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DEPARTMENT OF MINES
HON. MARTIN BURRELL, MINISTER; R. G. MCCONNELL, DEPUTY MINISTER.

GEOLOGICAL SURVEY
WILLIAM MCINNES, DIRECTING GEOLOGIST.

Summary Report, 1918, Part F

CONTENTS

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SUMMARY REPORT, 1918, PART F.

INVESTIGATIONS IN WESTERN NOVA SCOTIA.

By E. R. Faribault.

CONTENTS.

INTRODUCTION.

Field work in 1918 was continued in the southwestern part of Shelburne county, and a topographical and geological party was engaged there the whole season. The mapping of the Sable River map-area was completed, but more geological work remains to be done to complete the structure of the rocks of that area, and the Lockeport map-area adjoining on the south. The greater part of the country is flat and covered with a heavy mantle of drift, swamps, bogs, and meadows, affording very few rock exposures to work out the structure satisfactorily.

During the season the writer visited several mineral deposits and prospects which gave promise of furnishing products of economic value, and especially ore required for war purposes. A visit was paid to the tungsten deposits at Moose River Mines, Halifax county, where a trace of platinum had been detected last spring by the assay of heavy-fines collected from the concentrating mill, and more samples were collected for testing. Examinations were made of deposits of manganese at Black Rock, Colchester county, Nicholsville, Kings county, and Salem Road, Cumberland county; and of iron north of Aylesford and Berwick, on North mountain, Kings county. On November 12, a special visit was paid the molybdenite deposit near New Ross, Lunenburg county.

Field work was commenced on May 15 and continued until October 9. J. McG. Cruickshank and C. A. Brown were employed as assistants during this period and Milne Blanchard for a short time.

MANGANESE.

Black Rock Manganese Deposit. An examination was made of the manganese deposit at Black Rock on Lockherd point, at the mouth of Shubenacadie river, near Clifton post-office, Colchester county. The deposit can be seen only on the seashore, below high-water mark, where the difference between low and high tide levels is over 45 feet. It occurs in the form of a fissure vein, in impure laminated limestones, sandstones, and shales of Lower Carboniferous age. These rocks crop out prominently along the shore and dip to the southwest at an angle of 20 degrees, and they are affected by small, regular undulations, running east-west diagonally to the strike. The fissure vein cuts the rocks vertically in a southwesterly direction towards the river, in the course of which it divides into two veins, extending to low-water mark. The main vein is exposed for a length of 180 feet, from mud flats near high tide to the low tide; and the branch or north vein for 143 feet from the point of divide to low-water mark, where the two veins are 30 feet apart. The two veins are lenticular, and vary in width

from 1 to 30 inches, but for the greater part of their length they are from 2 to 6 inches. One lens of ore, which occurs at a bend on the main vein, has a width of 12 to 30 inches for a length of 50 feet; and a smaller lens on the branch vein measures 15 to 24 inches for 15 feet. At their extremities the veins thin out to nothing. The ore consists of manganese oxides, with a few small pockets or streaks of crystallized pyrolusite, and includes calcite, iron oxides, and fragments of wall rock. The deposit has been known for many years, and shallow openings have been made to prove its value. but it was apparently considered of no economic importance. Owing to the great demand for manganese ore for war purposes, the deposit was reopened lately by T. H. Donaldson et al, by stripping along the veins and two shallow openings 3 to 4 feet deep. To ascertain the value of the ore, a sampling of the veins was made by the writer every 5 feet along their length, and a partial analysis of the sample, made at the laboratory of the Mines Branch, Ottawa, showed it to contain:

(1) Manganese (Mn)	31·70 per cent.
Iron (Fe)	4·22 "
(2) Calcium (Ca)	8·14 "
Phosphorus (P)	0·011 "
Sulphur (S)	0·120 "
Insoluble residue	16·41 "

Equivalent to

(1) Pyrolusite (MnO_2)	40·42 per cent.
(2) Lime (CaO)	11·40 "
or calcium carbonate	20·36 "

The analysis shows that the ore is of inferior quality at the surface. It is possible that in depth some of the lenses on the veins may increase in size and the ore improve in quality, but as the deposit is completely submerged at high tide, development work has not yet been undertaken to prove it, because of the difficulty and cost which such work would entail. In view of the recent decrease in the demand and the price of manganese ore, the deposit now may not deserve the attention it might have received during war time.

Nicholsville Manganese Deposit. A vein of manganese has been opened on Burton Nichols' farm, at the head of Zebe brook on the northern slope of South mountain, 1½ miles west of Nicholsville, Kings county. The deposit occurs in the slates and quartzites of the Nictaux-Torbrook iron series, which has been correlated with the Oriskany stage of the Devonian period. These rocks have been synclinally folded here—with some close folding—faulted, and sheared. The vein has been traced for a length of 400 feet along the brook, by stripping and shallow pits, and a shaft sunk to the depth of 30 feet. At the time of the writer's visit the openings were filled with water and the vein could not be seen. The course of the vein is south 75 degrees west magnetic, and it dips almost vertically. The vein is lenticular and follows the bedding plane, having on one side a bed of purple, fawn, and grey coloured, soft, laminated, argillaceous slate, and on the other a bed of metamorphosed, calcareous, rusty sandstone. Ten feet west of the shaft the vein is said to be cut by a fault, beyond which it was not traced. The ore occurs in streaks and lenses, and the largest body is said to have been found in the shaft, and to be 3 to 4 feet in width. The ore consists of manganese oxides, mostly pyrolusite in massive and crystallized form, with streaks of iron oxides and white calcite mixed with decomposed country rock. The difference in the hardness of the two wall rocks, the calcareous and rusty nature of one of the wall rocks, and the synclinal folding and shearing, are all favourable conditions, which probably have contributed to the formation of the deposit.

The analysis of four different lots of ore taken from the shaft and submitted by W. E. Bishop, Aylesford, N.S., has given the following results:

—	No. 1.	No. 2.	No. 3.	No. 4.
Weight in lbs	50	20	193·75	?
Metallic manganese (Mn) per cent	25·97	30·57	25·96	38·4
Metallic iron (Fe) per cent	20·1	1·90	13·6	
Silica (SiO_2) per cent	20·52	44·86	31·82	21·8
Phosphorus (P) per cent	0·835	0·051	0·39	

No. 1. Laboratory, Mines Branch, Dept. of Mines, Ottawa, Feb. 6, 1918.
No. 2. " " " " " " Feb. 19, 1918.
No. 3. " " " " " " Mar. 27, 1918.
No. 4. " Nova Scotia Steel and Coal Co., New Glasgow, N.S., April 11, 1918.

The analyses all show that the ore is too low in manganese, and too high in iron, silica, and phosphorus for metallurgical purposes. As a rule, a manganese ore for the manufacture of 80 per cent ferromanganese should contain over 45 per cent metallic manganese and not more than 5 per cent iron and 0·25 per cent phosphorus, and its content of silica should be below 10 per cent.

The vein was first opened about the year 1885 by McPhail for Miner T. Foster; in 1908, approximately, Abraham Banks of Morristown did some more work and dug a pit 8 feet deep; and in the winter of 1917-18 John Dunright, working for W. E. Bishop et al, sank a shaft to the depth of 30 feet. A few barrels of ore have been shipped.

Salem Road Manganese Deposits. The deposits are situated on Fred S. Shipley's farm, Brookvale, on the west side of the road leading from Amherst to Salem, Cumberland county, where a broad belt of limestone holding manganese has been largely quarried. The limestone is of light reddish and grey colour, concretionary, yielding no fossils and producing good lime, a kiln capable of burning three hundred bushels at a charge having been in operation for a number of years. From several of the openings manganese ore has been extracted, which is said to have nearly paid for the cost of working. The ore was found in pockets, irregular cavities, and along fractures and joints in the rock. About twenty years ago, 60 tons of good ore was extracted from one opening 15 feet in diameter and 30 feet in depth, close to Mr. Shipley's house. The deposits are no doubt the result of local deformation and fracturing of the rocks, followed by the filling of the cracks with manganese oxide. Three sets of fractures or joints have been observed, two of which are vertical and at right angles, to the northeast and to the southeast, and a third one horizontal, dividing the rock in rectangular blocks. It is impossible to come to any practical conclusion, however, regarding the possible distribution of the ore-bodies. Though exploratory work for ore-bodies may not give promise of successful results, the working of the quarries for the limestone and its excellent lime product might lead to important discoveries of manganese ore.

PLATINUM.

Platinum has been found in the course of mining operations in some of the gold districts in Halifax county, and this year a trace was obtained by an assay of concentrates from the mill of the tungsten mines at Moose River Mines. The occurrences so far reported have all been found in quartz veins that have been worked for gold or tungsten in the lower quartzite and slate formation of the Gold-bearing series of the Atlantic coast. The veins are aggregated in groups on anticlinal domes, or on plunging anticlines, where they follow the stratification plane and conform with the struc-

ture of the folds. Sperrylite, a platinum arsenide ($PtAs_2$), is believed to be the mineral present, and the chief associated mineral is arsenopyrite. The sperrylite occurs in minute, thin, octahedral crystals, metallic tin-ware, hardness 6 to 7, specific gravity 10·60. It is possible that the old tailings accumulated for years in some of the gold districts, or the concentrates of the mills at some of the gold mines now in operation may contain platinum in workable amount, especially in districts like Moose River, Caribou, Oldham, Waverley, Cow Bay, Ovens, Baker Settlement, Pleasantfield, and Malaga, where scheelite occurs.

The three following occurrences of platinum have been recorded from gold mining districts in the eastern parts of Halifax county:

The Hall brothers informed the writer in 1904 that about the year 1880 while operating a gold property at Fifteenmile stream they received from the mint a button of platinum obtained from the refining of a gold brick derived from the Walton-Doran vein in that district. The vein is a "barrel"-quartz lead, 8 to 10 inches in width, following the plane of stratification and curving on the eastern plunge of an anticlinal fold in quartzite and slate. The lead is apparently underlaid at the distance of 70 feet by a large vein of white, barren quartz which outcrops along the crest of the fold for a length of over 1,000 feet and has a width of 30 to 40 feet.

O. W. Knight, a mineralogist of Bangor, Maine, reports[1] having found in 1910 several small crystals of sperrylite on a mining dump derived from a vein worked for gold in one of the gold districts, presumably in the vicinity of Caribou Gold Mines in Halifax county. The gangue mineral containing the sperrylite was quartz, the chief associated mineral was arsenopyrite, and a magnesia-bearing dyke was in proximity.

A trace of platinum and gold estimated at 0·04 ounce per ton, was found by an assay made at the laboratory of the Mines Branch, Ottawa, from a sample of heavy-fines collected from the Wilfley tables in the mill of the Scheelite Mines, Limited, at Moose River Mines, Halifax county. The mine is operated by M. J. O'Brien, Limited, for tungsten ore (scheelite). Sperrylite is probably the platinum-bearing mineral present. The gangue is quartz and the chief associated mineral is arsenopyrite which accompanies the scheelite in large proportion. The other associated minerals are dolomite, damourite a hydrous mica, tourmaline, and occasionally small acicular crystals of rutile. The veins occur interbedded in the lower quartzite and slate formation, in small, sharp folds developed along the crest of the highest anticlinal fold in the eastern part of the province. The veins are generally only a few inches in width and their extent is determined by the structure of the folds. The ore-bearing veins are very persistent in length along certain parts of the folds, more especially along the apexes and troughs; whereas in other parts they thin out to nothing. One vein has been worked or developed for a length of over 1,500 feet along the sharpest of the small folds which plunge to the west at a low angle. Many large veins of barren quartz also occur, generally following the planes of schistosity and the axial plane of the folds and intersecting or joining the interbedded mineralized veins. No eruptive rock has been observed in the immediate vicinity of the deposit; the nearest is a granite batholite 7 miles to the southeast. The associated minerals show that the deposit is of deep-seated origin, and that the tungsten-bearing veins are different in character and origin from the gold-bearing veins of the district.

[1] Jour. Min. Soc. of Nova Scotia, vol. XVI, 1911-12, p. 93.

INVESTIGATIONS IN NOVA SCOTIA AND NEW BRUNSWICK.

By Albert O. Hayes.

CONTENTS.

Illustrations.

INTRODUCTION.

During a field season extending from May 27 to October 15, successive surveys were carried on at eight localities. Two months were given to a continuation of a revision of the structural geology of the southeastern part of the Sydney coal field in order to locate more definitely the outcrops of certain workable coal seams. Examinations of three other coal fields were also made with a view to aiding prospecting and production. These included St. Rose and Chimney Corner, Inverness county; New Campbellton, Victoria county; and Kemptown, Colchester county. In the vicinity of Louisburg, at Simon point, Cape Breton county, an occurrence of sericite schist known as the "Talc mines of Cape Breton", and a reported discovery of iron ore were investigated. Ten days in September were spent at Stirling, Richmond county, making a survey for a detailed geological map of the vicinity of the zinc-lead-copper deposit now being developed by the New Jersey Zinc Company, but wet weather prevented the completion of the work planned. Visits were also made to a recently discovered deposit of salt at North Shore, Malagash peninsula, Colchester county, the first to be developed by mining operations, in the Maritime Provinces; and to a deposit of pyrolusite at Gowland mountain, Albert county, New Brunswick. Inquiries regarding the New Ross manganese deposits which were examined in 1917 were also made. Memoranda describing these localities will be given.

COAL.

Southeastern Part of the Sydney Coal Field.

A description of the area surveyed may be found in the Summary Report of the Geological Survey for 1917 [1]. Field surveys for an outline topographic map, begun in 1917 by D. A. Nichols, were completed in 1918 by C. H. Freeman and when compiled will serve as a base for the geology, more particularly to indicate the position of the principal coal seams. The present summary report is confined to remarks on the source of the superficial deposits, the inland continuation of the Tracy seam, an occurrence of oil shale, and the value of the gravel deposits at Mira beach and Broughton for use in road-making.

The glacial drift along Mira river to the south of the Sydney area of Carboniferous rocks contains no material from these Carboniferous sediments, but is composed of transported pre-Carboniferous, igneous, pyroclastic, and sedimentary rocks in place south of Mira river. The proportion of Carboniferous material, principally grey sand-

[1] Geol. Surv., Can., Sum. Rept., 1917, pt. F, p. 20.

stone, increases northwards, but at Broughton about 25 per cent of pre-Carboniferous rocks occur in the terminal moraine. Also, on the shores of the lakes in the vicinity of Caribou Marsh post-office, pebbles occur of Cambrian conglomerate and quartzite and granite typical of rock in place in the vicinity of Marion bridge and Grand Mira. This northward to northwestward movement of glacial ice is also indicated by glacial striæ along the Cow Bay road, where the direction of movement is shown by many grooves which at their northern extremity split up into a number of small scratches diverging northwards as though caused by the crushing of a pebble, moved in that direction.

Tracy Coal Seam. A calyx drill was in operation at Homeville in 1905 at a point 1,700 feet north of the highway leading to Homeville station and 900 feet west of the highway to Port Morien. At a depth of 550 feet the following section was obtained:

	Feet.	Inches.
Coal	3	9
Fire-clay	1	3
Coal	1	4

Parts of the broken core left at the hole were examined, but the crossbedded nature of the strata makes it difficult to determine the exact attitude of the seam. Assuming a dip of 10 degrees the outcrop of this seam would occur about 3,100 feet farther south or a little over one-quarter of a mile south of the road to Homeville station. This coal horizon is thought by the writer to be the inland continuation of the Tracy seam exposed by underground working on the north shore of Mira bay about one mile east of False Bay beach. The western continuation of this seam is also thought to have been found at the mine of the Cape Breton Coal, Iron, and Railway Company at Broughton, in the Moseley pits on the Ferguson road, and in the conglomerate slope on the Miller road where the seam is said to be 4 feet thick.

Oil-shale. Oil-shale was found on the western shore of Hay lake about 6 miles south of Sydney and 2 miles west of the Albert bridge road, on the dump of a prospect pit. The exact thickness is unknown as the pit was filled with water and no natural exposures were seen, but about 10 inches of similar shale is said to have been found in the pit.

The report of analysis made at the Mines Branch, Department of Mines, is as follows.

1343. Sample of oil-shale collected near Sydney, Nova Scotia, by A. O. Hayes, Geological Survey, Canada.

(*a*) Analysis (proximate)—

	Per cent.
Moisture	1·2
Volatile matter	33·6
Ash	51·2

A qualitative test showed the presence of carbonate in the shale. A part of the volatile matter was, therefore, carbon dioxide due to the decomposition of the carbonate.

	Per cent.
(*b*) Nitrogen	0·72

(*c*) Distillation test. The shale was distilled in an electrically heated oil-shale retort in a slow current of steam, the temperature being gradually increased until a maximum of 650 degrees C. was reached. The temperature was then held at this point until there was very little further evolution of gas.

The yields per short ton of shale calculated from the results of the distillation were as follows:

Volume of gas	approx.	3,500 cu. ft.
Weight of oil	"	230 lbs.
Spec. gravity of oil at 60° F.		0·928
No. of imperial gals. of oil	approx.	25
[1] Weight of ammonion sulphate	"	13 lbs.
Weight of residue	"	1,500 lbs.

[1] This amounts to 19 per cent of theory. Methods specially adapted to give high ammonium sulphate yields may give some 70 per cent of theory.

Road Materials. Samples of gravel from Levers beach, Gabarus bay, Mira beach, and Broughton were collected and tested by K. A. Clark of the Mines Branch, whose report follows:

Gravel from Mira beach, 100 feet south of highway crossing of railway. Collected by A. O. Hayes (Field No. 10).

Per cent wear	1·7
French coefficient of wear	2·4
Per cent of voids (compacted)	27·0
Cementing value	60·0
Per cent gravel (retained on ¼-inch screen)	82
Per cent sand (passing ¼-inch screen)	18

Mechanical Analysis.

Material retained on 3 mesh (gravel).

	Per cent.
Retained on 2½-inch	1·5
" " 2-inch	6·5
" " 1½-inch	13·0
" " 1-inch	22·5
" " ¾-inch	17·0
" " ½-inch	20·0
" " ¼-inch	19·5

Material passing 3 mesh (sand).

	Per cent.
Retained on 8 mesh	70
" " 20 "	15
" " 48 "	10
" " 100 "	5
" " 200 "	0
Passing 200 "	0

The pebbles of this gravel are worn round and smooth. This material is very deficient in sand. It cannot be expected to compact into a fine road without the addition of fine material to act as a binder.

Gravel from head of Gabarus bay, western part of Levers beach. Collected by A. O. Hayes.

Per cent of wear	0·2
French coefficient of wear	200·0
Per cent of voids	—
Cementing value	35·0

	Per cent.
Gravel (retained on ¼-inch screen)	100
Sand (passing ¼-inch screen)	0

Mechanical Analysis.

Gravel:

	Per cent.
Retained on 2½-inch screen	0
" " 2-inch "	3·5
" " 1½-inch "	15·0
" " 1-inch "	37·0
" " ¾-inch "	23·0
" " ½-inch "	15·0
" " ¼-inch "	6·5

This gravel has pebbles worn smooth and round and is totally deficient in fine material. It will not compact in a good road without the addition of fine material to act as a binder.

Gravel from Broughton, N.S. Collected by A. O. Hayes.

Per cent of wear	4·9
French coefficient of wear	8·2
Per cent of voids	23·0
Cementing value	400·0

	Per cent.
Gravel (retained on ¼-inch screen)	55
Sand (passing ¼-inch screen)	45

Mechanical Analysis.

Gravel from Broughton, N.S.—Con.

Gravel:	Per cent.
Retained on 2½-inch screen	4·0
" " 2-inch "	20·0
" " 1½-inch "	13·0
" " 1-inch "	20·0
" " ¾-inch "	10·0
" " ½-inch "	13·0
" " ¼-inch "	20·0

Sand:	Per cent.
Retained on 8 mesh sieve	29
" " 20 " "	33
" " 48 " "	17
" " 100 " "	7
" " 200 " "	6
Passing 200 " "	9

This gravel should give satisfactory results as a fine material. It has a tendency to have a high proportion of very fine material which absorbs water readily, and would make the road muddy in wet weather.

Gravel from Broughton, N.S. Railway cutting about 1 mile east of Broughton. Collected by A. O. Hayes.

Per cent of wear	8·2
French coefficient of wear	4·9
Per cent of voids	23·0
Cementing value	400·0

	Per cent.
Gravel (retained on ¼-inch screen)	50
Sand (passing on ¼-inch screen)	50

Mechanical Analysis.

Gravel:	Per cent.
Retained on 2½-inch screen.	
" " 2-inch "	10
" " 1½-inch "	15
" " 1-inch "	20
" " ¾-inch "	10
" " ½-inch "	20
" " ¼-inch "	25

Sand:	Per cent.
Retained on 8 mesh sieve	20
" " 20 " "	20
" " 48 " "	20
" " 100 " "	15
" " 200 " "	15
Passing 200 " "	10

This gravel would not make a satisfactory road. The pebbles are of very soft material and would not give good wear. There is also too large a proportion of very fine material in the sand. It would probably make a hard, compact road in dry weather, but would be muddy in wet weather. The fine material softens like clay when exposed to water.

Chimney Corner and St. Rose Coal Areas.

Coal is known to underlie two areas, the northerly at Chimney Corner and the southerly at St. Rose, separated by about 1½ miles of unproved territory. Three days, September 4, 5, and 6, were given to an examination of these areas with the object of reporting whether or not drilling is necessary to prove the field.

Chimney Corner Area. A section of strata is exposed across the strike in the cove at Chimney Corner in which three workable coal seams occur.

A bold, narrow ridge rises abruptly at Chimney Corner point and follows the coast southerly for about 2½ miles at an elevation of about 300 feet above sea-level.

This ridge is separated from the inland highland country to the east by a parallel-lying valley which emphasizes its elevation. The ridge owes its preservation from ocean erosion and steep seaward slope to a capping of thick-bedded standstone, which, together with the underlying soft shales and coal seams, dip in the direction north 50 degrees west magnetic at an angle of 35 degrees, under the sea (Figure 1).

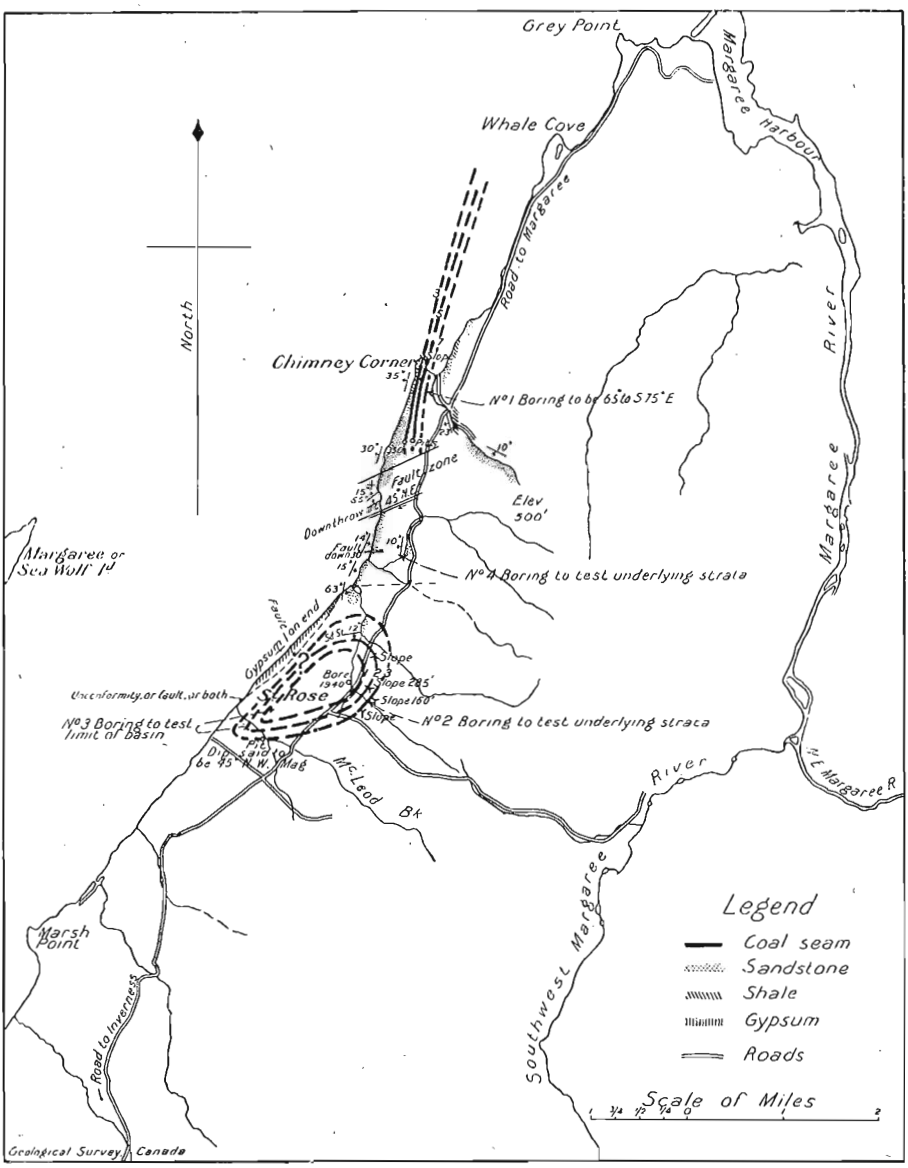

Figure 1. Chimney Corner and St. Rose coal areas, N.S.

The highest seam of workable coal, No. 3 of the section given on page 10, is now being mined by Mr. Doucet of Margaree Harbour, who holds a sub-lease from Mackenzie and Mann, but only in a very small way on account of lack of shipping facilities. The seam at the face of a slope driven about 300 feet at 210 degrees magnetic along

the strike was examined and found to contain 2 feet 10 inches of solid coal of excellent appearance. An average sample was taken and the following report of the analysis has been received from the Mines Branch, Department of Mines:

Sample of Coal from Chimney Corner Seam, Inverness County, N.S. Collected by A. O. Hayes, Geological Survey, Ottawa.

Sample mark	2 Chimney corner.	
Laboratory sample No.	1358	
Moisture condition of sample (see note)	R	D
Proximate analysis:	Per cent.	
Moisture	9·2	
Ash	10·3	11·4
Volatile matter	32·9	36·2
Fixed carbon (by difference)	47·6	52·4
Fuel ratio, fixed carbon, volatile matter	1·45	1·45
Carbon-hydrogen ratio, coking properties	Forms agglomerate.	

NOTE: Figures in column "R" refer to fuel *as received* and in column "D" to fuel *dried at 105 degrees C.* The analyses were made on the fuel as received and other results calculated therefrom.

The roof is of soft shale consisting of about 6 inches of black carbonaceous shale overlaid by grey clay shale containing thin shelled pelecypods probably the genus *Anthracomya*. This roof requires close lagging to prevent falling, as the soft shale crumbles and drops in small masses where exposed to the air. A careful survey should be made to determine the amount of cover at sea-level. In Fletcher's report[1] this coal is referred to as No. 3 and Prof. Hinds' measurements are quoted showing a thickness of about 300 feet of overlying strata. The writer did not confirm these measurements, but estimated that in certain places a much thinner cover is present at sea-level owing to unequal ocean erosion.

Prof. Hinds' section is as follows:

	Feet.	Inches.
1. Thin seams	1	6
2. Strata	about 300	
3. Coal	3[2]	
4. Strata	88	
5. Coal—main seam	5	
6. Strata	200	
7. Coal	3	6

Prior to 1873, 10,000 tons of coal are stated[3] to have been mined, principally from the main seam. The workings were nearly altogether below sea-level, but no difficulty was experienced on this account. Nos. 5 and 7 are not well exposed at present and no examination was made of them. Mr. G. V. Evans, manager of the St. Rose property, son of the late Mr. Thos. Evans who operated the Chimney Corner mines from 1866 onwards, kindly acted as guide to the localities where development work has been done. No. 5 coal appears good but No. 7 is somewhat dirty. Seams Nos. 3 and 5 are stated to have been traced southerly by sinking pits, for about three-quarters of a mile along their outcrops southward from Chimney Corner cove. The seams outcrop within one-quarter of a mile from the shore on the east (landward) slope of the ridge bordering the sea and extend southward with a regular dip for about one mile, where they are interrupted by faults extending inland in a direction north 70 degrees east. Two well-defined faults marked by nearly vertical cliffs occur about one-quarter of a mile apart and between them the strata are much disturbed, exhibiting irregular dips and indicating that any coal seams which might occur in this zone would be badly crushed and broken. At the south fault the direction of movement is well shown by fault drag to have been downward and westward on the north side, but no detailed correlation of the

[1] Geol. Surv., Can., 1882-3-4, p. 75 H.
[2] A. O. Hayes measured 2 feet 10 inches at face present slope.
[3] Fletcher, Hugh, Geol. Surv., Can., Rept. of Prog., 1882-3-4, p. 89 A.

measures across the disturbed area was made. To the north of Chimney Corner cove the regularity of the strata intermittently exposed for about 4 miles, suggests that the coal seams may continue to outcrop under the sea and dip steeply westward as at Chimney Corner. Prof. Hind assumes [1] that the submarine area is limited by a synclinal fold bringing the seams to the surface under the sea at a distance of half a mile westward of the mine. A shallow synclinal fold occurs to the south of the fault zone as shown by the dips indicated in Figure 1. There is perhaps one-quarter square mile of land area underlain by coal between the fault zone and the cove, and if the seams extend northerly uninterruptedly as far as Grey point there would be a much larger submarine than land area. Only a rough approximation of the recoverable coal, based on assumed data, can be made until further facts are known relative to the geological structure and the quality of the coal. Assuming the Chimney Corner area to be one-half mile wide and 2 miles long with a total thickness of 12 feet, 6,000,000 tons of coal may be recoverable. Assuming the outcrops of the St. Rose seams to be as represented on the accompanying sketch map (Figure 1) the gross tonnage of the 6-foot seam is about 5,000,000; of the 5-foot seam about 3,000,000; and of the 4-foot seam about 1,500,000. This is a gross total of 9,500,000 or a recoverable total of about 7,500,000, giving a recoverable total for both areas of 13,500,000.

The strata concealed in Chimney Corner cove, underlying the coal seams and estimated by Fletcher[2] to be about 685 feet, might well be proved by boring as indicated on Figure 1.

St. Rose Area. Three seams of coal have been proved to outcrop along Chimney Corner to Inverness road at a point about 3½ miles southerly from Chimney Corner. A shaft on the upper seam, marked No. 1 (Figure 1), is 200 feet east of the road. About 4 feet of coal is said to have been found in the shaft. About 700 feet from the road an underlying seam, No. 2, has been well proved by a slope down 285 feet. This slope is being kept dry by pumping and the seam was found to contain 5 feet 2 inches solid coal with only a ¼-inch clay parting 1 foot 8 inches from the roof. Its attitude is south 45 degrees west magnetic, dip 19 degrees west. The roof consists of 10 inches dark grey shale replete with a small pelecypod, probably the genus *Anthracomya;* and overlain by about 16 feet of grey clay shale also containing this pelecypod, as well as abundant ostracods and an unusual type which E. M. Kindle has identified as belonging to the genus *Calcisphæra* and regarded as plant seed capsule which in its spiral surface markings is similar to those on the seed of Chara. Two average samples of the coal were taken and analysed in the laboratory of the Mines Branch, and a report of the analyses follows:

Sample of Coal from St. Rose Mine, Inverness County, N.S. Collected by A. O. Hayes, Geological Survey, Ottawa.

	4 crosscut. 1356		5 main slope. 1357	
Sample mark				
Laboratory sample No				
Moisture condition of sample (see note)	R	D	R	D
Proximate analysis:	Per cent.	Per cent.	Per cent.	Per cent.
Moisture	5·3		5·0	
Ash	10·9	11·6	11·6	12·2
Volatile matter	34·5	36·4	34·4	36·2
Fixed carbon (by difference)	49·3	52·0	49·0	51·6
Ultimate analysis: sulphur			6·6	7·0
Fuel ratio, fixed carbon, volatile matter	1·45	1·45	1·40	1·40
Coking properties	Both form poor coke.			

Remarks: 1356, average sample from crosscut main slope to back slope south side.
1357, average sample from west haulage, main slope.

NOTE: Figures in column "R" refer to fuel *as received* and in column "D" to fuel *dried at 105 degrees C.* The analyses were made on the fuel as received and other results calculated therefrom.

[1] Hind, H. Y., Geol. Surv., Can., Rept. of Prog., 1882-3-4, p. 90 H.

[2] Rept of Prog., 1882-3-4. p. 75H.

The outcrop of this seam has been proved for over half a mile to lie in a curve to the northwest. At a distance of about 1,000 feet from the road, at right angles to the strike, No. 3 seam outcrops and is reported to be 6 feet thick. The coal is said to be of excellent quality and to contain two 4-inch partings, one 18 inches from the roof, the other an equal distance from the pavement. A slope (Bett's) was sunk a distance of 160 feet, the lower 40 feet of which is in coal. This was filled with water, preventing an examination. About 450 feet farther southeast on the stream north of McLeod brook (Figure 1) indications of coal are found in the surface material. The records of a boring in 1904, placed as Nos. 1 and 2, Figure 1, about 200 feet west of the road on the same stream, indicate a 4-foot seam of coal at a depth of 89 feet and an 8-foot 4-inch seam at 273 feet. The 8-foot 4-inch seam was reported dirty coal. A boring placed immediately below seam No. 3, indicated as No. 2 boring, would be valuable in prospecting the underlying strata. A pit from which coal was taken for the local trade many years ago was sunk about 2,000 feet from the seashore at the mouth of McLeod brook. The coal is said to have been overturned at the surface, but to dip northwesterly at greater depth. The overturning was probably due to ice shove as this phenomenon was observed about 1¼ miles southwest along the shore in measures dipping in the same direction, indicating that the ice movement was from the southeast. The thickness found in this seam was not ascertained. Fletcher[1] reports as follows: "There is an interval of a mile and a half, which extends a quarter of a mile past (north) the mouth of McLeod brook, concealed by a sandy beach and low banks of red drift; but a short distance inland, on the farm of Alexander McLeod, a seam of coal, said to be three feet thick, has been worked." A line shown in Figure 1 has been drawn from seam No. 3 through this coal pit to indicate that the coal is probably a continuation of one of the already discovered or accompanying seams.

The St. Rose seams appear to lie in a basin limited on the west side either by (1) an unconformity with considerable overlap of the coal measures over the Lower Carboniferous-gypsum horizon, or (2) a down-faulting of the coal measures, or a combination of these phenomena causing the coal to overlie the gypsum more closely than at Chimney Corner. A boring, No. 3 in Figure 1, placed about one-quarter mile up McLeod brook from the seashore or farther north if water could be obtained, would serve to prove the basin at this point and perhaps indicate the structure.

In regard to the synclinal lying between the fault zone south of the Chimney Corner area and the St. Rose area, no coal was observed in the exposures along the shore. These measures appear to underlie the coal seams and there seems to have been a considerable downthrow of the northerly block. A fault may exist also at the northerly extremity of the St. Rose basin in which the St. Rose block has been downfaulted relatively to the intermediate synclinal, leaving it as a horst between the two coal areas. If, however, coal occurs below the measures exposed along the coast a boring placed as indicated on Figure 1 would test the underlying strata.

Samples resembling oil-shales, collected at the localities mentioned, were analysed at the Mines Branch with the following results. The thicknesses of strata represented by these samples were not determined.

1418. Sample from pit 300 feet north of McLeod working, on first brook east of McLeod brook, St. Rose, Inverness county, N.S.

(*a*) Analysis:

	Per cent.
Moisture	2·5
Volatile matter	30·8
Ash	27·1
Nitrogen	0·91

The shale did not effervesce when treated with hydrochloric acid, indicating the absence of carbonates.

(*b*) The sample was too small to permit of a distillation test to determine the yield of oil that might be obtained from it. However, to obtain some indication as to whether the sample contained oil-producing material, the calorific value was determined.

Calorific value, determined directly in bomb calorimeter (uncorrected for sulphur):

$$5{,}600\ \frac{\text{grm. cal.}}{\text{gram}} \qquad 10{,}080\ \frac{\text{B.T.U's}}{\text{lb.}}$$

[1] Geol. Surv., Can., Rept. of Prog., 1882-83-84, p. 74H.

1419. Sample[1]*, from dump of shaft on 4-foot seam, 200 feet southeast of road at first stream east of McLeod brook, Inverness county, N.S.*

(*a*) Analysis:

	Per cent.
Moisture	3·2
Volatile matter	15·7
Ash	68·2
Nitrogen	0·50

The shale did not effervesce when treated with hydrochloric acid, indicating the absence of carbonates.

(*b*) Calorific value—determined by burning with standard coal in bomb calorimeter:

$$\frac{1{,}890 \text{ grm. cal.}}{\text{gram.}} \qquad \frac{3{,}500 \text{ B.T.U,s}}{\text{lb.}}$$

The following table of results obtained on samples of oil-shale is given for purposes of comparison.

Vol. matter.	Cal. value B.T.U's.	Yield of oil on distillation. Imp. gal.	Remarks.
	lb.	short ton.	
9·0	1,590	.....	
10·0	2,130	.....	
10·1	1,970	.....	
24·6	6,640	.....	
22·5	1,110	.....	Sample effervesced with HCl.
17·8	2,110	12	
7·5	.....	3	
8·1	.....	4	
33·6	.....	25	Sample effervesced with HCl.
23·7	.....	6	
30·8	10,080	.....	
15·7	3,560	.....	

A sample of the roof clay from the St. Rose mine was tested by J. Keele for its use in brick manufacture and his report is as follows:

"This is a hard, grey, fine-grained shale, which when finely ground and mixed with water makes a very smooth and plastic, wet body, with excellent working qualities.

"It burns to a dense, steel hard, buff-coloured body at low temperatures, but the shrinkage is rather too great.

"This shale fuses at a temperature of about 1,300 degrees C. so that it is not a fire-clay.

"It could be used for the manufacture of hollow building blocks or for face bricks, and would be especially useful to mix with a more gritty shale that was lacking in plasticity."

New Campbellton.

No coal has been mined from this area since 1907 when the property acquired by Burchell Bros. in 1893 was sold to the Anglo-Newfoundland Coal Company, representing Northcliff interests. In 1918 the Anglo Coal Company was formed and obtained a lease with option to purchase, beginning operations by reopening the most northerly workings at the terminus of the narrow gauge railway connecting the mine with the shipping pier at Kelly cove, 2 miles distant.

[1] Sample received November 20, 1918, from A. O. Hayes, Geological Survey, Ottawa.

A report and map descriptive of this field, by Robb and Fletcher, were published in 1875 and a summarized section across the measures where mining is now being carried on is given as follows:

	Feet.	Inches.
Coal seam D	1	8
Strata	237	
Coal 4-foot seam	4	
Strata	53	
Coal seam F	1	9
Strata	54	
6-foot seam	6	

Mining at this locality was formerly confined mainly to the 4-foot seam and the present operators propose to work the 6-foot seam at present. The tunnel is placed at the foot of a steep slope and was driven in a direction north 29 degrees west, penetrating the strata and coal seams which have a vertical dip, at right angles to their strike. The old workings in the 4-foot seam are 250 feet from the entrance to the tunnel. On October 2, the tunnel had been cleared a distance of 300 feet.

Samples were taken at several points and the reports of analyses are given below. As the 6-foot seam was inaccessible underground, a sample, No. 1366, was taken from the surface outcrop where exposed in a stream-bed on the hillside south of the tunnel, and about 135 feet vertically above. The following section was measured from east to west:

	Feet.	Inches.	
Coal	2	8	
Clay	..	3	not sampled.
Slate	..	2	
Coal	2	1	
Thin-bedded shale and coal	1	3	not sampled.

A grab sample, No. 1365, was taken from the 4-foot seam in the tunnel. This was not in place, but has apparently slumped in from the old workings. A grab sample, No. 1364, was taken from the dump at McLellan's pit, said to be on the 4-foot seam, about one-quarter mile west of the tunnel. A grab sample, No. 1367, was taken from a dump of about 500 tons of slack coal lying in the open at the mouth of the tunnel.

Sample of Coal from New Campbellton, Victoria County, N.S. Collected by A. O. Hayes. Geological Survey.

Sample mark	1		2	
Laboratory sample No.	1364		1365	
Moisture condition of sample (see note)	R	D	R	D
Proximate analysis:				
Moisture %	5·3	.....	5·2	
Ash	12·2	12·8	10·2	10·7
Volatile matter	35·2	37·2	35·4	37·4
Fixed carbon (by difference)	47·3	50·0	49·2	51·9
Ultimate analysis: sulphur %	6·7	7·1	7·0	7·4
Fuel ratio, fixed carbon, volatile matter	1·35	1·35	1·40	1·40
Coking properties	Poor coke.		Fair coke.	

Remarks: 1364. Grap sample from pit at surface. McLellan's pit.
1365. Grab Sample from 250 feet in No. 1 tunnel, coal dropped from seam above.

Note: Figures in column "R" refer to fuel *as received* and in column "D" to fuel *dried at 105 degrees C.* The analyses were made on the fuel as received and other results calculated therefrom.

Sample of Coal from New Cambpellton, Victoria County, N.S. Collected by A. O. Hayes, Geological Survey.

	3		4	
Sample mark				
Laboratory sample No.	1366		1367	
Moisture condition of sample (see note)	R	D	R	D
Proximate analysis:	Per cent.			
Moisture	6·3		6·6	
Ash	9·9	10·6	21·9	23·4
Volatile matter	38·3	40·8	33·3	35·7
Fixed carbon (by difference)	45·5	48·6	38·2	40·9
Sulphur	4·5	4·8	1·6	1·7
Fuel ratio, fixed carbon, volatile matter	1·20	1·20	1·15	1·15
Coking properties	Fair coke.		Non-coking.	

Remarks: 1366. From 6-foot seam in stream bed.[1]
1367. Slack coal from dump No. 1 tunnel.

NOTE: Figures in column "R" refer to fuel *as received* and in column "D" to fuel *dried at 105 degrees C.* The analyses were made on the fuel as received and other results calculated therefrom.

Kemptown, Colchester County.

The coal seam exposed in the slope now operated by Mr. Ernest Chisholm at Kemptown, Colchester county, N.S., was examined on October 7 and 8, with a view to reporting whether the output of the mine could be increased from 25 tons to 100 tons per day provided railway transportation was available. The opinion of the writer that the output could be so increased is based on the observations recorded in this report.

The occurrence of this seam of coal is mentioned by R. W. Ells[2] where it is stated that "A thin seam of coal . . . has been opened at several points from Kemptown on the Pictou road to the Folly river." No mine plans of the Kemptown workings were available and the accompanying sketch plan (Figure 2) is made from a compass and pacing survey hastily made at the time of visit.

Three slopes have been sunk as indicated on Figure 2. The oldest of these, marked No. 1, sunk in a direction north 33 degrees east, is not crushed. No. 2, not used at present, was sunk in a direction north 74 degrees east. No. 3, the main slope, is sunk on the dip of the coal seam at 22 degrees in the direction north 62 degrees east for a distance of 450 feet. At about 390 feet a nearly vertical fault occurs having a direction north 73 degrees west. The coal seam is down-faulted to the deep (north side), having a throw between 50 and 75 feet. A level was driven along the fault northwesterly about 120 feet, which gradually penetrated underlying strata until the coal was found at about 200 feet from the main slope. The level was then driven along the strike of the coal seam and on the date of examination had penetrated 165 feet in coal.

Mr. Ernest Chisholm, who is operating the mine at present, was manager for the Nova Scotia Coal, Iron, and Railway Company during the earlier development of the property. He stated that borings were drilled to the north of the fault, as indicated in their approximate positions on Figure 2, and coal was found at the following depths: bore-hole No. 1, at 150 feet; No. 2, at 175 feet; No. 3, at 207 feet. The coal was also found in a boring 800 feet deep, placed on the west side of the road 1,800 feet northerly from the entrance to the main slope. Records giving the exact depth at which the coal was found and its thickness are not at hand, but the

[1] Section through 6-foot seam.

Roof.	Feet.	Inches.	
Coal	2	8	
Clay	..	3	not sampled.
Slate	..	2	not sampled.
Coal	2	1	
Thin-bedded shale and coal	1	3	not sampled.
Pavement.			

[2] Geol. Surv., Can., Ann. Rept., 1885, p. 42E.

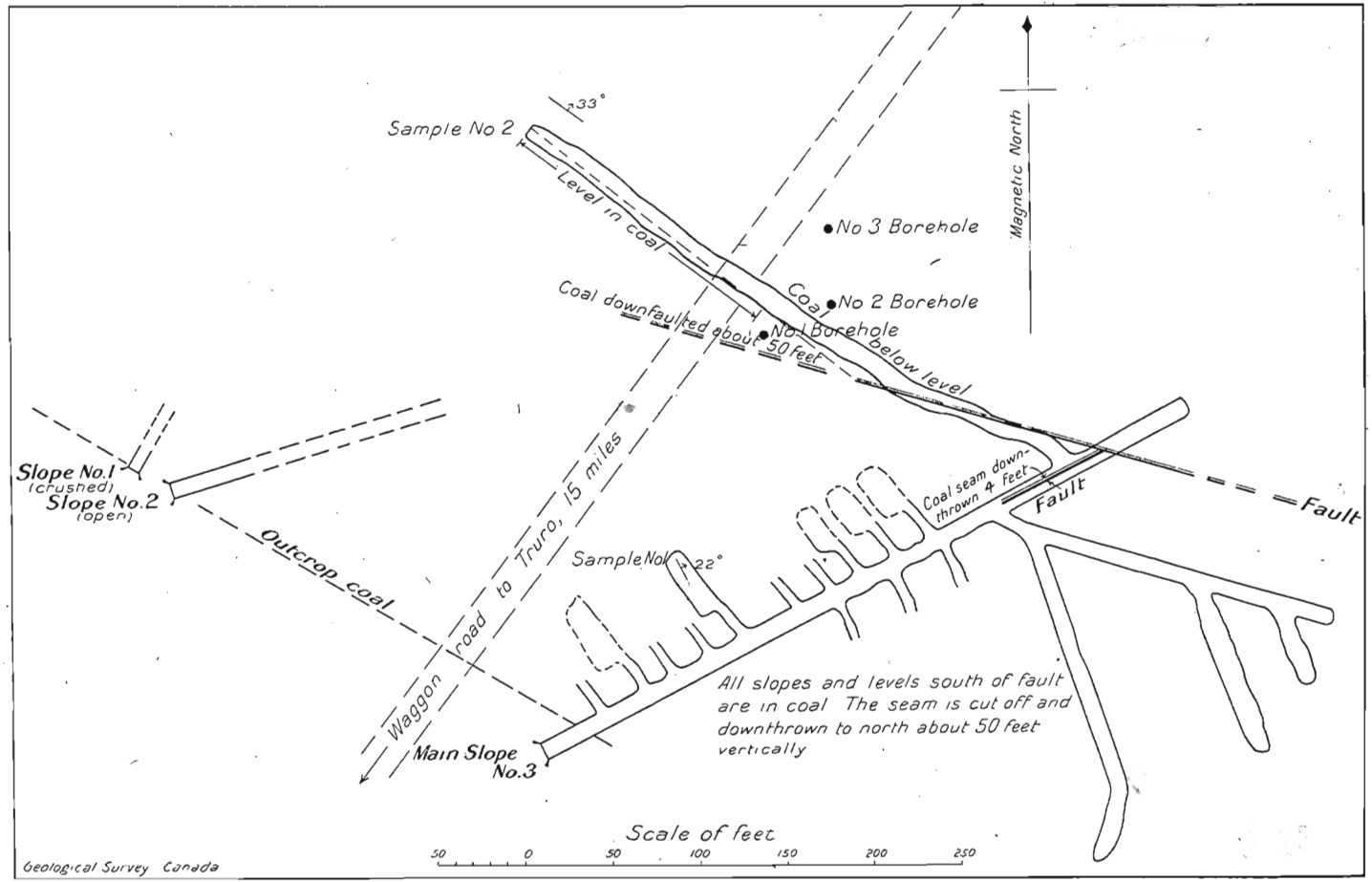

Figure 2. Sketch plan of Kemptown coal mine, Colchester county, N.S.

depths as stated indicate that the seam continues north of the fault without any serious displacement. Assuming the above-mentioned depths to be correct and the thickness to continue uniformly, the seam appears to continue to the deep at the same dip north of the fault, i.e. 22 degrees, as is found in the main slope towards the outcrop south of the fault. The steeper dip of 33 degrees, found at the face of the fault, is apparently due to drag, so that though the vertical displacement at the fault may be about 50 feet, the total displacement between the continuation of the normal planes may be about 75 feet.

Average samples were taken from the seam on either side of the fault as indicated in Figure 2, and analysed in the Mines Branch laboratory with the following results.

Sample of Coal from 5th Room to Northwest from Main Slope, Ernest Chisholm Mine, Kemptown, Colchester County, N.S. Taken by A. O. Hayes, Geological Survey, Ottawa.

	1	
Laboratory sample No.	1362	
Moisture condition of sample (see note)	R	D
Proximate analysis:		
Moisture %	0·8	
Ash	22·7	22·9
Volatile matter	19·6	19·8
Fixed carbon (by difference)	56·9	57·3
Ultimate analysis:		
Sulphur %	1·2	1·3
Calorific value:		
Determined, in calories per gram, gross	6220	6280
Determined in B. T. U. per lb., gross	11200	11300
Fuel ratio, fixed carbon, volatile matter	2·90	2·90
Coking properties	Forms agglomerate.	

NOTE: Figures in column "R" refer to fuel *as received* and in column "D" to fuel *dried at 105 degrees C.* The analyses were made on the fuel as received and other results calculated therefrom.

Sample of Coal from Face of Tunnel North of Fault, Kemptown Coal Mine, Kemptown, Colchester County, N.S. Taken by A. O. Hayes, Geological Survey.

	2	
Laboratory sample number	1363	
Moisture condition of sample (see note)	R	D
Proximate analysis:		
Moisture %	1·0	
Ash	15·0	15·1
Volatile matter	17·5	17·7
Fixed carbon (by difference)	66·5	67·2
Ultimate analysis:		
Sulphur	1·1	1·1
Calorific value:		
Determined, in calories per gram, gross	7170	7240
Determined in B.T.U. per lb., gross	12910	13040
Fuel ratio, fixed carbon, volatile matter	3·80	3·80
Coking properties	Forms agglomerate.	

NOTE: Figures in column "R" refer to fuel *as received* and in column "D" to fuel *dried at 105 degrees C.* The analyses were made on the fuel as received and other results calculated therefrom.

A vertical fault strikes parallel to the main slope by which the west side is downthrown 4 feet, as shown in Figure 2. This may indicate the throw of the main fault to increase westward.

The sections across the seam are as follows:

At point marked sample No. 1, south of fault, at face of room west side main slope.

Roof of medium hard black shale.
Coal 2 feet 8 inches with two ¼-inch partings.
Pavement—hard, grey shale.

At point marked sample No. 2, north side fault, face of level west of main slope.

Roof of medium hard, black shale crushed on account of nearness to fault.
Coal 2 feet 7 inches.
Slaty parting 4 inches.
Coal 3½ inches.
Pavement—hard, grey shale.

As shown in Figure 2 the method of mining adopted is to leave pillars 20 feet square on either side of the main slope and continuous pillars 5 feet wide between rooms which are to be 20 feet wide.

South of the fault in the triangular fragment west of the main slope and bounded by the outcrop and fault, there are about 6,500 tons recoverable coal ready to mine. East of the main slope and south of the fault, the levels have 5,000 tons already blocked out, which could be taken out at once. Mining operations could be continued farther east, where owing to a river valley the surface is depressed and the outcrop would tend to swing northeastward, forming a narrower reserve south of the fault. Using the information from the borings as a basis, and considering only the width actually opened along the outcrop, it can be reasonably assumed that about 150,000 tons of coal, or 5 years' output at 100 tons a day for 300 days per year, can be recovered from the deep on the north side of the fault. It is probable that the seam continues to the deep and a much larger tonnage is present.

Hugh Fletcher[1] writes as follows regarding coal in the vicinity of Kemptown:

"Mention has already been made in the course of this report of attempts to work coal in other localities, as at the Big Brook and Lorne, in graphitic shales or slates. At Kemptown on the north side of the Telegraph road, several shafts and a boring, said to be 137 feet deep, have been sunk on a small seam of mixed coal and shale, which is from two to four feet in thickness. Fragments of good coal were seen among the debris at the pit mouth. This is perhaps the seam opened among the nearly vertical flinty rocks above the railway between West River station and Riversdale and again in the south branch of the North river below Mingo's." The Mingo locality is about 2½ miles west of Kemptown and the locality between West River and Riversdale, about 5 miles east of Kemptown. It is probable, therefore, that mining operations could be continued along the outcrop as well as to the deep.

Judging from the southerly dip recorded on the geological maps, there may be an anticlinal axis to the south of Kemptown and, therefore, a possibility of a repetition of this coal seam outcropping to the south of Kemptown and with a southerly dip.

At present the coal is being hauled to Truro by wagons, a distance of 15 miles, at a cost of $3 per ton. Parts of the road are in a very bad condition and it may be impossible to haul in the late autumn or spring.

The railway siding from Kemptown to Riversdale on the Intercolonial Canadian Government railway is graded throughout its distance of 4 miles and rails could be laid quickly if available, making possible a continuous supply of coal for the city of Truro.

SERICITE SCHIST.

A zone of soft, altered, volcanic rocks, suitable in part for the manufacture of those materials for which talc is used, occurs on the coast of the Atlantic ocean to the east of Simon point 4 miles southwest of the town of Louisburg. This material forms an integral part of a series of stratified volcanic rocks extending over a large part of southeastern Cape Breton county, and is composed largely of pyroclastic rocks, both breccias and finer-grained ash rocks, with accompanying interstratified rhyolites and more basic lava flows. Plutonic intrusives of later origin are associated with the volcanic rocks.

About the year 1898, development work, consisting of two shafts and cross-cuts, was done. At present these workings are filled with water and debris. A stream, the

1 Geol. Surv., Can. Ann. Rept., vol. V, pt. 2.

outlet of Kavanagh lake, flows into the sea at this point and a barrier of coarse pebbles has formed a barasois. No outcrop of the zone of rocks cut by the workings is exposed and the workings are inaccessible. Mr. George H. Crowdis, one of the property holders, stated that the east shaft, which is placed about 50 feet east of the stream and about 200 feet from the beach at tidal water, was sunk 14 feet and a drift 23 feet to the north was driven. The collar of the shaft is about 10 feet above the level of the impounded water of the barasois.

The westerly shaft was sunk through an overburden of gravel at the shore about 550 feet magnetic west, from the east shaft. At present the sea has carried this gravel bank away and Mr. Cowdis prointed out the site of the shaft marked by a covering of timbers. This shaft was sunk to a depth of 61 feet and a cross-cut to the north driven 43 feet. Bedrock is exposed immediately west and south of this shaft and within a thickness of about 100 feet the section consists of a stratified series consisting of:

Sericite schist apparently an alteration from pyroclastic breccia..	Sample 1a.
Trachyte massive, irregular form..	" 1b.
Porphyry or pyroclastic? rock..	" 1c.
Sericite schist, purple and greenish yellow..	" 1d.
Southern part of zone prospected by west shaft and crosscut No. 1 (see sketch)..	" 1.

The attitude of these rocks is vertical with strike south 88 degrees east magnetic.

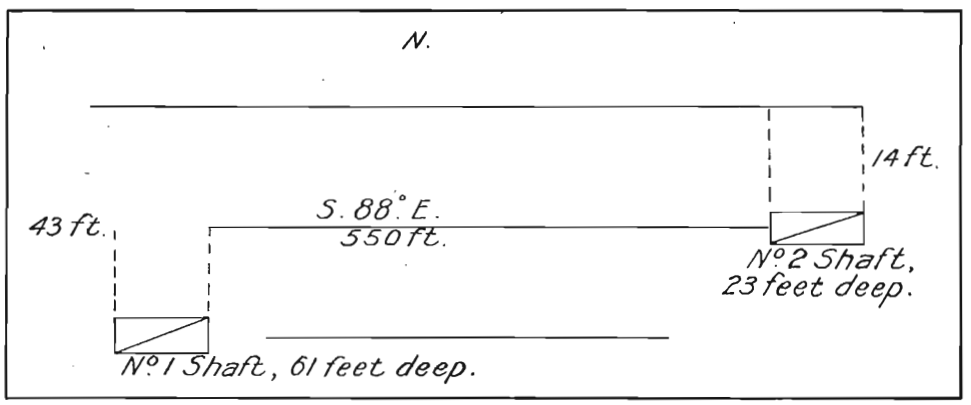

Figure 3. Position of shafts, Landing cove, N.S.

Samples were also taken from the dumps of the two workings; No. 1 from the west shaft and No. 2 from the east shaft. Mr. Crowdis stated that the best material had been shipped to a New York market at the time the work was done, so that these samples represent discarded rock, none of which appears to be of commercial value, but may be described to show the character of the country rock. R. A. A. Johnston examined these samples and reports as follows:

Sample No. 1. " Altered volcanic from dump of west shaft, Landing cove, 4 miles west of Louisburg."

" This is a sericite schist showing an indistinct mottling of reddish-grey and greyish to yellowish-white tints. Some portions of it cleave readily, affording fairly smooth surfaces; other portions cleave with difficulty, giving uneven surfaces. The cross fracture is for the greater part jagged. The hardness is variable; some portions scratch calcite readily, whereas other portions scratch with difficulty; generally speaking it averages a little more than 3 of Moh's scale. The lustre of cleavage surfaces is faint pearly, that of fracture dull.

"The fresh rock is compact and has a gritty feel; in a few instances where incipient weathering has developed the material is smoother to the feel.

"Under the microscope the material is seen to be made up of a compact mass of fine scales of sericite with more or less quartz in the form of minute grains unevenly scattered through the mass."

Sample No. 2. "Altered volcanic from east shaft, Landing cove, 4½ miles west of Louisburg, 1½ miles by water from Oldtown."

"This material does not differ in any essential respect, except in the matter of colour and lustre, from that represented by sample No. 1. It is nearly white in colour with pale greenish and yellowish shadings and has a somewhat more pronounced pearly lustre than has No. 1. Its general composition is the same as that of No. 1."

Mr. Crowdis stated that the soft, talc-like rock was found to continue the entire length of both shafts and crosscuts. It was found that the best material occurs in layers parallel to the stratification, up to one foot in thickness, and that partings of hard greenstone were interbanded; also bands containing quartz were occasionally met with.

As shown in Figure 3 the easterly shaft is apparently placed along the strike of the measures encountered at the north end of the western crosscut and if the attitude of the rocks is regular, a zone of about 50 to 60 feet has been crossed, composed of sericite schist.

The property comprises 750 acres of land owned jointly by Messrs. H. C. V. LeVatte and George H. Crowdis, of Louisburg, C.B., N.S.; John O'Shears of New York; and Matthew Lodge of Moncton, N.B. A licence to search, from the Provincial Department of Mines, is held over 5 square miles taken 2½ miles along the coast and 2 miles inland. About $16,000 has been spent in purchase price of property and development work.

IRON.

Loran, Cape Breton County. Boulders of magnetite occur at Loran about 2 miles northeast of Louisburg, and are of sufficient size and purity to interest prospectors in a search for their origin. A licence to search has been taken out by Mr. George Crowdis of Louisburg, and the writer spent two days in June investigating the occurrence. One of the boulders of magnetite was found to have molybdenite and fragments of a granitic rock associated with it. The direction of movement of the glacial drift in the district north of the Mira river has been established to have been northeasterly. Molybdenite is associated with the volcanic and intrusive rocks found along the north shore of Gabarus bay southwest of Louisburg and it is probable that this material has its origin in a nearby locality, presumably to the west-southwest of its present occurrence.

A reddish-brown, pyroclastic rock carrying a small percentage of iron occurs in place on the south shore of Louisburg harbour and underlying the town of Louisburg. Boulders of this material are also found at Loran. It is probable that horizons, perhaps fault zones, may occur which carry a larger percentage of iron. A traverse from Loran eastwards to the Sydney and Louisburg railway was made and observation taken by dip needle. This district is floored by bedded volcanic and pyroclastic rocks characterized by quartz veins. No occurrences of economic value were seen.

ZINC-LEAD-COPPER.

Stirling, Richmond County. Descriptions of the development work on the Stirling zinc-lead-copper deposit previous to 1918 were published by D. D. Cairnes[1] and A. O. Hayes[2]. No development work was done from July, 1917, when the Stirling Exploration Company stopped drilling, to July, 1918, when the New Jersey Zinc Com-

[1] Geol. Surv., Can., Sum. Rept., 1916, p. 255.
[2] Geol. Surv., Can., Sum. Rept., 1917, pt. F, p. 30.

pany commenced operations under an option to purchase from the original lessee, James Nolan of Glace Bay. J. T. Boyd is in charge of the present development work by which it is planned to prove the deposit at a greater depth than accomplished by the Stirling Exploration Company in 1917. Five calyx drills removing 3-inch cores were in operation, putting down angle holes at 35 degrees from the vertical. The drills were placed east and west of the line of extension of the deposit and boring carried on from opposite sides. The gangue, which varies from dense quartz to somewhat porous carbonate schist, offered great difficulty for the type of drills used and progress was, therefore, made more slowly than anticipated.

The drilling in 1917 indicated an impoverishment of the ore both laterally and in depth from the principle showing illustrated as Trench C in D.D. Cairnes' summary report[1] for 1916. Towards the south there is a heavy overburden of boulder clay and surface trenching is impracticable. The drilling 400 feet south of Trench C showed no ore, whereas 200 feet south of Trench C the ore-body was much smaller than in holes drilled under the principal showing, which also showed gradual impoverishment to a very low grade ore between vertical depths of 200 to 350 feet. Surface trenching at intervals to the north of Trench C shows a splitting of the higher grade ore into narrow bands which terminate entirely about 500 feet north. A drill hole placed about 200 feet north of Trench C shows similar characteristics at depths of 150 to 300 feet vertically, with low grade ore predominating.

In September 1918, a boring on the west side of the known deposits entered ore, indicating the presence of another band. The lenticular form and magmatic source of the ore suggests the probability of the occurrence of additional related ore, both laterally and in depth.

The country rock consists of a volcanic series of pyroclastic rocks and lava flows of rhyolite and trachyte, with interbanded carbonates of lime magnesia and iron, apparently alterations of the volcanic rocks. These are intruded by plutonic rocks consisting of diabase, quartz porphyry, and a porphyrite. There is also a dyke of mica diorite cut in a diamond drill hole at the south end of the ore-body and in a trench at the north end of the ore-body a similar dip is about 10 feet thick. This dyke was not encountered in any of the other drill holes, although they penetrated the intervening formation; therefore, two different dykes may occur. Although no large exposure of this rock was found in the vicinity of the workings, a similar intrusive plutonic rock occurs in large quantity, cutting a similar volcanic series, on the coast west of Seal rock, between Framboise and Capelin cove about 5 miles south of Stirling.

The whole series has undergone metamorphism accompanied by shearing with the development of a schistose structure, having a strike of north 31 degrees east (astronomic) with steep easterly dip. The ore appears to lie along one of the shear zones. The ore consists of a fine-grained, intimate mixture of the following sulphides in order of their abundance; sphalerite, pyrite, galena and chalcopyrite, containing small amount of gold and silver. The ore varies from high grade, consisting of an almost solid sulphide mass accompanied by a small amount of gangue principally calcite with subordinate quartz, to low grade, largely calcite with some quartz, containing a small amount of the sulphides disseminated through it in small masses. In the lower grade ore there is a greater proportion of pyrite to total sulphide contents, than in the higher grade ore.

[1] Geol. Surv., Can., Sum. Rept., 1916, Fig. 11, p. 257.

Typical analysis of the high and low grade ore from surface exposures are as follows:

Analysis of High and Low Grade Zinc-Lead-Copper Ore from Surface Exposures.

——	High grade.	Low grade.
Iron	10·60	8·57
Silica	23·12	9·29
Alumina	1·74	2·14
Lime	3·39	10·75
Magnesia	3·42	20·18
Sulphur	22·06	11·14
Chlorine	None.	Trace.
Zinc	20·82	4·73
Lead	4·95	1·07
Copper	1·65	0·65
Silver	4·77	1·52 oz.
Gold	0·06	0·04 oz.

NOTE: Gold and silver given in ounces per ton of 2,000 pounds.

A groove sample taken from the south side of a prospect shaft sunk in the trench immediately south of the laboratory, analysed in the laboratory of the Mines Branch, gives the following results:

Copper	4·40 per cent.
Lead	1·77 "
Zinc	19·67 "
Iron	11·24 "
Sulphur	22·93 "
Gold	0·02 oz. Troy per ton of 2,000 lbs.
Silver	3·80 " " "

The shaft is 5 feet wide in solid sulphide and the ore extends 6 inches farther in the trench on either side of the shaft beyond which it was covered. The total width at this point is said to be 7 feet.

The ore is overlain by boulder clay varying in thickness from 3 to 50 feet. The surface oxidation has penetrated to a depth which varies with the character of the ore, and is from a few inches to a few feet. Where the almost solid sulphides occur, little oxidation has taken place; in the low grade ore the gossan capping is thickest. This is probably due to the more easily decomposed carbonate rocks which largely compose the low grade ore. The ore apparently occurs filling interstices in and replacing parts of the schistose rocks, probably along a main zone of shearing where the magnesian and calcareous carbonate rock predominates. These carbonate members may owe their origin to alterations of the original rhyolite and trachyte flows before the introduction of the ore. This theory is strengthened by the study of a calcareous schist found at a depth of 174 feet in a boring at the south trench. Macroscopically the rock is of a light olive green colour with small white masses regularly arranged. Under the microscope it is seen to consist of a groundmass of very fine-grained holocrystalline feldspar and quartz, the feldspar considerably altered to a colourless mica probably sericite. The white spots occur as masses with oval outline and composed of a carbonate, probably calcite. These masses are arranged along the line of schistosity and are elongated parallel to this direction. Pyrite in minute crystals and masses is scattered throughout both groundmass and carbonate masses. The rock cleaves along a fracture plane which makes a small angle with the lines of schistosity, and the rectangular appearance of the calcite masses, causing them to appear like crystals in the hand specimen, is probably due to pressure brought to bear along these two lines of cleavage. The rock appears to have been originally a rhyolite with vesicular structure. The plane of shearing or schistosity appears to closely

follow the general bedding planes of the original rocks. The gas cavities were filled with calcite previous to the development of the schistose structure and the metallic sulphides were introduced after the cavities were filled with the carbonate.. The predominance of calcite as a gangue material suggests the probability that some of it may have been introduced along with the sulphides. This may also be said of the quartz, although some quartz veinlets appear to be of later origin.

The question of secondary enrichment in the high grade ore has been dealt with in an unpublished petrographical report by Professor Charles Berkey of Columbia university. He made microscopical analysis of representative specimens and stated positively that no secondary enrichment existed in these. He also held the opinion that the ore was formed as a replacement of what was apparently originally a carbonate rock.

It seems probable that the ore is genetically related to one of the intrusive rocks already mentioned, perhaps the quartz porphyry.

Owing to the limited amount of detailed geological survey work done in this district the period in which the ore is formed is not established. The ore occurs as a replacement in a series of volcanic rocks, probably of Pre-Cambrian age. Sedimentary rocks, consisting of conglomerate, cross-bedded reddish-brown and grey sandstones, and grey slates were mapped as lower Silurian by Hugh Fletcher in 1879. No fossils were found locally, but in Cape Breton county similar basal sediments are of Cambrian age. The conglomerate of Five Islands lake is cut by diabase dykes, and it seems probable that the plutonic intrusives associated with the ore-body may be in part at least Palæozoic, and the period of mineralization be post-Cambrian and probably Devonian.

MANGANESE.

New Ross, Lunenburg County.

Pyrolusite, manganite, braunite, psilomelane, and manganiferous calcite occur in fissure veins in the granite about 8 miles north of New Ross village in the northern part of Lunenburg county. The writer spent two days, August 16 and 17, 1917, at this locality, with a view to obtaining data upon which to base an opinion regarding the probable extent of the ore-bodies. Certain features were noted, the interpretation of which throws light on some phases of the origin of the ore, and these may be presented by giving first a statement of the physiography, general geology, and structural geology, followed by a description of the mine workings and a summary of observations bearing on the origin of the ore and extent of the ore-bodies.

The writer wishes to thank Mr. W. H. Riddle, president of the International Manganese and Chemical Company, Mr. J. H. Whidden, manager of the Rossville Manganese Company, and Dr. H. W. Cain, Falmouth, N.S., for their hospitality and kindness in furnishing information.

Accessibility. The workings of the International Manganese Chemical Company lie 20 miles north-northeast of Chester Basin in a straight line, or about 24 miles by road, and the Nova Scotia Manganese Company's mine is about 2¼ miles farther northwest. There is a good road from Chester Basin to New Ross, a distance of 15 miles with a rise from sea-level to an elevation of 400 feet. The road from New Ross to Mill Road, 4 miles, is somewhat hilly and rough, but fair compared with the final stretch of 5 miles from Mill Road to the workings at the mine, which is deeply rutted and very rocky. The elevation of the mines is about 600 feet above sea-level.

There is also a road from the mines to Windsor which is 19 miles from the workings in a straight line north 54 degrees east and 24 miles by road. Though this road has been especially prepared for hauling, it is reported to be in poor condition as far as Upper Falmouth, the remaining 15 miles being fair. There are few farmers living along the road in the vicinity of the mines and consequently no resident teamsters.

The ore and supplies from the Rossville Manganese Company's workings are hauled by ox teams to Chester Basin, for which a rate of $8 per ton is paid. A return trip requires three days.

A telephone line connects the Rossville and International camps with the New Ross exchange. The Rossville Company's ore is shipped to J. S. Lampson and Brothers, New York.

Physiography. The mines lie about 2 miles south of the height of land, from which some streams find their way northeastwards to Avon river and the bay of Fundy, others southward to Gold river and the Atlantic. The elevation above sea-level is about 600 feet and though slightly higher land may be seen to the east and west of the mines, in general an even skyline mets the eye in every direction. In detail the surface presents the local irregularities typical of granite rocks. Huge rectangular blocks have weathered out making progress difficult in the low-lying ground, and intervening hills are studded with bold rounded knobs of bedrock.

The outcrops of the mineralized fissures are marked by depressions and at each of the workings a scarp of granite marks the north wall and extends with interruptions along the fissure. A similar valley and scarp were noticed along the road to the Nova Scotia mine about 700 feet from the New Ross workings. The iron-stained outcrop suggests that a mineralized fissure also occurs at this point.

Though the detailed history of the relative movements of land and sea from Devonian time to the present is difficult to interpret, it is probable that the highlands of the Maritime Provinces, including the New Ross granite area, have stood above sea-level throughout most of the Tertiary and Cenozoic periods.

It is probable that a thick mantle of residual soil was formed in the easily decomposed granite in pre-Glacial time, to be later swept away by the Laurentide ice-sheet which moved southward carrying its load of rock materials towards the Atlantic ocean. A part of the ore-bodies may have thus been carried southward and boulders from the veins may be found at some distance from their source. As a closing phase of the glacial period a local residual ice-sheet flowed from the height of land towards the bay of Fundy as well as towards the Atlantic, bedrock north of the height of land may have been moved first southward and later northward, and along the height of land the lateral spread may have moved boulders in diverging directions.

General Geology. The granitic country rock, in fissures in which the manganese ore occurs, is found in the form of a batholith or mass outcropping in a rude crescentic area about 20 to 25 miles wide and 100 mile long. It extends west-northwesterly from Halifax to the manganese mines, which are in its central part, then west-southwesterly through the southern part of Annapolis county and southerly through a part of Digby county. In Annapolis and Kings counties the granite rocks cut lower Devonian sediments in the Nictaux-Torbrook district and in Hants county, in the vicinity of Windsor, the Lower Carboniferous conglomerate is composed of similar granitic material and these sediments lie unconformably above the granite rocks. Hence the plutonic rocks are thought to have been intruded in late Devonian time.[1]

Two varieties of granite are found in the New Ross district. The batholith as a whole is composed of a coarsely crystalline biotite granite with very large feldspar crystals attaining a size of one inch or more in length. In the vicinity of the New Ross settlement and Mill Road about 4 miles south of the mines, a younger miscovite granite of variable character is found. It is ordinarily finer-grained than the biotite granite, with transitions to an extremely coarse pegmatite in which triphylite, a phosphate of lithium iron and manganese, has been found at lake Ramsay, among a number of rarer minerals.

An outlier of quartzite belonging to the Gold-bearing (Meguma) series occurs between Mill Road and the manganese mines in the vicinity of Three lakes. These sediments are much older than the granite and their position in the central part of the granite suggests that they have been much thicker and more widely spread, forming a

[1] See also discussion by W. J. Wright, Geol. Surv., Can., Sum. Rept. 1912, p. 384.

part of the cover under which the granite slowly crystallized. Erosion has removed this cover, but the remnant indicates that in this vicinity at least comparatively little of the granite mass itself has been carried away.

Structural Geology. In the vicinity of the mines the granite is jointed in three directions, i.e., parallel to two vertical planes with steep dips to the northwest and approximately at right angles one to another along northeast and northwest directions, also parallel to the horizontal plane.

In the underground workings at the Nova Scotia Manganese Company's mine the main fissure changes its course locally, but at the 210-foot level at the face, the joints are north 45 degrees east, and north 60 degrees west. On the surface between the New Ross and the International Companies' workings the joints are north 50 degrees east and north 48 degrees west. The northeasterly joints are parallel to the fissure veins at each locality, and erosion has taken place along the joint cracks, which causes granite to break out in blocks. The bearings are referred to astronomic north.

Description of Mine Workings. Development work has been done on three properties. The New Ross Manganese Company opened up their property a number of years ago and the plant has been idle since 1906. The mine of the Nova Scotia Manganese Company was leased to the Metals Development Company in September, 1915, and subleased to the Rossville Manganese Company in June, 1917, and is now worked by the last-named firm.

The International Manganese and Chemical Company commenced operations in February, 1917.

New Ross Manganese Company's Property. The shaft and workings are filled with water and no examination underground was made by the writer. The hanging wall at the surface shows a strike north 60 degrees east, dip north 83 degrees, and exhibits vertical slickensiding indicating a fault fissure. The following information was furnished by Dr. H. W. Cain, at the time of the writer's visit in May, 1918.

The development work done on the New Ross property about the year 1906 consisted of a shaft 115 feet deep, on a lead of ore in a fissure vein. At the 40-foot level, drifts northeast and southwest were driven, each about 50 feet. At the 90-foot level a drift was driven southwest 50 feet. Eight hundred and nineteen barrels of high grade ore were shipped from this development work.

The shaft was sunk on an ore chute of varying thickness, averaging about 2 feet but frequently thinning to a stringer towards the east and thickening at one point at 79 feet depth to 5 feet 11 inches.

At the 40-foot level 30 inches of ore was found in the shaft to thin to the eastward to a stringer less than 6 inches thick. At the west side of the shaft the ore is cut off by a sharp break, the hanging-wall meets the foot-wall and continues barren for 12 feet, the ore again coming in along the foot-wall and widening to 22 inches at the face.

At the 90-foot level 14 inches of ore was found on the northeast side of the shaft. To the westward, where 4 feet of ore was cut in the shaft, the drift was driven to the south of the ore, and consequently nothing is known of its continuation in this direction.

Dr. Cain stated that he did not examine the bottom of the shaft, but a miner employed in sinking stated that the ore is 2 feet thick.

Judging from these descriptions and the data available the most probable location for ore appears to be at the southwest drift in the 90-foot level. The shapes of the ore chutes are so variable that it is impossible to estimate any tonnage from the data available.

The following description of the mineralogy of the deposit is an extract from a report written in 1906 by Dr. H. W. Cain.

"The ore lies in wedge-shaped chutes which dip at a high angle to the west. Two of these chutes have been opened, the blank ground between being about 12 feet. The base of the wedge lies to the west.

"In the surface drifts above the lead occurs a soft ore steel grey in appearance which is probably pyrolusite. This is also found above the high water-level of the immediate district.

"In the variable water-level occurs an ore that is low in manganese and high in iron. Just below this "gossan" if this term may be used, the main ore-body occurs; this consists mainly of manganite, which at the surface has been altered so that the ore is steel grey, with a bright lustre giving a black streak and running high in MnO_2 90 per cent, or better. At a depth of about 70 feet the ore gradually assumes the characteristics of unaltered manganite. The streak is reddish-brown in colour, the high content of MnO_2 is lost, and the ore becomes a typical manganite. The per cent of iron is always low and the metallic manganese high."

Eight hundred and nineteen barrels of ore obtained from the development work are stated to have been shipped. Analyses were made from samples of every tenth shovel as ore was barrelled, the samples being coned and quartered.

Analysis of Manganese, New Ross Manganese Company.

No.	Barrels.	Mn.	MnO.	Fe.	Where obtained.
1	7	61·37	91·04	0·50	28 to 42 foot level.
2	28	60·56	89·76	0·81	" " "
3	31	58·52	87·28	1·24	Jig product from dump of above.
4	3	18·81	.....	37·05	Gossan variable water-lead.
5	90	60·54	70·50	0·77	Shaft 42 to 75-foot level.
6	1·00	59·40	53·75	1·22	Shaft 75 to 90-foot level.
7	1·46	59·12	55·60	1·94	" " "
8	1·39	57·66	.....	3·38	Second class ore from different parts of mine.
9	29	58·08	75·41	1·35	Jig product, dump of above.
10	1	.....	89·06	0·81	Jig product above 28-foot level.

Analyst, J. W. Phelan, M.I.T., Boston.

Mn.	S.	P.	Chemist.
59·15	0·02	0·03	Mason, Halifax.
60·37	.....	.....	" "
56·44	.....	.....	Dr. Lomox.
59·63	0·015	0·013	Dr. Lomox.
60·50	0·016	0·043	Dr. Carmichael, Boston.
.....	0·018	0·017	Henry Souther.
.....	0·009	0·035	" "
		0·055	" "

Analysis made by different chemists.

Property of the Nova Scotia Manganese Company. The Nova Scotia Manganese Company's property comprises 9 acres of land obtained from the Church of England to which it was originally granted. It is known as the Dean Chapter, and a royalty of 2 per cent on ore sales has to be paid the Church of England with a minimum annual payment of $100.

The property originally opened up and operated by the Nova Scotia Manganese Company was operated under lease from October, 1915, until June, 1917, by the Metals Development Company, by whom it was subleased to the Rossville Manganese Company now working under the management of Mr. J. H. Whidden.

The writer examined the underground workings on August 17, 1917. The production in 1916 was 544·3 long tons and in 1917, 179 long tons. Unfortunately the mill was destroyed by fire early in 1918 and mining operations were suspended.

A shaft was sunk to a depth of 155 feet vertically and levels driven at this depth each way 170 feet to the northeast and 200 feet to the northwest. The 1916 production was taken from stopes above this level. In December, 1916, and January, 1917, the shaft was sunk to the depth of 210 feet and levels driven each way from the bottom; southwest 75 feet and northeast 180 feet. The shaft and levels are closely timbered on account of soft ground due to decomposition of the granite. The ore has been found to occur in lens-shaped chutes, usually more persistent vertically than horizontally. The plan of the ore-body shows a series of swells and pinches varying in thickness from a few inches to about 3 feet. The manganese occurs as oxides well crystallized in aggregates which exhibit porosity, also in lustreless, dense masses. Concretions in which both these forms occur were seen in the stock pile. Botryoidal varieties are of frequent occurrence. The ore is associated with red and brown, soft limonites and the botryoidal limonite. When the manganese ore is absent the iron oxides fill the fissure.

Underground examination could be made only at certain faces of the levels. In the 155-foot level northeast the bearing from 100 to 130 feet is north 40 degrees east. At the face 170 feet from the shaft no ore was seen. The faulted character of the granite is well shown, vertical slickensides are well preserved, and the crushing indicates that the northwest side is downthrown.

No examination of the southwest level was made. At the face of the southwest level at 210 feet depth, 75 feet from the shaft, two sets of joints are well developed in the granite, north 45 degrees east parallel with the ore-bearing vein, and north 65 degrees west, nearly at right angles.

Both sets of cracks are filled with limonite and the first-mentioned contain small amounts of manganese oxide. In this level a lens of ore 2 feet thick was found between 10 and 20 feet from the shaft and stringers of ore in the face. In the northeast level, at 210 feet depth, a trace of ore was found at 43 feet from the shaft; from 63 to 70 feet a lens of ore was found, stated to be 4 feet thick and to have extended downward for about 8 feet. Several hundred pounds were removed. Intermittent lenses up to 1 foot in thickness were found between this point and the face 175 feet from the shaft. No ore was seen in the face. Stoping is being carried upward from the 210-foot level. The ore chutes are said to have been continuous in the northeast level at 155 feet depth, varying in thickness up to 3 feet. They extend downward toward the 210-foot level. The granite is frequently so decomposed that it forms runs into the stopes. A cross-cut was driven to the south from the 210-foot level and a second parallel vein was found mineralized with limonite.

International Manganese and Chemical Company. The International Manganese and Chemical Company began work in February, 1917, and sank a shaft to a depth of 100 feet, from which levels had been driven along the vein in directions north 52 degrees east and south 60 degrees west, at the time of the writer's visit, August 6, 1917. Drifting was continued along the vein for 500 feet northeastward to the boundary of the New Ross Company's property, but no ore in workable quantity was found. A test shaft was also sunk in fault breccia coloured red by iron oxide, to a depth of 21 feet at a point 1,550 feet north 170° 30′ east of the main workings. A number of test pits along the vein have also been put down.

The main shaft was sunk vertically. The fissure has a steep dip northward about 87½ degrees. Between the surface and 10 feet depth about 100 pounds of manganese oxide was found in broken masses varying in size up to about 3 by 6 inches. Some of these fragments appear to be pseudomorphs of pyrolusite after calcite. Adjoining the hard, granite hanging-wall a peculiar, dark-coloured, twinned calcite was found varying in thickness from 1 to 3 feet. Towards the hanging-wall side a fault breccia, coloured red by iron oxide, occurs. The breccia is made up of finely comminuted granite and calcite as a matrix, in which larger fragments of unaltered granite and calcite occur. Pyrolusite in small masses is in many places completely enclosed in the calcite vein and also in the fragments of calcite in the fault breccia.

Decomposed granite 4 to 6 feet thick separates the hanging-wall or northern fissure vein from a similar fissure vein to the south which is also mineralized with the peculiar calcite and contains fault breccia and limonite. A small lens of broken pyrolusite was found in the northeast drift and a 1-inch stringer in the southeast drift. No workable quantity of ore had been encountered at the time of examination. The following analysis of ore taken from the shaft between the depths of 6 to 18 feet was made by F. F. McChester, Albany, N.Y.

MnO_2	96·71
SiO_2	2·80
FeO	0·45
P	0·016
Total	99·976
Mn	61·14

Summary. It seems probable that the shaft of the International Manganese and Chemical Company is sunk on a continuation of the fissured zone in which the New Ross workings are developed. Though only a small quantity of the manganese oxides has as yet been found in the workings of the former company, the character of the vein and the minerals accompanying the ore are unusually well shown. Two periods of movement in the granite are indicated. Calcite and manganese oxide were deposited together after the first movement. The later movement along this line of weakness resulted in the breaking up of the veins and in the formation of fault breccia composed of granite powder and comminuted calcite and manganese oxides. The geological age of the fault movements is unknown. It is probable that the jointing in the granite developed during its crystallization and more violent movements may have accompanied the intrusion of the pegmatite dykes in Devonian time and again at the close of the Palæozoic era.

The origin of the manganiferous calcite is not known, but secondary enrichment of the manganese oxides by action of surface water appears to be the immediate cause for the presence of workable ore-bodies. This is indicated by the replacement of calcite by pyrolusite in the pseudomorphs found in the International shaft and by the presence of botryoidal forms of manganese oxides in the ore from both the New Ross and Nova Scotia workings.

The soft outcrop along the vein has formed depressions on the surface which act as catchment basins for surface water at certain points, and thus marshy ground along a fissure appears to be favourable for underlying ore.

Secondary enrichments from surface waters would tend to form ore-bodies at some distance below the surface in chutes which would be local and limited in depth. The ore tends to follow the zone of greatest weathering, and to diminish as unaltered parts of the vein are reached. In both the New Ross and Nova Scotia mines the deepest workings are in more solid ground, the wall-rock being fresher than above, indicating that though circulating water may have penetrated much deeper than the present workings, there is a decided change in the character of the vein at the depths reached, and also a diminution in the amount of ore found in the Nova Scotia mine. The wall-rock of the New Ross mine is less weathered throughout than in the Nova Scotia mine and the fact that a considerable thickness of high grade ore occurs in this solid granite indicates that the enrichment may have reached to a considerably greater depth than the workings have yet penetrated. Other parts of the fissures may offer equally good opportunities for ore-bodies, and fissures not yet prospected may contain workable quantities of ore.

Gowland Mountain, Albert County, N.B. Manganese oxide occurs in a fault zone in a granitic rock complex, on the farm of Mrs. George Harrison on the Gowland Mountain road 4 miles east of Elgin corner. A pit through about 6 feet of glacial drift was cleaned out for an examination and at the bottom of the pit a vertical slickensided fault was exposed to the east, having a strike due magnetic north. A section from east to west across the exposure at right angles to the fault-wall was exposed and samples

taken. Massive manganese oxide 5 inches wide and nearly free from rock fragments, occurs in contact on the west side of the fault-wall. A transition zone about an inch wide occurs between the massive oxide and a leaner zone 10 inches wide composed of angular fragments of felsitic rock cemented by manganese oxide (B) followed by 1 foot of a pink, weathered felsite. The remaining 2 feet 6 inches width to the west side of the pit was composed also of felsite breccia with manganese oxide cement. The west limit of this material was not uncovered.

The exposure as a whole has the appearance of a fault zone which was originally filled with a fault breccia, a part of which, probably the most comminuted material, was replaced by manganese oxide. This replacement was apparently most effective along the east wall where the purer oxide ends abruptly against the smooth slickensided surface. Sample A, representing this richer oxide, and sample B, the leaner material, were sent to the Ore Dressing and Metallurgical laboratories of the Department of Mines, Mines Branch, for analysis and the following report has been received:

"Two samples of manganese ore were received on June 14, 1918, from Mr. Hayes of the Geological Survey. These samples were obtained from the farm of Mrs. Geo. Harrison, Gowland Mountain, N.B.

"Sample marked "A" was high grade and gave the following analysis:

"Mn — 50·62 per cent; Fe — 0·30 per cent; SiO_2 — 15·00 per cent.

"Sample marked "B" was low grade and gave the following analysis:

"Mn — 24·69 per cent; Fe — 3·00 per cent.

"The manganese was in the form of pyrolusite, finely crystalline in a reddish slate gangue.

"A test was made on 2,000 grams of B sample, crushed to 50 mesh, on the laboratory Wilfley table, to determine its adaptability to concentration. The results follow:

Product	Weight grams.	Analysis			Content. grams. Mn.	Percentage of Mn values.
		Mn. %	Fe. %	S. %		
Concentrates	433	52·29	3·50	9·85	226·416	45 85
Middlings	101	32·50	3·45		32·825	6·65
Tailings	890	9·85			87·665	17·75
Slime loss	576	25·50			146·894	29·75
Totals and averages.	2,000	24·69			493·800	100·00

"*Conclusions.* In practice, on an ore of this class to obtain a concentrate of grade 50 per cent manganese, a recovery of 50 per cent of the Mn values could be expected. To obtain a concentrate of grade 40 per cent Mn a recovery of 60 per cent could be expected."

It is impossible to say what may be the character of the deposit in reference to size, either in horizontal or vertical extensions. It will likely be erratic, probably lenticular, and the mineralization may be concentrated as in sample A or scattered through fault breccia as in sample B. Since the drift (overburden) may be easily removed, stripping might be done to advantage following the lead both to the north and south of the pit. Other pits might be sunk at some distance—say less than 100 feet in line with the fault or a little to the west. Though it is probable that the manganese oxide is of secondary origin, and does not extend to great depths, it is quite possible that a workable tonnage exists. Mr. George Harrison, sen., stated that a boulder containing several hundred pounds of "needle ore" (probably crystalline pyrolusite) was dug up to the south of the vein several hundred yards from the pit and other fairly large erratics of good ore are occasionally ploughed up. Other veins than the one located may exist. No information is at hand to explain why the pit in which the vein was found was sunk at this locality.

About 150 feet north 7 degrees east magnetic from the pit is an outcrop of fine-grained, purplish felsite and an attempt appears to have been made to cross-cut westward from this point to locate the vein. A small stream flows northwesterly from a point about 200 feet south of the exposed vein. About 200 yards down this stream shattered, coarse-grained granite occurs, and small amounts of manganese oxide fill the cracks. To the northwest of the granite a sheared greenstone occurs. Both the felsite locality No. 2 and the granite locality No. 3 contain small amounts of manganese oxide in joint cracks.

The geology and topography of this district were mapped by R. Ells and S. C. Ells (Map 35A, 1908-9) and these igneous rocks grouped together as Pre-Cambrian.

The location, which is on the northerly slope of Gowland mountain at an elevation, according to Map 35A, of about 1,000 feet, lies within one-half mile of the main road leading to the railway, at a point about 4 miles from Elgin station. Ore would, therefore, have to be hauled up hill half a mile to the road and thence down hill 4 miles to the railway, the ascent being 200 feet and the descent 800 feet.

Mr. F. M. Thompson of Hillsboro and Mr. Henry W. Bailey of Fredericton hold a licence to search over 5 square miles, including the occurrence now under consideration.

SALT (SODIUM CHLORIDE).

Malagash Salt Prospect, North Shore Cumberland County, N.S.

A thickness of 35 feet of salt strata has already been penetrated by a prospect shaft at a point about one-third of a mile from the tidal water of Northumberland strait, and drilling operations indicate the presence of a much greater thickness and persistence in lateral extent. This is the first deposit of its kind to be opened up in eastern Canada and credit is due to Mr. A. R. Chambers of New Glasgow, N.S., who has foreseen the possibilities of this district and instigated the development work.

A description of the deposit, with chemical analyses of brine and salt, a map of the area, and photographs were published by L. Heber Cole in the Canadian Mining Journal of January 8, 1919.

Brine springs have been known locally for many years and in 1912 when boring for water on his farm at North Shore, Mr. Peter Murray obtained a flow of salt water at a depth of about 80 feet. In June 1917 Mr. Chambers, associated with Mr. George Walker McKay of New Glasgow, commenced prospecting by drilling. Twelve holes were sunk by a churn drill and brine was obtained from six of these at depths varying from 85 to 113 feet below the surface and covering an area of about one-tenth of one square mile. A diamond drill boring was then sunk and proved the presence of salt in place extending from a depth of 94 to 173 feet below the surface. A shaft was then sunk 450 feet east of the diamond drill boring and the salt found at a depth of 85 feet. At the time of the writer's visit on October 5, 1918, a vertical depth of 17 feet of salt was exposed, and in a verbal communication on January 9, Messrs. Chambers and McKay stated that 35 feet had been passed through vertically in the shaft and a drift of 12 feet had been driven from the bottom of the shaft, all in salt. On account of the loosely consolidated condition of the rocks overlying the salt, the shaft had to be closely timbered above the salt and this material was seen only on the dump. The sequence described by the foreman in charge of the sinking was as follows:

	Feet.
Red mud and loose rock	0 – 24
Red rock	20 – 30
Greenish gypsiferous? rock	30 – 59
Broken clay rocks of dark grey, yellow, and red colours	59 – 79
Dark grey material	79 – 85
Salt and grey material interbanded with pure white salt	85 – 103

The dark grey material at 79 to 85 feet depth, resembles that interbanded with the salt and suggests a residual accumulation due to solution of a considerable thickness

of the former upward continuation of the salt strata which dip at angles varying from 25 to 55 degrees towards the south. The sediments overlying the salt are described as flat-lying and somewhat broken, suggesting slumping of gypsiferous rocks overlying or interbedded with the salt strata. The upper surface of the salt strata where uncovered in the shaft is described as a smooth horizontal plane and the nearly similar depths at which brine was obtained in the borings leaves little doubt that the outcrop as a whole was eroded to a nearly uniform depth. To the north of the brine area the comminuted material raised by the churn drills is described as hard and soft, red and grey rock, probably sandstone and shale.

The salt strata dip to the south, apparently forming a portion of the north limb of an overturned anticlinal fold.

Few exposures of bedrock occur inland in the vicinity of the workings, but intermittent outcrops along the shore are found, the nearest about 600 yards north of the shaft where about 12 feet thickness of limestone is exposed, overlaid by 4 feet of gypsum, the upper part of which is covered inland. A small collection of fossils from the limestone was examined by E. M. Kindle, who describes them as follows: "These fossils were embedded in gypsiferous limestone and comprise a small and very poorly preserved lot. The determinations are consequently provisional, as follows:

Productus cf *cora.*
Hartina anna.
Aviculopecten cf *simplex.*

The fauna is small and poor, but I believe larger collections will confirm my opinion that this fauna represents a horizon in the Windsor series."

To the westward along the shore are intermittent outcrops of reddish brown shale and grey sandstone of the Windsor series. The strata dip steeply south and form the northern limb of an overturned anticlinal fold. Farther westward the sediments of the Windsor series are unconformably overlain by a thin capping of a loose textured reddish brown conglomerate and sandstone, which dips northwards at 20 degrees and is exposed for half a mile along the coast, ending abruptly at a fault in a stream valley about 1½ miles west of the shaft. A small outcrop of similar rock occurs a few hundred feet south of the shaft.

The total thickness of the salt is unknown, but assuming the structure of the strata to remain uniform, as seen in the shaft, there is space underlying the area in which brine was found for a thickness of about 350 feet measured at right angles to the dip. Several bands of about one foot thickness of unusually pure salt occur in the 35 feet already exposed and thicker beds of this pure salt may occur. The association of potassium salts is possible and should be carefully considered. Average samples were taken of the 17 feet thickness exposed at the time of the writer's visit, but the results of analyses have not yet been received.

Although no accurate estimate of the available tonnage may be made until further development work is done, the bedded character of the deposit and the structure of the associated sediments suggest that the salt owes its origin to chemical precipitation on the bottom of an enclosed marine basin and, therefore, that the deposit may be persistent and extensive.

PEAT INVESTIGATIONS.

By A. Anrep.

NEW BRUNSWICK.

A few preliminary peat investigations have been made of the bogs in the vicinity of St. John city, but the bogs proved to cover very small areas and the quality of peat was mostly peat litter.

These bogs would be more suitable to be developed by farmers of that vicinity and the product used as peat litter for bedding under cattle and horses.

Cudmore Peat Bog. This bog is situated 3½ miles west of Canaan Station, Salisbury parish, Westmorland county, New Brunswick. The total area covered by the bog is, approximately, 350 acres with a depth varying from 3 to 7 feet.;

The bog is practically free from humus and would produce a fairly good peat litter. It contains approximately 99,000 tons of peat litter with 20 per cent moisture.

Hicks Peat Bog. This bog is situated about 1½ miles north of Canaan Station in Moncton parish, Westmorland county, New Brunswick.

The total area covered by the bog is approximately 252 acres, varying in depth from 4 to 20 feet.

The bog is principally composed of sphagnum mosses, is practically free from humus, and would produce a very good peat litter.

The total volume of peat litter available would be, approximately, 197,000 tons containing 20 per cent moisture.

"B" Peat Bog. This bog is situated about one mile south of Canaan Station in Moncton parish, Westmorland county, New Brunswick.

The total area of the bog is, approximately, 107 acres. The depth varies from 4 to 16 feet and the bog contains a total volume of 49,000 tons of peat litter with 20 per cent of moisture.

Canaan Peat Bog. This bog is situated about 1½ miles south of Canaan Station in Moncton parish, Westmorland county, New Brunswick, and is traversed through the centre by the Intercolonial railway between the mileages 17 and 18.

The total area of the bog is 879 acres, with depths varying from 4 to 13 feet.

The bog is principally composed of sphagnum mosses slightly intermixed with Eriophorum; it is very slightly humified and would produce a fairly good peat litter.

The total volume of peat litter available is approximately 481,000 tons, containing 20 per cent moisture.

Gades Peat Bog. This bog is situated about 4 miles south of Canaan Station or a mile west of Gallagher Station in Moncton parish, Westmorland county, New Brunswick.

The total area of the bog is, approximately, 825 acres, varying in depth from 4 to 22 feet.

The bog is principally composed of sphagnum mosses, fairly free from humus, and, as the depths are satisfactory, it is suitable for the manufacture of peat litter on a commercial basis.

The total volume of peat litter available is, approximately, 678,000 tons, containing 20 per cent of moisture.

There are a number of bogs in this vicinity which have not been investigated and from the investigations made so far it is evident that the bogs in this district will be more or less suitable for the manufacture of peat litter.

The peat areas above described are admirably suited for the development of the peat litter industry on a large scale as they are situated not very remote from the market and in the near vicinity of the railway for the shipment of the finished product.

In the immediate vicinity of the Gades bog a small peat fuel bog was investigated.

"A" Peat Fuel Bog. Situated about 1 mile west of Gallagher Station in Moncton parish, Westmorland county, New Brunswick.

The total area of this bog is 50 acres, varying in depth from 3 to 14 feet, with a total volume of 38,600 tons of well humified peat fuel.

A preliminary investigation has also been made of a bog situated 5 miles southwest of Coal Branch station.

This bog is, like the other bogs in this district, fairly free from humus, and would produce good peat litter. As it is a very large bog it would require a fuller investigation.

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