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# PAPER 46-12

# STRAIT OF CANSO MAP-AREA NOVA SCOTIA

(REPORT & MAP)

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M. & T. S. 1-4

CANADA
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GEOLOGICAL SURVEY
Paper 46-12

# STRAIT OF CANSO MAP-AREA, INVERNESS, RICHMOND, GUYSBOROUGH, AND ANTIGONISH COUNTIES, NOVA SCOTIA
(Summary Account)

By

S. A. Ferguson

OTTAWA, 1946

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Illustration


Preliminary map - Strait of Canso, N.S.

# STRAIT OF CANSO MAP-AREA, NOVA SCOTIA

## INTRODUCTION

The Strait of Canso map-area lies between north latitudes 45°30' and 45°45' and west longitudes 61°15' and 61°30'. It includes approximately equal areas on Cape Breton Island and on the mainland of Nova Scotia, with the Strait of Canso extending diagonally northwest between the two. The main line of the Canadian National Railways, from Truro to Sydney, crosses the area, and from Point Tupper a branch railway extends along western Cape Breton to the Port Hood and Inverness coalfields and another line leads east to St. Peters. A paved highway also crosses the area from east to west. Transportation across the Strait is by a fifteen-car railway ferry and a motor car ferry that will carry about twenty vehicles. A network of secondary roads is present on the Cape Breton side, but roads are less abundant on the mainland, and in the summer of 1945 those leading inland from Pirate Harbour and Middle Melford were not passable for motor cars. Mulgrave and Point Tupper are open to navigation throughout the year, but Ship Harbour freezes, closing Port Hawkesbury.

Detailed geological mapping was begun in 1945 in order to assemble information that may be of use in the location and construction of a proposed land connection across the Strait. Field work was begun under the guidance of W. A. Bell of the Geological Survey who, also, has identified the fossils collected. The Nova Scotia Department of Mines has made unpublished information available to the writer. Other geologists, including L. J. Weeks, D. J. MacNeil, Wm. Gussow, R.A. Brown, and N. W. Martison, visited points of geological interest and engaged in helpful discussion. Capable and willing service was given by members of the party which included Messrs. E. E. True, D. P. Manzer, E. L. Teed, and J. N. Marchand. The previous geological map of the area, by Fletcher, was invaluable for the accurate topographical and geological data it contained. Stratigraphic work by Hyde was also most helpful.

## TOPOGRAPHY AND DRAINAGE

Nova Scotia is characteristically a region of upland and lowland areas. The uplands are hills, mainly of resistant pre-Carboniferous crystalline rocks, which have steep slopes near the contact with the lowlands. Within the lowland region of Carboniferous sediments abrupt slopes are rare, and outcrops are largely confined to shorelines, creek beds, and along roads and railways.

This type of topography is fairly well illustrated on the Cape Breton Island side of the map-area but less well on the mainland. The highest point in the area, in the Creignish Hills, exceeds 850 feet above sea-level, and is occupied by a Geodetic Survey station. A large part of the surrounding lowland lies below an elevation of 300 feet; the rise to the upland area from the east is gradual, but the western flank is steep.

On the mainland side of the Strait the shores are higher and rise more abruptly than on the Cape Breton Island side. The hill,[1] south of Cape Porcupine, a small upland of crystalline rocks, exceeds 625 feet in height. Its immediate environs are at no great elevation,

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[1] Hereafter referred to in this report as Cape Porcupine Hill.

so that it is surrounded by steep slopes. However, the area here is mainly a plateau in which elevations from 400 to 550 feet are common and occasional domes rise to 600 feet.

The main streams are River Inhabitants, Little River, Goose Harbour River, and Clam Harbour River draining into the Atlantic; Harve Bouch Brook draining into the Gulf of St. Lawrence; and Melford Brook draining into the Strait of Canso. The longer streams tend to follow a northwest or southeast course parallel to the Strait. Near the shore many small brooks and occasional larger ones flow directly down the slope to the sea. Creignish Hills and an irregular area in the plateau southwest of Mulgrave form the divide between streams flowing into the Gulf of St. Lawrence and those flowing into the Atlantic. Nearly every watercourse flows through a rock canyon with cascades and falls throughout part of its length, although much of the rest of the course is not deeply incised.

River Inhabitants, the largest stream in the area, traverses the northeast corner of the map-area. It has a mature valley with gently sloping walls and low gradient, and for 2 miles along its course the valley flat has a width of $1\frac{1}{2}$ miles. The water is tidal to the Canadian National Railway crossing $5\frac{1}{2}$ miles from the open sea. At the northern edge of the map-area, the elevation of the river is less than 25 feet above sea-level.

## STRATIGRAPHY

The succession of strata in the Strait of Canso area is summarized in the following table:

TABLE OF FORMATIONS

| Age | Formation | Lithology | Thickness |
| --- | --- | --- | --- |
| Pennsylvanian | Riversdale group | Red and grey shales and siltstones; sandstones; coal seams near top. | Feet<br>10,000 |
| Mississippian | Canso group (Mabou formation) | Red and grey shales; siltstones and sandstones; thin limestone beds. | 3,342 - |
| | | ---- Disconformity ---- | |
| | Windsor group | Green and red shales, limestone, gypsum, and anhydrite. | 650 - |
| | | ---- Conformity to disconformity ---- | |
| | Horton group | Red and grey conglomerate, quartzite, arkose; red, grey, and buff shales | 3,600 |
| | | ---- Unconformity ---- | |
| Pre-Carboniferous (Precambrian ?) | | Granite, alaskite, diabase dykes (the dykes are in part of post-Horton age). | |
| | | ---- Intrusive contact ---- | |
| | | Andesite, chlorite schist, rhyolite, felsite; includes diorite and other intrusive types. | |

## PRE-CARBONIFEROUS

### Volcanic Rocks

The oldest rocks in the map-area consist mainly of acidic and intermediate volcanic rock types that in most localities are strongly altered. Included with them are probable intrusions of similar composition, which because of mineralogical and textural similarities and lack of outcrops in critical areas cannot be reliably identified. Amygdules constitute the only primary structure that is common, and in no locality could the attitude of the flows be determined.

The intermediate volcanic group is exposed on the south side of the Strait on Cape Porcupine Hill, north of the Strait as inliers in small outcrops near the shore, and in larger exposures in Creignish Hills north and west of Horton Lake. These rocks weather greenish to brown, are of medium to fine grain, and frequently show a diabasic texture. The feldspars show Carlsbad and albite twinning and range in composition from intermediate to basic andesine. In one locality augite is present, but more often chlorite is the predominant ferromagnesian mineral. Pyrite, titanite, and ilmenite are minor constituents. With increasing alteration the feldspars are replaced by carbonate and epidote. Chlorite and sericite (or talc) become the predominant minerals when alteration is sufficient to produce a pearl-grey schist.

Rhyolites occur in isolated patches on Cape Porcupine Hill and in Creignish Hills. In the central area of outcrop on Cape Porcupine Hill the rhyolite is strongly sheared and buff coloured, and the exposure on the southwest side of the granitic intrusion is pinkish. This area of felsitic rock might be a fine-grained phase of the intrusion rather than a metamorphosed volcanic rock.

### Possible Correlation with George River Series

In previous Geological Survey reports on this and adjacent parts of Cape Breton Island, Fletcher divided the pre-Carboniferous rocks into two groups: (1) syenitic, gneissoid, and other feldspathic rocks; and (2) George River limestone. In the marginal notes of Geological Survey Map No. 360A, Sydney Sheet (1938), Bell and Goranson redescribe in general terms the George River series at the type locality as essentially of sedimentary origin and composed of a quartzite-schist-gneiss member and a carbonate member. Field evidence suggests that the carbonate member overlies the other. Norman[1], in the Lake Ainslie area

[1] Norman, G. W. H.: Lake Ainslie Map-Area, N.S.; Geol. Surv., Canada, Mem. 177, p. 10 (1935).

18 miles to the north, has found similar lithological groups. Guernsey[2], . .

[2] Guernsey, T. D.: The Geology of North Mountain, Cape Breton; Geol. Surv., Canada, Summ. Rept. 1927, pt. C, pp. 51-56 (1928).

however, in the North Mountain area, adjacent to the Strait of Canso map-area, has included a volcanic member that he considers older than the other groups.

The carbonate member of the George River series is present in the unmapped part of this area. Further work may reveal that the volcanic group is part of the same series, as the degree of metamorphism corresponds with the alteration of that group.

## Intrusive Rocks

### Granite and Alaskite

Bodies of granite and alaskite show intrusive relations with the volcanic rocks. The largest and cleanest exposures are on the north flank of Cape Porcupine Hill (See Map), where steep cliffs face the Strait. Small, low outcrops occur in Creignish Hills.

The weathered surface of these rocks is generally pink to buff. They are medium-grained rocks with quartz usually prominent. The amount of dark minerals is low, so that in many localities the rock is alaskite. The major constituent is partly albite, but commonly is predominantly perthite. The cores of some feldspar crystals are more altered than the borders, which indicates a variation in original composition. The feldspars in specimens from Cape Porcupine Hill show twinning lamellae that are curved, and the crystals may also be shattered. Alteration products are sericite, saussurite, and epidote. The primary ferromagnesian minerals are now completely altered to epidote and chlorite. Pyrite, ilmenite, leucoxene, and apatite are present as minor constituents.

### Diabase Dykes

The two well-exposed diabase dykes shown on the accompanying map have widths of 15 feet; both dip steeply, and their strike varies from 5 degrees east to 10 degrees west of north. Along the railway track west of Cape Porcupine station a diabase dyke is exposed for 125 feet in a rock cut.

The most typical diabase is brown weathering, with cream-coloured feldspars showing the ophitic texture prominently on the weathered surface. The fresh surface is dark grey-green, with feldspars much less conspicuous. Feldspars, ranging in composition from intermediate, to basic andesine, and augite are the principal minerals; magnetite, ilmenite, and apatite are minor constituents. Chlorite, carbonate, leucoxene, epidote, biotite, and sericite are alteration products. One thin section shows a few grains of quartz.

Two of these dykes are associated with sedimentary rcoks, but the contacts are exposed only in the one in the branch of Auld Creek above the power house. There the dyke, showing chilled margins, cuts Horton quartzite at an angle of 15 degrees with the strike of the sediments and dips in the same direction but more steeply. These dykes are younger than the Horton beds that enclose them, but nowhere have they been observed to cut Windsor sedimentary rocks.

## HORTON GROUP

### Distribution and Thickness

The type locality for the Lower Carboniferous, Horton group is near Horton Bluffs at the mouth of Avon River, Nova Scotia.

Bell[1] has divided the group into the lower, Horton Bluff formation and

1 Bell. W. A.: Horton-Windsor District, Nova Scotia, Am. Jour. Sci., 5th ser., vol. I, p. 154 (1921).

the upper, Cheverie formation. These rocks have been traced eastward 140 miles to the Strait of Canso. They are exposed on the mainland throughout most of the present map-area, except where inliers of older rocks show through them, as on Cape Porcupine Hill, or where they are overlain by younger rocks near the Strait. On the Cape Breton side of the map-area they are exposed in and adjacent to Creignish Hills.

At the type locality the maximum thickness is about 4,000 feet, and in the Lake Ainslie area of Cape Breton Island the thickness is about 6,000 feet. No thick, detailed sections were measured in the Strait of Canso map-area during the past field season. The longest continuous section is exposed in East Brook, where, however, local folds and small faults have caused more or less repetition of beds. A composite section from outcrops along the roads, creek, and railway west of Mulgrave would give the best partial section available in the area; the structure there is thought to be simple. A graphical calculation from the data provided on the map would give an approximate thickness for the section exposed in this vicinity as 3,600 feet. Near Creignish, rocks of the Canso group are exposed within 1,650 feet of pre-Carboniferous andesite in a direction measured obliquely across the strike. This drift-covered interval is presumably underlain mainly by rocks of the Horton group.

## Lithology

The Horton group is not subdivided in this map-area. It consists largely of clastic rocks ranging from coarse boulder conglomerate to shales. Limestone beds and calcareous shales are known, but are not continuous over large areas, and carbonaceous shales, though present, are of no importance as a source of coal. Particular rock types are not separable into map-units, as they are intimately interbedded, and individual strata are lenticular.

### Conglomerate

The conglomerates are divisible into two groups on the basis of the grey and red colour of the matrix. The grey type is the more common and widely distributed. The thickest and most extensive red band is exposed on the hills west of the central part of Mulgrave, where the band is not less than 275 feet thick. The same conglomerate is exposed farther north in the creek that flows into the Strait at the railway ferry dock. It is underlain by a thinner band of grey conglomerate.

The conglomerates grade in coarseness from bouldery types to quartzites and arkoses. Pebbles more than 2 inches in diameter are well rounded, but fragments less than half an inch in diameter are usually quite angular. A conglomerate with most of its boulders more than 2 feet in diameter occurs in Creignish Hills on the east and north sides of a knoll forming a J-shaped outcrop. This locality is slightly less than 2 miles northeast of Troy station. The boulders are predominantly of pink granite with purple felsite and green andesite next in order of abundance. The more common types of conglomerate have pebbles ranging in size from 4 inches to ½ inch, and are composed mainly of white and pink quartz with pink and purple felsite next in abundance;

other pebbles are of pink granite and green andesite. Most conglomerates also contain a few pebbles of sedimentary rocks, but in no instance were they observed to comprise 25 per cent of the total assemblage. Most of the pebbles are not of local origin, as conglomerates lying on andesite contain very few pebbles of this type. The pebbles of the conglomerates are strongly cemented, so that the rock breaks through rather than around them. These beds are resistant to erosion, and the marker horizons in the southwest part of the area form ridges that rise from a few feet to 20 feet above the surrounding rocks.

In Creignish Hills, Horton conglomerate occurs on both the upland slopes and as isolated remnants on the summits. One such exposure overlies the pre-Carboniferous crystalline rocks at the highest point in these hills. These patches of conglomerate are no doubt relics of a once continuous sedimentary series.

### Quartzite, Sandstone, and Arkose

Throughout most of the map-area the sandstones are indurated to quartzite. More quartzite is exposed in areas of Horton strata than any other rock types. In the creeks that flow into the Strait at Pirate Harbour, and near the southwest corner of the area, where outcrops are abundant, quartzite is present almost to the exclusion of other rock types. The quartzite is white weathering, but is commonly greenish or grey on fresh surfaces, and may be micaceous. It is quite uniform in composition, with bedding planes spaced 8 inches to 2 feet apart. The attitude is readily determinable in creek sections, but in other localities where only low outcrops are exposed bedding cannot be distinguished from cleavage or sheeting except where coarser or finer material is associated with the quartzite. White quartz veins are often abundant in the quartzite, particularly near the southwest corner of the map-area.

The Horton rocks exposed on the shore of the Strait of Canso northwest of McDonald Brook are largely greenish sandstones containing abundant plant debris. They dip rather gently, and are less metamorphosed than other Horton rocks in the area.

Arkoses are common as occasional beds associated with other rock types, but nowhere constitute a series. The only thin section of an arkose examined showed quartz and feldspar grains in a fine matrix of quartz and chlorite. The feldspar is partly coarse perthite and partly a clear untwinned variety with a refractive index less than that of Canada balsam.

### Siltstones and Argillites

These rocks are differentiated from the quartzites, because they are finer grained and show a greater variety of colours, as black, grey, green, brown, and red. They are evenly bedded with individual strata 8 inches to 2 feet in thickness, and show no lamination nor cleavage. Concretionary calcareous nodules one-half to three-quarters inch in diameter are present in some of the grey beds.

### Shales

Variously coloured shales are known in the Horton group. They are most common as bands less than 20 feet thick associated with other sediments. An exceptionally thick shale band is exposed on the railway and road cuts just west of Port Hastings. The exposure along the railway track is about 148 feet thick and is composed, in ascending order, of 20 feet of buff weathering shale, 58 feet of grey to black carbonaceous shale with buff bands, and 70 feet of buff weathering grey to black shale. The buff bands contain calcite veinlets up to three-quarters inch thick. A specimen of this shale, but without veinlets, was digested in acid and 61 per cent remained insoluble. What is believed to be the same buff weathering band appears in a road cut northwest of Mulgrave, and is of particular interest in that it is the only Horton horizon that can be traced across the Strait.

### Limestone

A limestone bed was observed in the north face of a ridge 700 feet northeast of the small lake north of Cape Porcupine station. The rock is black, with numerous minute calcite stringers. It was found to contain 16 per cent insoluble material.

### Structures

The Horton rocks are believed to be shallow water terrestrial deposits. They show current and oscillation ripples, crossbedding, graded bedding, mud-cracks, and channelling.

### Biological Features

Comminuted plant remains are abundant at certain horizons, particularly in the sandstone beds outcropping on the shore northwest of McDonald Brook. The material consists largely of stems, many of which show dicotymous branching, but the exterior markings have been obliterated. The following fossils were collected: Micheevia corrugata (Dawson); Sphenopterids.

### The Horton-Windsor Contact

A laminated limestone forms the basal member of the Windsor group where Windsor strata overlie the Horton. An erosional scarp is frequently present at the contact, as Horton rocks are more resistant to weathering than those of the Windsor group.

The actual contact, which here is knife sharp, is best seen in the shore section on the north side of Steep Creek. At this locality the basal limestone lies upon a conglomerate member 30 feet thick, which, in turn, is underlain by 25 feet of red siltstone. A quarter mile up the main branch of Steep Creek the basal limestone rests directly upon the red siltstone member. In the shore section at Steep Creek quartz and carbonate veinlets cut both Horton and Windsor members transverse to the contact, and three-quarters mile southeast of Steep Creek the limestone is underlain by 7 feet of grey siltstone, 20 feet of red siltstone, 9 feet of green siltstone, and then by a conglomerate member of unknown thickness. This is thought to be fairly typical of the sections in the four creeks southeast of this point along the strike, as the conglomerate member appears at no great distance below the contact.

In several places, as in the shore section northwest of McDonald Brook, at the old quarry in Mulgrave, at Port Hastings, and along the contact $\frac{1}{4}$ mile and 1 mile to the north, the two groups are exposed within a few inches of the contact. At several other localities a small drift interval separates rocks of the two groups. In most of these localities the basal limestone overlies quartzite, sandstone, or sandy siltstone.

At all localities the two groups appear to be conformable, and no evidence of an erosional contact has been observed. The disappearance of the conglomerate member within a quarter mile of the mouth of Steep Creek is thought to be due to non-deposition rather than to erosion.

## WINDSOR GROUP

The Windsor group derives its name from the type locality at Windsor, Nova Scotia. Bell[1] has divided it into an upper

[1] Bell, W. A.: Horton-Windsor District, Nova Scotia, Geol. Surv., Canada, Mem. 155, p. 46 (1929).

and lower member, each with a characteristic faunal assemblage. In this area the Windsor group is not subdivided as the fossils are generally too poor for reliable identification and no marker horizons except the basal member have been recognized. The group contains many incompetent members, so that dips and strikes vary widely and probably unrecognized faults are present.

The thickness of the group at the type locality is estimated by Bell[2] as not less than 1,550 feet. The section at Plaster

[2] Bell, W. A.: Op. cit.

Cove, on the Strait of Canso, has been estimated by Hyde[3] to be 650 feet

[3] Hyde, J. E.: The Windsor-Pennsylvanian Section on the Strait of Canso; Geol. Surv., Canada, Sum. Rept. 1913, p. 269 (1914).

thick. On the mainland the observed thickness does not exceed 150 feet, and in places only the basal member is exposed.

### Distribution

The sedimentary rocks of the Windsor group are less resistant to weathering than those of adjacent groups, and, consequently, occur in low-lying areas. The strata overlie Horton rocks conformably in every locality where the succession is normal and the relations are exposed.

Windsor outcrops north and northeast and south and southeast of Port Hastings form the lowest group of strata along the edge of the sedimentary basin. Exposures are also present on the mainland west of the Porcupine-Creignish upland. On the eastern side of the map-area faulting and erosion have exposed members of this group.

### Lithology

The Windsor sediments are wholly marine, and consist of limestone, shale, gypsum, and anhydrite. Possibly lenses of salt are also present, as brooks traversing these rocks have a high degree of salinity.

The basal laminated limestone is the best horizon marker in the map-area. It is a fine-grained, dull grey rock with individual laminae about one-quarter inch thick. The limestone commonly contains calcite veinlets, and in places purple fluorite is associated with the calcite. The thickness of this member at Steep Creek is 65 feet, but elsewhere it is incompletely exposed and probably somewhat thinner. No fossils were found in it.

The following table gives two analyses[1] of the

[1] Goudge, M. F.: Limestones of Canada, Part II, Maritime Provinces; Dept. of Mines, Ottawa, Mines Branch, No. 742; (1934). C. L. O'Brien, analyst. Sample 84, p. 60; sample 124, p. 90.

basal Windsor limestone:

| Sample | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | $Ca_3(PO_4)_2$ | $CaCO_3$ | $MgCO_3$ | Total | CaO/MgO |
|---|---|---|---|---|---|---|---|---|
| 84 | 9.36 | 0.90 | 2.96 | 0.13 | 83.86 | 1.83 | 99.04 | 54/1 |
| 124 | 5.88 | 0.74 | 1.98 | 0.07 | 89.56 | 1.51 | 99.74 | 70/1 |

84 - Quarry at Mulgrave.
124 - Quarry 1 mile north of Port Hastings.

In addition to the basal limestone, at least two other limestone bands are exposed at Plaster Cove or in the middle creek flowing into Plaster Cove. These limestones are from 20 to 28 feet thick. Other limestone bands are exposed in the large fault block and one in a smaller fault block, both in the eastern part of the map-area. These are all fine-grained, dark brownish or grey limestones, and contain poorly preserved fossil remains. Eleven samples of these carbonate rocks were tested with copper nitrate stain, and all gave the reaction for calcite rather than for dolomite. This agrees with an observation by Jennison[2] that from his observation of limestones, with

[2] Jennison, W. F.: Gypsum Deposits of the Maritime Provinces, Dept. of Mines, Canada, Mines Branch No. 84, p. 40 (1911).

one exception, those associated with gypsum are particularly free from magnesia.

Outcrops of gypsum and anhydrite occur in many places, but their thickness and continuity along strike are uncertain. There is no particular calcium sulphate horizon, but lenses of this rock may be present at any horizon. In Plaster Cove the calcium sulphate bed is about 100 feet thick. Gypsum is also exposed on the west side of the middle brook of Plaster Cove along the strike, but is not the same bed, as limestone strata intervene. One specimen from the outcrops in Little River proved to be anhydrite. Jennison[3] remarks that considerable anhydrite is present with the gypsum at Plaster Cove, and also gives two

[3] Jennison, W. F.: Op. cit., p. 60.

analyses of average samples from that locality:

| | Sample I Per cent | Sample II Per cent |
|---|---|---|
| Lime | 40.48 | 33.80 |
| Sulphur trioxide | 55.48 | 46.08 |
| Water loss on ignition | 3.90 | 19.86 |
| Insoluble mineral matter | 0.44 | ----- |
| Total | 100.30 | 99.74 |

Soft, red, green, grey, and buff shale and silt bands and a few sandy beds are associated with the other lithological types. They are less well exposed than either the limestone or gypsum. Some of the grey and buff shales are fossiliferous.

## Fossils Collected

An unidentified species of *Productus* and numerous specimens of crinoid stems, and algal-like ~~masses~~ were collected from the limestones. *Leaia* and *Estheria* are found in the shales.

## THE WINDSOR-CANSO CONTACT

The Windsor-Canso contact is nowhere well exposed, and commonly is poorly defined. In the shore section, on the north side of Steep Creek, a 12-foot drift interval separates a soft red shale from overlying, brownish, sandy siltstone. In the shore section northwest of McDonald Brook Windsor shales are overlain by similar rock types. Windsor shales contain a few specimens of *Leaia* and *Estheria* that cannot be differentiated from similar types in the Canso rocks. At some localities no Windsor rocks are exposed beneath the Canso group, and at other places the thickness of the remaining Windsor varies widely. Erosion had removed various amounts, in some localities possibly all, of this group before Canso deposition began.

## CANSO GROUP

### Type Section and Thickness

The Canso group is a thick series of terrestrial sediments that overlies the Windsor group. Lithologically these rocks resemble the Mabou formation to the north. The type section is in this area along the Cape Breton shore southeastward from Plaster Cove toward Port Hawkesbury. It was first described by Fletcher[1]. In marginal Note 2 of Map No. 205, published in 1884,

[1] Fletcher, H.: Part of the Counties of Richmond, Inverness, Guysborough and Antigonish, Nova Scotia; Geol. Surv., Canada, Rept. of Prog. 1879-80, pp. 80F-83F, beds 47-143 (1881).

he states that the boundary between his Lower Carboniferous and Middle Carboniferous is a somewhat arbitrary line drawn about 2,000 feet above a Leaia bed indicated in his section. Hyde[1] examined part of the same

[1] Hyde, J. E.: The Windsor-Pennsylvanian Section on the Strait of Canso, Nova Scotia; Geol. Surv., Canada, Sum. Rept. 1913, pp. 264-269 (1914).

section and described it in groups, but was unable to locate the particular Leaia bed referred to by Fletcher as such beds are common. The upper contact of the Canso group is here, also, drawn somewhat arbitrarily beneath a grey sandstone bed exposed on the road from the shore toward Emery Lake, which fixes it at a definite recognizable horizon close to Fletcher's contact. This contact is calculated as about 2,685 feet below the base of the thick grey sandstone marker horizon of the Riversdale.

Calculated thickness of the Canso Group and Part of the Riversdale on the Shore of the Strait of Canso Southeast from Plaster Cove Toward Port Hawkesbury

| | | Fletcher | Hyde | N.S. Dept. of Mines[1] | Ferguson[2] |
|---|---|---|---|---|---|
| Riversdale | Estimated from base of massive sandstone marker horizon | Feet 2,139 | Feet 3,896 | Feet 2,673 | Feet 2,525 2,685 |
| | Concealed | 40 | | 656 | 160 |
| Canso | .. | 660 | | | 465 |
| | Section | 794 2,000 3,666 | | 860 | 715 3,342 |
| | Concealed | 368 | 200 | 235 | 322 |
| | Section | 178 (Top of Leaia bed) 1,666 | 2,043 | 1,810 | 1,840 |
| | Concealed | 754 | (754) | 778 | 800 |
| Windsor | Total | 6,599 | 6,893 | 7,012 | 6,827 |

[1] Unpublished information.

[2] Preliminary calculations, subject to revision.

## Lithology

The lower part of the type section has been described by Hyde[1] as follows:

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[1] Hyde, J. E.: Op. cit., p. 269.

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"Alternating shales and sandstones. The shales are red, grey, or greenish, abundantly mud-cracked, harder and tougher than in the overlying member. Some are sandy, others are fine grained. Beds of dark grey, almost black slaty shales with thin beds of limestone apparently higher in iron carbonate are common. These three types, the red shales, the greenish-grey shales, and the very dark grey shales with limestone form distinct members, often 200 or 400 feet thick, but with thin beds within them of the other types. The sandstones, grey or red, are of minor importance, and are scattered throughout. The series shows little evidence of pronounced current action. Leaia and Estheria are abundant in certain beds, but Anthracomya are rare. The fauna is, so far as observed, practically confined to the greenish or light grey beds. It has not been observed in the dark grey limestone-bearing beds.

"Incipient secondary cleavage is developed in the shales and the mud-cracks and fossils are uniformly elongated parallel to this direction. Veins of calcite and quartz are common........ "

The part of the Canso section above the central drift interval is generally similar to the lower part. However, siltstone and sandstone are the predominant lithologic types, with a few thin shale bands. One 6-inch band of limestone conglomerate is present. The colours are predominantly red and brownish. Dips are gentler than in the lower part of the section, ranging from 20 to 46 degrees, and quartz-carbonate veinlets are less abundant. Ripple-marks are the most conspicuous structures.

The section at Red Head consists of red and green siltstones and shales with occasional thin sandstone strata. Throughout most of the section quartz-carbonate veinlets are absent but one zone about 130 feet thick contains them in abundance, in a parallel or interlacing pattern. Current, oscillation, and interference ripples are present, and also mud-cracks in the shales.

The section on the mainland opposite Heffernan Pond contains a large proportion of grey shale members, some of which are calcareous and contain carbonate veinlets. Grey and red siltstones and a few sandstones are the other rock types. Ripple-marks and mud-cracks are common.

The sections on the shore north of Heffernan Pond and on the shore and in the creeks near Creignish are predominantly red shale, with grey shale bands and siltstone and sandstone members. In the section between Heffernan Pond and Low Point a zone 250 feet thick consists mainly of red and grey sandstones, with some associated red shale. Grey sandstone members are less than 15 feet thick, but are more abundant in the section opposite Creignish than in the section farther south. One instance of channelling was observed.

## Fossils Collected

The fossils collected include shells of species of Leaia and Estheria, Anthrapalaemon, Anthracomya angulata Dawson, and plant remains, as Neuropteris and Calamites cistiformis Stur,

## RIVERSDALE GROUP

### Distribution, Contact Relations, and Thickness

Riversdale rocks form the youngest group in the map-area. The type section is located about 12 miles east of Truro in the vicinity of Riversdale. In the Strait of Canso area they occur in a basin-like structure in the central part, and also in two fault blocks farther east. The lower part of the group is well exposed in a series of overlapping sections in the Emery Pond-Ship Harbour area, and in creeks tributary to Emery Pond, but the higher members are poorly exposed. In the upper part of the section only the beds more resistant to erosion and those adjacent to them, and, consequently, protected, outcrop.

The calculated thickness of the part of the section below the sandstone marker horizon is 2,685 feet. A rough estimate is that this is about one-quarter of the total thickness, which would then exceed 10,000 feet.

The Canso-Riversdale contact is somewhat arbitrarily drawn, but above the contact a lithological change takes place. Sandstone members, mainly grey, are more abundant and of greater thickness, with many beds exceeding 20 feet and occasional beds about 100 feet thick. In the shore section the accompanying siltstones and shales of the lower 2,500 feet are predominantly red, whereas the succeeding 1,350 feet do not contain a single red bed. Higher in the section both colours are represented in the scattered outcrops. In the lower part of the section a few beds of limestone fragments in a limy matrix form strata from 6 inches to 3 feet thick.

### Lithology

Two of the most conspicuous members have been described by Hyde[1] as follows:

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[1] Hyde, J. E.: Op. cit., p. 268.

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"Finely laminated and abundantly ripple-marked, fine-grained, dark, slaty shales, almost black, the laminae separated by yet thinner laminae of yellowish, finely sandy shale. Current-marked sandstones of unimportant thickness are present. No fossils have been observed. This member can be traced inland at least 4 miles to the northward, within which distance it loses its ripples almost or quite entirely, but it continues lithologically easily distinguishable. The top is shown on the shore at the head of Hawkesbury Harbour between the railway and wagon bridge .... 946 feet.

"Massive grey sandstone, hard and resistant current-marked and with prostrate <u>Lepidodendron</u> trunks; best shown and measured in the deep cut of the Intercolonial Railway near Point Tupper station, but easily recognizable at other points. The easily determinable presence of this member at the head of Embree (Emery) Pond makes possible the correlation of the Hawkesbury Harbour section and that from Embree Pond to Port Hastings .... 95 feet."

The massive grey sandstone has been used as a marker horizon. It is recognizable in the vicinity of Port Hawkesbury and southeast of Ship Harbour for 2 miles. At a point 2 miles north of Emery Pond it has been recognized 100 feet upstream from the road in the south branch of North Little River. The overlying black shale member with yellowish laminae is also exposed along the road in this locality. The black shale member is also exposed in the branch of Emery Creek that crosses Crandall road about a mile north of Port Hawkesbury, but the present stratigraphic work has not been detailed enough to locate the marker horizon between the exposure north of Emery Pond and that in the south branch of North Little River. The most northerly exposure is about $3\frac{1}{4}$ miles along strike from Ship Harbour, not 4 miles as Hyde states above.

Many on the sandstones contain abundant plant debris. As noted by Hyde, three prostrate tree trunks, each of which is about 8 inches in diameter, and one of which is exposed for a length of 10 feet, are found in the sandstone marker horizon in the railway cut east of Point Tupper. The outer part of the tree trunks is carbonaceous material, but the woody part has been lithified so that the fibrous appearance is preserved. Other smaller stems, 2 to 3 inches in diameter, are fairly common in the higher sandstones. A few coal seams are present in the upper part of the group.

### Fossils Collected

Fossils collected from the Riversdale group include animal remains, as species of Estheria and Anthraconauta, and plant remains, as a species of Cordaites, Neuropteris smithii ? Lesquereux, Calamites suckowi Brongniart, Samaropsis cornuta (Dawson), and unidentified seeds.

## STRUCTURE

### CRYSTALLINE ROCKS

The central core of Cape Porcupine Hill is an irregular stock of granite partly surrounded by older volcanic rocks. At no place was the writer able to determine the attitude of the flows, as the lavas have been so metamorphosed and the structure so complicated by minor intrusions of similar mineralogical and textural types that it is impossible to map continuous bands of the originally dissimilar rocks. Pencil structure, formed by intersecting cleavages, gives a plunge that is usually toward the north.

In Creignish Hills, also, no strike, dip, nor top determinations were made. The southern inliers adjacent to Horton Lake are composed of intermediate volcanic rocks. Farther north flows both of andesite and rhyolite flank a central mass of granite, presenting conditions similar to those on Cape Porcupine Hill.

### FOLDS

Any original dip of the sediments away from the crystalline uplands is obscured by later folding. The central structural feature of the younger rocks is a north-trending anticline, whose axis roughly corresponds with that of the Porcupine-Creignish upland. Erosion has separated the rocks younger than the Horton into two groups flanking this anticline. The western group is restricted to an area near the shore at the northwest extrance of the Strait. The other group occupies the central and eastern part of the area.

The Horton rocks are folded into a series of open anticlines and synclines. On the mainland these have a general gentle plunge toward the north, but on Cape Breton Island the plunge of the central anticline is toward the south. The overlying rocks conform with the folds in the Horton, but with decreasing intensity, as Horton structures are usually only slightly reflected in Riversdale rocks. An exception to this generalization is the anticlinal axis at the mouth of Melford Brook, which may correspond with a flexure in the Riversdale rocks on the opposite shore.

The Windsor and Canso rocks on the mainland northwest of the Porcupine upland form the east limb of a syncline, and the Canso rocks north of the Strait in this locality are also folded into a syncline. In the central part of the map-area the Windsor, Canso, and Riversdale groups form a partial basin structure that is bounded by faults on the eastern and southern edges. Because of this faulting the full diameter of the basin is nowhere exposed, but the Riversdale rocks in the central part have a diameter of 6½ miles. On the exposed rim of the basin the Windsor and Canso groups have a width usually somewhat less than 3 miles.

## PERIODS OF FOLDING AND WARPING

At any place where Horton and Windsor rocks are in contact they appear to be conformable. However, because of the lenticular nature of the Horton beds they do not provide satisfactory evidence of a conformity. In the small creek on the east side of Cape Porcupine Hill the basal Windsor limestone is exposed within 900 feet of the pre-Carboniferous crystalline rocks. The thickness of the Horton strata is obviously less here than elsewhere, but whether it indicates erosion of the Horton before Windsor deposition or overlap of Horton sediments on the basal crystalline complex is uncertain.

A period of uplift and erosion followed Windsor deposition. On the mainland at Steep Creek, where the contacts are best exposed, the Windsor is about 150 feet thick, and at some other places only the basal limestone is exposed. At Plaster Cove Hyde[1] estimated the thickness of the Windsor as 650 feet. At Hood Island Norman[2] measured a thickness of more than 1,600 feet of Windsor rocks.

The Canso-Riversdale contact in this area is chosen arbitrarily, and is conformable. On the north shore of Minas Basin, in the vicinity of Parrsboro, there is an angular unconformity between the Canso and Riversdale groups. In the present area increasing amounts of sandstone indicate uplift of the land. The fact that anticlinal and synclinal structures expressed in rocks older than the Riversdale are only slightly reflected by rocks of the Riversdale group suggests that this period of folding was subsiding as Riversdale deposition began, and probably was associated with the uplift.

After Riversdale time further crustal stresses were active. The sedimentary basin was broken into several fault blocks, and in the western partial basin structure the dip was considerably steepened.

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1 Hyde, J. E.: Op. cit., p. 269.

2 Norman, G. W. H.: Op. cit., pp. 34, 39.

## FAULTS

Three miles east of Port Hawkesbury two faults, one striking about north-south and the other meeting it at an angle of about 110 degrees, outline the boundaries of two adjacent fault blocks. The north-south fault shows a relative displacement of the hinge type, with the movement increasing southward toward the intersection. In the western fault block, at the point of intersection of the faults, the Windsor lies beneath the Canso and Riversdale groups, which have a combined thickness estimated at more than 2½ miles. The vertical displacement along the faults at the point of intersection is considered to be of this order.

The fault block to the northeast bounded by the two faults contains a sedimentary basin, which, if tilted, would show steeper dips on the uptilted edge and gentler dips on the opposite edge of the basin. From the data on Fletcher's map of the area the basin seems to have gentle dips on all sides, commonly less than 20 degrees and rarely more than 30 degrees. The southern edge of the basin does show slightly steeper dips, but in this locality is adjacent to the boundary between fault blocks. It appears that this fault block has not been greatly tilted since the time of deposition.

On the assumption that the greater amount of relative movement has actually taken place in the western or downthrow block, the depression of the Windsor-Canso contact, a vertical distance of 2½ miles, would increase the dip 30 degrees for a basin with a radius of 4 miles centred at the point where the two faults meet. The partial basin structure west and south of the faults dips in most places from 50 to 60 degrees. A hinge line would result near the rim of the basin as the forces encountered more rigid Horton rocks with discordant structures.

The upthrown east side of another fault, west of Port Richmond, has been eroded so that Windsor rocks are exposed. Gypsum and limestone outcrop on Little River, and on the southerly side of Carleton Head the drift contains many gypsum boulders.

An east-west fault is indicated on the mainland just north of Steep Creek, and downfaulted Windsor and Canso rocks are preserved to the south of it. This fault continues across the Strait, where movement is in the same sense.

Near Creignish, Canso rocks outcrop within 1,700 feet of pre-Carboniferous crystalline rocks. The dip of the sedimentary rocks is here vertical, so that this measurement represents about the true thickness of intervening Horton and Windsor strata, if present. Sufficient factual data are not available to establish whether this is an instance of non-deposition or faulting. In the shore exposures along the base of Cape Porcupine Hill there are many broken zones that show slickensiding. One of the most conspicuous of these is on the north side of the hill, where a small inlier of andesite is in contact with Horton rocks. The andesite is considered to be pre-Carboniferous, as it is cut by granite dykes. The contacts are believed to be faults.

## GLACIAL GEOLOGY

Glacial striae are fairly numerous throughout the map-area. These striae preserve a fairly uniform strike of about southeast and are roughly parallel with the Strait. This direction corresponds with the elongation of many oval hills, particularly on the mainland. On the east side of the pier at Eddy Cove the rocks show a good glacial polish at the edge of the glacial till where they have been protected until recently from the effects of weathering. On the main line of the railway, 590 to 650 feet east of where the road crosses the track at the head of Ship Harbour, finely laminated grey shales are exposed south of the track in a rock cut. At the top of the outcrop, where the rock passes into drift, numerous small plates of shale, practically in place, have been rotated toward the southeast. It is believed that this movement is due to glacial push, which would indicate that the glacier was moving toward the southeast.

The glacial till is generally fairly thin, as even tiny brooks expose bedrock. The thickest cover is toward the eastern part of the area. From the south border of the map-area northward to Red Head the shore cliff, about 30 feet high, consists of bright red glacial till containing scattered, irregular to subangular boulders and pebbles. At Carleton Head the shore cliff is estimated to be about 100 feet high, but is brown to buff in colour and contains numerous gypsum boulders. Near the southwest corner of the area there is a so-called driftless area where outcrop is abundant. Here the surface of the rock is quite flat, and white quartzite beds form low outcrops that are striated and rounded by glacial action. In this area the rock occupies the low areas, and surrounding topographic prominences are composed of glacial material.

Throughout the map-area very little glacial material has been deposited by water. The deposits used for road material are of the outwash type, with highly inclined bedding planes and very little evidence of sorting. One bedded deposit that has been used for road material is on Roderick McDonald's farm about 2,000 feet northwest of Heffernan Pond Creek and about the same distance northeast of the road. This deposit is of gravel, and includes a 6-foot bed of crossbedded sand. About half a mile north of Grant Lake the 425-foot contour outlines an elongated oval hill. This ridge has steep sides and probably consists of water-laid material.

## RECENT DEPOSITS

Wave and current action are forming beaches and bars along the coast. From Red Head southward to the edge of the map-area there is a cobble beach where the cobbles have diameters of about 3 inches. These consist of quartzite, quartz, granite, porphyry, conglomerate, and diabase in order of relative abundance. At Eddy Point a cuspate bar with enclosed lagoon contains similar material to that of the beach just described, with the addition of sandy material. Bars of cobblestones are also present across the mouths of Heffernan, Long, and Archie Ponds.

Many small inland lakes, particularly on the mainland, are bordered by low ridges usually less than 5 feet high. These ridges are most conspicuous where a swampy area adjoins the lake. Expansion of the winter's ice, with rising temperature before the melting point is reached, would form these boulder ridges.

## PHYSIOGRAPHIC HISTORY

Guernsey[1], in his description of the adjacent North

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[1] Guernsey, T. D.: Op. cit., p. 70C.

Mountain says:

"The nature of the Horton strata and their relations to the older rocks indicate that the pre-Windsor topography consisted of valleys separated by areas of high land. Presumably North Mountain was one of these areas of high land."

North Mountain rises to an elevation a little more than 700 feet above sea-level, whereas Creignish Hills rise slightly above 850 feet. The highest point, occupied by a Geodetic Survey station, is formed of Horton conglomerate. Consequently, throughout part of Horton time the present Creignish upland was in the area of deposition rather than of erosion.

The basal member of the Windsor, a laminated limestone, is present in the Lake Ainslie area to the north, and extends westward to the Antigonish district. It is also present on both sides of the Porcupine-Creignish upland, but has not been found by Guernsey at North Mountain although at this locality Windsor limestone and gypsum beds are present. The early sea must have been continuous over a wide area in order to deposit a similar member throughout. Guernsey[1] considered the lack of the basal limestone as "perhaps indicating that at North Mountain the Windsor as it rose encroached upon an upland."

After the close of Palaeozoic sedimentation folding and faulting occurred, and a cycle of erosion began. There is no evidence of interruption of this erosion cycle in this region throughout Mesozoic and early Cenozoic time. Goldthwait[2] suggested the name Atlantic upland for the surface developed. The upland truncated the pre-existing highlands and bevelled the folded and faulted Carboniferous strata. It is now represented by the upland summits, which increase in height to the northward in Cape Breton and Newfoundland. The present inclination is considered to be due to a later warping movement, after which renewed erosion began or continued the formation of the present characteristic upland and lowland regions.

Goldthwait[3] says that about the beginning of the Glacial period, either before or after the advance of the ice-sheet, sinking of the land occurred to about the present elevation.

River Inhabitants is a consequent stream, and flows directly down the slope of the warped Atlantic upland. Throughout most of its length it is confined to lowland areas, but many of its tributaries rise in the Creignish upland, and one tributary, Rough Brook, has its source at the western edge of the upland.

The Strait of Canso appears to be an old river valley that has been drowned by coastal subsidence. The general alinement is

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1 Guernsey, T. D.: Op. cit., p. 710.

2 Goldthwait, J. W.: Physiography of Nova Scotia; Geol. Surv., Canada, Mem. 140, p. 4 (1924).

3 Goldthwait, J. W.: Op. cit., p. 5.

parallel to the submerged St. Lawrence River Valley beneath Cabot Strait, and to River Inhabitants. Goldthwait[1] suggests that it was most probably

[1] Goldthwait, J. W.: Op. cit., p. 47.

occupied by two streams that headed near the middle and discharged in opposite directions. Neither the surface nor submarine contours in the vicinity of the Strait lend strength to this hypothesis. Further, River Inhabitants, with a mature valley, is located 6 miles east of the head of Ship Harbour so that the river on the Cape Breton side would not drain a large area. On this hypothesis, too, the Strait would, presumably, be shallowest along the divide between the two streams, in the vicinity of the Porcupine upland-Point Tupper area, and would become deeper toward each mouth. Soundings show the Strait is somewhat deeper from Archie Pond to the southeast entrance. The same general slope is shown in the approaches to the Strait, as the 25-fathom contour comes within 25 miles of the northwest entrance and within 6 miles of the southeast entrance.

It is probable that after the warping of the Atlantic upland a consequent stream flowed down the slope partly in the position of the present Strait. This stream could have been continuous from Ship Harbour to Landrie Lake and down Seacoal Brook to the sea. At present the highest elevation along this route is less than 50 feet above sea-level. As the drainage pattern became better established piracy of this stream could have resulted in abandoning part of this channel in favour of a subsequent stream following the hinge line along the edge of the basin structure. This valley may have drained a large area to the northwest.

The time at which this cycle of erosion began is in some doubt. It is generally agreed to constitute Tertiary time, but Goldthwait[2] has suggested that the valleys may have been carved as early

[2] Goldthwait, J. W.: Op. cit., p. 59.

as the Cretaceous period.

## Shoreline

As already mentioned, a great submergence of the land took place at about the beginning of Pleistocene time. At Cabot Strait, 140 miles northeast of Canso Strait, the old St. Lawrence Valley is 1,500 feet below sea-level. This submergence drowned the river valley along Canso Strait and partly drowned River Inhabitants Valley.

The most conspicuous identation in the shoreline of the Strait is at Ship Harbour. This indentation may have begun its development as part of a consequent valley in line with the northwestern part of the Strait. During Glacial time the open mouth of this valley pointing upstream and flanked by lower shores than the mainland must have diverted a considerable amount of ice down the original valley, which widened and accentuated the mouth.

Another conspicuous irregularity occurs at Pirate Harbour. This is linked to geological structure with a weak rock lowland flanked by more resistant rocks. The bay contains a synclinal axis, and the adjacent headland an anticlinal axis. Within the part of the area where geological mapping has been completed no evidence was observed of pre-existing shorelines. However, from the road north of Creignish, and possibly beyond the northern edge of the map-area, two terraces may be seen. The road is at an elevation of about 100 feet above sea-level, and the terraces, cut in glacial material, lie between the road and the present strand.

## ECONOMIC GEOLOGY REFERENCES

The deposits of economic importance consist principally of limestone, gypsum, and coal. None of these deposits has been worked during the present century, and little new information can be added. For these reasons no description of the deposits will be attempted, but the publications of previous investigators will be cited.

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### OIL

Boyd, H. E., and Hendricks, J. A.: Geological Report of Northern Nova Scotia Relative to the Possibilities for Oil and Gas; Dept. of Public Works and Mines, Nova Scotia, Ann. Rept. 1927, pt. I, pp. 185-242 (1928).

During part of the summer of 1944 a geological party employed by the Richmond Petroleum Company, Boston, operated in the area.

## GEOLOGY AS RELATED TO THE PROPOSED BRIDGE, TUNNEL, OR CAUSEWAY ACROSS THE STRAIT OF CANSO

In the proposed construction it is desirable to avoid belts of weak rocks. Also, if tunnelling is considered, the rocks should be as impermeable to water as possible. The weakness of a particular group of rocks may be due to inherent qualities, or may have arisen as the result of dynamic forces in the earth's crust.

The rocks that are inherently weakest are those of the Windsor group, which consists of gypsum, limestone, shales, and probably salt. All these lithological types have low resistance to compressive and shearing forces, and further, limestone, gypsum, and salt are soluble in groundwater. As the material of the rock is carried away in solution surface cavities called sinkholes are produced. In the dry season the creek on the mainland 1 mile southeast of Steep Creek follows an underground channel to the shore from the point where it intersects Windsor strata. This underground channel is about one-quarter mile long. At Steep Creek, and at the limestone quarry in Mulgrave, springs issue from Windsor rocks, and elsewhere creeks flowing through areas of Windsor strata are conspicuously saline during the dry season, when the proportion of groundwater is at a maximum. The Windsor shales, although insoluble, may be very little harder than clay. Because of their low compressive and shearing strength, and the loss of material due to solution, the rocks of this group are, therefore, the weakest group in any area where they are present, and any crustal adjustment tends to be localized within them, thereby contributing further to their weakness.

The rocks of the Canso group are somewhat more competent than the Windsor strata. However, at the base of the exposed section on the north shore of the Strait are more than 400 feet of shales, with other, higher shale members more than 100 feet thick. These rocks surround the Riversdale basin, and in the folding and faulting of the western part of the basin the hinge line is thought to have been in these rocks. This hinge line provided the zone of weakness that the ancient river valley followed from Plaster Cove to the southeast entrance of the Strait.

The rocks of the succeeding Riversdale group nowhere occupy the deepest part of the Strait. They are farthest offshore on the north side of Point Tupper. There the basal strata form a thick series of red shales with interspersed sandstone and siltstone members. This particular locality is at the widest point of the Strait proper, and would be an improbable point for the proposed construction.

The strongest rocks are those of the Horton group, where conglomerate, sandstone, quartzite, and siltstone are the predominant rock types. Shale bands, where present, are usually thin, but one band 148 feet thick is known.

The only fault known to be present in the Strait crosses in the vicinity of Steep Creek and McPherson Ferry. Three miles northeast of Plaster Cove a fault crosses the Horton-Windsor contact, and may follow a curved course along the bedding and be present in the Windsor rocks at Plaster Cove. Another fault could be present between the Canso and pre-Carboniferous groups on the west side of Creignish Hills, as the intervening drift interval allows only an exceptionally thin section of Horton and Windsor rocks. A hinge line is thought to be present in the Strait southeast of Plaster Cove, but no displacement has resulted.

Solution of Windsor rocks produces cavities near the surface. At greater depths the incompetency of the rocks will result in rock flowage, which will decrease the amount of open space. Many openings, particularly along bedding planes, are present in rocks of the other groups. These bedding planes serve as channelways for the circulation of groundwater. Where bedding planes provide the principal channels for such circulation it would be advisable to choose a place where the strike of the rocks is approximately parallel to the Strait. Otherwise, the groundwater has the additional head from the hilltop to sea-level. Jointing and cleavages are usually much less prominent than bedding, but should either of these be present the head of water would still be effective.

From a geological viewpoint the part of the Strait from Port Hastings-Cape Porcupine northwest about 4 miles to the Horton-Windsor contact is the most desirable section for any of the proposed engineering projects. A fault may cross the Strait in this section, but the rocks are not well enough exposed to determine its occurrence. Reconnaissance drilling would be of doubtful value, although a broken or sheared zone might be traced. Any correlation of beds between drill holes is most uncertain, as individual beds in the Horton are lenticular and consequently, vary in thickness and character along the strike or down the dip.

Cape Porcupine Hill is the most conveniently located source of desirable fill for a causeway. The central part of the hill consists of granitic rocks that are somewhat altered, and in thin section show some brecciation. Neither of these effects is considered to be of sufficient importance to materially affect the properties of the rock as fill. No heavy jointing or sheeting was observed, but perhaps only quarrying operations can determine whether large blocks are obtainable.

The other possible source of material for fill within the area is in Creignish Hills. There, however, the few, large exposures of granite are at a considerable elevation, and are in flat areas not adapted to a hillside operation.