CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

PAPER 56-2

SURFICIAL GEOLOGY OF FREDERICTON, YORK AND SUNBURY COUNTIES NEW BRUNSWICK

(Preliminary Report and Map 2 - 1956)

By

Hulbert A. Lee

OTTAWA

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Price, 50 cents

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SURFICIAL GEOLOGY OF FREDERICTON MAP-AREA, NEW BRUNSWICK

INTRODUCTION

Field work in the Fredericton map-area was carried out in part of 1951 and in 1954. Intensive work was done on the geology in cleared areas and along roads. In wooded areas work was largely restricted to those places where it was deemed advisable, from a study of air photos, to make ground observations.

The writer was ably assisted in the field by R. M. Wall in 1951 and by P. O. Hachey in 1954. He is indebted for data on bore-holes to David Sullivan, well-driller; to George Giles of Defence Construction (1951) Limited; to W. L. Barrett, engineer of the city of Fredericton; and to the engineers of the New Brunswick Hydro Electric Power Commission. Without the sub-surface data so provided some of the columnar sections could not have been constructed.

Relief and Drainage

The surface of the Fredericton map-area is in general undulating to rolling with a considerable area of swell and swale topography. Average elevations are 100 to 300 feet above mean sea-level in the eastern part of the area and increase to about 450 feet in the western part. Exclusive of the river valleys the local relief is about 50 feet, but it is greater near streams. For example the Saint John River is about 200 feet lower than the high tops of the valley bluffs.

Prominent elevations above the general level of the land include Mount Harvey, Porcupine Mountain, and Horseback Ridge. Mount Harvey, in the extreme southwest corner of the map-area, rises abruptly 350 feet above the surrounding land and can be seen clearly from as far as the village of Keswick Ridge 19 miles to the north-northeast, on the north boundary of the area. Porcupine Mountain, 9 miles northeast of Mount Harvey, forms the rim of one segment of a west-facing escarpment developed on quartz-pebble conglomerate. The escarpment is about 100 feet high and extends southward from Porcupine Mountain to leave the map-area where it crosses the Hanwell Road. This road trends almost directly northeast across the map-area to the city of Fredericton. Horseback Ridge, in the south central part of the map-area, is a high segment of an esker that may be traced intermittently to the northern side of Porcupine Mountain.

Drainage is poor throughout the area and there are numerous swamps and bogs in low places. Some of the smaller swamps occupy depressions in the impervious clay till, whereas others occupy swales that reflect underlying bedrock structures. Also on either side of the Oromocto River, which occupies a drowned valley, there is a wide strip with numerous lakes and ponds.

Former Ice Movement and Frost Action

Drumlins and glacial striae trend southeast and indicate former glacial flow in this direction. That the ice motion was to the southeast rather than northwest, is indicated by certain glacial features developed on bedrock outcrops along the New Maryland Road about 2 miles south-southeast of the city of Fredericton. These include stoss-and-lee features well displayed on sandstone, knobs-and-trails, and chipping of the southeastern parts of pebbles exposed in the conglomerate. Granite is the most numerous of the glacial erratics transported from the northwest into and across the area, and is especially prevalent in the western half.

Evidence of former frost features, such as involutions, stone rings, and trains of broken rock are present. Contortions, believed to be primarily formed by frost action, are numerous in upper layers of the red shale that outcrop along a road 1 mile east of the Maritime Ranger School in the city of Fredericton. Stone rings are developed south of the settlement of Rear Maugerville near Portobello Creek in the northeastern part of the map-area. Parallel bands of broken angular rock, which may represent former rock glaciers, trend southeast from an outcrop 2 miles north of Yoho Lake in the southern mid-western part of the map-area.

DESCRIPTIONS OF DEPOSITS

Bedrock

Major divisions of the bedrock are mapped according to the standard geological systems with only the larger areas of outcrop shown on the accompanying map. Boundaries are modified by the writer from those shown by Bailey, Matthew and Ells (1884)[1].

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[1] Geol. Surv. Canada, Map No. 2SW, New Brunswick, 1884.

Where the mantle over the bedrock surface was not completely cleared-off by the ice-sheet, a regolith (A) from several inches up to 3 feet or more in thickness was left. An example of deep decomposition of bedrock is to be seen in an outcrop of Devonian granite along the Mactaquac River, for there, throughout the full 10-foot depth of exposure, individual crystals of feldspar and quartz are easily separated between the fingers. Indeed the till derived from the granite batholith contains more discrete crystals of feldspar and quartz grains than granite fragments. Two other more widespread areas of decomposed rock (A) are south of Fredericton where the upper 3 feet of normally red shale and siltstone are decomposed to a brown silt.

The age of the weathering is not known beyond the fact that it is post-Pennsylvanian and preglacial till.

In many places within the Fredericton map-area bedrock is near the surface but covered by rock rubble. In some places these areas of rubble (A) are sufficiently large to outline and are shown on the accompanying map.

Pre-Till? Gravel and Sand

Gravel and sand were found underlying till at two places approximately 22 miles apart. In one bore-hole on the eastern side of the Oromocto River (locality 18BH) the following sequence was encountered, measured from the surface:

	Thickness (feet)
(a) mixed sand and clay - - - - - - - -	3
(b) silt - - - - - - - - - - - - - - - - -	1
(c) till - - - - - - - - - - - - - - - - -	156
(d) gravel, sand - - - - - - - - - - - -	56
(e) bedrock at 216 feet.	
Total thickness	216

Unbroken pebbles from the gravel and sand are rounded to well rounded. No weathered or organic material was found in the cuttings that would indicate the presence of a soil profile, thus the sand and gravel is probably the same age as the till and hence may have originated as glacial outwash deposited ahead of an advancing ice margin.

A second exposure of the pre-till? gravel and sand is near the settlement of Smithfield, about 4 miles northeast of Mount Harvey, (locality 13) where a section shows the following:

	Thickness (feet)
(a) grey-brown till, fragments of shale numerous - - - - - - - - - - - - - - -	1.5
(b) reddish brown till, fragments of red conglomerate and granite - - -	2.0
(c) yellow-brown sand, crossbedded- -	8.0
Total thickness	11.5

The base of the sand was not reached so that the sand may be a lens within a till body, rather than underlying it. Sand and gravel layers within till are, however, rare in New Brunswick, and a thickness of over 8 feet of sand below the exposed till almost eliminates the possibility of the sand being a lens. If the lack of soil profile is considered, then the till and gravel are approximately the same age, hence, as the gravel underlies the till, it was probably deposited as glacial outwash in front of an advancing ice margin.

Glacial Deposits (1-2)

Drumlins (1). In Fredericton map-area drumlins are composed of sandy till, as revealed by a 30-foot cut through the northern tip of the centermost drumlin, 4 miles south-southeast of the city of Fredericton, and by dug-holes in other drumlins.

Ground moraine complex (2). Materials at the surface in the swell and swale topography are varied, with generally broken shattered rock at the tops of the swells, a small exposure of bedrock part way down the slope, till farther down, and finally up to 3 feet thick of semi-stratified wash-material at the base. Because these separate areas of till, shattered rock, wash material, and bedrock are too small to map individually they have been grouped for map purposes as ground moraine complex (2).

The till, within the Fredericton map-area, occurs as patches and lenses, in most places less than 3 feet thick and in many only a few inches. The only thicker deposits are in the drumlins and on the east side of the Oromocto River where, in a borehole (locality 18BH) 156 feet of till was encountered.

Till in the area of pre-Carboniferous rocks is generally buff in colour, silty and stony in composition, and contains a high percentage of greyish black slate pebbles. Numerous granite erratics are strewn over the land surface in the western part of the area, which have come from the adjacent granite terrain to the northwest.

In the area underlain by Pennsylvanian rocks, where interbedded red shale and grey sandstone are common, there are several types of till; red clay till, a brown, very sandy till, a buff sandy till, and various mixtures of these. Adjacent exposures of distinct red clay till and buff sandy till are not uncommon. Red clay till is found to overlie, or occasionally to be a short distance down the direction of ice flow from red shale bedrock. Buff sandy till, on the other hand, is similarly distributed with respect to grey sandstone bedrock. A brown sandy till found in the vicinity of Yoho Lake contains large erratics of quartz-pebble conglomerate derived from the rocks of Porcupine Mountain.

In the area underlain by Mississippian (?) rocks, two tills are exposed, and in places are superimposed. These are a red clay till with numerous rock fragments of red shale and a grey clay till with grey slate pebbles. About 2 miles northeast of Mount Harvey (locality 12), 2.5 feet of red clay till overlies 2.3 feet of grey clay till. In some places the superposition is reversed and the grey till is found over the red. On the contact between the two tills (locality 12) was found a flat rock slab with striations on the upper surface trending south 50 degrees east, approximately parallel with one set of glacial striae on the nearby bedrock. A shift in the direction of ice flow is indicated from southerly (one set of striations) to southeasterly, and this shift appears to have been sufficient to change the source of debris being deposited at this place. This simple explanation could account for the varied superposition of the two tills.

Glacio-fluvial Deposits, Phase 1 (3-4)

Eskers (3). Several short eskers occur along the Saint John River in the western part of the map-area, and along the Nashwaak River in the northeastern corner of the area. These trend southeast and south respectively. The most prominent esker, however, is to be found in the south central part of the area where it continues with some breaks for about 14 miles and in places has a relief greater than 75 feet.

Kame and outwash (4). Kame and outwash occur in association with many of the eskers and as disconnected areas forming ridges or plateaux on the higher land. Some of the disconnected plateaux areas may possibly represent raised beaches, but there is no definite evidence to support such an interpretation.

Glacio-lacustrine Deposits (Possibly in part Estuarine)

Beds of clay and silt are found below an elevation of 125 feet above mean sea-level, and are consequently more or less restricted to strips along the valleys of the Saint John River and

its tributaries. The combined thickness varies rapidly and unpredictably over distances of a few hundred feet. Locally the beds are absent below the 125 foot contour, yet in other places they are at least 115 feet thick (city of Fredericton, locality 7BH).

In exposures in the city of Fredericton and in the eastern part of the map-area strata of buff silt up to 15 feet thick overlie 5 feet or more of grey, banded clay. Varved clay is exposed in numerous places west of the city of Fredericton, such as at Garden Creek 1/4 mile above its mouth, and along Currier Creek. The varved clay is below the buff silt and may be equivalent in age and origin to the banded grey clay. Alternating beds of clay, silt, and sand are exposed at the mouth of the Keswick River and are interpreted as a facies of the clay and silt beds.

The following section is exposed at the brickyard in the city of Fredericton (locality 15):

	Thickness (feet)
(a) buff silt, indistinctly laminated and with black matter along parting planes - - - - - - - - - - - - - - - -	15
(b) grey clay, banded, with red laminae - - - - - - - - - - - - - - -	5 exposed
Total exposed thickness	20

Fragments of carbonaceous matter from the bottom part of the buff silt strata were identified[1] as the outer coating (Periostracum) of

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[1] Identification by Dr. Frances Wagner, Geological Survey of Canada.

?Yoldia arctica (Gray) a marine species but tolerant of muddy and brackish water conditions, such as are found at the mouths of glacial streams.

In North Devon (locality 8), a section exposes 4 feet of buff silt overlying banded grey clay, with a sharp contact between them.

Along the Rusagonis River in the mid-southeastern part of Fredericton map-area (locality 17) there is a foot of buff silt over grey banded clay.

The beds of clay and silt are interpreted as follows. First, the clay strata is interpreted, on the evidence of the excellently developed varves, as the deposit of a glacial lake. It is not

apparent however why, in parts of the area, the clay strata are varved and in other parts are only colour banded. Second, the buff silt stratum is tentatively interpreted as the deposit of an estuarine environment. Narrow embayments or fingers of a former arm of the sea would no doubt have received considerable fresh water from both sides of the embayment and from meltwater coming off the ice-sheet vanishing to the northwest. Such an influx of muddy fresh water into a long fingerlike arm of the sea would form the muddy, brackish water favourable for the species Yoldia arctica, and could account for the interlayered thin beds of clay, silt, and sand near the mouth of the Keswick River, whose valley was a main meltwater run-off channel.

The variation in thickness of the combined clay and silt beds depends on two known factors. First, the deposits were laid on uneven surfaces of bedrock and till, and second there has been deep erosion of the clay and silt beds by meltwater streams.

Glacio-fluvial Deposits, Phase 2

Valley train (6). Beds of gravel and sand extend along the valleys of the Keswick, Nashwaak, and Saint John Rivers filling deep channels in the underlying clay and silt deposits, and forming a blanket over them. The average thickness of the gravel and sand is about 30 feet, but it appears to thicken east of Fredericton where it is reported to be 300 feet thick in a bore-hole at Barker's Point, and 400 feet thick in another bore-hole at Fredericton Municipal Airport (David Sullivan, personal oral communication). Cut and fill structure is superbly developed in the gravel and sand deposits and shallow crossbedding is prevalent. The top level of the gravel and sand strata is near the 300-foot contour along the valley of the Keswick River and thence downstream along the Saint John Valley. Yet farther up the Saint John River, above the entrance of the Keswick, the gravel and sand deposits are much thinner and have their tops about 200 feet above mean sea-level. A glacio-fluvial (valley train) origin for the deposits, with a source up the valley of the Keswick River, is indicated, first, by the large volume of gravel and sand which in part occupies deep channels trenched into the clay and silt strata and second, by the gradient along the valley of the Keswick River and on down the valley of the Saint John River.

Mapped with the valley train deposits, and resting directly on them, are beds of gravel and sand deposited during modern floods and spring freshets. These recent deposits are most prevalent near the village of Upper Maugerville.

Early post-Glacial Deposits (7-9)

Colluvial deposits (7A, 7B). Colluvium is a general term to cover all materials produced by mass-wasting processes. It includes all materials on slopes and at the base of slopes brought there by downhill movements, such as landslide and slope-wash deposits. Colluvium is widely distributed throughout Fredericton map-area but only in a few places is it sufficiently continuous and thick enough to warrant mapping, elsewhere the underlying deposit is the material mapped.

There are three types of colluvial deposits within Fredericton map-area. The first type is prevalent within the area of ground moraine complex and is on gentle to moderate slopes and in local basins and swales. The material is a mixture of sand, silt, clay, and pebbles, which form semi-stratified deposits up to 3 feet thick. The widespread distribution of this phase of colluvium may suggest a relatively long period of post-Glacial erosion, possibly since mid-Wisconsin time, or perhaps a more intense period of general land degradation over a shorter period.

The second type of colluvial deposits (7A), is characterized by material concentrated on steep slopes along streams and in the valley bottoms where it may be partly sorted and grades towards alluvium. The thicker deposits of this second type are along Waasis Creek and Rusagonis River (locality 17) where, at the latter place, 5 feet of mixed sand, clay, wood, and muck overlies the beds of clay and silt (6).

The third type of colluvial deposits (7B) is restricted to the valleys of the Saint John, Nashwaak, and Keswick Rivers. It is composed of sand and silt generally mixed with large rock slabs, and is found on steeper slopes contiguous with the valley train but where those deposits are locally absent. The thickness may be as much as 5 feet on the lower parts of slopes, but thins higher up on the valley walls. There is no sharp upper contact. The formation of this third type of colluvium may in part be correlative with the valley train.

Aeolian deposits (8). A sheet of windblown sand with some dune development is developed around Fredericton Municipal Airport. The dunes are about 75 feet high and are stabilized except for small blowouts. The outer limits of the sand sheet are indefinite.

Undifferentiated deposits (9). Those areas of sand and gravel which could not separately be classified as to origin, yet overlie the clay and silt beds are denoted here as undifferentiated. They include valley train deposits, windblown sand, and possibly lake sand.

Late post-Glacial Deposits (10-11)

Alluvial deposits (10). Most of the alluvial deposits are being formed during present day spring freshets and floods when the rivers, in particular the Saint John River, rise to about 20 feet above their low levels and in places flood their banks. Alluvial fans are formed where the swollen tributaries drop their heavy loads, on entering the main river. These fans are left hanging when the level of the main river falls. Many of the gravel bars are ephemeral features built where swift water is locally checked and its load of gravel is deposited.

During these periods of rapid run-off the streams take on a heavy load of suspended silt and organic debris. In many places, where the streams overflow their banks, temporary shallow lakes are formed on the flood plain, which on drying up leave a deposit of silt containing bits of wood and other organic matter. These are the floodplain deposits (10A) and they reach a maximum known thickness of 30 feet near the north shore of the Oromocto River near its mouth.

Swamp and shallow lake deposits (11). A large part of the map-area is swampy and ill-drained. Some of the permanently wet areas contain deposits of muck and peat and some contain clay and silt, whereas others, less permanent, are bottomed with impervious till without any mantle of peat, muck, clay, or silt. The most widespread distribution of peat and muck is in the 'barrens' which are areas up to 3 miles long and 1/4 mile wide; bare of vegetation except for sphagnum and other mosses, a few low herbs, and a very few scattered trees of tamarack and spruce. Innumerable other areas of peat and muck, too small to be mapped separately, are included in the area of ground moraine complex. Clay and silt in some swamps (11B) have been washed from surrounding slopes and deposited in the water of shallow ponds.

ECONOMIC GEOLOGY

Gravel and sand occur in abundance (see Map), larger sources being in the eskers (3), outwash and kame (4), and the valley train (6) deposits. Most of the gravel is composed of a high proportion of large separate grains and crystals of feldspar and quartz and to a lesser proportion of slate, shale, sandstone, and other types of rock fragments. This composition may make the gravel unsuitable for certain types of concrete aggregate.

Fine gravel, used in the manufacture of concrete blocks, is presently being excavated from the valley train at Barker's Point. The dunes provide a source of well-sorted (graded) sand, mostly between the grade sizes of 1/8 and 1/2 mm. diameter.

Brick and tile were formerly made of the buff silt and grey clay from the brickyard in Fredericton, but now brick and tile are made of red shale from the Pennsylvanian rocks by a different process.

The ground-water supply for many shallow wells comes from gravel and sand of the valley train. Other deeper wells draw from the buried outwash and kame deposits, or from bedrock. An occasional well taps water from the pre-till? gravel and sand beds.

DESCRIPTION OF SECTIONS

Localities 1 to 11 are shown as columnar sections.

		Thickness (in feet)
Locality 12		
(a)	Red clay till - - - - - - - - - - - - - - -	2.5
(b)	Grey clay till, changing to shaly till -	2.3
	Total thickness	4.8
Locality 13		
(a)	Grey-brown till, fragments of shale numerous - - - - - - - - - - - - - - -	1.5
(b)	Reddish brown till, fragments of red conglomerate and granite - - - - - - -	2.0
(c)	Yellow-brown sand, crossbedded - - -	8.0
	Total thickness	11.5
Locality 14BH		
(a)	No information- - - - - - - - - - - - -	14
(b)	Grey varved clay - - - - - - - - - - -	61
	Total thickness	75
Locality 15		
(a)	Buff silt, indistinctly laminated with black matter along parting planes- - -	15
(b)	Grey clay, banded with red laminations - - - - - - - - - - - - - - -	5 exposed
	Total thickness	20
Locality 16		
(a)	Reddish sandy till - - - - - - - - - - -	1.5
(b)	Brown gravelly till - - - - - - - - - -	1
	Total thickness	2.5

		Thickness (in feet)
Locality 17		
(a)	Mixed sand-clay-wood-muck - - - - -	5.0
(b)	Buff silt - - - - - - - - - - - - - - - -	1
(c)	Grey laminated clay - - - - - - - - -	1.5
(d)	Red clay till - - - - - - - - - - - - - -	1
	Total thickness	8.5
Locality 18BH		
(a)	Mixed sand and clay - - - - - - - - -	3
(b)	Silt - - - - - - - - - - - - - - - - - -	1
(c)	Till - - - - - - - - - - - - - - - - - -	156
(d)	Gravel, sand - - - - - - - - - - - - -	56
(e)	Bedrock encountered at 216 feet - - -	
	Total thickness	216

Note: Locality 18BH is a bore-hole about 1 1/4 miles east of the map-area. It is located on the east side of Oromocto River at its confluence with St. John River, between low and high water docks and approximately 100 feet south of St. John River.