*		Ru	*Rumex*
Ce	Chenopodiaceae		Nu	*Nuphar*		Gr	Gramineae		Sh	*Shepherdia*
Co	Compositae		On	Onagraceae		Ix	*Ilex*		Sr	*Sarracenia*
Cs	*Cornus*		Pg	*Potamogeton*		Le	Leguminosae		Th	*Thalictrum*
Ct	*Comptonia*		Pl	*Plantago*		Me	*Menyanthes*		Ty	*Typha*

Radiocarbon dating from the bottom 40 cm (1.5 feet) of the usable core gives an age of 5,300 ± 105 years BP, (Brock University Laboratory, No. B.G.S.-18) and thus the lake and the low-level kame terrace must be considerably older in origin. A general rise in sea-level occurred about 3,000 to 5,000 years ago (Lyon and Harrison, 1960).

2. Shoreline. Steep sea cliffs rising to several hundreds of feet bound Fundy Park along the Bay, broken only by coves at Point Wolfe, Goose River mouth and the mouth of Mile Brook. In many places the cliffs display a typical notch or nip at the base, where waves at high tide have undercut the rock (Fig. 7). Sea-cliffs of comparable size occur from the swimming pool north to the Alma River, but are there cut in glacial outwash. A narrow abrasion platform is present here; it is wider at Joel Head across the delta.

Stacks or chimneys are not common, but an exceptionally good example occurs on the coast due south of the Agricultural Station.

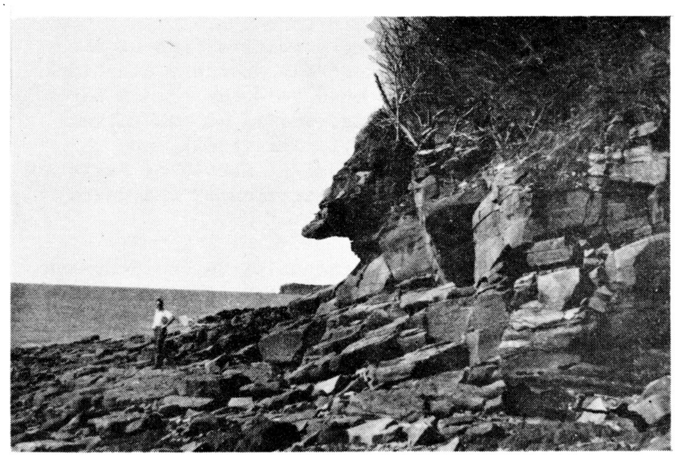

FIG. 7 Notch or "nip" in gently dipping Boss Point sandstone, about 2 miles north of Herring Cove, N.B.

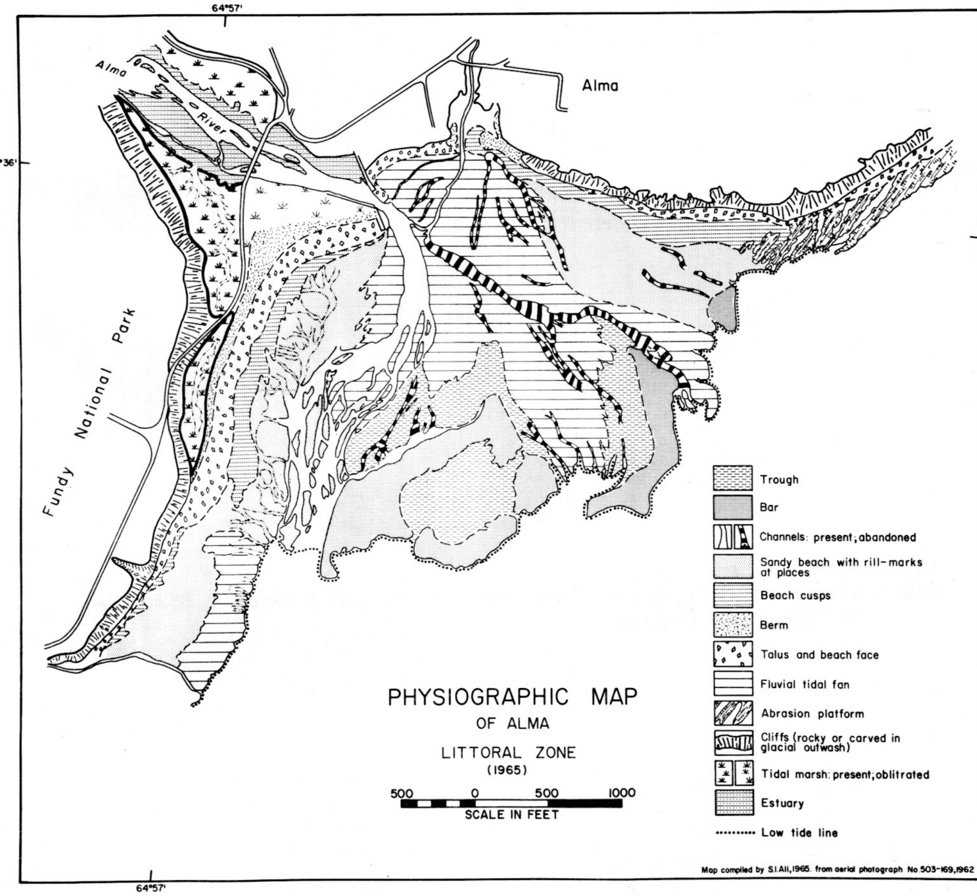

FIG. 8 Physiographic map showing extent of delta, stream channels and tidal marshes in 1962 around Alma, N.B.

3. Delta. The delta of the Upper Salmon (Alma) River is one of the most interesting features of the Park. A width of almost .5 miles is exposed at low tide, when the river waters are able to mold the sand and gravel being brought down. When the tide races in, the delta becomes a battleground for the waters of the sea and those of the river.

Figure 8 shows the approximate extent of the delta and the location of stream channels and tidal marshes in 1962. It has been re-drawn from a map which formed part of a M.Sc. thesis at the university of New Brunswick by S.I. Ali (1962), now Deputy Director of the Geological Survey of Pakistan, who has kindly permitted publication of the delta information presented here.

The river channel on the delta is braided, and has frequently changed its course. At present the channel lies a considerable distance to the east of that shown in the sketch.

Several features of Alma Delta are worthy of special attention or explanation:

1. Much of the delta is made up of reworked and rounded coarse gravel and boulders derived from the glacial outwash of the lower end of the river in the Park area. However, estuarine muds are also present in the tidal marshes and the estuary itself. Gravel in these muds was probably rafted in by the winter ice.

2. The marshes are typical of deltas, and in the summer are covered with salt-grass much like that in the great marshes that lie along the Fundy shore to the northeast. These marshes are contained by low levees on the channel side, which are built up of sediment deposited from waters slowed down on overflowing their banks during spring or storm tides.

3. A changing complex of beach cusps, berms, old channels, bars, tidal fans and sandy beaches comprises the delta proper.

4. Besides the features mentioned, many well-developed minor sedimentary structures can be observed on the delta at low tide. These include rill marks, beach chutes, ripple marks and animal trails and borings.

Hence, within a small area of the delta, estuarine, beach and delta environments are to be seen. The processes of channel-shifting and bar-building on this fluvial tidal fan are analogous to those on large and famous deltas of the world such as the Mississippi or the Nile. The principal difference, besides size, is in the coarser grade of the sediments handled at the Alma River mouth. They are derived from the abundant glacial outwash deposits and from the eroding bedrock of nearby highlands.

4. Rejuvenation. The abrupt sea clifs on the shore, the numerous falls and rapids, and the V-shaped cross-profiles of most of the streams and rivers in the area all attest to recent uplift of this area--probably crustal rebound when the great weight of the ice-sheet was removed following deglaciation. However, it is interesting to find within the Park remnants of the original pre-uplift peneplain surface.

The upper portion of the Broad River drainage system is one such remnant: the falls on the river mark the limit of headward erosion of the stream following crustal uplift. The valley is a typical "two-cycle" valley, and the elevation at which the falls occur--about 650 feet--marks a nickpoint (Fig. 9). Limits of renewed erosion on other streams occur at about the same elevation on Lake Brook, Upper Vault Brook and Laverty Brook. The upper falls on Bennett Brook, previously mentioned, is also at a limit of headward erosion, and is at a nickpoint.

Further evidence of this pronounced topographic unconformity abound in the park: on Keyhole Creek, on the brook draining Marven Lake, on Mile Brook, and on the ridge north of Herring Cove Road. In fact, once aware of its existence, this nickpoint is seen to be ubiquitous throughout the Park on rivers and streams, hillsides and sea cliffs.

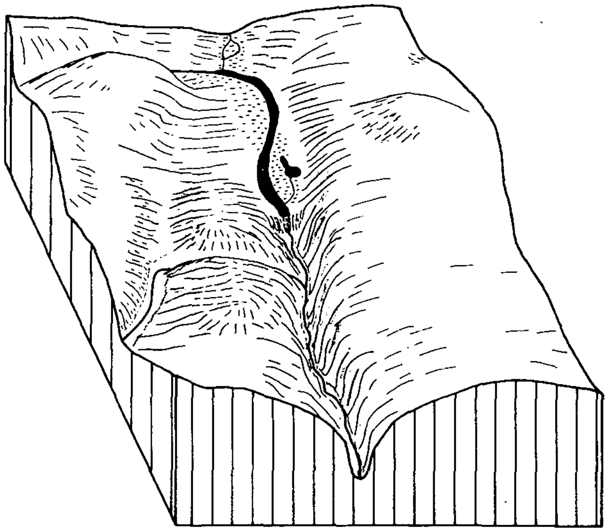

FIG. 9 Diagram of Broad River Valley to show nickpoint and head of valley rejuvenation.

It is well to state, however, that considering the hard crystalline rocks in which it is developed this nickpoint may be a relict from a more ancient time.

An additional effect of this recent rejuvenation appears to have been stream piracy. Haley Brook, which, as already mentioned, occupies a rather broad, probably a glaciated valley, may once have been an old glacial outlet, flowing northward beyond the Park limits into the Pollett River. The latter was probably one of the chief drainage channels for the local ice cap which occupied the Caledonian Upland (vide Prest and Grant, 1969). Some confirmatory evidence for this is seen in a prominent (on aerial photographs), north-trending, rounded, dry, glacial trough extending south in line with Broad River from the junction with Haley Brook.

Rejuvenation has apparently given the Alma River and its tributary, the Broad River, greater ability for downcutting and headward erosion than the Pollett River, which is farther from its base-level, with the result that Haley Brook and Laverty Brook have been captured and now drain southward into the Alma River. They have supplied the latter with great quantities of outwash material in the postglacial period. This may be inferred from the thick deposits of outwash that lie on either side of the River just above its mouth, as well as from their abundance in the relatively large delta itself.

Geomorphological History and Conclusions.

Much of the history of landscape evolution in Fundy National Park has been incorporated within the body of the text. To recapitulate: rocks forming the Caledonian Highlands were probably deposited and intruded in the Precambrian, and were further deformed and faulted against the later-deposited Carboniferous along part of the Fundy shore some time near the end of the Palaeozoic Era. Erosion has been more-or-less continuous to the present day.

During the Pleistocene, Fundy Park, like most of Canada, was covered by continental ice-sheets, which formed and abated many times. During the last phase a local ice-cap presumably occupied the highest part of the Caledonian Upland. Some gouging and deepening by moving ice took place along belts of weaker rock, as well as in parts of the Bennett Brook and Laverty Brook drainage systems.

A displaced ice-mass lodged in the valley of Dickson Brook, necessitating drainage--and deposition of a high-level kame terrace--from the Alma Sluiceway to take place behind the blockage, and down Hueston Valley to Point Wolfe Cove. Wastage of this huge block of ice proceeded, with a major halt when the sea-level was just over 100 feet higher than at present. At that stage--besides the burial of spawned chunks of ice in the low-level kame terrace near the present Alma River mouth--crevicing and stack-formation took place on the steep-cliffed coast along the Bay.

It is quite possible that the final rebound of the earth's crust in this area should be correlated with the development inland of a topographic unconformity and nickpoint at an elevation of about 650 feet.

Final melting of the ice remnant in the northwest portion of the Park upland has resulted in the deposition of heterogeneous valley train and outwash features along valleys and in depressions. This has produced a typical derangement of streams, as well as the series of tandem lakes and ponds on the Bennett and Laverty drainages.

Continued sea-level fall, with concurrent erosion and deposition to the present time, have added the final touches to the Fundy Park landscape: the precipitous cliffs and ever-changing delta on the seashore, and the falls, gorges and terraces on the streams and rivers. Only scattered traces of the glacial and postglacial past persist-patches of outwash deltas and kames, eroding terraces and gravel beaches, and remnants of rounded, glacial troughs on an ancient peneplain surface.

References

ALI, S.I., 1965, Study of Recent sediments of the beach and delta at the mouth of Alma River (Bay of Fundy), Unpubl. M.Sc. thesis, Geology Department, University of New Brunswick.

BAIRD, D.M., 1960, Rocks and scenery of Fundy National Park, Geol. Surv. Can. Misc. Report 2.

CHRISTIE, D.S., 1968, Fundy National Park Report, mimeographed.

FLINT, R.F., 1957, Glacial and Pleistocene geology, John Wiley & Sons, Inc., New York, N.Y.

HOWIE, R.D. and CUMMING, L.M., 1963, Basement features of the Canadian Appalachians, Geol. Surv. Can. Bull. 89.

KINDLE, E.D., 1962, Point Wolfe, N.B., Geol. Surv. Can. Map 1109A.

LEE, H.A., 1960, Late-glacial and postglacial Hudson Bay sea episode, Science 131, no. 3413, p. 1609-1610.

LOUGEE, R.J., 1954, The role of upwarping in the postglacial history of Canada, Revue canadienne de geographie, 8, nos. 1-2.

LYON, C.J., and HARRISON, W., 1960, Rates of submergence of costal New England and Acadia, Science 132, p. 295-296.

PREST, V.K., 1963, Pleistocene geology and surficial deposits, in Geology and Economic Minerals of Canada, Geol. Surv. Can. Econ. Geol. Ser. no. 1, p. 443-493.

__________, and GRANT, D.R., 1969, Retreat of the last ice sheet from the Maritime Provinces-Gulf of St. Lawrence region, Geol. Surv. Can. Paper 69-33.