GEOLOGICAL SURVEY OF CANADA.

A. P. LOW, DEPUTY HEAD AND DIRECTOR.

THE BARYTES DEPOSITS

OF

LAKE AINSLIE AND NORTH CHETICAMP, N.S.

WITH NOTES ON THE

PRODUCTION, MANUFACTURE AND USES OF BARYTES IN CANADA.

BY

HENRY S. POOLE.

OTTAWA
GOVERNMENT PRINTING BUREAU
1907

No. 953.

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(SINCE 1885)

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857. Infusorial Earth.
858. Manganese.
859. Salt.
860. Zinc.
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877. Graphite.
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7442—1½

A. P. Low, Esq.,
Deputy Head and Director,
Geological Survey of Canada.

Dear Sir,—I beg herewith to hand you my report on the Geology of the Barytes deposits of Lake Ainslie and North Cheticamp, N.S., with notes on the Production, Manufacture and uses of Barytes in Canada.

I am, Sir,
Your obedient servant,

Henry S. Poole.

Ottawa.

INTRODUCTION.

BARYTES.

BARITE, HEAVY SPAR, BARIUM SULPHATE, TIFF, CAWK, CAUK.

Composition.—Ba S O_4; with a hardness of 2.5 to 3.5; and a high specific gravity, 4.3 to 4.6, which gives it the common name of Heavy Spar. It is white or stained some light tint, more frequently reddish, by iron. It is heavier than and not nearly so hard as quartz. It is harder than gypsum and it is readily distinguished from limestone and marble by its greater specific gravity and by its not effervescing in acids. As a mineral it may contain small amounts of iron, alumina, magnesia or lime, with one to three per cent of silica. It crystallizes in the orthorhombic system. Barium carbonate or Witherite is exceedingly rare in Canada.

Among useful minerals barytes is looked at askance as a cheap make-weight and impurity. The intrinsic merit which it undoubtedly possesses in certain of the arts is obscured by the public knowledge of its general employment as an adulterant. It differs in this respect from some other substances at times used in a similar manner, yet without the same attached stigma. The character of starch, for example, is not smirched by its use to dilute mustard and cocoa.

Occasion will be taken in this Bulletin to accentuate this point and mention will be made of several industries in which barytes is used for its acknowledged good qualities and not as a surreptitious, inferior substitute.

With the grade of each class of goods subjected to adulteration it remains a moot point where effective treatment ends and imposition begins. A tacit agreement seems to permit trade names giving to terms a meaning at variance with that of common parlance. The Inland Revenue Department undertakes to restrict an extension of this practice and analyses in its laboratories various samples of manufactured substances whose composition is not readily detected by inspection.

The highly poisonous nature of its base, barium, is so well locked up in the insolubility* of this compound that no danger results from its use; it can be handled and breathed and swallowed with the modicum of detriment that accompanies contact with any substance, inert and not benign.

The Genesis of Barytes.—Cumulative researches in the laboratory of the Geological Survey at Washington, D.C., have included computative and mean results of the relative abundance of the primary elements of matter in the primitive rocks of the earth's crust, eruptive and crystalline.

These investigations have led to the discovery that although barytes is practically insoluble barium in perceptible quantities is almost universally diffused in igneous rocks. On an average of over 600 determinations of rocks of this class the percentage of baryta was found to be 0.11, equalling manganese oxide 0.10, and the chemical elements, sulphur 0.108 and phosphorus 0.11. To these elements a closer comparison of quantities may be made by giving the amount of barium 0.089 and manganese 0.084 in their elementary state.

On the other hand a composite analysis of equal weights of over 800 samples of limestone failed to detect even a trace of barium, while a similar treatment of 250 samples of sandstone, a sedimentary rock, showed an average content of 0.05 of baryta. It would then seem that while barytes and calcspar often are both constituents of a mineral vein, the circumstances of deposition of limestone in mass are not suitable to the dissemination through it of minute depositions of barytes.

The conclusion derived from the composite analysis would thus imply the primary source of barium to be direct from the primitive rocks of the earth's crust in which, as shown by a large number of laboratory tests, an appreciable quantity exists. From the same source also come chlorides, and the sequence of reactions which the chemical affinities of these substances require, suggests why deposits of the insoluble sulphate should be looked for in clastic rocks of an eruptive region and in such rocks as the felsites of Lake Ainslie, which are of igneous origin and are deposited around the immediate centres of ancient volcanic activity. Pertinent to this inquiry is the presence of baryta and strontia in a great number of the saline waters of Canada. In the springs of Varennes, St. Léon, and Lanoraie, the precipitates obtained were found to be mixtures of the barium and strontium sulphates. In the last named spring there was detected 0.03 of barium chloride in 1000 parts of water with a further

*Though totally insoluble in acids barium sulphate is partly soluble in sodium hyposulphate.

addition of .01 of barium carbonate. The chemical history of these and other mineral waters was fully discussed in The Geology of Canada, 1863, pp. 550-3.

How a mineral so inert and so unaffected by chemical re-agents in the wet could be so universally disseminated is partly illustrated by a growth, in some coal mines of the north of England, of soft layers of barytes in the water-troughs and pipes. In these pits the mine water contains barium chloride, and when the pyrites, present in the coal, decomposes on exposure to the air in the workings, free sulphuric acid is generated and there is a consequent precipitation of barium sulphate.

The chemist Bischoff states that barytes* can be decomposed by heated solutions of alkaline carbonates and that when these are cooled it is reformed and deposited. Dawson suggests that it has probably been introduced in this manner into the vein at Five Islands in Nova Scotia.

In connexion with the marked insolubility of barytes in the laboratory of the chemist it may be noticed in the field that the outcropping mineral which has been exposed to the weather for untold ages has a very uneven surface, the layers, patches and streaks of greater opacity standing out above the level of the more crystalline and friable mineral.

CHAPTER I.

OCCURRENCE.

Where barytes accompanies metallic ores as the gangue of a vein it does not as a rule occur in commercial quantities. Where it has been worked for the mineral itself it has generally been found in pockets or lenses, often in limestone or along an unconformable contact with associated rocks, the pockets being sometimes distinct from each other or connected by a small leader. The ore sometimes occurs in limestone merely as nodules. Many illustrations of a scattered accompaniment may be found in the Reports of the Geological Survey of Canada, as for example in the writings of Mr. H. Fletcher† and in the Mineralogy of Nova Scotia by Professor H. How, edition 1869‡, the first comprehensive

*Geological Observer De la Beche, p. 768.

†Vol. V., 1889-91, Part P, pp. 175 (River John), 176 (Londonderry), 185 (Tennycape) and 192 (Five Islands).

‡H. How, pp. 111-113 (Manganese of Tennycape); 116 (Manganese of Onslow); 91 (brown hematite beds, Londonderry).

handbook on Nova Scotian minerals ever issued, and a fruitful source of information for subsequent writers on that subject.

Ontario.

Among the earlier references to barytes are those of Sir W. E. Logan in his Geology of Canada, 1863, where he mentions (pages 458 and 771) occurrences in the second lot of range viii (or vii) of Lansdowne; in lot 4 of range vi of Bathurst township; in MacNab at the mouth of the Dochert; in cavities of the Laurentian limestone near the hematite of Iron island, Lake Nipissing; in the Gaspé sandstones of the York river and in the veinstones of the large lodes carrying copper ores, on the north side of Lake Superior, between Pigeon river and Fort William, and in Thunder bay.

In the last locality the mineral, with green octahedral fluor-spar lines, intersects a porphyry*. For many years past this mine has not been worked.

Barytes has been found crystallized in geodes in the dolomites of the Calciferous formation and occasionally in those of the Niagara at the falls, and as small almond-shaped masses of a reddish cleavable variety, with gypsum, in shales of the Hudson River formation at Cape Rich on the southwest side of Georgian bay.

The Annual Mineral Resources of the United States refers to barytes works on the American side of the Niagara falls with a capacity of sixty tons a day, which at one time drew part of their supply from the north shore of Lake Superior.

Other barytes veins occur on the adjacent islands: the principal one is on McKellar island.

The vein was discovered in 1869 by Messrs. McKellar Bros. It is very large, consisting of coarsely crystalline calcite and barite, occurring in separate ribs for the most part, although they are mixed in part of the vein. There is also a small proportion of quartz, generally colourless. The metallic minerals consist of zinc blende with a little galena and pyrites. In addition to the main vein, which is composed of solid spar, and is about sixty feet wide, there are on the south side of the island numerous side stringers intersecting the country rock of the west wall

*The vein is ten feet thick, and has been worked for silver to a depth of about 150 feet.

of the vein. The enclosing rock is a dark green coarse-grained trap. This composes the whole island, which is only some eight or nine chains wide. During the summer of 1886 the barite rib on the east side of the vein was worked down from the surface, some thirty men being employed at this work, and the product, after handpicking to extract as much of the calcite and quartz as possible, was shipped to the United States, the purchasing firm giving $5 over the rail at the island for the best quality.*

According to the Descriptive Catalogue for the Colonial Exhibition, the principal deposit of barytes on the northwest shore of Lake Superior is on McKellar island, which is one mile south of Pie island. The vein is forty-five feet in width, of which one-third consists of white barytes in bands of from two to six feet, running parallel to the walls of the vein, while the rest of the vein is crystalline calcite holding argentiferous galena and native silver. This deposit in 1890 was operated by the United States Barytes Company of Cleveland, Ohio. The Canadian production of barytes that year amounted to 1,842 tons, valued at $7,543, obtained from two deposits, the main one being the McKellar Island vein. Almost the whole of the production was exported to the United States. (Mineral Statistics and Mines for 1890). In 1894 the mine had been purchased by Messrs. Barnes and Upton of Duluth. The ore was tested and several hundred tons used with good results (Ontario Bureau of Mines Report for 1894). The following year the deposit had been purchased by Mr. W. P. Lardner of Duluth, and associates. It was said that results of tests of the barytes were very satisfactory. (Ontario Bureau of Mines Report, 1895).

About four miles north of Kingston city, on the road thence to Elginburg, a vein of barytes, with a width varying from a few inches to over three feet, is said to extend from the road to Sydenham on the east in a northwest direction as far as Varty lake, a distance of nearly fourteen miles. At the eastern end it is well exposed on lots 17–18, R. IV, Kingston township, and has been traced for a short distance southeast, across the Kingston road. In a northwest direction it has been uncovered on the south half of lots 16 and 15, R. V. The vein is nearly vertical and cuts across the limestone formation of the district, which lies in nearly flat strata and is similar in character to that of the city of Kingston, usually regarded as of Black River age or possibly a portion of the upper Chazy, since the rocks lie beneath the beds which hold the large and characteristic Black River fossils so common to the formation. The limestone is usually a somewhat hard and cherty rock with dark shaly partings. The mineral is found in a long, straight

*Geol. Sur. of Can., Vol. III., pt. H., p. 42.

fissure and is usually of a dirty white colour, the contact with the limestone or sides being sharply defined and the barytes containing a small admixture of carbonaceous matter, probably anthraxolite, along the margin. The vein has been opened on lot 17, R. IV, to a depth of about twenty feet and about 100 tons have at different times been taken to Kingston for shipment. In places the barytes is mixed with calcite and in one of the pits, at a depth of about eighteen feet, the mineral was almost entirely replaced by the calcite. There appears to be a large amount of the mineral in this vein, but the somewhat impure character of the ore has apparently interfered with its development.

Barytes also occurs, in Ontario, in the Laurentian rocks of Lanark county in the township of North Burgess, lot 4, range IX; of Packenham, lot 3, range XI; of Lavant, lot 22, range I; of Ramsay, range IV; also at Dog lake, Stormington, Frontenac county and at Galway in Peterborough county. It occurs in the Cambrian rocks in Ontario in the second cutting west of McKay harbour on the C.P.R., in the district of Thunder bay; in Oso, Frontenac county; in Lansdowne and North Crosby, both in Leeds county; in Bathurst and in Lavant, both in Lanark county and in Madoc, lot 15, range VI, Hastings county.

Quebec.

Barytes has been found in the province of Quebec, in the Saguenay valley; in Wright county, near Perkins Mill, range XII, lot 12; at the Haycock mine in Templeton where crystals of barytes are associated with specular iron, calcite, beautiful green fluor-spar and reddish feldspar and in Buckingham township, range IV, lot 21, Labelle county, where some of the exposures of the limestone are intersected by veins of opaque white barytes, holding galena. One vein is from six to fourteen inches wide with two strings of galena, of a width, where exposed, of one inch and one inch and a half, with an underlie N. 40° E. $<72°$. Another vein of the same character lies thirty paces westward. It is six inches wide with less galena, and on a course S. 53° E. was exposed for sixty feet. Still another vein of barytes was exposed 250 paces northeastward of the first mentioned, with a course N. 54° W.*

A vein of barytes nine inches wide has been found at Anse à la Vieille, in Bonaventure county.

In Wright county, on the west half of lot 7, in concession 10 of the township of Hull, four miles from the Gatineau river, the Canada Paint

*Geol. Sur. Report for 1863-66, pp. 19, 20.

Co. followed a vein for 300 feet in a N.N.W. direction, and worked it to a depth of twenty feet. In 1899 the Company took out of the Foley mine 416 tons of barytes and in 1900 about 460 tons, valued at $3,220. The vein is in the Laurentian system and varies from two to four feet in width. The country rock is a very crystalline white limestone, dipping at a high angle S. 67° E. The barytes is of an opaque white colour, associated with sea-green fluor-spar. This spar is hardly in a sufficient quantity to detract from the value of the barytes, and, when ground, it forms a powder almost as white as the latter.

Newfoundland.

The first mention of barytes in the shipping returns of this colony was for the year 1902, when 315 tons, valued at $2.00 per ton, were exported to the United States.

New Brunswick.

Dr. Bailey *notes the occurrence of barytes in the Laurentian limestones on Frye island and Grand Manan, also near the summit of the Lower Carboniferous at Gouldville, associated with some galena. From this locality a considerable quantity was once shipped. Barytes has been reported near Memramcook by Daniels in 1878.

Nova Scotia.

Probably the earliest reference to barytes in the Lower Provinces is in the "Geology of Nova Scotia" by Jackson and Alger, 1832, p. 79, where mention is made of it in geodes of the hematite of the East river of Pictou. In this locality, when the mining of limonite was actively prosecuted by the Nova Scotia Steel and Iron Co. in the nineties, the association of barytes in the deposit was of frequent occurrence and proved objectionable in the blast furnace. It was distributed in such detached crystal groups or was so disseminated through the iron ore that it was not profitable to clean it sufficiently to render it marketable.

Sir J. W. Dawson† mentions a deposit of barytes quarried on the banks of the Stewiacke. He adds that the deposit appears to be exhausted in so far as it can be reached by ordinary quarrying operations. He also mentions barytes as occurring in small crystals lining fissures, and in compact veins of ankerite in the Great Village river, as also in veins

*Geol. Sur. Report for 1897, Pt. M.
†Acadian Geology, 1855.

in the banks of the East river of Five Islands, which veins he considered to be a continuation of the great iron veins of Londonderry, and from whence large quantities of barytes have been exported to the United States.

The presence of barytes in the Carboniferous rocks of Nova Scotia, in veins and pockets at the contact of formations of distinctly different horizons, has been long known. It is found both compact and crystalline, also in well defined crystals lining cavities and coating minerals already deposited. In this crystalline form it is seen at Bridgeville in Pictou county in the limonite mines already referred to on the contact of the Lower Carboniferous with Silurian strata, where it is deposited, but not in quantities, associated with the ores of manganese, spathic and other iron ores of the East River district. In other localities in Nova Scotia the mineralized zone at the contact of the Sub-Carboniferous with lower formations has been found to carry barytes scattered and in patches. The irregularity of the deposits has entailed an amount of deadwork out of proportion to the quantity of mineral obtained. Operations have not, hitherto, been continuous. The most extensive deposits of this character opened up were at Five islands and on the north side of the Stewiacke valley to the east of Brookfield station, where the contact is of Devonian and Lower Carboniferous. (*See* Geological Survey maps.)

In distinct veins barytes is known to occur in quantity on the Gulf shore of Cape Breton, north of Cheticamp island, also inland about Lake Ainslie. In both of these localities the country rocks are of the oldest in the province, and lie in, or in the neighbourhood of, eruptives. They are classed as Pre-Cambrian.

In Inverness county near Port Hood, Brook-village and in the Judique Chapel brook near John Cameron's, there is a deposit in veins in a fine conglomerate.* At Finlay point, near Mabou Coal Mines, barytes in some quantity occurs along the line of contact of the Carboniferous rocks with felsite. It also occurs in Richmond county near Loch Lomond and, in Devonian strata, near McMillan point on the Strait of Canso†; at Springhill, in millstone grit, on the south branch of Black brook, in veins a few inches wide; at Greenville; on the west arm of the river Avon; on the East mountain of Onslow; at Frenchmans Barn, Arisaig; and at Hodson, five miles from River John it occurs in small veins and lenses mixed with calcspar, in grey sandstones of the Upper Carboniferous or Permian rocks. One belt is about seven feet wide.

*Geol. Sur. of Can., 1882-84, Pt. H, p. 69.
†Geol. Sur. of Can., 1879-80, Pt. F, p. 125.

First opened in the seventies when there was a brisk demand for barytes, some 480 tons were shipped and valued at $5 per ton. The locality was again prospected in 1900. In the same rocks in many of the branches of River John, above John McKay's, near Mr. Morrison's, on Nabiscump brook, near Peter Gratto's mill, near McBean's house, and at Welsford between the mills and the shop, barytes occurs. In one conglomerate the pebbles are held together by barytes mixed with a white crystalline calcspar.

Its association with ores of iron at Bridgeville has been mentioned. At the Acadia iron mines barytes is associated in small quantities with specular ore and ankerite; and it is common with the iron ores of Clifton and at the mouth of the Shubenacadie river. At the latter place white and reddish crystals, a quarter of an inch long, line the walls of cavities in the ore, and in some places are curiously coated over with a velvety oxide of iron, which gives them a rounded outline.*

Barytes Mining.—Among the earliest reported workings of barytes in Nova Scotia were the operations of Mr. Sewell of Bath, Maine, about thirty years ago. He opened the Eureka mine, Colchester county, by an adit driven from Bass river. On what appeared to be an extension of the same deposit on the top of the hill the Dolphin mine was opened, and, at a still later date, (about the year 1896), J. Prendergast, a prospector well known in the seventies, explored part of the ground for Mr. T. R. Gue. The deposit is reported to be at the contact of two series of rocks and is said to be too irregular in deposition for profitable operations. The barytes occur in places highly crystallized and, in parts, coated with large crystals of calcite. Some of the crystals of barytes were dotted with inclusions of pyrites, and the crystalline masses were sometimes stained a reddish tint which detracted from the value of the ore.

The Eureka mine was near the village of Five Islands, and the mineral contents of the deposit were found generally well crystallized. These were chalcopyrite and specular iron ore, masses of tabular crystals of barytes, generally with inclusions, and barytes in pockets encrusted in cavities by dog-tooth spar. Large aggregates of both calcite and barytes were obtained. In all some 3,000 tons were mined, but the deposits were found too irregular for profitable mining. The mine was shut down for many years but eventually the deposits were re-examined, and further explorations in the neighbourhood were made costing nearly $2,000. These explorations extended from the East river, over the hill

*Geol. of Can., 1873-74, p. 220

for about a mile and a half to the adjoining ravine, and confirmed the conclusions of the previous workers. The deposit is spoken of as blanketing the hill only a few feet below the surface, and rarely exceeds fifteen inches in thickness; the thickest portion uncovered in the latter openings was a lense or kidney nearly four feet thick. The quality of the mineral is described as excellent.*

Mr. H. Fletcher mentions white and reddish barytes being quarried from numerous irregular veins, sometimes three feet wide, or beautiful crystalline masses in the slates on the steep banks of the East and Bass rivers of Five Islands. Elsewhere the reports of the Survey note that this deposit of barytes is two miles up Bass river. Eight hundred tons of ore were shipped to the United States in 1874-75, with a total shipment to 1885 of over 3,000 tons, valued at $10 per ton. The ground material was stated to be worth $30 per ton. Part of the output was used in the paint mill of the Dolphin Manufacturing Co. of St. Catharines, Ont. The ore in part occurs in rocks which were at one time assumed to be Cambro-Silurian, but which are now regarded by Mr. Fletcher as Devonian at a contact with Lower Carboniferous.

The Stewiacke deposit lies about six miles east of Brookfield station, or a mile west of Bill Putnam brook, and half a mile north of the river. Professor How† describes the operations previous to 1868. The ore was in three veins, averaging eighteen inches in thickness, perfectly free from pyrites and other metallic minerals, but containing traces of graphite. Mr. H. Fletcher says that the veins seem to traverse irregularly a grey argillaceous limestone, which is also cut by small veins of bright red calcspar. At Upper Brookfield in the neighbourhood of the iron mine, two to three miles from the railway station, a pocket of mixed limonite and barytes was said by Professor How* to be fifteen feet wide.

Cape Breton.

The workable vein deposits of the island of Cape Breton centre round Lake Ainslie and the shore section of North Cheticamp.

THE DISTRICT OF LAKE AINSLIE.

Topography.—Lake Ainslie, roughly triangular, is the largest sheet of fresh water in Cape Breton, and its attractive scenery vies with that of the Bras d'Or. It is fringed by fine farms hedged in by high hills. The northeast corner of the lake forms at Outlet the headwaters of the south-

*Geol. Sur. of Can., 1882-84, Pt. L, p. 23.
†Mineralogy of Nova Scotia.

west branch of the Margaree river, a well known fishing stream. Its northwest angle, Loch Ban, is touched by the Inverness and Richmond railway at Strathlorne station, and from Lakehead, its southern apex Ainslie Glen, with the Mullach on its left, descends to Whycocomagh on the Bras d'Or. The surface of the lake, at high water, is about 155 feet above sea level; its depths are shallow varying from twenty-four feet, with a muddy bottom in the centre, to a maximum depth of fifty-seven feet off Sand point where it narrows towards its southern end, and the ancient glacier, crowded between high hills, has deepened its bed. Some thirty years ago, when it was proposed to drain the lake through the glacial drifts that dam back its waters at Strathlorne, systematic soundings giving the above results were made by Lauchlin McMillan who tells me that there is shallow water off the northern side and another shallow off the east side of the lake to Outlet, with deeper water nearer the shore. This depression may be assumed the line of drainage before the final damming up of the lake waters. The foreshore of the lake is generally stony, with well worn coarse pebbles so packed together as to present a paved appearance, while the larger boulders have been seized by the ice and thrust against the banks, for even in this lake the ice-shoves in the spring have great power and make heaps many feet in height. During open water strong winds cause currents and great waves to assort the sands and smaller stones, and form with them beaches in the coves. These collections are most noticeable where the streams of pre-glacial times flowed at a level lower than their present beds and originated the coves, which, since the formation of the lake, have been the collecting ground for recent deposits, the accumulation of wash from the land and sand from the abrasion of the grit-stones in the rocky beds of the watercourses pouring down the steep hillsides, the beach deposits being a measure, as it were, of the time that has passed since the glacial period deposited the mounds of mixed earth and stone along the lake-edge and the outlets of the gorges. At McLean point and onward to Lakehead are mounds with steep sides, clothed with brush to the water's edge, and partly faced by boulders; they are now subject to little or no wave action, even at the point the most exposed to the strong sweep of the winds across the lake from the northwest. The coves which the pre-glacial stage left at Glenmore, East Lake Ainslie, Trout river and about McLean point are now partly silted up with the sands which the lake waves have sorted out and cast ashore. The characteristic red brick clays of the glacial period seem to be absent from this locality.

Geological Structure.—References will be found in the opening pages of Mr. H. Fletcher's report on the Geology of northern Cape Breton*

*Geol. Sur. of Can., 1882-84, Pt. H; map sheets 13, 14 and 15.

to the basal rocks, classed as Pre-Cambrian, and to those of them which form the steep west front of the plateau of high ground lying between Lake Ainslie and Middle river. The course taken by the broad ridge is approximately parallel with the west coast of the island and was seemingly determined by long past orogenetic pressures. Its surface deeply eroded prior to Carboniferous times, the inequalities became occupied by massive beds of coarse grit and, together with Pre-Cambrian protrusions, were reduced by sub-aerial agencies to the approximate peneplane of later periods.

References are also made to the igneous rocks, the felsites and traps which are now shown to have an important relation to the barytes deposits to be considered in this bulletin.

No trace remains in this region of any sedimentaries of intermediate ages, Cambrian, Silurian or Devonian. Of members of the Lower Carboniferous, Mr. Fletcher places the coarse grits occupying the higher ground with the Carboniferous conglomerate and classifies the other succeeding members of the series with the Carboniferous limestone. These softer beds of red marls, shales, fine-grained sandstones, gypsum and dark limestones suffering greater denudation, give direction to the glens and river-courses and determined the lake site. Small patches of grey measures on the south shore of the lake, near the chapel, and again where associated with some bituminous shales on the Margaree river, two miles below Outlet, are probably millstone grit. Of the higher members of the Carboniferous system that carry coal seams in places near the shore no repetition seems to have been left inland in the shelter of the monoclinal and anticlinal folds.

The series of Lower Carboniferous rocks of this locality has its lowest members, reddish shales and mottled clay beds, resting on igneous rocks. These are not always present, and in such cases the contact bed is apt to be an impure dark limestone which outcrops at many places along the hill front. This limestone is in turn overlaid by argillaceous shales and bedded sandstones. No gypsum has been exposed on the east side of the lake, but depressions at several spots in the surface, similar to the so-called "plaster pits," suggest its presence. On the west side of the lake gypsum is to be seen.

On the higher lands to the east the rocks capping large areas are coarse grey grits which supplied much of the loose stones and boulders sprinkled with granite on the surface. The grits are classed as Carboniferous conglomerate. The valley of Glenmore, which is occupied by Lower Carboniferous rocks, would appear to have been eroded before Carboni-

ferous times to a lower level than that at which the streams flow to-day, while the ravine of the Gairloch road marks an erosion subsequent to the period of the Lower Carboniferous. At many places exposed along the contact there is much disturbance of the newer strata with high dips and, possibly, some overturns.

The Discovery of Barytes.—In this district, previous to 1890, the presence of a white rock, heavier than quartz, was well known to the inhabitants on the east side of the lake. At the foot of some of the hills were blocks of it far too large to move and measuring up to eight feet in length. Those of smaller size were gathered up and cast on the stone heaps or thrown on the roadside out of the way of the plough. The smaller stones and pebbles of the same rock became exposed on some hauling-roads over the lower slopes; the unusual weight of the rock attracted attention and induced the youth of the neighbourhood to select boulders of suitable size to try their skill at putting the stone, but it was not until about 1890 that the name and value of the rock became known.

The barytes-bearing district of the lake lies along the flank of the high land on the east side from Outlet, to the mouth of Trout river near where the lake narrows at McLean point.

Within this field, for a distance of some six miles, indications of barytes have been detected at many places. The indications nearest to Outlet have been noticed on the brook flowing behind the house of Edward Campbell, but no exposure of a deposit has yet been made. The next appearance is half a mile westward by the side of a wood road on the rear lands of Farquhar McKinnon, at a height of 600 feet, where some ten tons were removed from an outcrop which has a bearing S. 60° W. The rock here is a mottled grey felsite; between it and the main road are dikes of very dark trap and from it the old road to Outlet passes down over a strip of red shales which underlie grey sandstones of the Lower Carboniferous series that fringe the shore of the lake. Crossing Cobb brook in a westerly direction a few scattered boulders have been seen on the lands of Allan McLean and J. McDougall. On the grant to Lauchlin McMillan, now divided between McMillan and Thomas Campbell, occur the important deposits now being developed by S. M. Brookfield and his associates of Halifax under the management of H. H. Harrison, to whom acknowledgments are due for much assistance and information respecting this field.

The mining operations here are on the cleared hill rising from the right bank of Mill brook, on which the Geological Survey map marks a grist mill. Beyond the left bank of this small stream, on the property of J. J.

McLean, some surface boulders may be seen, but on the next three adjoining farms along the lake-front none as yet have been observed, or, at least, reported. Onwards toward Trout river barytes drift has been found in varied abundance and with wide veins standing prominently above the surface of the hill at Norman Johnston's, where Messrs. Henderson and Potts, paint manufacturers of Halifax, have been mining for several years. On the adjoining grant to Murdoch McDougall, just across the Gairloch Mountain road, a vein has been opened. On the next three properties belonging to D. D. McKenzie, Donald McKay and L. R. McKay, numerous large boulders are exposed, but their source has not been determined.

On the holding of the last named, occupying the right bank of Trout river, indications of barytes cease on the east side of the lake. Beyond the river the rocks in places are thickly covered by glacial drift, and the only exposures on the lake side are Lower Carboniferous beds which continue to occupy the lake front and the high ground to Lakehead.

MINING OPERATIONS AT LAKE AINSLIE.*

When it was recognized that the heavy, white boulders strewn about the fields were not quartz but barytes which possessed a market value, operations were begun on the holding of Norman Johnston, 1,000 paces from the lake. There the white rock stood boldly out above the surface of the hill beside the Gairloch Mountain road as it enters the ravine to wind up the rising ground to the level of the plateau.

This float of barytes is supposed to indicate the presence of some seven veins, three of which have been partly exploited. The strike of the veins is N. 80° E. to S. 75° E. and is across the axis of the felsite hill and the north fork of the ravine. Boulders of barytes are in the soil on the left bank of this fork and nearly up to an exposure of a dike of trap running N. and S. which is supposed to cut off any extension of the veins to the eastward. Beyond the dike are coarse grits of the Lower Carboniferous. In the other direction the dark limestones and sandstone beds and shales of the Carboniferous limestone have been exposed overlying the western extension of barytes veins.

Operations on the main vein, which is about eight feet wide, consisted of an upper and lower drift for some 200 feet westward, at which distance a vertical cross vein or branch came in from the northward and yielded barytes from nine to twenty feet in width for a length of 125 feet. The extent of these north and south leaders and the number of them that are

**See* Addendum, p. 43.

workable have not been determined. From the openings made an opinion has been formed that they do not carry their great width continuously in depth.

Towards the top of Johnston hill a trench has been dug along an outcrop east and west across the hill and has exposed from eighteen inches to three feet of barytes dipping 80° northward; float of barytes 125 paces north of this trench indicates another vein which would extend across the ravine to the eastward.

No mining was prosecuted in 1904, there being a supply on the dump from the previous year's operations. The mineral ore is carted by the way of Ainslie glen twelve miles to Whycocomagh for shipment, at a cost of two dollars per ton. Messrs. Henderson and Potts, the mine operators, report having extracted in all some 3,574 tons to the end of 1904 since they began work in 1890.

West of Gairloch Mountain road the only openings made were at 180 paces from the road, where four feet of barytes outcropped on the hill side, course N. 85° E. A drift some twenty feet lower found the vein pinched but to what extent was not proved. From this point the Pre-Cambrian continues nearly to Trout river, but the reddish felsite is not seen in the river ravine or any farther to the westward. If any extension exists it is hidden under heavy surface cover which does not show any float of barytes. The surface pebbles are chiefly composed of the coarse grit which occupies so much of the high land. The last boulder of barytes to be seen is on a knoll behind L. R. McKay's house, some 650 paces from the highway bridge at the mouth of Trout river. The exposure looks like an outcrop and is not less than eight feet wide, but it has not been fully uncovered. Other boulders of large size lie nearby and, in the soil sloping northward, are many smaller ones. They range along the lower slope through the adjoining farms close behind the homesteads of D. McKay and Mrs. McMillan.

Returning northward along the Pre-Cambrian range no trace of exploration is seen until Mill brook and Burnt hill are reached. Here are situated the latest developments, conducted by the Eastern Milling Company, under Mr. H. H. Harrison. These operations are carried on in veins which trend parallel to the north face of Burnt hill, and, with a southerly dip, approximate the average course of the Gairloch Mountain road veins.

Operations have been pursued at three points, viz.:—To the east (on the land of Lauchlin McMillan) by an open cut near the crest of the

hill. In the centre, at a somewhat lower level and parallel, 200 feet northward (on the John McDougall property); and to the west on the steep face of the hill on the Campbell vein. No openings have been made on the south slope of the hill to the brook. Eastward, prospecting stopped short at a point 900 feet along the series of veins, where the water courses attain high ground and lose their rapid flow, but, seemingly, the barytes-bearing rock, felsite, extends much farther in that direction and probably carries mineral with it.

The McMillan open cut extends some 170 feet and, where worked, shows a width of from eight to sixteen feet of ore. The hanging wall is well defined; the foot wall is somewhat shattered and the disturbed blocks of rock are cemented with barytes.

On the McDougall vein openings have been made 125 feet east and forty feet west of a drift to it from the north slope of the hill, and several parallel stringers of irregular width were cut. At a depth of thirty feet the vein opened out below a pinch and there shows a width increasing to eight feet at one part.

The Campbell vein has been worked by five drifts on the western face of the hill; the lowest, at the base of the hill and near the engine house, is driven in on the vein 175 feet, the second sixty feet, the third forty feet, the fourth thirty feet and the highest (250 feet above the lowest level) fifteen feet. They all show over seven feet and even up to fourteen feet of vein, with a grey clay gouge on the foot wall.

The foot hill extending westward under the deposits of the Carboniferous limestone doubtless also carries, in that direction and in depth, extensions of the barytes veins.

A tramway round the shoulder of the hill brings the ore from the open cut to a shoot, at the base of which, on the west front of the hill, a track runs to the lake and to a steam barge for conveyance eight miles across the lake to a special siding near Strathlorne station on the Inverness and Richmond railway. From these veins a great deal of float has been carried down hill towards the north; only one solitary boulder of barytes was to be seen on the crest of the hill about a hundred yards to the southward of the strike of the veins, in which direction no discoveries of ore have been made. But across Mill brook, in the ravine, at a lower level, some barytes boulders occur in the soil. The northerly drift of the float has carried barytes boulders half a mile on to rising ground by the roadside where no rocks in place are visible and where the beds underlying are assumed, from their surroundings, to be Carbonifer-

ous limestone. On Burnt hill, as well as on any exposures of rock surface along the hill front of East Lake Ainslie, there is no glacial polishing or grooving. The only indication of moving ice coating was seen on a sandstone bed, without direction, high up on the hillside east of Cobb brook.

McMillan's open cut on the hill-top has shown no ice-polished surfaces, but the superficial rock and the outcropping of the veins are shattered by long exposure to subaerial agencies, the only evidence of heavy frost being a layer of angular fragments of rock, washed clear of clay and small stones, lying on top of the disturbed and fractured rocks and underlying the mixed soil and stones of the surface.

Analysis of Lake Ainslie barytes by F. H. Mason, F.C.S., &c.:—

Moisture lost at 100° C.	.05
Sulphate of baryta.	94.20
Sulphate of lime	0.02
Carbonate of lime.	4.44
Silica.	0.05
Ferric oxide.	0.11
Alumina.	0.04
Magnesia.	Trace.
Loss on ignition.	1.01
	99·92

Vein Associates.—In the principal barytes veins there may occasionally be seen both calcite and fluor-spar in small quantities; at McDougall's opening on Burnt hill the fluor-spar is apt to be more aggregated in the narrow leaders than in the main deposit, in which it appears as small crystalline centres of a light green colour, where the vein matter is not compact but is in part vesicular. The semi-crystalline cavities near the surface of the veins are often found to be dusted over with a black powder which examination has shown to be wad, impure manganese oxide, soluble in acids.

Petroleum.—But in other parts of the veins there are spots where acid fails to clean off the matter, which there discolours the barytes and coats the cavities and their imperfectly formed crystal faces. This substance was pointed out to the operators and shown to be inspissated petroleum, which can be got rid of by heat. The quantity seen was small and quite local, but the presence of two such dissimilar substances requiring different treatment is worthy of note so that care may be taken in the mining and any sorting deemed expedient may be then made.

When the search for petroleum was made on the lake shore as described by Mr. Fletcher,* there was one hole put down on the north side of the Gairloch Mountain road half a mile from the lake, close to the barytes mines of Henderson and Potts, and sixty paces short of a strong spring of water having a metallic taste. At fifteen feet the borehole passed through the surface soil and entered a white rock in which it continued, it is said, to a depth of 200 feet. The borings whitened the bed of the brook and formed a layer on the beach of the lake but were not recognized as barytes. The mineral was supposed, at the time, to be plaster.

It is unfortunate that no complete records have been published of the numerous boreholes around the lake which pierced Lower Carboniferous measures in search of oil, and that no one seems to know the character of the rocks passed through or at what depths changes were met.

Springs and their deposits.—Numerous springs of water issue at the foot of the range near the contact of the Carboniferous limestone beds and the Pre-Cambrian. Several are of great volume and two have supplied power for milling purposes. Some have a metallic taste, and some have doubtless been the source of the deposits of red and yellow ochres at the base of Burnt hill and other places. These have found a local use. Elsewhere the swamps of other springs have been blackened by the deposition of an impure oxide of manganese. These latter have not taken the fancy of the mineral prospector as they have in the neighbouring province of New Brunswick, where rights of search for manganese in bogs no more extensive than those in Cape Breton have been a source of much revenue to the Government.

The deposits of barytes at Lake Ainslie appear to furnish an exception to the previous experience of the provincial miners which indicated the occurrence of barytes only in irregular pockets and not as a component of persistent vein matter. The exception can only be spoken of provisionally, as the workings on the veins are not sufficiently extensive to enable one to speak with assurance.

It will further be noticed that the more productive veins form a group of their own, all approximately parallel to one another in a direction quite oblique to the course of the hill range in which they occur, and to the mountain foldings which established the highlands of Cape Breton.

Veins other than those having a general course about N. 75° E., and oblique to the hill range, have been found carrying barytes, but the ex-

*Geol. Sur. of Can., Rep. for 1882–84, Pt. H., pp. 43, 90. Summy. Rep. for 1897, p. 102.

perience hitherto gained in the openings on veins affords greater inducement to the prospector and operator to search in the particular district for mineral veins having a bearing true northeast and southwest.

In the Report of the Geological Survey of Canada, 1882-4, the igneous rocks of this field are classed as felsites, those that carry the veins of barytes being of a banded variety or granular and highly quartzitic.

It would further appear that there may be a bond between this particular class of felsite and the barytes as vein matter in the fractures which resulted from movements or strains oblique to the general folding of the country. The frequency of the repetitions of the veins in parallel cannot be wholly accidental; at any rate it is sufficient to make it marked and to warrant, in further searches, a preference being given to protrusions of the same kind of rock in this hill country of Cape Breton.

The greater quantities of mineral found in veins having the reddish felsite for their country rock has already suggested a preference for localities where the conditions appear similar; prospectors of the district about Lake Ainslie have been encouraged, by the present activity in this branch of mining, to extend their explorations beyond the escarpment facing the lake on its eastern side. They are now ready to follow to their source the shoad-stones dotting the surface soil at other places, on the Middle river, five miles to the eastward, and again across the lake on the south slope of the igneous mass at Brookville and immediately to the west of Lakehead, where barytes float is reported.

The barytes-bearing series of rocks are more widespread than appears on the surface, for, not only are the Pre-Cambrian deeply covered in places by drift which retards prospecting, but they are evidently overlaid along the hill flanks by rocks of later deposition. Beds of Lower Carboniferous near the contact have been proved to be, in places, quite shallow. The surface drift is of variable thickness, and bore-holes have proved it to be, in places, as much as forty feet. It forms the eastern shore of the lake, except where rocks occasionally protrude through it. The holes bored for oil along the lake side passed through a great thickness of bedded deposits, indicating a continuation of the steep front to the older rocks underlying them. This view also applies to the shelf of felsite which carries with it barytes veins at a level nearer that of the lake. The shelf appears to present a steep front to the submerged north and from its edge the covering of Carboniferous measures has been eroded, exposing the shoulder and its veins, from whence, doubtless, came the loose, overlying boulders.

It may be surmised that the same range of rocks continues the shoulder west of the Trout River ravine although it is hidden from sight by a superficial covering of soil and Carboniferous beds, under which it may extend as far as the low ground to McLean point. There is nothing to justify a supposition that the prolongation westward of the Pre-Cambrian felsite is cut off at Trout river, beyond the fact that it has been reduced to a lower level and put out of sight by the pre-glacial erosion of the stream.

THE DISTRICT OF NORTH CHETICAMP.

This field has, of late, been second in importance to that of Lake Ainslie and, although the presence of barytes was long known, it was not until 1900 that any workings were attempted. They have been made in the section of country lying along the shore between Cape Rouge and Presqu'ile.* In his Mineralogy of Nova Scotia, Professor How mentions on the authority of Mr. Barnes the occurrence of barytes boulders fourteen miles northeast of Cheticamp. This doubtless refers to the neighbourhood of the Lazaar river (Corney brook) some eight miles eastward of the more modern settlement, Eastern Harbour, the farthest point in that direction at which barytes float has been seen, and which is one of the places lately opened. The schists in which the barytes deposits occur are spoken of by Mr. H. Fletcher as equivalent to the Louisburg shales elsewhere described by him.

The barytes bearing schists have a general dip to the north at a high angle, the planes of schistosity dipping 60° to the northwest. They are very fissile and much jointed, readily furnishing slabs that are often six-sided and rather suggestive of enlarged cleavages of mica. Their characteristics have been more particularly described by Mr. M. V. Grandin, who has for many years been an enthusiastic observer of the geology of this field. Mr. Grandin permits me to extract the following from his unpublished notes, a description of the topography of the field, with some of his views on the lithological characteristics of its schists and faulting:—

"*The veins* traversing the schists in this locality carry besides barytes, "quartz, calcite, and fluorite with a later deposition of hematite in the "joint planes; the quartz and calcite are in masses at times several feet "in width and the fluorite is more abundant than in other sections of "the province so far explored.

"The veins of this field have a course generally parallel and a sinuous "bearing nearly north and south observed in some cases to be on an

*Geol. Sur. of Can., Rep. for 1882-84, Part H, pp. 21 and 95, also map-sheet No. 6.

"average N. 4° W., with a heading nearly vertical and also sinuous. The "sinuosity of these veins is associated with a lateral displacement and "has left the contents somewhat in the form of lenses, a swelling out "occurring when the deflection of the course is in one direction and a "pinching or thinning of the vein following an undulation to the other "side of the general bearing. Changes in the hade of the lower workings "were observed to be attended by a similar variation in the width of "the veins in depth, and these alternations were sufficiently numerous "to warrant the miners anticipating the thickness of the veins ahead of "them, but operations have not yet been sufficiently extensive to deter- "mine the probable frequency and extent of the lenses of vein matter.

"Operations on the lands of Amedée Comus at Corney brook have "opened a vein from the upper part of the shore cliff inwards for a dis- "tance of over 100 feet and show it to vary from ten inches to four feet "in thickness, expanding, in one place, to a width of over eight feet. "The vein passes close to the house of E. Comus but has not been fol- "lowed southward beyond a small water-course which has deeply eroded "into the schists where it crosses. On the shore below the house the "downward extension of the vein is hidden, but a series of parallel veins "bearing about northeast and southwest under the water is easily seen, "and they are apparently a distinct deposit. From the opening made "some 950 tons of barytes were shipped, but operations were hampered "by a want of shelter for vessels, the coast east of Eastern harbour lying "exposed to the full force of all northerly winds.

"A second vein was opened near the west side of Trout brook, but "the workings were confined to a lense of barytes also having a course "N. 10° W. by the side of the shore road, crossing near the brook's mouth. "Here the schist is sericitic, and dips north at about 30°.

"A third opening on a vein of barytes was made nearer Presqu'ile "on the land of Eusebe Poirier, about 400 feet to the south of his house, "at an elevation of 350 feet above sea level, and some 500 yards from "the shore. At the lower opening, where the vein was first attacked, "it headed E. $<30°$ but as the cut extended south on the vein it became "practically vertical.

"A drift along the vein for 120 feet proved a width of from three to "six feet, and other openings on the hillside showed the vein to continue "for a like distance farther to the south. At the southern extremity of "the cut, along the vein, a narrow cavity, that extended downwards, "was exposed, but its depth and extent were not improved; possibly "this cavity may have been caused by the removal of calcite from the

"vein. At the 'face' there was also exposed a small pocket of fluorite "deeply eroded, an unusual condition for fluorite and a suggestion, per- "haps, of vast age or of the effects of emanations of volcanic character. "About 200 yards west, at a lower level, less extensive openings, off the "old road, have supplied barytes, fluorite and calcite; of the barytes "about 700 tons have been exported within the past two years.

"*Topography of North Cheticamp.*—The barytes-bearing schists of "Cheticamp occupy part of a narrow tract of country extending along "the shore in a northeasterly direction from Jerome mountain to the "mouth of Corney brook. Small as this tract is, from the great variety "of its geological structure it contains a remarkable diversity of scenery, "and the visitor, whether he be artist, tourist, geologist or miner, cannot "fail to find much to instruct, interest and admire.

"At the southwest extremity of this tract, four and a half miles in a "northeasterly direction from the village of Eastern Harbour, stands "Jerome mountain, a bold promontory of the grand escarpment of the "great plateau of northern Cape Breton, towering a thousand feet above "sea-level and presenting, with its craggy and castellated cliffs and "majestic talus slopes, one of the most salient landmarks of Cheticamp. "On a bright day the vivid and strongly contrasted colours of its red "granites, black and purple basaltic dikes, variegated sedimentaries set "in sparkling beaches on deep blue sea, make a most brilliant picture. "In clear weather its summit, on all sides, commands the surrounding "country: from the brow of its southern precipices one looks down on "the dark-mountain glen of Jerome brook, its floor littered with huge "fragments from the impending cliffs; to the southwest lies, spread out "like a map, the fertile and undulating plain of Cheticamp, dotted with "many homesteads, the river meandering through its flood-plain to the "sea; in the distance Eastern Harbour and Cheticamp island complete "the view. To the south and east, as far as the eye can reach, stretches "the great plateau with its sea-wall trenched by labyrinths of ravines and "gorges; to the north, at the base of the mountain, and separated from "it by a pretty, oval lake, rises Presqu'île, its verdant ridges and bright "ribbon-like beach linking it to the mainland beyond which spread the "blue waters of the Gulf of St. Lawrence, out of which, in clear weather, "the Magdalen islands loom against the northern sky. To the north- "east is overlooked the whole extent of the barytes range, rising at first "in lofty mural cliffs from the sea and then by steep craggy slopes to the "level of the plateau. In the distance Cape Rouge elevates its ruddy "summit, and between lie the high V-shaped gorges, excavated by Corney "and Trout brooks and their feeders in their descent from the plateau. "At the mouth of the Trout, fifty feet above the beach, stretches a long

"level terrace, suggestive of some ancient shore-line formed during a "period of rest when this land was emerging from the sea.

"The main road through this tract follows the shore trend, winding "around steep slopes and edges of dizzy cliffs until it terminates at the "base of Cape Rouge mountain; from it many striking views can be "obtained and all the known barytes deposits can be easily seen or "reached.

"The barytes deposits of Cheticamp, so far located, lie within a belt "of Pre-Cambrian schists, which extends an undetermined distance into "the interior, but is bounded on the southwest by the granites and traps "of Jerome mountain, on the northeast by the granites and other igneous "rocks of Corney brook, and on the north by the Gulf of St. Lawrence "and two small patches of Carboniferous rocks, one at Presqu'île and "the other at Trout brook.

"*Lithological Characteristics of the Schists.*—Although many of the "Cheticamp schists are probably altered igneous rocks, the schists of "this section appear to have been originally shales and argillaceous sand-"stones. At the extreme eastern end of the belt they are less quartzose "but more fissile than in the middle and at the western end. The latter "are more heavily bedded, splitting up into slabs varying from three-"quarters of an inch to four inches thick or more, and no doubt represent "sandstones, while the former readily split up into laminæ of about an "eighth of an inch thick or less, and were probably originally shales. "The schists of this section may be classed as hydromica or sericitic "schists. They are usually a greyish green colour, soft and somewhat "greasy to the touch, with a silvery lustre on the planes of foliation due "to thin laminæ of mica deposited along those planes.

Foliation,—"Between the Cape Rouge barytes deposit and the granite "to the east of it, the schists are more curved and crumpled and the folia-"tion is more lenticular than is the case with the schists to the west, in "which the foliation is usually flat, parallel and evidently coincident with "the bedding planes which are often indicated by layers of slightly differ-"ent colour.

Metamorphism.—"From the fact that the Carboniferous conglomerates, "which in places overlie the schists, frequently contain fragments of "the latter it would seem proved that the metamorphism of the schists "preceded the deposition of the conglomerates.

Joints.—"A very complex system of jointing has been developed in these " schists with two series of master joints, a north and south and a north-"east and southwest. It is they that have determined the peculiar shape "of the three, four and six-sided slabs into which the schists break up. "The intersection of the more or less vertical joint planes encloses spaces "which are either triangles, rhomboids or hexagons. These planes, "being again intersected at about right angles by the planes of foliation, "cause the schists, when exposed to weathering agencies, to break up "into many sided slabs.

Folds.—"A comparison of the structure of the schists of this section with "that of the* L'Abime schists (South Cheticamp) makes it appear that "they owe their origin to deposits of different kinds. The schists of this "section are situated on an anticlinal or monoclinal fold and are in a "state of tension, whereas the L'Abime schists occur between uplifts "of granitic rocks and are in a state of compression. In the former, "then, we may expect normal faults and deposits of the fissure vein type "to predominate and in the latter reverse faults and deposits of the com-"pression vein type. And such appears to be the case; the axis of the "fold in this section runs approximately east and west, but it is also "occasionally traversed by small cross-folds whose axes pitch north. "Where these cross-folds occur the schists have been compressed and "compression veins may be expected. A deposit of such a nature occurs "on Trout brook in close proximity to the axis of a cross-fold.

"*Faults and Mineral Veins.*—In the uplifting of the granitic platform "at least two series of faults were developed in the schists, one running "in sinuous lines approximately north and south and the other northeast "and southwest parallel with some of the main jointing. The north and "south series are dip faults, whilst the northeast and southwest series "are sometimes oblique and sometimes strike faults. The fault fissures, " when not occupied by igneous rocks, are now usually found filled with "either barytes, calcite, quartz or fluorite, or mixtures of these gangue "minerals."

Calcite veins.—Of these, the two largest known have a north and south strike. One, exposed in the cliffs of Presqu'ile lake and in openings on the flanks of Pousnette mountain, in close proximity to parallel trap dikes, carries in places considerable quantities of copper pyrites. The horizontal and vertical pinches and swells, so common to fissure veins in general and characteristic of those of this section, are probably due to horizontal and vertical displacements which have brought pro-

*Faribault brook of Geol. Surv. map-sheets 6 and 9; Summy. Rep. for 1898, p. 148.

jections in the fissure walls opposite projections, and depressions opposite depressions. The copper ore is very unevenly disseminated through the gangue, small nodules of almost microscopic size prevailing in some parts, while in others masses weighing up to seventy pounds occupy almost the entire width of the vein. In some places the vein is perfectly barren of ore, being occupied entirely by compact crystalline calcspar. In other places the ore has evidently been leached out, leaving cavities which have been subsequently filled with wad. This vein varies from two to four feet in thickness.

The next calcspar vein of importance is one averaging about five feet in thickness and intersecting a sheet or dike of trap at Jerome mountain. The vein strikes north and south and the dike N.N.W. and S.S.E. They both hade towards the east, the former at 20°, and the latter at 60°. This vein also carries copper pyrites associated with secondary ores, such as red oxide and green carbonate of copper, but the ores are apparently confined to the point of intersection, the openings on it, on either side of the dike, showing the vein to be barren. The ores are found in layers and masses along the walls of the dike at their contact with the granite, in lesser quantities disseminated through the dike and also in the granite sometimes at a distance of two to three feet away from the dike. The intensity of the shearing movements to which the dike has been subjected is shown by the development of cleavage planes parallel to its walls, which has given the trap a somewhat schistose appearance.

Fluorite Veins.—Of these only one which can be said to be mainly fluorite has yet been observed. This vein is displayed in an opening at the base of the cliffs at Presqu'île beach. It occupies the north side of a trough piece of a trough fault running northeast and southwest, which is evidently connected with a powerful fault which traverses the country for miles parallel to the shore line. The thickness of this vein is not easy to determine owing to the shattered condition of the schists, but it was evidently very variable, the maximum thickness probably not exceeding fifteen inches. In places the vein carries a fair quantity of copper pyrites associated with ochreous hematite. On the south side of the trough piece the gangue mineral is quartz.

Fluorite.—Inquiry is often made for this mineral, for which reason reference is made to its occurrence in this locality, in much greater quantity than is known elsewhere in the province. There is, however, no reason to expect that it may exist in masses sufficiently large to warrant independent working; possibly as an associate mineral, it may justify separa-

tion and collection, should mining operations be again conducted in this neighbourhood.

Other localities where fluorite has been detected in minute quantities are noted by Mr. Fletcher in his reports.

Quartz Veins.—Of these none indicating vertical and horizontal continuity have yet been located in the Cheticamp district. Much time has been spent by prospectors searching for quartz veins carrying free gold, but in this section conditions do not appear to have been favourable for the formation of such deposits. The belief so general with Nova Scotian prospectors that similar conditions to those found in the Atlantic gold-quartz series must prevail in all rocks of a slaty appearance, has here been followed by disappointment.

Principal Faults.—Probably the most powerful fault which traverses this belt is one with which the fluorite vein is connected. At the eastern end of Presqu'île, on the beach, black carbonaceous shale containing fossil fish remains is seen in close proximity to the schists. Here the fault (being parallel to the strike and hading with the dip) evidently conceals the basement beds of the Carboniferous formation which are seen at Jerome mountain, where, so powerful has been the effects of the fault, that the Carboniferous strata have not only been thrown on end but bent back upon themselves, thus reversing the order of their succession and giving them the appearance of dipping under the granites.

The next great fault is to be seen at the junction of the schists and granites at Corney brook. This fault appears to have a N.N.E. and S.S.W. course. From the wrinkled and crumpled condition of the schists here and the fact that they have been so intensely metamorphosed as to have a somewhat trachytic appearance, it would seem that considerable heat was developed during the upheaval of the granites.

CHAPTER II.

MANUFACTURE OF THE CRUDE BARYTES.

Treatment.—The mineral from the mine may either be shipped in the state it is delivered on the dump or it may first be passed through a rock breaker to reduce the lumps to such a size as may be found most suitable for handling in transit to the mill.

In Nova Scotia there are at present two mills reducing barytes to a powdered state. Messrs. Henderson and Potts, besides grinding for

their own use at the head of the Northwest Arm, Halifax, compete with the Eastern Milling Company at Dartmouth for the Canadian trade.

At the Dartmouth mill the rock is broken to the size of small nuts and then elevated to the washer, where in batches of three to six hundredweight it is subjected to an acid bath heated by steam pipes. Thence drained it is essential that it be carefully washed free of acid.* Dried, it is then pulverized and ground to the necessary degree of fineness between four horizontally revolving granite stones and French burs. In its floured state it is barrelled and shipped to the consumer. It is graded by tint, the whitest commanding the highest prices.

At the mill at the head of the Northwest Arm, which grinds from twenty to thirty tons per week, the ore is first hand-cobbed and separated into three grades, "white," "selected" and "off colour." Broken to the size of a hen's egg it is further reduced by cyclone crushers, after which it is elevated and riddled, the coarser particles returning to the crusher. The fine riddled material then passes between three French burstones and is barrelled. The presence of small quantities of fluorite is not considered detrimental to paints, as it grinds white.

When estimating the degree of purity in samples of the ground material, turpentine furnishes a ready test, a drop added to the powder having the property of causing the grades that are off colour to assume a still darker tint.

A variation is found in the degree of freedom with which ores from different localities are ground, the crystalline grinding more freely than the compact.

The barytes from Trinity bay, Newfoundland, has a pinkish tint which is hard to eradicate in the milling. It grinds easily down to the crystallized grain, but not beyond that degree of fineness, and, altogether, it is not so easy to grind as the ore from Stewiacke.

Uses of Barytes.—The earlier applications of barytes for purposes of trade were, broadly speaking, as an adulterant, for which its exceptional weight, cheapness and general absence of colour make it serviceable in many industries; in paints and putty; as a loading of rubber goods and pulverized sugar; for dressing calicoes and supplying a satisfying weight to French candies. But in addition to these purposes barytes has been found to possess a definite value of its own, as an ingredient of certain

*Laboratory of the Inland Revenue Department notes the presence of objectionable free acid in some samples submitted for analysis.

qualities of pulp colours and for the finish of wall papers. It supplies much of the barium used in the chemical trade for the manufacture of other compounds which have it as a base and are used for fireworks; it refines sugar and it is used for softening water in steam boilers. Barytes is also used in enamelling iron, paper collars, and oil cloths, and in coating canvas in which hams are packed; as a cheapener of white paints it is in chief demand. The Oil and Colourman's Diary, 1895, says of barytes:— "Whereas formerly this mineral was considered as an adulterant, it is now recognized that barytes has excellent qualities of its own that make it of value as a pigment. When it is used in combination with white lead or zinc, these qualities appear to advantage. Barytes has a pure white colour which is permanent, and it is unaffected by the weather or by gases that, in some instances, blacken white lead."

At the potteries of North Staffordshire, barytes has been used in the manufacture of certain wares, especially at Etruria, in the classic figures of Wedgewood ware. Mr. A. H. Church remarks that "the white particles of the barytes served to reflect the colours of the various oxides used as staining material for the differently tinted jaspers."

In some qualities of Paris green of German manufacture from eleven to twenty-five per cent of barytes is used as an adulterant.* In Canada, some years ago, an adulterated article was sold, containing up to fifty per cent, but now only pure paris green is supplied to the farmers.

The fitness of barytes as a pigment is due not merely to its weight and absence of colour, but to its aptitude to take colour-stain uniformly and make a small quantity of a decided colour cover much surface, a property not equally borne by other white substances, such as gypsum and marble, which the manufacturers of barytes for market find it desirable to remove by special treatment. Barytes acts as a base for aniline and certain other pigments.

Barytes, when manufactured for the paint trade, is known as *blanc fixe*, and is regarded as of special value as the only known white pigment that is unaffected by the weather. Zinc white is nearly permanent, but white lead discolours and even turns black after a time. In the trade barytes is regarded as decidedly useful for reducing white lead, although the admixture has not an equal covering power, and specific names are given to the various mixtures of certain manufacturers as "venice white," when the proportions are equal, "hamburg white," when the barytes is

*Engineering chemistry, T. B. Stillmann, 1900.

two parts to one of white lead, and "dutch white" when three parts of barytes are mixed with one of white lead.

The covering property of barytes varies with the degree of subdivision to which it is reduced and the method of its preparation. When artificially prepared, the sulphate is in a much finer state of subdivision than can be obtained by any method of grinding the natural sulphate, the mineral barytes; the covering power of the artificial sulphate far exceeds that of the ground mineral, especially while in the nascent state, for its exceptional value is partly lost by drying. The fineness of the former, also, is influenced by the strength of the barium chloride from which the sulphate is thrown down, the weaker solution yielding a precipitate of a greater covering capacity.

The method of preparing the various compounds of barium is described by J. Bersch,* who says:—"Enamel white, as usually prepared, is finely "ground barytes heated with coal, when it is converted into barium "sulphide; on this material the action of hydrochloric acid converts it "into barium chloride from which in solution there is precipitated by the "addition of sulphuric acid finely divided sulphate, enamel white. This "preparation is cheaper than white lead, but it is not so extensively used "in oil paints as it is in paper staining. Its value as a pigment largely "depends on its purity and freedom from acid by careful washing."

In Canada the admixtures of white lead and barytes have their local trade names. Several of these are mentioned in reports Nos. 78 and 91 of the Laboratory of the Inland Revenue Department, by which it appears that of 141 samples of white lead and oil offered for sale in Canada 100 were found to be pure; of the rest twenty-five, containing barytes, were sold under special names, the remainder being classed as adulterated. The reports call attention to the Act which prohibits the use of the terms "pure" or "genuine," unless the article has a specified composition, and which further defines an article as adulterated if any substance has been mixed with it so as to reduce, lower or injuriously affect its strength or quality.

Rubber Filling.—Incorporated in the dough as a filling, barytes is one of several inert substances used for that purpose by the rubber manufacturer, who, however, regards its want of colour as a detriment rather than an advantage. While the inductive capacity of vulcanized pure para rubber is 4 to 4.2, a capacity of 10 to 12 can be obtained by heavily oading it with the alkaline earths, baryta, &c. The capacity, however,

*Mineral Pigments, by J. Bersch, 1901, pp. 41-42.

is attended by a reduction of the dielectric strength, 15 to 20 kilovolts per millimetre is the standard, which strength is fairly sustained in some compositions containing sulphur and sulphuret of antimony, *e. g.*:

Para	58.	per cent.
Sulphur	2.	"
Talc	26.	"
Zinc oxide	14.	"
	100	

Besides those named the following materials are also used for loading rubber: infusorial earth (tripolite), whiting, Paris white, white and blue lead. It is difficult to obtain statistics regarding the use of barytes for this purpose, but an estimate given me places the annual consumption for loading rubber goods made in Canada at about 200 tons. In favour of barytes, it is claimed by manufacturers to add to the resiliency of rubber, to be of service in objects of bulky shape, such as carriage and other forms of springs and, when thickness is required, to fill up inequalities between joint faces and to prolong the life of the sheet packing so employed after the rubber and cloth insertion have become deteriorated by time and heat.

Sugar Refining.—In the clarification of saccharine juices which contain soluble mineral salts, and other organic bodies, the organic impurities are precipitated by boiling with milk of lime, a process which is called *defecation*. This may be carried too far with the formation of sucrates of lime and loss of sugar unless corrected by an acid, such as carbonic, with complex interchanges and possible imperfect purification.* A great improvement was effected in the process by double carbonation, and here in the second step of the treatment the possible use of a barium compound comes in, for European chemists have recognized that the oxide of barium is the best defecating agent, especially for the juice of sugar beets. It is the most active of the alkaline earths group: baryta, strontia and lime; but the last in the series, lime, is generally used on account of its cheapness, and doubtless because of the poisonous qualities of the soluble compounds of barium. Yet, in the use of baryta the precipitates are so insoluble that no trace of it remains in the sugar. In the year 1899-1900 some seventeen beet-sugar factories in France used baryta as an auxiliary to lime in the second carbonation, when it acted as a precipitant of impurities which the lime in the first half of the process did not throw down; but it does not seem to be so used in Canada.

The cost in this country of converting barytes into baryta and revivifying the carbonate in the waste is probably too great to be thought of

*The Technology of Sugar, by J. G. McIntosh, 1903, p. 130.

at present, so that an adoption of the French process would necessitate the importation of the barium hydroxide in its manufactured state.

According to "The Mineral Industry, 1903," the United Barium Co., of Niagara Falls, operates two furnaces of the direct heating arc type to produce twelve tons of barium hydrate a day. Each furnace uses 400 H.P. and requires 2,500 amperes at 120 volts and has an efficiency of 74 per cent. A ton of barytes so treated generates $S O_3$ sufficient to make half a ton of 50 per cent sulphuric acid. The statement is made with an implication that it is used for the separation of the uncrystallized sugar from molasses, baryta forming with sugar the compound $C_{12} H_{22} O_{11} Ba O$, which is then treated with carbonic acid gas; the barium separates as $Ba C O_2$, which is insoluble and thrown down.

Similar works for the manufacture, to be followed by similar application of this compound of barium, may be looked for in Canada so soon as the power plant under construction on the Canadian side of Niagara river is completed.

The United Barium Co. of Niagara Falls is said to own a mine of barytes near Silver islet on the north shore of Lake Superior, and "The Mineral Industry for 1903" further describes how an intimate mixture of 137 parts of pure barytes with seven to twelve parts of carbon is treated in the electric furnace with the following re-actions:—$4 Ba S O_4 + 4 C = Ba S + 4 C O + 3 Ba S O_4$ followed by $3 Ba S O_4 + Ba S = 4 Ba O + 4 S O_2$. In the first part of the reaction the sulphate is transformed into sulphide and in the second the sulphate is decomposed into barium oxide and sulphur dioxide gas, the practical result being 60 per cent of barium oxide and 40 per cent barium sulphide.

CHAPTER III.

Value and Statistics.—The Report of the Department of the Interior at Washington for 1903 gives the value of crude barytes at from two to four dollars per ton, the variation being principally due to the grading of the mineral, No. 1, the whitest, bringing the highest price.

The same authority puts the value of barytes after it is cleaned and ground at $7.00 to $14.00 per ton. These figures are for the manufactured article ready for use as a pigment or for the manufacture of other compounds of barium. Of the imports of barytes into the United States the principal supply comes from Germany, with small amounts from

Canada and Newfoundland. In 1903 the value of the crude was $3.21 and that of the manufactured $8.54 per short ton.

"The Mineral Industry, 1903," of the United States, gives the following scale of prices:—

Domestic No. 1 Manufactured, $9.00 per ton of 2,000 lbs.
No. 2 at $8.00, and No. 3 at $7.75 per ton.
Imported German grey at $14.50 and white at $17.00.
Artificially prepared amorphous sulphate, blanc fixe, at two cents per pound.
Crude crystalline ore at $4.00 to $4.50, and flake at $3.50 per ton, f.o.b. cars Sweetwater, Tennessee.
In 1902 finished barytes brought $18.00 per ton.
In December, 1904, the crude ore imported from Newfoundland was invoiced at $2.50 per ton.

Mineral Rights.—The terms under which grants of lands in Nova Scotia have been conveyed from the Crown have varied from time to time in their reservations of mineral rights. Speaking generally it may be said that the ownership of minerals was surrendered by the Crown in 1858 to the grantee of the surface with the reservation only of gold, silver, lead, tin, copper and iron, and coal. The right to mine such minerals as gypsum, dolomite, barytes, &c., and such ores as those of manganese, &c., has since been exercised by the owner and occupier of the soil. But, in 1892, a change in Statutes required that all future grants from the Crown should reserve the mineral to be subsequently leased or otherwise dealt with as occasion may serve. This change does not affect the title to minerals in the lands held under grants of prior date, and as a source of revenue it is seriously doubted whether the change is worth while. The change does not encourage mining, nor ensure a better title to the prospector. It does, however, add to the complications regarding title, now sufficiently varied and exceptional for a country in which mining is so important an industry.

It has always to be remembered that the licenses to work minerals reserved by the Crown, as they are so designated, may carry with them a colour only of title. In practice there has been no guarantee from the Crown to the lessee that its reserved rights may not already have been transferred in whole or in part to others. Subsequent adjustment or appeal to the courts may be necessary to undisputed possession. With the late change in question an opening is given for further litigation in relation to squatters' rights obtained by lengthy occupation of lands. Rightly or wrongly, the present holders of ungranted lands consider that

their title acquired by occupation extends not only to the portions fenced but also to the unfenced portions of the lot they and their fathers have occupied in the range, marching with those held under grant by their neighbours; they further claim the minerals in their lands, a matter of grave importance to the mine worker, and it will be apparent that sound legal advice is now more than ever advisable in conducting a search of title.

From time to time statements, evidently incomplete, have been published of the barytes mined in Nova Scotia, the figures given being often only approximate, and it has not been possible to check them. Professor How sums up the output of 1866 as 500 tons from Five Islands, and 1,200 tons from Stewiacke, the two principal early sources of supply.

The first entries of barytes in the Reports of the Provincial Department of Mines were made by myself in 1874-7, and represented a total output of only 460 tons. The year 1879 shows 480 tons. Then, with the exception of 1881, with a forty ton product, there is no note until 1885–8 during which time the yield was 2,030 tons. A hiatus of nine years follows, succeeded by entries which sum up 4,000 tons to the end of 1903, and a total to that date of 8,670 tons. A separate memorandum of Messrs. Henderson and Potts gives the output at Stewiacke from August, 1886, to June 1889 as 760 tons and from August, 1891 to August, 1900 as ninety-six tons.

BARYTES IN CANADA.

Production.			Imports.*		
Year.	Tons.	Value.	Year.	Cwt.	Value.
		$			$
1885	300	1,500	1880	2,230	1,525
1886	3,864	19,270	1881	3,740	1,011
1887	400	2,400	1882	497	303
1888	1,100	3,850	1887	379	676
1890	1,842	7,543	1888	236	214
1892	315	1,260	1889	1,332	987
1894	1,081	2,830	1890	1,322	978
1896	145	715			
1897	571	3,060			
1898	1,125	5,533			
1899	720	4,402	Note.—Since 1890 the imports of barium compounds have not been separately entered by the Customs Department.		
1900	1,337	7,605			
1901	653	3,842			
1902	1,096	3,957			

Note.—The above is the record of the Section of Mines of the Geological Survey Department.

*Subject to a duty of 20%.

For the purpose of showing the value of barium compounds as articles of trade and commerce, the following is inserted:—

Imports into the United States in 1903 of barium compounds other than barytes—

Witherite, barium carbonate	$35,762.00
Barium binoxide	84,549.00
Barium chloride	68,762.00
Barium sulphate, artificial; blanc fixe	35,466.00

All of these compounds have a very much higher value than natural barytes. The artificial sulphate, for instance, is valued at $25.72, as compared with the mineral barytes at $9 per ton.

PRODUCTION OF CRUDE BARYTES, 1882-1903, IN THE UNITED STATES.

Year.	Quantities in Short Tons.	Value.	Average price per Ton.
		$	$
1882–1892	254,388	1,039,206	4 07
1893–1896	90,902	290,323	3 19
1897	26,042	58,295	2 23
1898	31,306	108,339	3 50
1899	41,894	139,528	3 33
1900	67,680	188,089	2 78
1901	49,070	157,844	3 22
1902	61,668	203,154	3 29
1903	50,397	152,150	3 02

Importations of barytes, both crude and manufactured, into the United States.

Year.	Manufactured.		Crude.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.	$	Short tons.	$
1882–1892	11,557	183,235	35,753	89,757
1893–1899	10,062	107,889	11,150	32,462
1900	2,454	24,160	2,568	8,301
1901	2,454	27,062	3,150	12,380
1902	3,908	37,389	3,929	14,322
1903	5,716	48,726	7,105	22,777

Note.—The import duty into the United States is $1.12 per ton on crude barytes, and $6.72 per ton on the manufactured article.

STRONTIUM.

A few words on strontium naturally accompany a report on barytes, both being employed for the same economic purposes.

In spite of its poisonous nature, baryta (barium hydroxide) is used, especially in Germany, in beet-refining factories. So long as sugar-refiners are amenable only to the ordinary laws of human nature, and are not prevented by the special laws of government, so long will baryta continue to be thus used. It is twice as cheap as strontianite in the form of strontium hydrate. Principally owing to the cheapness of barytes, the mining of strontium on the American continent has never, so far as the writer is aware, been on a commercial basis, nor is it likely to be until laws are passed prohibiting the use of barium hydroxide in sugar-refining.

The other chief use of strontianite, in the form of strontium nitrate, is in pyrotechny, to which it supplies the well-known strontia-red.

The known occurrences of strontianite in Canada are few, though it is possible that some of the at present supposed deposits of barytes contain strontianite.

"On the south shore of the Ottawa river, a short distance below the road leading down to the old Skead mill, on lot 31, concession A of Nepean township, strontianite occurs in the form of veins, traversing the lower part of the Chazy limestone and varying from four to six inches in thickness. The mineral occurs below high-water line and thus can only be seen at a low stage of the river." Mr. Johnston's analysis of carefully selected crystals dried at 100° C. gave—

Carbonic acid	30.54
Strontia	65.43
Lime	3.38
Insoluble	0.17
	99.52*

Mr. C. W. Willimott writes: "When the mineral is first extracted, the colour, near the middle of the vein, is pale apple-green, merging into almost white as it approaches the walls."

*Geol. Surv. of Can., 1899, Pt. G, p. 44.

The consumption of strontium salts in the United States is, at present, very small, the total value of the imports for 1903, nearly all of which were said to come from Germany, amounting to only $1,337.

The chief strontium mines are at Strontian (Scotland); Yorkshire; at the Giant's Causeway (Ireland); Saxony; Saltzburg, and in the Harz mountains.

At the present time Scotland is shipping strontia to Germany. The strontia mined in the United Kingdom from 1884 to 1892 amounted to 87,852 tons, valued at $290,160.

Celestite, so called from its delicate blue colour, is found in orthorhombic crystals, resembling in form those of barytes. It occurs principally in Sicily, finely crystallized, with native sulphur. It is reported to occur on Strontian island, in Lake Erie. Of its occurrence in Canada, which is very rare, Mr. C. W. Willimott writes:—

"This mineral occurs in veins in the Laurentian and Cambro-Silurian rocks. In the township of Lansdowne, in the province of Ontario, an important vein, made up of large modified crystals of a light bluish and reddish colour, occurs; the crystals are often so densely packed as to obliterate their terminal edges, giving it the appearance of a crystalline mass.

In the township of Bagot, in the same province, a white, fibro-bladed mineral occurs in diverging and reticulating masses, often associated with tremolite. This latter mineral has the same colour and similar external characteristics, and may often be mistaken for celestite, but may, however, be easily detected by its greater hardness. The vein appears to be of some importance, but could not be properly examined during my last visit owing to the thick covering of snow.

In the city of Kingston white semi-fibrous crystalline celestite mixed with calcite and blende occurs in a bed of Black River limestone along the lake shore for half a mile west of Barrie street.

At the forks of the Credit, in the township of Caledon, nodules, often several inches across, of a reddish, tabular, crystalline mineral occur in the Niagara limestone, which also encloses selenite and calcite.

In the township of Hawkesbury, in the province of Quebec, a light bluish fibrous mineral occurs in thin veins in limestone and shale."

Mr. Hugh Fletcher* reports having found celestite on the right bank of Sydney river, about a mile and a half above Sydney bridge, where a bluish grey bed, about one foot thick, containing specks of galena, may be seen for a considerable distance along the stream, overlaid by grey, slaty limestone.

NOTE.—At Lake Ainslie the open cut at the top of the hill is some 300 feet in length and has at its eastern end a cavity some 50 feet deep where the deposit continues to hold its full width.

On the west front of the hill the lowest tunnel has been driven over 300 feet, the barytes carrying a width of 12 to 16 feet with a clay gouge on the foot wall.

Near Outlet the ore has been found 6 feet wide on E. Campbell's land and has been traced south on McKinnon's property 2000 feet. On the former a sinking for 40 feet has yielded some 2500 tons of white ore the chief source of output of late.

*Geol. Surv. of Can. Report for 1875-76, p. 418.

UNGAVA AND LABRADOR.

217. Hudson Strait and Bay, by R. Bell. 1885. (15c.)
267. James Bay and east of Hudson Bay, by A. P. Low. 1887-88. (25c.)
584. Labrador Peninsula, by A. P. Low. 1895. (30c.)
657. Richmond Gulf to Ungava Bay, by A. P. Low. 1896. (10c.)
680. Hudson Strait (south shore) and Ungava Bay, by A. P. Low. 1898. (15c.) } Bound together.
713. Hudson Strait (north shore), by R. Bell. 1898. (20c.) }
778. Hudson Bay, east coast, by A. P. Low. 1901. (25c.)
819. Nastapoka Islands, Hudson Bay, by A. P. Low. 1901. (10c.)

NEW BRUNSWICK AND NOVA SCOTIA.

218. Western New Brunswick and Eastern Nova Scotia, by R. W. Ells. 1885. (20c.)
219. Carleton and Victoria cos., by L. W. Bailey. 1885. (20c.)
242. Victoria, Restigouche and Northumberland counties, N.B., by L. W. Bailey and W. McInnes. 1886. (10c.)
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Final report on the experiments made at Sault Ste. Marie, under Government auspices, in the smelting of Canadian iron ores by the electro-thermic process. Eugene Haanel. 1907.

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Preliminary report on the industrial value of the Clays and Shales of Manitoba. (Only a few copies available.) J. W. Wells. 1905.

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Report of the Commission appointed to investigate the Zinc Resources of British Columbia and the conditions affecting their exploitation. W. R. Ingalls. 1905.

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