REPORTS

OF

Geological Survey of Newfoundland

By
ALEX. MURRAY, C.M.G., F.G.S.
AND
JAMES P. HOWLEY, F.G.S.

FROM

1881 to 1909

ST. JOHN'S, N.F.
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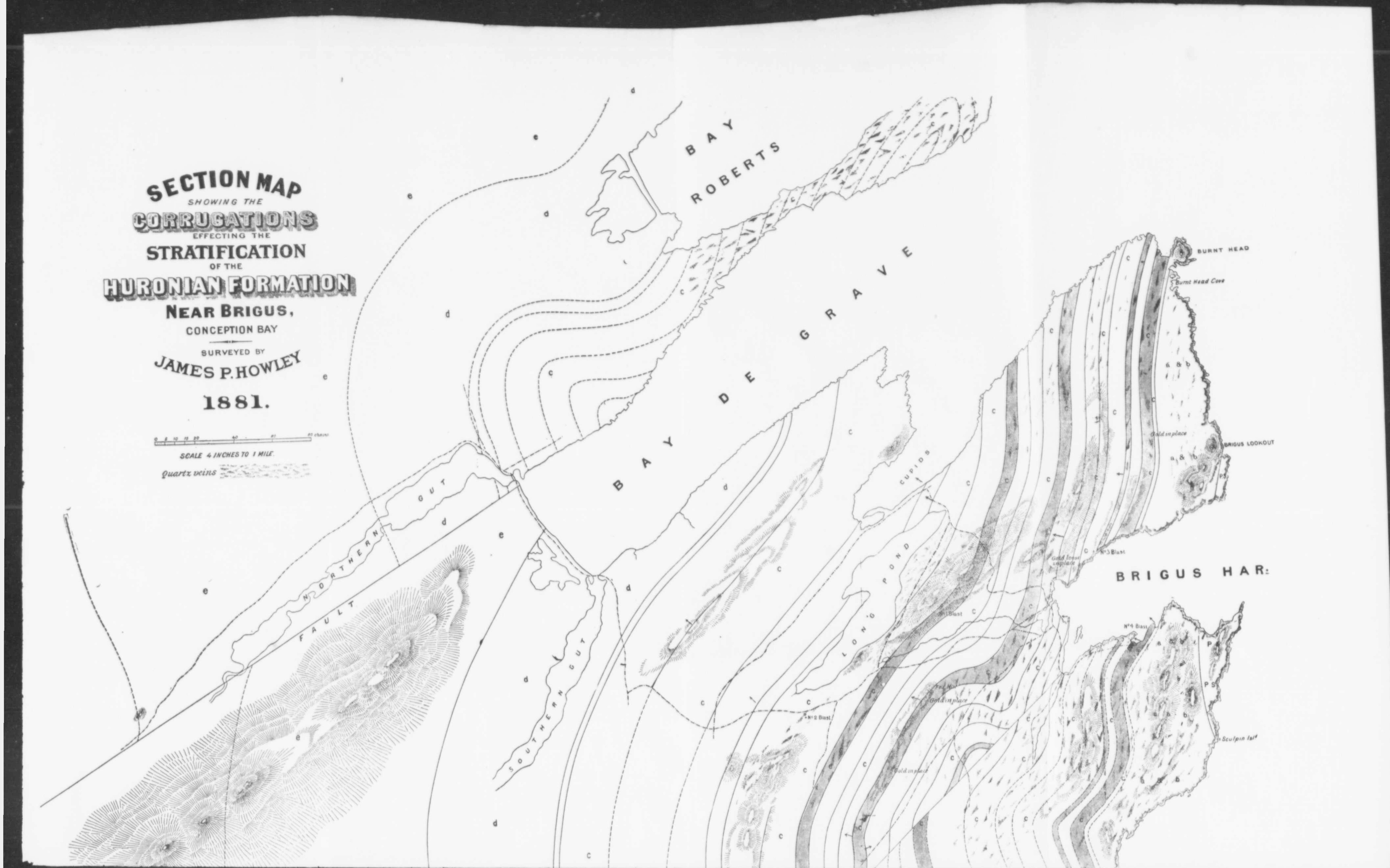
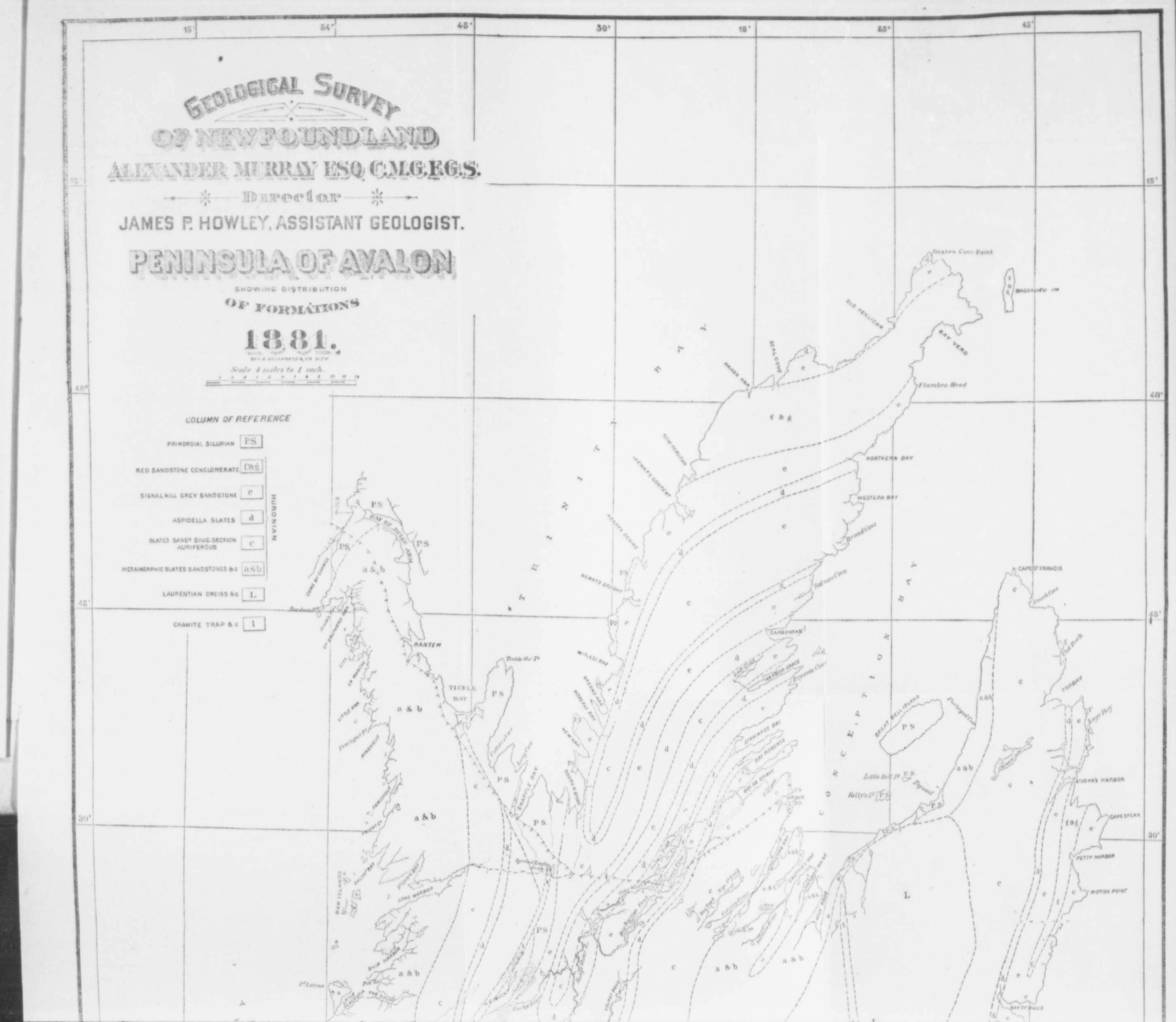


SECTION MAP
SHOWING THE
CORRUGATIONS
EFFECTING THE
STRATIFICATION
OF THE
HURONIAN FORMATION
NEAR BRIGUS,
CONCEPTION BAY
SURVEYED BY
JAMES P. HOWLEY
1881.
SCALE 4 INCHES TO 1 MILE
Quartz veins
BAY ROBERTS
BAY DE GRAVE
BURNT HEAD
BRIGUS LOOKOUT
BRIGUS HAR:
NORTHERN GUT
FAULT
SOUTHERN GUT
LONG POND

SCALE 4 INCHES TO 1 MILE
Quartz veins
BAY
BRIGUS LOOKOUT
BRIGUS HAR:
NORTHERN GUT
FAULT
SOUTHERN GUT
LONG POND
DULL COVE



GEOLOGICAL SURVEY
OF NEWFOUNDLAND
ALEXANDER MURRAY ESQ. C.M.G. F.G.S.
Director
JAMES P. HOWLEY, ASSISTANT GEOLOGIST.
PENINSULA OF AVALON
SHOWING DISTRIBUTION
OF FORMATIONS
1881.
Scale 4 miles to 1 inch.
COLUMN OF REFERENCE
PRIMORDIAL SILURIAN PS.
RED SANDSTONE CONGLOMERATE f&g
SIGNAL HILL GREY SANDSTONE e
ASPIDELLA SLATES d
SLATES SAND^S DIV. C. SECTION AURIFEROUS c
METAMORPHIC SLATES SANDSTONES &c a&b
LAURENTIAN GNEISS &c L
GRANITE TRAP &c 1
HURONIAN
RANTEM
TICKLE BAY

GEOLOGICAL SURVEY
of
NEWFOUNDLAND

CHAPTER I.

Report of Alexander Murrry, C.M.G., F.GS., for the Year 1881

Geological Survey Office,
Athenæum Building,
St. John's, Newfoundland,
6th March, 1882.

SIR,—Herewith I have the honor to furnish you with an account of the proceedings of the Geological Survey during the year 1881, with Mr. James P. Howley's Report to me of his labors in the field the same year.

During the early part of 1881, while I was in England, on leave of absence from the Colony, I took the opportunity for revising and correcting the whole of earlier Reports of Progress on the Geological Survey, and having them re-printed and bound in a single volume by Mr. Edward Stanford, of Charing Cross, London. At the same time, some discrepancies which were observed in the original draught of the large Map, issued in the first place for the uses of the Boards of Education, were corrected and some additional work inserted, while the surface was laid off in contour lines of equal elevation and depression of 500 feet apart. Some of these Maps were coloured orographically; others were left uncolored. These also were executed by Mr. Stanford. Copies can be obtained at this Office, of Reports and Maps, or at any of the Stationers at St. John's.

Since my return to St. John's, nearly all my time has been occupied in fitting up and arranging this office, placing all Maps, manuscript or printed, in such order as to be readily accessible at any moment by the Officers of the Crown Lands' Department, with which Department, the Geological Survey is connected; and which I have been instructed to superintend in the absence of the Surveyor General.

For the last few seasons past, in consequence of the scarcity of competent Surveyors, the labors of the Geologists have been almost altogether directed towards topographical and coast surveys, for the purpose of furnishing correct data to the Crown Lands' Office, for issuing Licenses of Search for Minerals, or laying off Grants of Land. In the performance of these duties, no doubt much valuable Geological information was acquired; but such was more of a Local than a General description, and applies more particularly to economic results within certain limited areas, than is the purpose of a systematic and scientific Geological investigation, in which all parts are equally important, as shewing the distribution of the formations, and the manner in which these formations are related, together with their special characteristics, mineral and fossil.

The structure of the South-Eastern portion of the Island is somewhat complicated, and at some parts very obscure, and I have long been desirous to have it closely examined, so that the true succession and distribution of the strata might be accurately ascertained. With this object in view, which was rendered the more imperative by the discovery of Gold in certain strata in the neighborhood of Brigus, Conception Bay, which may eventually become a source of wealth to the Colony, I considered it my duty to direct the investigation of the season towards working out the details of structure in the Peninsula of Avalon. This duty Mr. Howley was instructed to perform, and I am greatly gratified to inform you that the result of his labors is highly satisfactory, and reflects much credit upon his diligence, patience and perseverance under very unfavorable circumstances. Full particulars will be found in his report to me; but amongst others mentioned, one circumstance is very remarkable, which is, that notwithstanding the most careful examinations of the various places where free Gold had been previously found, amongst others, the spot where the metal had been blasted out under my own supervision, he failed to procure a single specimen where it was visible. This fact, however, as has been already observed in my report, p. 535, Geological Survey of Newfoundland, is by no means to be considered as a conclusive proof of the non-existence of the precious metal, which is as frequently, if not more frequently, invisible to the eye even in some of the most remunerative veins.

In 1868 I blocked out the groups of strata which make up the Huronian or Intermediate system and which are so largely distributed over the Peninsula of Avalon, (see Geological Survey of Newfoundland, p. 145.) These groups Mr. Howley has followed out in considerable detail, and has proved the succession and superposition, as given originally, to be on the whole tolerably correct, although some discrepancies may be found eventually with regard to thicknesses. Since his return to St. John's, Mr. Howley has plotted all his field work upon a large scale, from which he has constructed a Map on a reduced scale—4 miles to 1 inch—which is colored to represent the Geographical distributions of the groups as they occur in nature, while he has drawn a section across that portion of the measures which includes the Gold bearing quartz veins, on a scale of 4 inches to 1 mile. As these and such like draughts are infinitely more intelligible than any quantity of description, I should strongly recommend they may be lithographed for publication for the information of future explorers or those who take an interest in the Geology of the Island.

I am indebted to Staff Commander Maxwell, R. N., of the Admiralty Coast Survey, for tracings of some of his recent Surveys, particularly that of the Bay of Islands on the Western Shore, and of Hall's Bay in Notre Dame Bay, and take this opportunity of tendering him sincere thanks for the same. The former of these has been reduced to our own general scale of 1 mile to 1 inch, and the latter is in hand. It is satisfactory to find that on comparison, certain points determined by myself in 1866 precisely correspond in position with the same points as fixed by Captain Maxwell in 1881; which circumstance will give confidence in the general accuracy of the Surveys of the interior, which were in great measure dependent upon those points, from whence they were started. Capt. Maxwell's Surveys of Notre Dame Bay, appear also to confirm the accuracy of Mr. Howley's Surveys of the same region made previously, although in minute detail some slight disparities may be recognized.

I am at present engaged in preparing a paper upon the effects produced by ancient glaciers in modifying and moulding the surface of the Island to its present form. It was in order to study out such phenomena that an Orographical Map was constructed, and which the paper alluded to is intended in some measure to explain.

I have the honor to be, Sir
Your most obedient Servant,

(Signed,) ALEX. MURRAY.

The Hon'ble
W. J. S. Donnelly,
Surveyor General,
St. John's.

Report of Mr. James Howley, Assistant Geological Surveyor for the Year 1881

Geological Survey Office,
6th March, 1882.

Sir,—In accordance with your instructions, I was engaged during the open season of last year, 1881, in following out the Geological structure of the Peninsula of Avalon in detail, to accomplish which, a great amount of Topographical surveying was found to be indispensable. To map out the actual distribution of the formations upon a correct Topographical plan is the special purpose of a Geological Survey, and ought, when time and opportunity afford, to be carried over the whole surface of the Island; but the presence of Gold in the rocks near Brigus, Conception Bay, which was verified by yourself in 1880, called for immediate attention on the part of the Geological Survey, in order to substantiate the probability or otherwise, of a future remunerative development of the precious metals, and hence the selection of this Peninsula for the season's operations.

I accordingly commenced my labors at Brigus Head, whence a line was run transverse to the general strike of the stratification past the Town of Brigus, which terminated at the Southern Gut of Bay de Grave; I then, after examining the strata around Brigus Harbor and up to Turk's Gut, proceeded to the head of Collier's Bay, whence a Survey was made for several miles inland by a succession of Lakes and Ponds, which were nearly on the strike of the stratification. Several conspicuous summits are visible from these Lakes, from one of which, called Jack's Mountain, a very extensive view of the surrounding Country was obtained. From Jack's Mountain I returned to Brigus by a different route, in order to ascertain certain facts regarding structure, and to collect specimens of quartz from certain veins expected to be crossed on the way; and while at Brigus a further local examination was continued, for the double purpose of studying the stratified sequence of the rocks of the Country and to test the numerous quartz veins for Gold. I then prepared for an excursion across the Peninsula from Brigus to Placentia Bay ,and when all was ready, sent the canoe and baggage forward by land to Hodge Water Lake. The latter Waters having been already surveyed, I pushed on to Snow's Lake, or Pond, which was carefully surveyed. Following the course of the Stream, which issues Easterly from Snow's Pond, the survey was continued to its outlet into Conception Bay at the Lagoon, known as Northern Gut of Bay-de-Grave. The next excursion was to the prominent Hill, known as Spread Eagle Peak, whence I was enabled to obtain some useful structural information towards the Shores of Trinity Bay; afterwards, returning to Hodge Water Lake, thence crossing to Big Barren Pond, the head of the Eastern branch of the same, a detour was made to the Eastward to the headwaters of Colinet River.

The junction of the branches of the Hodge Water River, at Wagedigulsiboo Gospen, was reached on the Second of September, and on the following day the Junction of Rocky River, about twelve miles above its outlet into St. Mary's Bay. These Rivers and vicinity having been already surveyed, in the season of 1872, were now only availed of as the readiest means of arriving at a point, from whence the unexplored Country, in the direction of the North East Mountain of Placentia, could be more easily approached.

The ascent of the Western branch of Rocky River, which takes its rise in the elevated table land of the above named Mountain range, was very tedious and difficult. We were soon compelled to abandon our canoe and all such baggage as was not absolutely needful, and proceed towards the Mountain on foot. The River was surveyed upwards to a point from whence the Mountain was accessible The survey was then continued to its summit, and a set of bearings taken, to correct the positions of the various points on this and former surveys. A splendid panorama of the main features of Avalon was exposed to view from this, one of its loftiest elevations. After a few days spent in exploring this neighborhood, we proceeded Westward towards Placentia Harbor, and arrived at the head of the North East Arm on the 15th September, and thence by boat down the Arm to Great Placentia Harbour. A few days were spent at Placentia refitting, and in the meantime a cursory examination of the rocks in the neighborhood was made. I also paid a visit to Little Placentia, and took the same opportunity to see the lead veins on the South side of the Sound.

Having dispatched my men for the canoe and baggage left behind on the Western branch of the Rocky River, I proceeded overland myself to Colinet Arm, where they shortly afterwards rejoined me. A survey of the Colinet River was then commenced, and its course followed upwards to Colinet Pond, a distance of about twelve miles. The River proving exceedingly rugged and unfit for canoe navigation beyond this point, and furthermore being unfavourable for the acquisition of any special Geological information, the survey was abandoned, and we returned to Colinet Arm. Three of my party were dispatched thence to Salmonier, where an attempt was made to put our canoe,, which was in a sadly dilapidated state, into sufficient order to enable us to get up the Salmonier River. Pending the delay in effecting such repairs, I, with my remaining man, and one from Colinet as a guide, made a hurried excursion inland, Eastward of the Colinet River to a great string of Lakes, which spread themselves in all directions over this part of the Country. I regret very much that the lateness of the season, and the means at my disposal, prevented me from making a regular survey of these waters, nevertheless, much valuable information was gathered, enabling me, to some extent, to connect the structure with that already ascertained in Conception Bay. An attempt was then made to ascend the Salmonier River, but in this we failed, owing to the shallowness of the waters and the utter impossibility of keeping our worn-out canoe in a fit condition to carry our provisions, &c. The Falls were however visited and the Shores of the Arm examined. The canoe was sent hence to St. John's, and I proceeded to the Half-Way house on the main road, in the hope of procuring a flat for the purpose of visiting some large Lakes in the neighborhood, but failing in this in consequence of the absence of the proprietor, and the season being now far advanced, (Oct. 19), and the ground already covered with a heavy fall of loose snow; the Lakes and Ponds frozen, and winter in all its rigour threatening, I was compelled to desist from further attempt at surveying, and return to winter quarters at St. John's which we reached on Oct. 21st.

Since my arrival at St. John's I have been fully occupied in plotting the work accomplished in the field. A Map of the entire Peninsula has been constructed on a scale of four miles to one inch upon which the Geology is colored, being the result of the investigations of former years, together with that of last season, the coastline is taken from the latest Admiralty surveys. A section has also been drawn, upon a scale of four inches to one mile, of the Country in the neighborhood of Brigus, shewing the arrangement and distribution of the Huronian or Intermediate system, where it has proved to be auriferous. As more may be learned from a glance at the drawings than from volumes of printed matter, it is very desirable that they should be lithographed for the use of future explorers.

Geographical Description.

The Geographical character of the Peninsula is very varied, but notwithstanding that the coast line is bold and precipitous, and many parts of the interior abrupt and hilly, or even in some parts mountainous, there are large areas of its surface level or gently undulating and much of it clothed with a dense growth of Forest. There are also many very extensive Marsh Lands, and Lakes and Ponds are simply innumerable. The scenic differences of the landscape at the various parts, correspond with the difference in quality of the rocks distributed, the harder metamorphic strata of the

Huronian age, producing cliffs and mountains, while the slaty or shaly portions of the system, and notably the portions occupied by the Cambrian strata, give a soft or gently undulating surface, which is often capable of being profitably reclaimed. On the line of this season's survey a vast tract of level land was observed between the Hodge Waters and the Rocky River, and thence up to the North cast Mountain Range, much of which is occupied by enormous marshes interspersed with isolated clumps of wood. Ponds and Lakes are met with at every turn, a generally marshy Country prevails on the Western side of Rocky River, which extends almost uninterruptedly from St. Mary's Bay to Trinity Bay. Towards Conception Bay also there are great tracts of marsh, but the Country, generally, is fairly wooded. The view from the summit of the North East Mountain, looking Eastward, presents a vast plain, broken here and there by a set of mammillated hills, or by the gleam of a lake or pond, while the dark patches of woo' give a pleasing variety to what otherwise would be a rather monotonous picture.

The indigenous timber of the forests is, for the most part, small in size, but there is, nevertheless, a fair proportion of the trees available for various economic purposes. The prevailing varieties are fir and spruce, the former very abundant, frequently attaining a large growth, which will, no doubt, prove of commercial value. The ordinary white birch is frequently met with, and yellow birch, commonly called wychhazel, is found in considerable quantity, especially around the upper reaches of the Colinet River. Black and red spruce of sufficient dimensions for small spars were occasionlly seen. Pine is of rare occurrence, and the size and quality of the trees insignificant. Tamarack is moderately abundant, sometimes reaching a fair heigh and girth. Although the timber of the Peninsula is for the most part stunted, and much of it worthless for any purpose but firewood, there is, nevertheless, a great amount fit to be utilized, and no doubt will be when access to the coast is obtained by means of constructed roads.

Patches of good reclaimable land were frequently met with during this and former explorations, but these were always verv limited in extent. There is a good tract of land in the Valley of

Hodge Water River, and sundry fine spots occur on the road leading to Long Harbour of Placentia Bay. Some good interval land occurs on the Colinet River, and at the forks of the Rocky River there is a beautiful strip of alluvial soil, which stretches up the Hodge Water and along the Western branch.

The capabilities of the Country, on the whole, for Agricultural pursuits are certainly not great, still there are many limited areas where settlement on a small scale might be established with advantage, and where an amount of labour equal to what is expended upon the boulder-encumbered shores of the Bays, would certainly be rewarded with very superior results.

Distribution of the Formations.

In the Report for 1868, p.p 145, 146, Geological Survey of Newfoundland, a section is given of the Huronian or Intermediate system, which is there described, under seven sub-divisions, represented by the letters,—*a, b c, d, e, f, g*. The characteristics given of these sub-divisions, which, on the whole, seem to apply pretty generally, have enabled me to follow out their distribution in considerable detail, over the region examined in 1881; and, moreover, they afford a clue to the structure at other parts which have not been so closely inspected. It has been shewn in former Reports that this series of metamorphic rocks occupies by far the greater part of the Peninsula of Avalon, resting upon a nucleus of Laurentian gneiss and succeeded by the fossiliferous beds of Cambrian age, which skirt the shores of the Bays and forms most of the Islands therein. The latter rocks are found to rest unconformably upon the basset edges of the upturned and altered Huronian, and occasionally in contact with the still older Laurentian, and are but the remains of a series which once was spread far and wide over the former, worn down and re-distributed by a succession of vast denudations.

The whole of the members of the Huronian or Intermediate system are more or less developed in the region between Conception and Placentia Bays, a set of wave like undulations, producing frequent repetitions, of the same strata. The lower sub-divisions, *a* and *b*, are partially displayed at and near Brigus, where they are, as in the original section, succeeded by *c*, the base of which is intersected by a great reticulation of quartz veins, occasionally auriferous. Some strata lower than that given in the original section was found at the base of division *a*, at Colliers and Gastries Bay, which was also observed at the Western end of the survey, at the Harbors of Great and Little Placentia, whence they extend Northerly and form the greater portion of the isthmus which separates Placentia from Trinity Bay. These rocks consist of trappean beds, volcanic ash, and epidotic layers, the epidote sometimes distributed in spots and patches, and at others, being the prevalent constituent, becomes an epidotic slate. These strata are greatly disturbed at both ends of the line of section, and they are intersected and cut up by vast and repeated intrusions of trap which sometimes follow the line of strike, as at Gastries and Collier's Bay, where the beds are violently tilted and contorted. One great intrusion runs out to the coast between Salmon and Cat's Coves, Conception Bay, which in its Westerly course forms the Blue hills and some of the higher peaks in that region.

The succeeding division (*c*), consisting of bluish and greenish slates, flaggy sandstone, thick bedded quartzites and occasional fine conglomerates towards the top occupies a large area of the region. In the neighborhood of Brigus the division maintains an average width of about five miles, the belt extending South-westwardly in the direction of St. Mary's Bay, where it runs out at Salmonier Arm. In its Easterly extension from Brigus it comes to Bay-de-Grave, where it joins the long projecting point between that Bay and Bay Roberts, and thence runs out into the waters of Conception Bay. The same part of the series was recognized on the Eastern side of St. Mary's Bay, South from Salmonier, and on the Colinet Islands, whence their strike would carry them in the direction of Cape Pine, and probably it holds the coast of the Peninsula to Cape Race. On the Atlantic coast North of Cape Race, it occupies a belt of Country about four miles wide, until reaching Renews, where it strikes inland; the coast to the Northward presenting cliffs of the higher divisions.

In the neighborhood of St. John's, division (*c*) is spread over a very extensive area occupying most of the Country between that place and Conception Bay; its Easterly strike carrying it out to the coast between Torbay and Cape St. Francis. On the North West side of Conception Bay the upper part of division (*c*) is brought to the surface on the axis of an anticlinal fold, between Harbor Grace and Carbonear, whence it extends South-westerly through the centre of the Peninsula, and was recognized on the Western branch of the Rocky River, a short distance above the forks. A second anticlinal occurs on the Peninsula between Conception and Trnity Bays, the outcrop of division (*c*) on the former, extending from Adam's Cove to Northern Bay, where it has a breadth of about six miles, trending in a southwesterly direction from this place for about sixteen miles, and then nearly due South, the breadth contracting as it approaches Trinity Bay, where it finally runs out to a point about awo or three miles from the head of Dildo Arm, where it is flanked on either side by the Aspidella slates of division (*d*).

In the centre of Avalon the structure assumes the form of a great Synclinal, as shewn upon the Map; all the divisions from (*a*) to (*d*), inclusive, succeed each other with considerable regularity in the direction of Placentia Bay, where the lower divisions, (a) and (*b*), as already stated, run along the Eastern shores towards the isthmus, dividing Placentia Bay from Trinity Bay. The Northern strike of the rocks as observed around Placentia Bay, would carry the upper members of the group, (*c*) and (*d*), towards Tickle Harbor in Trinity Bay, while their Southern course points towards North Harbour in St. Marys Bay, but in each case at these places they are concealed beneath the unconformable beds of Cambrian age. The places where Gold has been detected, hitherto, have invariably been within the boundaries of division (*c*), and confined, moreover, to the lower portions of that division, which circumstance alone will shew the importance of having these boundaries accurately delineated; so that, independently of the interest to be attached to a Geographical and Geological Map, scientifically, the result of the season's enquiry will probably be found of considerable value to explorers or adventurers in search of the precious metals, or other economic substances.

Division (*d*) of the section as described in the Geology of Newfoundland, p.p. 145, 146, as consisting of the dark brown or blackish slates of St. John's, with interstratified arenaceous beds towards the top, was found at some parts of its distribution to contain a greater prevalence of arenaceous than argillaceous material being a grey thin bedded flaggy sandstone, with occasional slaty and shaly partings, but it is peculiarly characterized by the presence of fossils, the only forms of organic life hitherto recognized in rocks of Huronian age. These forms were examined and described by the late Mr. E. Billings, Palæontologist of the Geological Survey of Canada, who named one *Aspidella Terranovica*, and the other *Arenicolites Spirales*, the latter being a fossil that is known to occur in a formation below the Primordial rocks of Sweden. These characteristics offer great facilities for the ready recognition of the Huronian when tracing out the structure which, otherwise, would be extremely difficult, as the division, generally, being composed of material easily acted upon by denuding forces, is often worn down and disintegrated, while the ruins are spread over great areas of surface, so as completely to conceal the outcrops. Hence, it is that the Country, occupied by this part of the formation, is invariably more favourable to the pursuits of Agriculture than elsewhere, and it may also be remarked, that most of the principal towns and settlements are founded either on or close to where the division occurs. The North side of St. John's Harbor, and all the inhabited parts of the city is founded on the Aspidella slates, as are also Harbor Grace, Carbonear, with many other settlements. Tracing the division Northerly from St. John's, it was found to run out into the sea at Outer and Middle Coves, whilst in its Southern strike it runs up the Riverhead valley, but is lost to view under debris and forest after passing Killbride. It was recognized again South of Bay Bulls, at the heads of the various indentations of the coast, and, finally, was found to run under the waters of the Atlantic near Aquaforte Harbor. A fine section is exposed at Ferryland, where the characteristic fossil *Aspidella* was found in vast abundance.

At Harbor Grace and Carbonear, division (*d*) is exposed on both sides of the anticlinal to which reference has already been made. The Harbor Grace Islands belong to this division, and afford a good example of the rapid disintegration to which it has been subjected and which is still in process. These Islands have evidently been at no very remote period, connected with the long projecting point, called Feather Point, on the South side of the Harbor; and thousands of tons of the rock, which is a fissile splintery slate, intersected by numerous faults and fissures, have fallen from time to time, in huge avalanches within the memory of people still living. The place on the outer Island, where the original foundation of the Light-house once stood, has long ago crumbled away, while the present building near the centre of the same Island is in imminent danger of a sudden catastrophe. In its South-weterly strike, the division was met with on the Hodge Water road, and afterwards near the head of the Colinet River, striking towards St. Mary's Bay, where, however, it is concealed below the unconformable Cambrian strata. It occupies the Valley of Hodge Water River, and is spread over a considerably large and flat area of Country near the junction of that water with the Rocky River. On the Western side of the anticlinal it was seen to cross the Western branch of the Rocky River about two miles above the fork. The division flanks the sides of the anticlinal fold on the Peninsula between Conception and Trinity Bays, and was recognized at Black Head, Northern Harbor, and other places on the South side, while upon the North side the strike carries it across the Peninsula, obliquely, towards the shore of Trinity Bay, near New Harbour, where the horizon is indicated by numerous *Aspidella*.

At Grate's Point, the extreme point of the same Peninsula, there are some dark-colored blackish bands, which were supposed to represent the harder portion of the division (*d*), and the order of sequence in relation to the upper members would bring it into that position, but as no opportunity has yet offered for a close examination of that part, this remains uncertain.

According to the same order of sequence division (*d*) was supposed to occupy the Country on the West side of the great central trough, West from the North East Mountain, where the succeeding division (*e*) was distinctly recognized, and is entered accordingly as such upon the Map, but as the stratification there is rather indistinctly exhibited, the reality is still uncertain.

The upper members of the system (*e*), (*f*) and (*g*), or Signal Hill group, in consequence of their extreme hardness, and capability of resisting denuding influences, offer a bold and rugged outline where ever they are exposed, with steep or vertical cliffs and escarpments. The Signal Hill, from which the name is derived on the North side of St. John's Harbor entrance, is an example, while many other instances of similar grand and imposing scenery, both on the coast and in the interior, have been witnessed, which owe their picturesque attractiveness to the presence of these rocks. All the headlands and much of the rugged coast line facing the Atlantic, between Flat Rock and Cape Broyle, are composed of one or other, or all the members of this group, whence they can be seen, as one sails along the shore, making several synclinal and anticlinal folds, and frequently affected by abrupt twists and dislocations. The group is again largely developed on the Western side of Conception Bay. It forms the elevated range of Spaniard's Bay, striking South-westerly till reaching the Valley of Northern Gut River, whence the course is interrupted by a fault, throwing the strata to the Eastward, which then forms the Drohedy Hills between the two inlets of Bay-de-Grave. The course of the sandstones thence is marked to the Southward by a more or less rugged Country, and they are recognized in force at Big Barren Pond, and afterwards running across the Rocky River about three miles above its outlet. At this latter point the angle of inclination to the horizon being moderate, the group is spread over an extended area and gives a more level surface than is usual. The great central synclinal includes the North East Mountain range of Placentia; the group keeping the surface by a set of minor undulations over a very wide expanse. The group is prominently displayed on both sides of the anticlinal of the Peninsula, dividing Conception and Trinity Bays, where it also affected by minor undulations. The lower measures on the North side, strike into the land from Northern Harbour in a Westerly course and cross the Peninsula to Trinity Bay, the coast of which they, for the most part, occupy to the mouth of the Dildo River. On the South side of the anticlinal the measures strike in a South-westerly direction, leaving the coast between Carbonear and Broad Cove, in the form of a trough, which, after crossing the Head waters of the Dildo, bears for the great synclinal of the North East Mountain.

The red sandstones and conglomerates, (*f*) and (*g*), or upper members of the series, rise in a bold escarpment about two miles inland from Northern Bay, where the strike is nearly N. E. and S. W. (True), which brings them to the coast at Fiambro' Head, and they constitute the headlands of Bay-de-Verde, and the Island of Baccalieu. Sections of the same strata were observed at

Old Perlican and King's Head, whence they strike inland, and finally run out again into the Bay at New Perlican; the group forming a subordinate synclinal, which terminates at the point of the Peninsula and Baccalieu.

LAURENTIAN SYSTEM.

The gneissic rocks which form a nucleus to the Peninsula of Avalon, are described in the Geological Survey of Newfoundland, p. 14, as being members of the Laurentian system, protruding through the Huronian strata, by which they are surrounded. This part of the Country requires much more investigation, as very little is yet known of its topography, and the character and distribution of the rocks have been only hitherto studied to a limited extent. It has been observed, however, that a great plutonic belt of granitoid or porphyritic rock intersects the region running obliquely through the Peninsula, and forms some of the most elevated and conspicuous of its hills and ridges, as for example the Butter Pots of Renews and Holyrood, the Hawk and Chisel Hills, each about 1000 feet high. A beautiful quality of granite may be seen in the beds of some of the brooks between Kelligrews and Holyrood, which has already been partially quarried, and is probably destined to be of much value hereafter. This is considered to be a spur of the great igneous belt.

Another great igneous intrusion runs nearly along the centre of the Western Peninsula of Avalon, terminating at the Southern extremity between Gull Cove and Lance Cove, near Cape St. Mary's and forming the Islands off the coast, known as the Bull, Cow and Calf. The intrusion at this part appears to be nearly four miles wide; but it seems to contract in width in its course Northerly. It was recognized as forming the Green and Sawyers Hill ranges, the N. E. Mountain of Placentia, and, finally, the Spread Eagle Peak, on the North. At the two extremes the rock of this igneous belt is of nearly identical character, being in each case a coarseish, somewhat friable, hornblendic greenstone, while at the Sawyer's Hills and elsewhere it is amygdaloidal.

The displacements occasioned by these two great intrusions are exceedingly difficult to determine, in consequence of the highly altered condition of the rocks intersected. I have, however, attempted to represent, approximately, on the Map, the value of the dislocations in the Western Peninsula, where the Primordial strata, which are intersected, although often much altered, are more readily identified ,than they are on the Eastern Peninsula, where they are everywhere very obscure. By such evidence as I have been able to gather, I am inclined to suppose that the intrusion through the Eastern Peninsula, is of older date than the trap of the Western Peninsula, though probably of later date than the Huronian; as the former does not appear to have effected the Primordial strata, while the latter evidently has. Many smaller intrusions have been observed cutting up the fossiliferous Cambrian Rocks in Trinity Bay, at Chapel Arm and other places, mention of which will be found at page 242 of Geological Survey of Newfoundland. These Trap Dykes are chiefly amygdaloidal, supposed to be off-shoots or spurs connected with the great mass of Spread Eagle Peak. An intrusive mass of a different character to all the other exposures occurs on the West side of Tickle Harbor, Trinity Bay, of which mention is made in the Geological Survey of Newfoundland at pp. 202 and 289. It consists of a variety of igneous or metamorphic materials, amongst which are patches of jasper, masses of porphyry and vitreous quartz, layers of steatite with talc, asbestos, bole, &c. At this place the intrusion appears to run along the unconformable junction of the Primordial with the Huronian formations, but the juncture is very obscure, being covered by shingle or by water.

Another vast intrusive mass is exhibited on the coast of Conception Bay on the Peninsula between Salmon Cove and Collier's Bay, whence it strikes into the land and forms some of the most conspicuous features of the Country, including the Cat's Cove and Blue Hills, Jack's Mountain and other remarkable Peaks. This eruptive mass appears to have been in active operation prior to the deposit of the higher members of the Huronian system, as the strata intersected are confined to the lower divisions (*a*) and (*b*), while the measures above are comparatively but little disturbed, except in the instance already mentioned at the N. E. Mountain, where the trap cuts through the Signal Hill sandstones; and at Great Colinet Island and at the West branch of the Rocky River, where in each case the higher measures are affected by volcanic agency. The trap of the Colliers and Blue Hill ranges, varies in mineral character to a considerable degree. It is at some parts a compact and solid greenstone; at others an amygdaloid, the cavities filled with white calcspar, which in certain parts of its strike assumes the peculiarities of clinkstone. The Colinet Island dyke is probably a melaphyre, it forms a high ridge in the direction of the greatest length of the island in its centre, cutting through the strata from end to end. The dyke at Rocky River, while of no great width, is a brownish porphyry with disseminated bright red crystals of feldspar.

ECONOMIC SUBSTANCES.

GOLD.

At page 532, Geological Survey of Newfoundland, a report will be found of the occurrence of Gold in the neighborhood of Brigus, Conception Bay. The purpose of the expedition of the season was to establish the exact horizon of the strata intersected by the auriferous quartz veins, and to trace them out to the furthest limits possible. It is certainly remarkable that notwithstanding the careful examination I made of the quartz veins at various places, several of which were within a few yards of where small specimens of the precious metal had been extracted previously, I failed to discover, even with the aid of a good lens, a single example of visible Gold. An attempt was made occasionally to test the quartz, chemically, while in the field, but the means of doing so were quite inadequate, and, consequently, a collection was made for further and more careful examination, when time shall permit of doing so. As, however, such assays as are made in a laboratory to test the presence of the precious metal, are not the most satisfactory means of proving the economic value of an auriferous deposit, such as these, I would strongly recommend those parties who are interested in the claims at Brigus, to club together, for the purpose of collecting the quartz from different parts of its distribution, in parcels of half a ton or more from each locality, to be submitted to crushing and analysis on a large scale. It very frequently happens that in some of the best paying auriferous veins, visible or free gold does not occur, (see p. 535, Geological Survey of Newfoundland). It has already been stated that the horizon which is chiefly effected by the intrusion of the auriferous quartz veins is near the base of division (*c*) of the Huronian system; and it is worthy of remark, that similar quartz veins which intersect the same horizon near St. John's proved to be auriferous, some specimens having been produced from that locality which displayed specks of free Gold. Quartz veins are not to be supposed to be confined to the horizon indicated, only, for they are abundantly exhibited elsewhere in other strata, but in the latter case, it has yet to be proven whether they are auriferous or not. Occasionally, but rarely the veins run parallel with the stratification; and in some cases may be true fissure veins, but those which have hitherto proved to be auriferous are veins of segregation as described in Geological Survey of Newfoundland, page 534.

There is little variety in the general aspect of the quartz itself. It is usually of a dull opaque whiteness, sometimes very white or milky, of close compact texture, except when mixed with chlorite, which it frequently is, to a cavernous structure, the cavities occasionally, assumes a hackly or cavernous structure, the cavities being lined with minute glassy crystals of quartz. Talc is occasionally present, generally as a thin filmy coating over the more crystalline portions of the veinstuff. The cavities are frequently filled with decomposed feldspar, and more often with a black earthy material which forms a coating over the crystals, most probably oxide of manganese. An olive greenish, translucent mineral in thin fibrous crystals, resembling epidote, is very prevalent. Pale yellow stains, no doubt from the decomposition of minute cubes of Iron pyrites, frequently shew themselves, and the appearance of fine quartz crystals thus stained is sometimes very deceptive. A pale pinkish coloured mineral, Barytes or heavy spar, is associated with the quartz sometimes forming nearly a third of the mass, as at Fox Hill and Shea's Ridge, but I am not aware whether any Gold has been found in the latter gangue. The quartz of both the above-named localities has yielded fine specimens of free Gold. At p. 533, Geological Survey of Newfoundland, it was shewn that some of the finest nuggets were deposited in the chloritic masses entirely indpendent of the quartz, and this is a characteristic worthy of consideration. The latter matrix occurs so frequently and forms such a large portion of the veinstuff in many instances, that I imagine were it proved auriferous to any great extent, the cost of crushing and breaking it would be much less than that of the ordinary quartz. Iron pyrites, or in fact, iron in any form, is exceedingly rare in all this quartz, ás well as all other metallic substances which might be expected to occur. However, crystals of both copper and iron sulphides were seen in a fw insteancs, and galena still more rarely, was met with. A large quartz vein in Brigus, Riverhead Valley, differs somewhat from most of the others, being almost free from chlorite or any extraneous substance. It is extremely white in color, very dense and compact, but contains occasional cavities lined with large coarse crystals, sometimes over two inches in length.

Many instances occur of quartz veins shewing no visible Gold, which yield, nevertheless, remunerative quantities of the precious metal when carefully and scientifically treated; on the other hand there are some notable examples of an unprofitable nature, where free Gold is present in the quartz. In the State of Maine, according to a report of Mr. Revere, beautiful nuggets of Gold occur in a set of quartz veins examined by him, but an analysis of the body of the quartz proved entirely destitute even of the smallest traces of the metal. It would appear as though all the Gold contained in the veins was concentrated into a few little spots, which were too infrequent to yield a paying quantity of Gold per ton of rock. It is really wonderful how small a quantity of the precious metal when minutely distributed through the rock, can be made to yield remunerative returns, when economy and skilled, scientific labour and appliances are brought to bear on its manipulation. Many instances of this are cited in India, Australia, California, Nova Scotia, and in fact every Gold mining region on the Globe. In an article entitled "Causes of success and failure in modern Gold mining," by Alfred G. Lock, F.R.S.S., published in the Journal of the Society of Arts, No. 1,470, January 21st, 1881; examples are quoted in Australia, where quartz yielding such small quantities as 5 dwts. 13 grs., raised from a depth of from 700 to 1,000 feet below the surface, gave a large profit. Others averaging only 2 dwts. 22 grs., 2 dwts. 10½ grs., and yet another yielding only 1 dwt. 14 grs., have realised large profits. But the lowest yield of all is that of the "Imperial Company of Ballarat, which crushed 2,100 tons of quartz, affording only 21.99 grs. of Gold per ton, with a fair margin of profit on the operation."

The same author gives several instances of Mines which had to be abandoned for want of proper management, and which were afterwards proved by official assays to be rich in Gold, one yielding 1 oz. 6 dwt. 3 grs. a ton, besides silver. In many cases, the tailings thrown away proved sufficiently rich to be again profitably treated, and often yielded more Gold than was originally extracted from the quartz.

I am not as yet satisfied that the percious metal is altogether confined to the horizon of division (*c*). It remains to be ascertained whether the lower and more highly metamorphosed rocks of divisions (*a*) and (*b*), at the base, are barren of Gold or otherwise. Reports of its having been found in the neighborhood of the Salmon and Cat's Cove Hills, if reliable, would seem to indicate that it was derived from these latter divisions of the formation.

COPPER.

The presence of Copper ores in the rocks of the Huronian age has been adverted to more than once in former reports. The forms under which these minerals usually occur are as sulphides, copper pyrites, copper glance, tetrahedrite, erubescite, which are very frequently met with in small strings and nests, lining fissures, or in quartz veins, chiefly confined to the lower measures of the formation. Specimens of a beautiful blue ore of copper, probably covelline, were shewn me from Collier's Point, Conception Bay; and native copper in small specks and lumps, in a matrix of calcspar was produced from the Blue Mountain Tolt, near Salmon Cove. Numerous instances are recorded of the occurrence of these ores, especially the copper glance, erubescite and yellow pyrites, around the shores of Placentia Bay; and in the vicinity of Great Placentia Harbor attempts at mining these ores had at one time been made. Again at Holyrood, Salmon Cove, Crow's Gulch and Turk's Gut. in Conception Bay, similar attempts were made. So long ago as 1779, a mine was opened at Shoal Bay, near Petty Harbor, on the Eastern coast, on a vein of copper, I believe of similar character to those of Placentia, copper glance and erubescite. This was probably the first attempt at mining enterprise in Newfoundland. Several trials have been made in the same neighborhod in more recent times, but it would appear that they were not attended with remunerative results, and as in the case of all these mentioned above, the works were abandoned after a short interval. The frequency of their occurrence, and the richness of the ores, generally, still hold out inducements to mining prospectors. With few exceptions these ores are found in divisions (*a*) and (*b*) of the formation near Quidi Vidi and Small Point, similar ores have been found in the Signal Hill red sandstones division (*f*) near the top of the series, but in no case in appreciative quantity.

LEAD AND ZINC.

Ores of galena and zinc blende, or in some cases calamine silicate of Zinc), chiefly confined to the more or less calacareous veins intersecting the lower divisions of the Huronian formation; though gelena occurs sparingly in quartz veins as high as the Signal Hill standstones, and in one instance is associated with copper pyrites in a small quartz vein in Tickle Harbor, Trinity Bay, cutting rocks of Lower Cambrian age. The gangues of these ores which fill the fissures in the lower strata, are usually calc spar, bitter or brown spar, and occasionally barytes, the two former of which predominate, and seem to be most favourable for the concentration of the metals. The well-known LeManche lead vein is a good example of this. In the neighborhood of Great and Little Placentia, there are several promising lodes which are well worthy of a fair trial. At Little Placentia, on the South side of the Sound, a set of small fissures, roughly parallel, and cutting the strata at right angles, occur, in which an unusually rich ore of argentiferous galena, associated with zinc blende and specular iron ore, is found. Specimens from these veins yielded, on analysis, as high as 159 oz. of silver per ton of ore, of 2,240 lbs. The matrix in this case is chiefly calc spar, anda decomposed earthy material derived from the Country rock, often of a black color, either due to the presence of manganese, or the oxidation of part of the iron and silver contained in the ore itself. The veins holding the ores are small, but, in consequence of the irregularities of the opposing surfaces of the slip, which give rise to the fissures, where salient parts occasionally come in contact, cavities or vugs are found which are frequently more or less filled with prill ore. One of these veins has been drifted upon for about 20 or 30 feet, and increased in thickness from a mere thread to about eight inches at the bottom of the drift, where it exhibits a bunch of prill ore about three inches in thickness. Another parallel vein, situated above the former, which at the time of my visit merely shewed a few isolated crystals of ore in a gangue of black earthy material, scarcely half an inch thick, was, by my direction, afterwards tried. On a few blasts being inserted near the outcrop, it was found to increase rapidly in thickness, and some rich looking specimens were afterwards shewn to me as the produce. Three such veins were seen to contain ore, and were traced over the surface across a projecting point of the shore, about one hundred yards. There is great probability, owing to the disturbed condition generally, that these are leaders to a stronger and better defined lode, which might reasonably be expected to occur somewhere in the neighborhood.

The ores of zinc, combined with galena, as observed at both Great and Little Placentia, are of a pale yellowish or green color, somewhat pearly lustre, and most probably a silicate of zinc (calamine); and if so is a valuable ore, if in sufficient abundance.

Many other useful economic substances occur throughout the Peninsula of Avalon, such as building stone, lime stone, slate, flag stones, heavy spar, and manganese ores, &c. Most of which will, no doubt, some day add to the wealth and prosperity of the province, when the time shall have arrived to render them available for local industries, and the necessities of the Country shall call for their development.

I have the honor to be, Sir,

Your obedient Servant,

(Signed,) JAMES P. HOWLEY.

ALEX. MURRAY, ESQ., C. M. G., F. G. S.,
Director of the Geological Survey, St. John's.

APPENDIX

Fossils recognized in the Rock Series which constitute the structure of the Avalon Peninsula.

No. 1.—HURONIAN.

Aspidella Terranovica.—BILLINGS.

DESCRIPTION.

There are small ovate fossils five or six lines in length, and about one-fourth less in width. They have a narrow ring-like border, within which there is a concave space all round. In the middle there is a longitudinal roof-like ridge, from which radiate a number of grooves to the border. The general aspect is that of a small *Chiton* or *Patella,* flattened by pressure. It is not probable, however, that they are allied to either of these geneva.

Associated with these are numerous specimens of what appear to be *Arenicolites spiralis,* a fossil that occurs in a formation lying below the primordial rocks in Sweden.

CAMBRIAN OR PRIMORDIAL.

No. 2. *a.*—Straparollina Remota.—Billings.—Sp. nov.
" 2. b.—Straparollina Remota.
" 3.—Hyolithus excellens.—B.—Sp. nov.; *a.* Rate of tapering; *b.* Transverse section.
" 4.—Agraulos socialis.—B.—Sp. nov.
" 5.—A. strenuus.—B.—Sp. nov.
" 6.—Anapolenus venustus.—B.—Sp. nov.
" 7.—Paradoxides tenellus.—B.—Sp. nov.
" 8.—Iphidea bella.—B.—Gen. nov.

GREAT BELL ISLAND, CONCEPTION BAY.

No. 9.—Eophyton Linnœanum..Torrell.
" 10.—Anthraria antiqua....Billings.
" 11.—Lingula Murray*i*......B.
" 12.—Lingulella spissa. *a*...B.—Ventral valve.
" " Do. *b*... Dorsal valve.
" " Do. *c*... Side view of both valves.
" 13.—Cruziana similis......B.—*g*. Median groove; L *r*. L*r*. Ridges at the sides.

CAMBRIAN OR PRIMORDIAL.

Description.

No. 2 *a.* and 2 *b.*—*Straparollina remota.* Billings. Sp. nov.—Shell small hemispherical, spire depressed and rounded in outline, height 2 to 3 lines, width 3 to 4 lines, whorls about three, suture deep. The whorls are nearly uniformly rounded, more narrowly so as on the upper side close to the suture, and also on the basal side. On a side view the minute apical whorl is scarcely at all seen; the next below it is elevated about half its own diameter above the body whorl. In a specimen 4 lines wide, the width of the aperture is about 1½ lines, as nearly as can be determined from an individual partly buried in the matrix. Surface very smooth.

Locality where found—Smith's Sound, Trinity Bay.

No. 3.—*Hyolithes excellens.*—*a,* represents the rate of tapering on the ventral side; *b,* the transverse section. The dorsal side of *b* is too much rounded.

Shell usually about two inches in length, tapering at the rate of between four and five lines to the inch. The ventral side is nearly flat or very gently convex; the lateral edges narrowly rounded, in some specimens rounded angular; the most projecting parts of the sides are at about one-third the height; above this the sides are gently convex, the dorsum more narrowly rounded. The shell is thin, nearly smooth, with very fine obscure striæ, about ten in one line. The striæ curve forwards on the ventral side, forming an arc the height of which is equal to about one-third the width of the shell. On crossing the lateral edges the striæ curve backwards, until they reach the most projecting part of the sides, then cross up and over the dorsum at a right angle. On a side view the shell is gently curved upwards on approaching the apex.

A specimen 24 lines in length on the ventral side is 8½ lines wide, and 6 lines in depth, at 20 lines from the apex.

Locality where found—Smith's Sound, Trinity Bay, in red limestone.

No. 4.—*Agraulos socialis.*—Nov. sp. Billings.

Head (without the moveable cheeks), semi-elliptical or conical, width at the base a little greater than the length, gently con-

No. 1.

2

4.

6.

2 a.

2 b.

3.

4.

5.

6.

7.

8.

vex. Glabella conical and (including the triangular projection backwards from the neck-segment) about two-thirds the whole length of the head, neck-furrows all across, but obscurely impressed; neck-segment with a triangular projection backwards, terminating in a short sharp spine Fixed cheeks gently convex; front margin sometimes with a portion in front of the glabella thickened. Eyes of moderate size and situated on a line drawn across the head at about the mid-length, distant from each other about the length of the head. Surface nearly smooth.

In small perfect specimens no trace of glabellar furrows can be seen, but in some of the large ones four or five obscure furrows are exhibited.

The largest specimen seen is six lines in length and seven in width.

Locality where found—Chapel Arm, Trinity Bay.

No. 5.—*Agraulos strenuus.*—Spec. nov. Billings.

Head (without the moveable cheeks) irregularly quadrangular, broadly rounded in front. Glabella rather strongly convex, conical, variable in its proportional length and width, either smooth or with several obscure impressions on each side representing the glabellar furrows; neck segment with a strong triangular projection backwards; neck furrows all across but usually obscurely impressed. In some specimens the front of the head has a thick, convex marginal rim, separated from the front of the glabella by a narrow groove. In others this rim is scarcely at all developed. The eyes shown by the form of the lobe, appear to have been semi-annular, and about one-third the length of the head. The surface appears to be smooth. The following are the dimensions of the best preserved specimen:—

Length of the head, including the large posterior projection, 6 lines; width of the convex marginal rim, 1 line; width of the groove between the rim and the front of the glabella, 1-3 of a line; length of the glabella, including the projection 5 2-3 lines; width of the glabella at the posterior margin, 3 lines; width of the fixed cheek from the centre of the edge of the eye-lobe to the side of the glabella, 2 lines. A line drawn across the head at 2¼ lines from the front margin, would pass through the anterior angles of the eyes. The length of the eye appears to be nearly 2 lines.

Localities where found—Topsail Head, Conception Bay; and Red Cliff Pond near Brigus, Conception Bay, the latter in pinkish limestone.

N.B.—Another species of Augraulos, A. *affinis*. Nov. sp. was found at Branch, Placentia Bay.

No. 6.—*Anapolenus Venustus.*—Spec. nov. Billings.

Glabella convex, most elevated in front, obscurely angular along the medial line, widest at the anterior third of the length; sides gently concave in the posterior two-thirds, and slightly diverging from each other forwards; anterior third and front uniformly rounded. Neck segment with the margin convex and projecting backwards, an obscure tubercle, or rather an angular elevation in the middle, neck furrows all across. There are four glabellar furrows; of these, the posterior is strongly marked, and extends in nearly a straight line all across; the next two are linear, slightly impressed, extend inwards about one-third the width of the glabella, and are gently curved backwards, but still almost at right angles to the sides. The anterior furrow is short, extends inwards about one-fifth the width of the glabella, and curves backwards at an angle of about 45° to the sides. The dorsal furrow around the glabella is very shallow. The fixed cheeks are triangular, nearly flat, with a small elevation, close to the extremity of the posterior furrow. Front of the head with a moderately convex marginal rim, almost in contact with the glabella, or separated therefrom by a narrow space. The eye-lobe starts from a point close to the side of the glabella and just opposite or a little behind the short frontal furrow, and runs with a gently sigmoid curve (at first convex outwardly, and then concave) backwards and outwards to the posterior marginal furrow, which it reaches at a distance from the sides of the glabella, about equal to the length of the neck-segment. The facial suture leaves the side of the glabella a little in front of the anterior furrow, and runs outwards, nearly at a right angle, but with a gentle convex curve, to the margin.

The surface is covered with fine rippled striæ. These on the marginal rim are irregularly parallel with the margin; on the glabella they curve around the front, but further back, and on the neck segment they have a rudely longitudinal direction, curving outwards in crossing over the glabellar lobes.

Length of the head of the largest specimen examined, 6 lines; length of the glabella, including neck segment, 5 lines; width of the glabella at the neck segment, 3 lines; at the front pair of furrows, 3½ lines; width of the posterior margin of the fixed cheek, 3 lines; length of the eye-lobe, 4 lines.

Locality where found—Chapel Arm, Trinity Bay.

No. 7.—*Paradoxides Tenellus.*—Spec. nov. Billings.

Glabella clavate, convex, most elevated at the anterior third of the length, front and sides in the anterior half, rounded, becoming sub-parallel in the posterior half. Neck segment strongly elevated in the middle, where there is situated a small tubercule, neck furrow extending all across. There are four glabellar furrows, of which the posterior extends across, but is very indistinctly impressed in the middle; the next two in advance extend inwards about one-third of the width of the glabella, while the small one in front is somewhat shorter. The furrows are all nearly at a right angle to the longitudinal axis, and about equi-distant from each other. The anterior margin of the hęad, is bordered by a narrow convex rim, which is separated from the front of the glabella by a flat space, varying in width from once to thrice its (the rim's) width. The fixed cheeks are sub-triangular and nearly flat. The anterior extremity of the eye-lobe is situated at a point nearly opposite, but a little behind, the anterior furrows, and is close to, but not in contact with the side of the glabella. The lobe is slightly sigmoid, its posterior extremity opposite the last glabella furrow. The dorsal furrow is distinctly impressed along the posterior half of the glabella, but obscurely marked in front.

The surface is minutely granular. In all of the three specimens collected there is a small straight rounded ridge, which runs from the front of the glabella to the margin. It is situated exactly on the median line.

Of this species we have three specimens of the glabella, two of which retain portions of the fixed cheeks and shew the form of the eye. The largest is three lines in length, including neck segment and front marin.

Locality where found—Chapel Arm, Trinity Bay.

N.B.—Another species of Paradoxides, *P. Decoris,* sp. nov. is described by Billins from the same locality.

No. 8.—*Iphidea bella.* Ventral? aspect.—Gen. nov., Billings.

Of this genus we have no specimens shewing the internal structure, but the external characters seem sufficient to separate it from any described generic group. The ventral? valve of *I. bella,* is conical, strongly elevated at the back, hinge-line nearly straight, posterior angles narrowly rounded, sides and front nearly uniformly rounded, forming rather more than a semi-circle. Posterior side with a large false area, and a convex pseudo-deltiduim, the width of which at the hinge line is nearly one-third the whole width of the shell. The dorsal valve is semi-circular, moderately convex most elevated at the back. The hinge-line appears to be straight. The form and structure of the posterior side, (such as the area, foramen, deltidium, &c.,) cannot be made out from the specimen, owing to its imperfection. The surface is covered with fine concentric striæ, which in the ventral? valve are continued around the area. Of these striæ there appear to be from 15 to 20 in the width of one line, their size varying somewhat in different parts of the specimen. There are also a few obscure radiating striæ. Width of ventral valve, 7 lines; length, 5 lines; height, 2 lines. In the specimen figured there is an aperture in the back, but in another there is no appearance whatever of a perforation. This genus resembles *Acrotata,* but differs therefrom in having a large convex deltidium. It seems to be also closely allied to *Kutorgina.* The shell described by Billings under the name of *Obolus Labradoricus* belongs to this genus.

I. bella was found by T. G. Weston, in a boulder of limestone associated with numerous fragmentary trilobites, of primordial age, near Trois Pistoles, below Quebec. A closely allied species of the same genus occurs in the primordial limestone at Topsail Head, Conception Bay, Newfoundland.

GREAT BELL ISLAND, CONCEPTION BAY.

Potsdam.

No. 9.—*Eophyton Linnaeaum*...Torrell.—Part of a slab of sandstone with several fragments supposed to be of this species.

The slab of standstone about 15 inches in length and 12 inches wide, on the surface of which there are about thirty stems of the fossil. Most of these lie across the stone in a direction nearly parallel to each other. They appear to have been when perfect, slender, cylindrical, straight, reed-like plants, about three lines in diameter, with the surface longitudinally striated; four striæ upon an average in the width of one line. Some of the stems, which have been partially flattened by pressure, are coarsely grooved or fluted; but when the surface of such is perfect, the fine striæ can always be seen on the large ridges and in the furrows between them. When pressed quite flat some of the stems only exhibit the fine striæ. The stems were not observed to be branched; but one of them, which is pressed flat is bifurcated, due, as Mr. Billings suggests, to the pressure having split the stem into two portions.

It was found impossible to distinguish the species from some of the figures of the Swedish form. As it occurs above the *Paradoxides* beds, while the Swedish specimens have as yet only been found below, it is most probably a distinct species.

Eophyton Jukesi.—Spec. nov., Billings, from same locality as the above.

In this species the stems are nine lines in diameter, cylindrical, straight, or slightly flexuous. They are longitudinally striated, but the surface of the specimens examined, are not sufficiently well preserved to exhibit the dimensions of the striæ. It is separated from the former principally on account of its much greater size.

No. 10.—*Arthraria antiquata.*—Gen. & spec. nov., Billings.

The fossils for which the above generic and specific names are proposed, are small cylindrical bodies, with usually an expansion at each end, giving the form of a dumb bell. Those which were examined are from six to nine lines in length, and from the manner in which they are grouped upon the surface of the stone, they appear to be segments of a jointed plant. Similar forms occur in the Clinton formation.

No. 11.—*Lingula Murrayi*—Spec. nov., Billings.

Shell elongate, sub-pentagonal; front margin straight or gently convex for a space equal to about two-thirds the width in the middle; anterior angles rounded; sides somewhat straight or very gently convex and parallel for two-thirds the length, then converging to the apex, where they meet at an angle of between 70° and 80°. In one of the two specimens examined, there is a flat margin on each side one-sixth the whole width of the shell. Between these two flat margins the remainder of the shell is gently convex. In the other specimen this central space is slightly convex in the anterior part of the shell, but on approaching the beak it becomes an angular roof-shaped ridge. The shell is thin, black and shining, with obscure fluctuating, concentric undulations of growth and with very fine, obscurely indicated, longitudinal stiræ.

Length, nine lines; Width, five lines.

No. 12 a.—*Lingulella? Spissa* spec. nov., Billings.

Shell sub-pentagonal, or sub-ovate, length and width about equal, sometimes strongly vertricose. Dorsal valve with the front margin straight or very gently convex for about two-thirds the width in the middle; anterior angles rounded; sides straight or slightly convex and sub-parallel until within one-third or one-fourth the length of the beak, then converging to the apex, when they form an obtuse angle, which varies from 100 to 110 degrees. This valve is generally very convex, sometimes almost hemispherical, the outline on a side view is rather abruptly elevated in the rostral third, depressed convex for a short space in the middle, and then more descending to the front margin. Most of the specimens of this valve are eight or nine lines in length, and about the same in width. The shell which is supposed to be the ventral valve of this species, is gently convex, with usually a somewhat flat space extending from the front margin upwards towards the beak. The apical angle appears to be from 90 to 100 degrees. Shell very thick, of a lamellar structure, dark brown or nearly black, and sometimes, where exfoliated, of an ashy grey color. Surface with a number of obscure undulations of growth and with fine longitudinal striæ, about ten in the width of a line.

Lingulella Affinis.—Spec. nov., Billings.—Not figured.

Ventral valve elongate, conical or acutely triangular. Apical angle about 45°. Front margin gently convex in the middle, rounded at the angles; sides nearly straight, uniformly converging from the anterior angle to the beak. Surface with very fine longitudinal striæ, about ten in the width of a line.

This species is founded upon a single specimen of a ventral valve. The upper two-thirds is partly worn away in the middle, leaving only the outline in the stone. It appears to have been, when perfect, gently convex, the rostral portion near the beak semi-cylindrical. Length, about thirteen lines; width, nine lines. The dorsal valve has not been identified.

No. 13.—*Cruziana similis.*—Spec. nov., Billings.—*g.* The medium groove; *r. r.* the ridges at the sides.

The specimens are from twelve to fifteen lines wide, divided along the middle by an angular groove, and bordered on each side by a narrow ridge, about one line wide. The space on each side between the median groove and the marginal ridges, are moderately convex and crossed obliquely by numerous irregular raised lines, with furrows between them. These lines usually have the form of a gentle sigmoid curve, sometimes extending quite across, but are often crowded together in a somewhat confused manner, still preserving the general oblique direction. Upon an average there are about ten lines in the length of half an inch. The marginal ridges are sometimes longitudinally striated.

This species was at first referred by Mr. Billings to *C. semiplicata,* Salter, but although closely allied, none of our specimens agree exactly with the figures of the British species.

Mr. Billings further remarks upon the collection sent to him from Newfoundland for examination:—

"Besides the above species, many of the beds of sandstone of Great Bell Island, are covered with several species of *Palaeophicus,* and other forms allied to *Eophyton* and *Cruziana*. To describe these would require further collections. In the upper strata there are yet two or three new species of *Lingula*, of which we have only fragments."

CHAPTER II.

Report of Alexander Murray, C.M.G., F.G.S., for the Year 1882

St. John's, Nfld.,
12th March, 1883.

SIR,—

The Government having resolved that a general system of Survey of the whole Island should be adopted, upon a plan such as I suggested, and which was to a limited extent carried out in 1875, I was directed in the early part of last year (1882) to organize parties for that purpose, and to instruct the Surveyors in charge as how to proceed. In consequence of the scarcity of Surveyors competent to undertake a work of this description, and being incapacitated from illness as well as advanced age from undertaking it myself, I deputed Mr. James P. Howley, the assistant Geologist, to superintend the operations in chief, while Mr. J. C. Harvey. C. E., was appointed to direct a separate party for a special purpose, of which an account will be found in his report to me. The Reports of both these gentlemen I now have the honor to submit for the information of the Government. A third party was organized by the Railroad Company, under the superintendence of Mr. L. M. Cunningham, C. E., who was directed by Mr. Howley to connect the work of Mr. C. McLeod, C. E., in the Gander Valley in 1875, with his own Survey of the late year (1882).

As is usual in carrying on extensive operations in a wild and uninhabited country, certain unlooked for contingencies occurred during the season, which involved considerable loss of time, and occasioned much greater expense than was anticipated in the first instance; nevertheless the work was thoroughly well performed, and the gentlemen employed deserve the greatest credit for their patience and steady perseverance under many difficulties.

It is greatly to be regretted, that in order to accomplish their

Surveys accurately, it was found necessary to employ the officer of the Geological Survey, whose labors ought more properly to have been directed towards the structure and distribution of the Geological formations, and the development of the mineral resources of the country. The expenses incurred in payment of wages, providing supplies, and travelling in connection with these Surveys, very far exceeded the whole amount of the Grant for the Geological Survey; the balance of which, after deducting the Salaries of the Officers, has usually been found scarcely sufficient to pay for the annual field work and the maintenance of the Museum The accounts paid by myself, with vouchers for the same, which I have furnished the Government, will explain.

Since Mr. Howley's return to St. John's the whole of the field work has been plotted on a scale of one mile to one inch, upon which all particulars regarding the character of the country are recorded.

With much respect, I remain, Sir,

Your most obedient Servant,

(Signed,) ALEX. MURRAY.

J. O. Fraser, Esq., M.H.A.,
Surveyor General, &c., &c.,
St. John's, Newfoundland.

No. 19.

Report of James P. Howley, Esq., Assistant Geological Surveyor. for the Year 1882

Geological Survey Office,
St. John's, 10th March, 1883

Sir,—

Herewith I beg to submit the following Report of the past season's operations in the Valleys of the Exploits and Gander Rivers:—

Till within the last decade the physical features, abundant timber and agricultural resources of the Country, through which these two great North flowing streams wend their way to the sea, were almost entirely unknown. It is true that Lumbering operations had been carried on upon the Lower reaches of the Exploits, and that a Salmon fishery, dating back to the earliest settlement of Notre Dame Bay, had been established at the mouths of each river. Combined with the latter in former times, trapping wild animals, or furring as it was termed, occupied the attention of the Salmon catchers during the winter season. The furriers were then supplied with guns, ammunition and traps, and distributed themselves in gangs throughout the forest in search of the principal fur-bearing animals indigenous to the Country, such as the Beaver, Otter, Martin and Fox. During these hunting expeditions they occasionally penetrated considerable distances into the interior, some few are even reported to have visited Red Indian Lake. The aboriginal Red Indians, who at that time confined themselves chiefly to this portion of the country, were, it is stated, frequently encountered by these furriers, against whom the former cherished a deadly enmity, having its origin in the pilfering propensities of the poor untutored savage. On such occasions the half naked and nearly defenceless Bœothuck, armed only with his bow, arrows, and spear, was shot down without the least compunction, as though equally an object of destruction with the other wild denizens of the forest. These exploits, as they ignobly termed them, were not only achievements to be boasted of, but to perpetuate the remembrance of such atrocious barbarities, the term was applied to the River and Bay of Exploits.

Such was the inhuman character of their so called Exploits, that the authorities finally awoke to the necessity of endeavouring to put a stop to the cruel and merciless slaughter, and bring the perpetrators to justice. It was also determined to open up friendly commerce with the Indians, with a view to civilizing them. These measures led, in the year 1810 to an expedition up the Exploits River, under Lieut. Buchan, of the Schooner 'Adonis,' who was commissioned to make the attempt. During the winter of that year, while his vessel lay frozen up in the Bay, he ascended the River on the ice with a party of his men, accompanied by a few of the furriers as guides. On reaching Red Indian Lake he met with an encampment of the Indians, and after apparently establishing a friendly understanding with them, he left the Lake to bring up some presents which he had laid aside several miles down the river. He was accompanied by two of the Indians, while two of his own men volunteered to remain behind as hostages. On his return to the Lake, he found the wigwams deserted, the Indians fled, and the naked and headless bodies of his two unfortunate marines stretched on the ice.

The Lake was again visited in the winter of 1819, by a party of furriers, when the woman Mary March was captured and brought out to the coast.

In the following year, 1820, Lieutenant, now Captain Buchan, was again commissioned to restore Mary March to her people, but the friendly intercourse which it was hoped her kind treatment would eventually bring about, was destined to be again frustrated. She died on the very eve of starting, on board the "Grasshopper," brig of war, at the mouth of the Exploits River. It now became Captain Buchan's melancholy duty to convey her poor remains only back to the great Lake.

The philanthropic and intrepid traveller, Mr. W. E. Cormack, was the next whiteman who undertook a journey to the Red Indian Lake. In the autumn of 1827, he, with a party of Micmacs, traversed the country from Hall's Bay and hit upon its waters at the head of the North East Arm. In his diary, he gives a most glowing description of the beautiful scene which the Lake presented in the early dawn of a calm still morning. His swift and perilous passage down the great River on a frail raft was a most daring undertaking, and is most graphically depicted.

Subsequent to the above dates several individuals have from time to time visited the lower reaches of the river. Bishop Englis of Nova Scotia, on one occasion ascended as far as the first fall or chute, now named from this circumstance the "Bishop's Fall."

Sir Gaspard Le Marchant, I believe, visited the Grand Falls, which were, then, named "Governor's Falls," but this name has not been retained.

Long previous to any of the above recorded expeditions, it would appear, from an unpublished MS., that a Lieut. Cartwright, acting under orders from Governor Pallisser, in 1768, ascended the River during the summer season. This expedition was undertaken partly in search of the aborigines, and partly, as he asserts, in his narrative, to ascertain the feasibility of opening up a route of travel to the Western Coast; thus proving at that early date, that the Valley of the Exploits was looked upon as the most direct means of connecting the Eastern and Western parts of the Island. Cartwright visited Red Indian Lake, which he named "Lieutenant's Lake."

It was not, however, till more than a century had elapsed that any attempt at a regular Survey of this fine stream, and an official report of the lumbering and agricultural resources of its splendid valley was undertaken by yourself during the summer of 1871. The River was then dialled and great part of the Lake triangulated, and the first reliable information of the natural capabilities of this fine region, given to the public.

Your Report for that season (see Geology of Newfoundland, Chapter XI.,) gives a full and graphic description of the Country in question.

In 1875 a division of the Railway Survey ascended to the head of Red Indian Lake, and commenced a traverse line, running East from thence to the Gander River. During this same season also, the Upper Valley of the Exploits above the Lake was surveyed by myself, and the Survey continued through Lloyd's Pond and George IV. Lake of Cormack, thence across the country to La Poile Bay. The Victoria branch of the River, a large tributary flowing into Red Indian Lake, was also surveyed, and Victoria Lake, a fine sheet of water sixteen miles long, after which a descent was made to the Southern Coast at Grandy's Brook near Burgeo.

The Gander River and Lake, a still less known region, was Surveyed by yourself in 1874, and the Survey continued by me in 1876, when the Gambo River was also Surveyed. Previous to these Surveys, nothing was really known of a reliable character as to the physical features, or natural capabilities of these two great valleys; a crude and exaggerated idea of the former, only, could be obtained from an inspection of the best maps then in existence. The annual Reports of the years 1874-76 contain ample details of the work then accomplished.

The vast forests of valuable timber, especially pine, together with the valuable character of much of the land bordering on these great Rivers and Lakes having now been fully established from reliable data, it became a matter of great moment that such resources should be opened up and utilized. But to do so in a proper and systematic manner, it was necessary in the first place to have the country blocked off in regular and uniform areas, on some fixed and permanent plan, and as a preliminary step to actual settlement, lumbering operations on an extensive scale should be encouraged. A plan was submitted by you after the Survey of 1874 which met with approval, and in the following season a commencement was made in the Gander Valley by Mr. C. H. McLeod, C. E., under your direction. Mr. McLeod then established a meridian line at Salt Island, in Gander Bay, which he prolonged Southward eight miles, then running West six miles, so as to confine his work to the immediate vicinity of the River, he again turned South for six miles further, and finally ran West six miles, which ended his season's work.

The continuance of this work, however, remained in abeyance until the present season. The commencement of Railway construction in the Island, and consequently the near prospect of opening up these lands for lumbering and settlement, imperatively demanded that no time should be lost in carrying out the system of blocking off the land. In view of the fact that as yet the lands in question are ungranted wild lands, it is therefore a matter of great consequence that ere the indiscriminate practice of squatting on unoccupied lands should be allowed to extend itself into these regions, the work should be fully accomplished.

At the desire of the Government, the operations of the Geological Survey were devoted to this object during the past season. Two parties were sent into the field, one under the direction of Mr. Charles Harvey, C. E., and the other under my own supervision, while I was also commissioned to direct all the operations of the season's field-work for the time being.

The fifty-sixth meridian of West longitude which divides the Island into two nearly equal portions, was selected as the most convenient to form a standard meridian for the whole Island. It was to be taken up on the South Side of Hall's Bay, at a point accurately fixed by the recent Admiralty Surveys, and run from thence South towards the Exploits River. The principal Base Line, situated on or near the 49th parallel of latitude, was to be carried East and West across the Valleys of the Exploits and Gander, and the point of intersection with the principal meridian considered as the initial point upon which all blocks of land to be hereafter erected upon this base, were to depend. The base was also to be carefully measured and staked at every mile section each way from the initial point.

Mr. Harvey was entrusted with the running out of the meridian line, while the construction of the base line devolved upon myself.

We left St. John's in company, early in July last, and having arrived at the mouth of the Exploits River, my party were landed, while the schooner "Bessie," which conveyed us Northward, proceeded on to Hall's Bay to land Mr. Harvey's party; after which we did not meet until the end of September.

Having effected all necessary preparations, we proceeded up the River some twelve miles. Here our line was started West true, from the left bank, and continued Westward, through a dense forest, during the months of July and August, till the Badger River was reached. In the vicinity of this Stream the intersection with Mr. Harvey's line from Hall's Bay was expected to take place. During the interval two canoes were constantly employed conveying stores up the River and depositing them at convenient points, where they could be reached from our line; special care being taken to have a sufficient supply deposited at the Badger River for both parties, at an early date.

When several miles of our line had been cut out, Mr. Cunningham, C. E., joined me. He had been sent up by the Railway Company to be employed in such manner as I should direct. Not having room for him on my staff, I sent him down the River to engage a crew and commence running a meridian line from my starting point Northwards towards the Bay and at the end of twelve miles, run East till he reached the Saltwater. After accomplishing this he was to proceed to Gander Bay, ascend the Gander River, and taking up the end of Mr. McLeod's line, continue it Westward six miles, from which point he was instructed to turn South and continue until he met the extension of my base line in that direction. The object of the latter being to connect McLeod's work with that of the present season, and utilize it as part of the same general system for subdividing the land.

Mr. Cunningham succeeded in accomplishing the work allotted to him, though compelled to remain out till a late period in the fall.

After a delay of some days at Badger Brook, Mr. Harvey's party not having put in an appearance, I started off with two Indians in search of him. In the meantime, I entrusted Mr. A. White, my assistant, to continue our line Westward across the Badger, which he did for three miles further.

Having ascended the main branch of the Badger in a canoe some twelve or fourteen miles, excursions were made in the different directions, the highest ridges were ascended, and an extensive view Northwards obtained from some of the highest treetops. No camp smoke, nor any other indication of their presence being visible, I was compelled to return again to camp. Two other excursions were made before leaving, one up the Eastern branch of the Badger, but with no better result. I could only conclude that they had abandoned their line and retreated to Hall's Bay. A fortnight having elapsed, and our provisions beginning to run pretty low again, we were compelled to return down the river to our starting point, where we arrived on the 22nd September. Immediate preparations were then made for the continuance of our line on the Eastern side of the Exploits. Having occasion to visit the mouth of the River, I here met Mr. Harvey and party, who, having, as I conjectured, abandoned their line from Hall's Bay, owing to the failure of their provisions, had come around to the Exploits for further orders. He had reached his twenty-sixth mile and was within six miles of the intersection point when obliged to leave. It being a matter of great consequence to have the intersection made this season, as the measurement of the base line entirely depended upon this intersection, I immediately set about arranging for Mr. Harvey and his party getting up the Exploits to the Badger Brook. After finding the end of his line, he was then to continue it out, and having made a junction with the base, measure and stake the latter Eastward. Two canoes with their crews of Indians were hired for the purpose of conveying up their stores, besides which I supplied them with one of my own boats, and no time was lost in getting them under weigh. When a fair start had been made up the river, I continued my line Eastward towards the Gander Valley. In this direction many difficulties were met with, and the facilities for getting provisions, &c., up to the line were not nearly so great as on the Western side of the River. Our greatest labor, however, commenced when after reaching about seven miles, we entered an immense tract of burnt woods extending far away to the Northeast and long beyond the furthest horizon South-westerly. Through eighteen miles of this desperate character of country we were obliged to hew our way, no locomotion being possible in many places until a track was cut. This occupied part of September and the entire month of October. Fortunately we were favored with most beautiful weather nearly all the time, though the nights were often very cold and frost very severe for the season of the year. On the 2nd of November we again reached the green woods and got out to the Gander River on the 6th. In the meantime I had heard from Mr. Harvey, who, having completed his line and measured the base out to the left bank of the Exploits, had then proceeded home by the S. S. "Plover" on the 24th ulto.

We struck the Gander River near the outlet from the Great Lake, and having now no boats with us, we were obliged to construct six rafts of dry pine logs. Upon these rude craft our whole party, with all their baggage, successfully ran the entire thirty miles of this great River to the sea in safety, though not without some thrilling experiences. From Gander Bay we proceeded to Fogo in boats, and thence home by the "Plover."

The Western extension of our base line runs roughly parallel with the River's course for the entire distance of twenty-five miles and averages about three miles north therefrom. It passes through a dense forest, broken only occasionally by small strings of marshes, which occupy the lower levels of the country. For the first ten miles after leaving the River's Bank, the surface presents a succession of low rounded ridges, alternating with narrow valleys, through which small brooks usually wend their way. Those flowing northward join the Peter's Arm River, here called Cruiser's Brook, all the South flowing brooks being tributaries of the Exploits. The soil over this section is usually very good, being a light yellowish sandy loam, more especially on the slopes of the hills and levels, but is frequently much encumbered with boulders. Between the tenth and twelfth mile posts a great belt of reddish syenite rock is crossed over, which gives rise to a more barren soil and consequently a smaller and much less valuable growth of timber. The rock frequently protrudes through the scanty covering, and presents bare patches supporting nothing but white moss, lichens, and occasional tufts of low bushes. Beyond this, the country improves very much, until reaching the seventeenth mile, where a steep ridge of trap rock, being the Southerly extension of Hodge's hill range, is surmounted. Here vertical cliffs of bare rock are exposed, and on the top of the ridge the line passes through a gorge between two such cliffs. On the western slope of this ridge the country again improves, and on approaching the Badger Brook it assumes a very level character for several miles on either side. Here, however, marshes become more frequent, and much of the country bordering on the banks of the Badger is very low and swampy.

Very few ponds were met with on this portion of our line, only four small ones being actually crossed, the largest of which was but 56 chains wide, containing a surface area of less than half a mile.

The dense forest which occupies the great Valley of the Exploits River is composed of the usual varieties of our indigenous trees—pine, spruce, fir, birch, and tamarack, prevailing—other varieties, such as aspen, are not infrequently met with, especially near the mouth and along the banks of the river. Dogwood, or mountain ash, cherry, white and red maple, constitute the rare varieties, and are usually of inferior size. Willows and a species of thorn, the latter confined to the river's banks, were still more rarely met with. Alders are profusely abundant in all the low flats, especially bordering the edges of the brooks and streams. Ground hemlock and ferns constitute the usual forest undergrowth, which is frequently very luxuriant. There are three if not more varieties of spruce, the black, white and red spruce, and these trees preponderate over all others, constituting at least two-thirds of the entire forest. They are not often intermixed; more frequently the black spruce prevails in one place and the red or white at another. Most of these trees are of a large size, very tall, and usually well grown. Many sticks suitable for small spars were seen near the line. Where the soil is poor and marshy a small stunted variety of black spruce invariably occupies the surface, which is of little economic value except perhaps as firewood. The fir timber comes next to spruce in point of quantity and probably is nearly equally distributed throughout the forests. It is here generally of good quality and the trees often attain to a large size. Though a soft wood, fir is perhaps the most useful timber we have for the purposes of the fisheries. With it the fisherman constructs his fishing punt, flake, stage, house, and all the wooden implements used in the prosecution of his calling. He makes all his fish drums, oil casks, herring barrels, &c.; most of his firing is fir. The bark of the tree frequently takes the place of shingles on his stage or house roof, and is always brought into requisition for covering the fish bulks on the flake. It is also occasionally used in barking his nets and sails. Altogether, fir is most admirably adapted for the uses of the country generally. It is a durable timber under ordinary circumstances, and possesses the advantage of being readily procured and easily wrought.

It is doubtful whether pine or white birch rank next to fir in quantity in this particular district; both are very abundant, but as a rule the pine is more generally distributed. Birch is scattered throughout all the forest, but more frequently occurs in isolated patches. Some of these are of considerable extent. One splendid ridge of this timber occurs between the 12th and 13th mile posts. It is almost exclusively birch of very large size, and apparently of excellent quality. A second patch, extending over a considerable area, occupies all the Southern slope of the ridge above mentioned, as occurring at the 17th mile. Many smaller patches of this most beautiful of our forest trees were met with, and as a rule the timber was superior to most of the birch I have ever seen. This should prove a very valuable timber for many articles of manufacture, such as furniture.

The pine proper of this region is entirely of one variety, the white pine (pinus strobus). It is not generally of large size, averaging perhaps not more than two feet in diameter at the butt; nevertheless many trees of three feet and upwards, in diameter, were seen, and even one of five feet diameter, but as a rule the smaller timber is the sounder. This giant of our forest towers over all the other trees, and from this circumstance, as well as its peculiar foliage and pale green color, can be distinguished for long distances on the sides or summits of the ridges. For the first ten miles pine is very abundant; it is, however, now, pretty well culled out within three miles of the river side, but beyond this limit it remains still intact, occupying a belt of country at least seven miles wide and extending from the banks of the Exploits above the Grand Falls out to the sea coast at the bottom of Peter's Arm, Northern Arm and New Bay. Where easily accessible from these Arms it is always more or less culled. Beyond the tenth mile the pine disappears, or is only represented by an occasional tree of poor quality, but after passing the ridge at the seventeenth mile it again begins to assert itself, and becomes more and more plentiful towards the Badger Brook, where it is very abundant in some places, especially on the left bank near the mouth of that stream, where a magnificent grove of fine pine occurs. Along the sides of the main Exploits river, above the Grand Falls, and on the islands which occupy a long stretch of the river near the mouth of Rushy Brook, pine is very abundant, and apparently of excellent quality. As yet the operations of the lumberers have not extended themselves into this part of the region. Pine continues more or less abundant all along the river, and for many miles above the confluence of the Badger beautiful grooves of magnificent trees are of frequent occurrence. It is needless to mention the immense utility of this valuable timber which is so universally used all over the world. Perhaps there is no more valuable material in the form of wood. The immense extent of forest occupying the Valley of the Exploits has had many narrow escapes from being entirely demolished by fire within recent times, and sooner or later, I fear such a fate is inevitable. There is ample evidence, even now, in the many charred stumps still standing, and the immense accumulation of fallen and decayed timber, as well as the young and vigorous appearance of the present growth, that it has not altogether escaped in times past. Cartwright, before mentioned, speaks of a fire which he says occurred some seventy years before his expedition up the river, or about 184 years ago. This great fire, says Cartwright, "consumed all the woods from the North and South heads of the Bay of Exploits up the main river on both sides, long beyond the knowledge of any person till now." This fire would thus fix the age of the present growth of timber at about 180 years.

Tamarack is not very abundant in this part of the country, and is only found in the more moist valleys and around the edges of the marshes. Some fine trees were met with on our line, and a few which had to be cut away proved very good and sound.

On the Eastern side of the Exploits the surface is more uneven and the country generally assumes a more broken and rugged appearance. For the first six miles the timber is still green, but several burnt patches occur, the pine here being for the most part also removed. Beyond the water of Jumper's Brook, (a tributary of the Exploits), a steep ridge of trapean rock occurs, which, stretching down the valley of the main river, forms the abrupt wooded ridge on the South side of Norris Arm. After crossing this ridge the country becomes more and more rugged, bare protuberances of trap, with deep narrow valleys intervening, characterize it to the Eastward. Ponds and tarns abound in these valleys, and several considerable streams, tributaries of the Little Rattling Brook, were encountered. To add to the desolate appearance of this part of the country, fire has swept over it, destroying all the timber which once covered the surface. Much of this timber is, however, still standing erect, and in some of the valleys a great deal of fine pine remains bare and bleached, but perfectly sound and good, and might be utilized. Notwithstanding the generally uninviting appearance of this tract of country, there are at intervals small patches of excellent soil, especially on the slopes of the ridges and in some of the valleys crossed by our lines. On reaching the neighbourhood of the Blue mountain (Mt. Peyton) the country becomes still more rugged, and the fire having divested it not only of its timber, but of the scant covering of moss and peat, has exposed a great area covered only with innumerable large boulders of the country rock, chiefly red syenite, which gives it a most desolate appearance. At about four miles from the Gander River the green woods are again reached and the country, at once, begins to improve. Heavy timber is passed through from thence out to the river, pine in particular being very abundant to the north of our line along the slope leading down to the river.

The country from Hall's Bay, through which Mr. Harvey ran his line, is reported by him as very broken and uneven for the greater part, the first sixteen miles being denuded by fire. Towards the junction with the base line the country improves and a good deal of fine timber was seen.

Mr. Cunningham's line, north from our starting point, crossed obliquely the valleys of Peters' Arm and Northern Arm streams, and terminated northward near a large pond, the waters of which flow into New Bay. Much fine timber was seen, especially near the shore of the pond above mentioned, but in the two valleys between his line and the sea coast, all the best pine has been culled out.

The continuation of McLeod's line on the Gander is represented as running through a very good tract of country, especially after rising out of the immediate river valley, westward. Pine and the other forest trees are abundant and of good size and quality, while the soil is spoken of as extremely good over a large area.

System of Blocking off the Land.

The system now adopted for laying off the available lands, both for lumbering and agricultural purposes, is that common to Canada and the United States. It consists in dividing up the lands into regular uniform square blocks, first into areas of thirty-six square miles, which are termed townships. Each township is then divided into square mile blocks or sections, and these latter are again subdivided into four equal areas or quarter-sections of 160 acres each. When it is required to lay off a section of country thus, the first operation is, to establish a standard meridian line in the most convenient position, so as to intersect the country North and South. From this meridian line, a series of base lines, run upon parallels of latitude, are extended on either side of the meridian, East and West true, as far as may be deemed necessary, or as the country is available for settlement. These base lines are situated 24 miles apart, and midway between them, or at 12 miles from each base, a parallel line or correction line, is established. The base lines are all carefully measured and staked at every mile and half mile, or section and quarter section corner, East and West from the point of intersection with the standard meridian, or the initial point, as it is termed. Every sixth mile or township corner is marked in a different manner from the rest by a larger stake, upon which the number and range of the township is legibly cut or otherwise distinctly indicated. Meridian lines are next carried North and South from each corner post on the base lines, to a distance of 12 miles on either side, or until the intermediate or correction line is reached. In other words, to a depth of two tiers of townships, North and South by a base line. The object of this is to avoid discrepancies arising from the convergency or divergency of the meridians, which would render the blocks of more and more unequal dimensions were the meridians continued any greater distance either way without a break. In theory a slight discrepancy actually does exist in a distance of 24 miles, but the material difference is of too little consequence to be appreciable. A fresh start is made from each base at every mile or 80 chains distant, which causes a slight angle or jog. This has the effect of moving each tier of townships resting upon the correction lines, further and further Eastward or Westward, according as the townships are situated on the respective sides of the standard meridian, and as we proceed Northward. By means of this jog, however, the blocks are all kept uniform in shape and dimensions.

Ranges are lines of townships succeeding each other Northward from the principal base or standard parallel, and are called East and West from their position in relation to the standard meridian. When a considerable extent of country has to be laid off a second or guide meridian is sometimes used for the purpose of readjusting the township corners, which the increasing distance from the standard causes to project or jog too far, as well as for the purpose of making a fresh start. Every base line, correction line, range, township and section, is distinctly numbered, both in the field and upon the plan of reference. The base lines and correction lines are called first, second, third, &c., as they succeed each other northward from the principal base. The townships are also numbered as they succeed each other, thus: township 1, 2, 3, 4, &c. The ranges, on the contrary, are numbered East and West from the principal meridian, Roman numerals being always used to designate them, as Ranges I. II. III. East; Ranges I. II. III. IV. V. West, &c. The sections in each township are numbered 1 to 36, always beginning at the lower right corner section and ending with the upper, the number alternating at every sixth section, from right to left, and *vice versa*.

It may appear at first sight that the system of laying off wild lands, as above described, is rather complicated, but a short illustration, and an inspection of the proposed plan now in this office, will, I think, suffice to make it easily intelligible. Every section must be situated in a township and every township in a range. If the numbers of the range, township and section are known, there can be no difficulty in locating the exact place, either on the map or in nature. For example, a person may purchase section 20, township 7, range IV. East. The map shows the range numbers on the top, and by following this line with the eye, range IV., East, will soon be detected; glancing down the range, township 6 will be the sixth in regular succession from the principal base northwards. The second square mile block from the left side of the township, in the fourth row, is section 20. If it were required to find the same in the field, it would only be necessary to find the first base line north of the principal base, which would of course be properly marked and staked. By following this line along, range IV. is met with. The second township north from this line will be township 6. Section 20 would then be easily found, being the second block on the fourth row from the Western side, as indicated above.

In Canada, where land is purchased at any of the regularly established Land Offices, a plan of the township, with all necessary marks and directions, is furnished the purchaser with his Bill of Sale.

It must be obvious, that such a perfect system of disposing of and settling our wild lands, possess very great advantages. It not only enables an intending settler to see beforehand the exact position and character of the land he is about to purchase, but gives him also every facility for utilizing the same. All boundary lines are defined beyond question, and no possibility of disputes arising from conflicting claims can occur, such as so frequently happens where irregular and indiscriminate settlement is allowed to take place. Had a similar system to the above described, for laying off our mineral lands been adopted, as suggested by you years ago, many protracted and annoying litigations, which have from time to time arisen, would never have had an existence, and mining development would, I believe, be in a much more flourishing condition at this present moment

I have the honor to be,

Your most obedient servant,

(Signed), JAMES P. HOWLEY.

To ALEXANDER MURRAY, C.M.G., F.G.S.,
Director of the Geological Survey,
St. John's, Newfoundland.

CHAPTER III.

Report for 1883.—Survey of Lands in the Codroy Valley.

[COPY.]

St. John's,
January, 1884.

SIR,—

I have the honor to transmit the following short account of my last season's operations in the Codroy Valley, for the information of the Government.

Our party left St. John's early in June last, and in due course of time arrived at the Great Codroy river, when the work of blocking off the lands was commenced with as little delay as possible. It was found necessary in the first place, however, to make a re-survey of the entire estuary of the river, and greater part of the outer coast, the details of which were not laid down with sufficient minuteness for that degree of accuracy now required. This work was performed in the usual way, by a connected system of triangulation on true bearings, having a carefully measured base for its foundation.

While the triangulation was progressing, my assistant, Mr. A. White, with two Chainmen, was employed measuring the shore lines as a further check, occasion being also taken to chain most of the principal roads in the vicinity.

This portion of the work being accomplished, a base line was next started from a well marked point at the mouth of Muddy Brook, situated about five miles from the entrance to the Main River. The point was selected owing to its central and prominent position and as being the most suitable one anywhere in the vicinity of the furthest settlements.

From Muddy Brook or Ryan's Point the line was continued East magnetic for a distance of fifteen and a quarter miles up the valley, or as far as the land appeared at all fit for agricultural purposes. At every mile along this base line, north and south lines were run across the valley from the base of the Anguille Range to the foot hills of the Long Range mountains. Stakes were placed at every quarter of a mile, and a stout post with the number distinctly cut upon it marked each mile or intersection along the base line. It was at first intended to adopt the American township system of laying off the lands on true bearings, in blocks of thirty-six square miles each, as was commenced last year in the valley of the Exploits, and continued this season by Mr. Harvey in Central Avalon. On arriving at Codroy, however, and making a cursory survey of the general features of the country, it was found that so much of the land was already occupied, while the upper and unsettled part of the valley was so narrow the system could not be carried out here with any advantage either to the country or the settlers. It was deemed advisable, therefore, to abandon the idea so far as the Codroy valley was concerned.

The fact that the general course of the river and of the entire valley ran almost exactly east and west magnetic, as well as its complete isolation from the St. George's Bay country, further determined me in adopting magnetic east and west, north and south bearings. Any other courses here, especially when the blocks come to be subdivided, would cause many ill-shaped and badly proportioned farm lots. The upper and unoccupied portion of the valley being thus cut up into regular shaped blocks, at right angles to the prevailing features of the country, my attention was next directed to the defining of the boundaries and extent of the various farm lots, already in occupation, on the lower reaches of the river and coast outside. This was not an easy task to perform as might be expected, owing to the irregular system of squatting on unoccupied lands, here as everywhere prevalent; the absence of defined boundary lines, and also on account of the usual prejudices existing amongst squatters to anything like systematic surveys. Thanks to the good sense of the people, however, and the influence of their esteemed pastor, Monsignor Sears, P. A., I was enabled satisfactorily to overcome these difficulties and proceed with the work. They soon became convinced that properly established boundary lines upon which only they could hope to obtain clear titles to their lands were of the utmost importance.

and if further delayed the undertaking would become almost an impossibility. I insisted as far as possible in running all boundary lines N. S. E. & W., so as to form rectangular blocks, and by bounding all lots on the rear by straight lines irrespective of the irregularities of the frontages, to leave the still unoccupied rear lands in a condition to be properly laid off. There were cases, however, where deviations from the courses only, had to be made, on account of two great bends of the shore on the south side of the estuary, which necessitated running the lines on such bearings as would give proportional areas according to the frontages claimed. On the north side also of the estuary, where many of the lines were already cut out on a bearing N. 7° E. magnetic, and so thoroughly agreed upon beforehand by the settlers on that part of the shore, no alteration could be attempted. As it happens, however, this does not effect the whole scheme, from the fact that the lots here reach well up the slopes of the Anguille Range, and no settlement can take place in the rear, the land being too steep for any attempt at cultivation.

The season's work terminated with the lots situated on the Grand River and outer Coast line. The latter extending from North West Cove near Larkin Point, to Woody Head on the north. Part of the estuary of Little River was also surveyed, but time did not permit of laying off any of the lots situated on the latter river.

The measurements made during the season amounted to a total chainage of 149 miles and 5 chains. Ninety-seven miles of this were cut out, mostly through dense forest, composed for the greater part of heavy witch-hazel, white birch, spruce and fir. Twenty-five miles of coast line and twenty miles of roads make up most of the balance.

The number of farm lots in actual possession on the coast line and shores of the estuary of Grand River, located and laid off, was 93 in all, having an average acreage of 163 acres, 1 rood 38 perches, or a total of 15, 204 acres, 3 roods, 18 perches. A further amount of 2,121 acres, 1 rood has been applied for or other wise claimed on the Grand River. On the Little River estuary and coast southward, about 8,960 acres are occupied or held in possession. As yet only twelve applications for the latter district have been made. There are twenty-seven vacant lots between the two rivers and on the outer coast, having an acreage of 3,530 acres, 0 roods, 28 perches, or an average of 130 acres, 2 roods, 39 perches.

The upper and unoccupied portion of the Codroy Valley was estimated to contain a total area of about forty-two and a quarter square miles, or 27,040 square acres. About one-third of this area is occupied by extensive barrens and marshes, while probably one quarter of the remainder is covered by inferior soil, and a small growth of timber. This would reduce the available agricultural land in the upper valley to about 13,521 acres.

From the foregoing figures it will be seen that the total area of the entire valley of the Codroys is as follows:—

	A.	R.	P.
Area occupied on the estuary of the Grand River and coast outside	15,204	3	18
Area claimed on Ditto	2,121	1	0
Area occupied on estuary of Little River and coast, Southward	8,966	0	0
Vacant lots between Rivers	3,530	0	28
Vacant lots on Upper Valley	27,040	0	0
Total	56,862	1	6

The general character of the country has been so fully and faithfully described in Mr. Murray's Report for 1866 that nothing can be added thereto. Though his survey of that year was undertaken for purely Geological purposes, and did not present the same opportunities for acquiring a thorough knowledge of the whole region as ours of the past season, nevertheless his estimates are very nearly correct.

In conclusion, I would suggest that a further sub-division of the still available land in this valley, into say 100 acre lots be made. That each lot be numbered, and either sold to intending settlers at an upset price per acre, to be regulated according to the position and character of the lot; or otherwise, grants in fee for 50 acres with a right of pre-emption over the remaining 50 be given every bona fide settler, upon the performance of certain conditions within a stated period. The terms should be made easy and payment taken in kind, so as to enable the poor and really industrious man to obtain his land on terms best suited to his circumstances. If it be desirable to have the lands settled and cleared in a legitimate manner, it would be a grave mistake to enforce conditions that an ordinary settler could not comply with. Every encouragement should be given to the man who will face the wilderness in this country and carve out a home for himself. My experience of the past season convinces me more than ever, that the proper class of settlers for our wild lands, and the only persons who will succeed in turning them to account are those whose position in life of necessity compels them to labor hard with the sweat of their brow, till by dint of the most persevering toil, they succeed in laying the foundation of comfort and prosperity; if not for themselves, at least for their posterity. Of such a class as this, the hardy Cape Breton Highlanders and Acadian French, who for the most part occupy the lands of the Codroys, are a splendid example.

The early settlement of the Codroy Valley must have entail ed the most trying hardships upon these people. Without markets for their produce or any means of communication with the outer world, they had to depend solely upon their small clearings for their means of subsistence. Though of late years much has been done towards improving their condition, and the best possible return has been given for the small annual outlay on roads. The non-completion of the main line to Port-aux-Basques is still a great detriment to the advancement of the settlement. It is very much to be regretted that some means cannot be devised whereby this line could be completed with as little delay as possible, and its extension to St. George's Bay vigorously pushed forward. The completion of such a line of road would open up an immense tract of the best land in the island for settlement, and I feel confiident that the effect which would be produced in the course of a short time, upon our markets here, and along the whole Southern Coast of the Island, would be of a highly beneficial character.

I have, &c.,

(Signed), JAMES P. HOWLEY.

To J. O. Fraser, Esq.,

Surveyor General.

CHAPTER IV.

Report for 1884.—Townships' Survey in St. George's Bay—Observations upon the Geological Structure underlying and in the immediate vicinity of the Graving Dock at River Head

To the Hon. Surveyor General:—

SIR,—

Herewith I beg to submit the following report of my past season's work for the information of the Government.

On the 3rd June last I started in the S.S. "Curlew" for St. George's Bay, and arrived at Sandy Point on the 7th. My party consisted, on leaving, of an Assistant, Mr. A. White, two chainmen and five axemen, which was further augmented by the addition of seven axemen and a cook. My crew being thus completed we got fairly started with our work on the 10th June.

The object of the Survey was to lay off the large tract of land, situated on the South side of St. George's Bay, into townships of thirty-six square miles each, in accordance with the provisions of the new Act, passed last Session of the Legislature, and upon the lines of a plan previously approved of by the Executive.

Selecting Seal Rocks Point, on the South side of Flat Bay, as the best defined and most conveniently situated for the commencement of our survey a set of observations were here taken to establish a true meridian. . A line was then started from the initial point, running S. 46° 10′ E. true, or at right angles to the shore of the Bay, and continued for a distance of three miles and seventy-two chains, to the base of the Long Range Mountains, terminating in the vicinity of Cairn Mountain, a conspicuous peak of the Range, near the head of the Flat Bay Brook.

The principal base line, which is so situated as to lay parallel to the main South shore of the Bay and about midway between it and the Long Range, was turned off at right angles from the termination of the last line or on a course S. 43° 50′ W. true. This base line was then pushed forward during the months of June, July and August, and part of September, and at every sixth mile, or township corner, side lines at right angles were run to the Coast, on the one hand, and towards the mountains on the other. At the sixth and twelfth corners, however, the character of the land on the inner side did not warrant carrying out the lines to their full extent of six miles.

The base line terminated at a distance of twenty-eight miles, having then reached the bare summit of the Anguille Range, not far from the head waters of the Codroy, and being sufficiently extended to take in all the available agricultural land on this side of the Bay. Having finished the base line, we next cut out to the shore from the twenty-fourth mile post, striking the Coast about one mile west of the mouth of Crabb's Brook. At the end of six miles the front line of the townships, which runs close along the seashore, and parallel to it and the principal base line, was then started on either side. This line extended westerly six miles, passing through the settlement known as the Highlands, and terminating at Ship Cove, near the foot of the Anguille Mountains. In its easterly extension, it crosses the estuaries of Crabb's, Little or Middle Barachois, and Robinson's River, inside of Robinson's Head, passing over the bank a mile beyond. For a distance of about five miles and a quarter it skirts along by the shore, at about ten chains distant from the bank. At the mouth of Berry-brook it again takes the land, and, passing somewhat over a mile inside of Bank Head, it finally runs out to the shore on the South side of Flat Bay, one and a half miles from its extreme head.

While occupied in running out this front line occasion was taken to lay off the lands claimed by the settlers along the shore, whose lots came within the township boundaries. At first much difficulty was experienced in getting the settlers to conform with the township lines laid down, but after explaining the necessity of having all boundary lines within township limits parallel to each other, and pointing out the advantage which would result from a uniform system, where no one individual's boundaries could conflict with his neighbors, &c., these difficulties were removed. After a while the great majority of the settlers expressed their approval of the plan adopted, which gave equal justice to all, and they even became most eager to have their lines at once defined and marked out. In fact, the demand upon my time became so great that I was compelled to forego running out the back lines of the inside townships, which I had contemplated finishing this season.

The people of Crabbs, Little Barachois and Robinson's Rivers had hitherto no definite claims, they formed a sort of joint stock company and held all their lands in common; but the plan did not work well, some took advantage of others, and no one knew exactly what to call his own property. In order then to satisfy all parties here the entire frontage held in possession, and where no boundaries already existed, was divided and marked off into lots of equal areas, according to the number of families or individuals entitled to held land in each settlement. Only one or two individuals anxious to secure a lion's share, raised any objection to this plan.

A narrow fringe of land on the immediate coast line, and outside the township lines, has been used in common as a pasture for cattle during the past half century or more, and, as such, it was decided to allow it to remain, any attempt at sub-dividing proving utterly hopeless.

Altogether one hundred claims were laid off along the coast, averaging about one hundred and thirteen and a half acres each, or a total area of 11,350 acres, about two-thirds of which is probably available for agricultural purposes.

On all the township lines due allowance was made for roads as specified on the Act, viz., one chain at every mile on the base and front lines, and at every alternate mile on the side lines, giving the townships each a total breadth of 486 chains and depth of 484 chains. A stout post was driven at every mile or section corner, upon one side of which the number of the section, in Roman characters from I. to VI., was legibly cut, those on the base line having the reverse side also marked onward from I. to XXVIII. The townships on the outer or seaside of the base line have their four sides completed, and are all ready for sub-division into sections. One of those on the inner side has three of its four sides cut out, and two others two sides each. Altogether ninety-seven miles of line were measured during the season.

The work was of a very laborious character, owing to the fact that all provisions, camp equipage, &c., had to be continuously backed along the lines, little or no opportunity of availing of water carriage by boats or flats presenting itself. Frequently during the summer, wh n obliged to renew our stock of provisions, portages of fifteen and twenty miles had to be made at one time.

By reference to the large map which I have constructed since my return home, on a scale of two and a half inches to one mile, it will be seen that the whole of the available land of the South side of St. George's Bay is included within nine townships, which are numbered in red on the plan. Only six of these, however, contain their full complement of land, or nearly so. The three remaining townships are incomplete, owing to the irregularity of the coast line in one instance, and the projection of spurs from the Anguille and Long Range Mountains, in the case of the other two. No 1. contains thirty square miles, being deficient by six; No. V., twenty-seven square miles, deficient by nine; and No. VI., twenty-four square miles, wanting twelve of its full complement, or a total defiiciency of twenty-seven square miles. This is, however, counter-balanced by about an equal amount of available land inside the rear lines of Nos. VII. and VIII. townships. The projecting part of the shore at Bank Head, outside townships No. II., equals an area of six square miles more, giving a total area for the whole tract of 330 square miles, or 211,200 square acres. Probably one-third of this great area would have to be deducted as unfit for settlement, owing to the prevalence of barren and marshy land, which would still leave 220 square miles, or 140,800 square acres available. The character of the soil spread over so extensive a surface is, of course, very diversified; fully half of Nos. I., II., III. and IX. townships is occupied by extensive barrens and great bogs, of little value except as runs for sheep and cattle. In the remaining townships the good land preponderates, and the soil in many places is of superior richness, especially in the vicinity of the large rivers, where much interval land appears. The prevailing character is a deep red or yellowish sandy loam; but the alluvial interval deposits partake more of the character of a rich, dark sometimes nearly black, mould. The fertility of these latter soils is well attested in the size and quality of the timber they support. Yellow birch, (wych hazel) white birch, balsam poplar, maple, large spruce, and fir are the prevailing varieties; but considerable tracts are frequently covered with a dense growth of large alders, intermixed with elder and whitewood, certain indication of a rich, moist, alluvial soil. It is worthy of note that these characteristics are well known and recognized in the other provinces, especially in New Brunswick, Nova Scotia and Cape Breton Island. Mr. Edward Jack, of New Brunswick, a high authority on the land and timber of that province, who recently paid a visit to this country, confirms the above statement, and has authorized me to use his name in connection with this subject. To use Mr. Jack's own words "The soil which covers the lower carboniferous formation in New Brunswick is almost invariably good, the same holds true of Nova Scotia and Cape Breton. It is, in fact, a very marked characteristic, and must strike the attention of even the casual observer. When I have been exploring the forests of New Brunswick, wherever I saw the characteristic red of the sandstones and conglomerates of this formation, I at once assumed that I was in a country whose soil would be well adapted to the purposes of agriculture. The growth of wood on this soil is of a better quality and frequently of a larger size than on any other rock formation that I know of, with perhaps the exception of the friable calcareous slates of the upper silurian, which disintergrate readily and leave behind them a soil free from stone."

The cause of the fertility of such soils is readily accounted for in this way,—nine-tenths of the superfiicial deposits spread over any tract of country are composed of the debris of the rock formations immediately underlying them. When, as in the case of the lower carboniferous, the bulk of the formation is composed of soft sandstones, shales, clays, marls, limestones and gypsum; an intermixture of these various ingredients must naturally result in superior character of soil. On the contrary where the underlying rocks are chiefly crystalline, siliceous, or feldspathic, containing little or no lime, the resulting soils are usually poor and hungry, requiring a constant supply of fertilizing agents to render them at all productive. The question then of the superiority, or otherwise, of the soil, over any tract of country, can at all times be determined upon Geological grounds, when the rock structure of the country is known.

St. George's Bay can scarcely be said to have any roads, as yet and without these indispensable necessities to agricultural development, no settlement can possibly take place inside the immediate coast line. Wherever the land can be reached and utilized, it is now occupied, and, were access given to the lands in the rear, I believe many of the people would avail of them. During the past season a good deal of work has been performed by the coast settlers in opening up a main line of road from the Highlands towards the head of Flat Bay, and much energy and skill has been displayed by the people in their mode of construction, as yet, however, there are only a few sections of this road finished, with long intervals, where the track only has been marked out. There are many difficulties to contend with, especially at the crossing of various rivers where heavy bridging is required before this line of road can be completed. In a few instances a little better engineering skill might be used to advantage in improving the present location. Nevertheless, I consider that a very good return has been given for the expenditure so far. The people of the Highlands petitioned the Legislature last session for a small grant to open up a line of road some three miles in extent, leading from their settlement back from the shore to a patch of very fine interval land on Highland river, where they had already proved the superiority of the soil by several small clearings previously made. Their petition was answered by a grant of $200, for which they were very grateful. The road was commenced shortly before my arrival there, and such was the eagerness displayed to reach the land in question, that they actually completed three-quarters of a mile in one day. Several of our township lines are well adapted for line of road, but especially the twenty-fourth side line, which presents throughout its entire length of twelve miles, a very gentle upward grade from the sea shore, it passes through a dense forest all the way, does not cross any large stream, the land on either side is good, and the line itself most centrally and conveniently situated. Many of the sub-division lines, when cut, will also be admirably suited for road lines.

The construction of a main line of road through this valuable tract of country, connecting it with the Codroy Valley and Port-aux-Basques, is of paramount importance to the future advancement of the West Coast. The subject has been frequently urged before, but the past season's experience impressed me more than ever with the absolute necessity of such an undertaking, ere any permanent settlement on a large scale can take place inside the Coast line. Two routes present themselves as feasible for such an undertaking. The first, by following up the Codroy Valley and passing inside the Anguille range, where a narrow gorge separates the Anguille from the Long Range mountains. I had an opportunity while in the vicinity during the past fall of inspecting this route, and from all I could observe, there is no practical difficulty in the way of constructing a good road. The valley, though narrow, is tolerably level, well sheltered, and appears as if placed by nature for the purpose of connecting the two districts. Once through this pass, several courses are then open to choose from, for the further extension of the road to Flat Bay. A line running close along by the foot hills of the Long Range and terminating at Seal Rocks, would be perhaps the most direct; but, I imagine, a more feasible, and certainly more central line, would strike obliquely across the country in a straight line for the extreme head of Flat Bay, where so much work has already been accomplished. There of the two settlements of Codroy and St. George's Bay only, were the chief points aimed at, it appears quite possible that a road might be located along the shore on the western slope of the Anguille Range, from Codroy Village to the Highlands. Here it would meet the present main line along the shore of St. George's Bay, where so much work has already been accomplished. There are many difficulties to contend with on this route, and several deep gorges in the side of the Anguilles would have to be crossed. A considerable amount of engineering ingenuity would be required to be exercised in carrying out its construction, but with the aid of trestle-work bridging, I believe the gulches might be easily spanned, and that no other insuperable difficulty exists. The necessary timber required for bridging is abundant on the slope of the hills. The comparative lengths of either route differ but slightly, and may be set down at about ninety miles from Port-aux-Basques to Flat Bay. About fifty miles of the latter line is already partly finished, and about forty of the former.

The outcrop of the Coal seams on Robinson's and Little Barachois Rivers being within two miles of the point where our base line crossed the rivers, the opportunity was availed of to make a further examination of these deposits. The seam on the former Brook, discovered by myself in 1873, being situated low down in the bed of the stream, was completely hidden from view, and all traces of our former work obliterated. This was caused by the freshets and ice carried down the stream in Spring, having moved the loose gravel and stones, filling up the opening then made and even removing every fragment of coal left upon the bank. It was only after a very diligent search and much labor in removing boulders that the seam was re-discovered. The outcrop was then uncovered for several yards towards the bank, when a good section was procured. The seam, including under and upper clays, measures on the outcrop six feet across, but the angle of inclination which it makes with the horizon reduces the actual vertical thickness to about five feet. At least four feet of this thickness is good coal. It is rather harder than ordinary Sydney, very bituminous, caking coal, emitting much gas while under combustion, and burns freely when once fairly ignited. The dip of this bed is down stream or towards the Northwest, and it appears to lie in a narrow synclinal trough, in which case it should come again to the surface from a mile to a mile and a half further West with an opposite inclination. Where,however, the latter outcrops might be expected, the rocks are totally concealed by debris for some distance. The Jukes seam, on the Little Barachois River, named after Mr. J. B. Jukes, F.G.S., who discovered it in 1840, was also visited. It is just two miles distant, up stream from our base line, while the side line separating townships VII. and VIII. crosses the river thirty chains below, and passes on the South Side within sixteen chains of the outcrop. In 1873 Mr. Murray carefully examined and measured this seam, the result of which is given in the Report for that year, as follows: "Coal, 1 foot 3 inches; coal in thin layers, alternating with thin layers of argillaceous and carbonaceous shale, 2 feet 3 inches. Juke's seam, 3 feet 6 inches."

A second seam, one foot five inches in thickness, occurs in the same section about 120 feet higher up. It was the opinion of Mr. Murray, at the time, that the two latter seams were a continuation of the Robinson's Brook seam, on the opposite side of the trough; being here split in two by a wedge of sandstone, &c., as is frequently the case in other coal fields. The past season's observations, however, seem to point to a different conclusion, and I have reason to believe they are entirely distinct seams, that on Robinson's Brook, being at a lower horizon, in which case it might be expected to cross the little Barachois Brook, a half a mile or so down the stream from the outcrop of Juke's seam. Should such prove to be the case, there would then be an aggregate thickness of not less than eight feet of coal in the three seams. The value or otherwise of those deposits will entirely depend upon the superficial area they occupy, and this can only be satisfactorily determined by the application of the boring rod. The probability of these being the only coal deposits of value in the Island, is, I think, sufficient warrant to urge the advisability of determining their extent without delay. We already possess the necessary apparatus, and the carrying out of the work need not be very expensive, if proper means be adopted. The boring rod judiciously applied to this region, would effect the double purpose of determining the extent of the coal seams already known to exist, and be perhaps the means of revealing others whose surface outcrops might never be discovered. As an instance of the importance of this coal area to the future of Newfoundland, the following estimate will give some idea:—A seam of coal one foot thick would yield per square acre 1,500 tons, per square mile 960,000 tons, we have only to multiply this amount by eight (the aggregate thickness here), when the result per square mile would give 7,680,000 tons. Should the seams be persistent in thickness, and the boring prove them to occupy an area of, say five square miles, we may then confidently rely upon no less than 38,400,000 tons of available coal in this district. As a further illustration of its importance, I may here state that the above estimate equals the whole annual output from all the Cape Breton Mines, taking the average between the years 1858 and 1870 for a period of 111 years to come.

The immense gypsum deposits so frequently met with throughout this region cannot fail to become of considerable economic importance in the future, especially as much of it partakes of the character known as alabaster. Its value as a fertilizer, should the country become settled with an agricultural population, can scarcely be over-estimated. Many substances of minor importance, such as building stones, lime stones, brick clays, grindstones, whetstones, &c., occur in abundance .

The Laurentian hills in the rear give promise of considerable deposits of iron ore, boulders and fragments of which are found plentifully distributed along the beds of the principal streams.

These and other less known resources, combined with the greatly superior quality of the soil, must in time render the District of St. George's Bay one of the most flourishing and prosperous in the Island of Newfoundland.

I have the honor to be, Sir,

Your obedient Servant,

(Signed), JAMES P. HOWLEY.

Observations upon the Geological Structure underlying and in the immediate vicinity of the Graving Dock at River Head, 1884

St. John's, 26th December, 1884.

SIR,—

I have been requested to offer a few observations upon the Geological Structure underlying and in the immediate vicinity of the Graving Dock at River Head, for incorporation in your Report. The importance of a correct knowledge of the foundation upon which the Dock rests, and of the improbability of its being affected either by springs or quicksands, such as so frequently render structures of the kind unsound and expensive to maintain, can hardly be over-estimated. I beg, therefore, to submit the following notes, trusting they may be sufficiently explicit to establish the foregoing position.

The Harbor of St. John's for the greater part lies along the strike of a set of bluish grey slates, known locally as the St. John's slates. In their Eastern and Western extension they trend down the valley of the River-head stream, partly underlie the town and strike into the land again in the vicinity of the Railway wharf; thence onwards towards Quidi Vidi Lake. Flanking these slates on the South side is a hard greenish grey siliceous sandstone, in massive beds, known as the Signal-hill sandstone; while they are underlaid on the North side by highly indurated and variegated slates and flagstones. These latter occupy the greater portion of the country in rear of the town, being frequently repeated by folds and flexures of the stratification.

Though the St. John's slates are of a hard and tough nature, they are, nevertheless the least durable of all the rocks comprising the great Huronian series, to which the whole of these strata are referable. The angles of inclination at which the various bands dip from the horizon are of course subject to the intensity or otherwise of the movements which have effected the whole series. In the vicinity of the harbor, however, the dip becomes more regular, though maintaining a high angle, with an inclination towards the South Side hill.

Over the entire surface of the country, wherever depressions in the rock crust admit of it, a superfiicial deposit consisting of sand, gravel and clay is everywhere met with, the debris of the disintegrated and denuded rocks themselves. Apart from the ordinary atmospheric action other agencies, but especially ice in the form of glaciers, has added its influence in remodeling the contour of the whole country. The enormous abrading power which the latter exerted is made apparent, not only in the character of these superfiicial deposits, but more clearly in the rounded, grooved and polished surfaces presented by the rocks wherever exposed to view. The effect produced by the movement of the ice-sheet in its downward tendency from the higher levels towards the sea, was to dislodge from their parent beds all projecting fragments of rock, grind down the surfaces over which it passed, push before it, or carry upon its sides, vast piles of rubbish, which it finally deposited or left after it in the deeper hollows, in the form of unstratified drift or till. The harder sandstones and argillites resisting to a certain extent the onward movement, diverted its course, and directed the full force of the great ice-plough to seek the line of least resistance, viz., along the strike of the softer St. John's slate band. In the course of time the result was the deeply grooved valley and basin of the harbor as it now exists. The finely pulverized slate, with a certain proportion of oxide of iron and lime derived from mineral veins intersecting the adjacent rocks, combined with the fragments of the rocks themselves, all firmly cemented together, forms the till in question. In fact, it is a natural concrete of a very durable description. Upon reaching it in the course of excavating the Dock Basin, it was found so extremely tough that much labor was expended in removing a thin layer from its surface. Such then is the material upon which the Graving Dock rests. It would be difficult to conceive a substance more admirably adapted for a foundation, not even the rock surface itself could afford a more desirable or more substantial bedding.

The deposits overlying this moraine drift at the head of the harbor consist of sand, mud and clay, subsequently brought down by the drainage of the country, and greatly augmented since the occupation of St. John's, by refuse and sewage from the upper part of the town. The glacial drift, however, undoubtedly forms the lowest superficial deposit, as is the case everywhere around, and has nothing intervening between it and the naked upturned edges of the slates upon which it rests. The impossibility of any river silt underlying this drift, rests upon the fact, that no river existed prior to the scooping out of the valley by the action of the glacier.

I regret that my absence from home during the greater part of the time the excavations were being conducted, deprived me of the opportunity of measuring a vertical section of these superficial deposits. Through the kindness of Mr. Shuster, Superintendent of Construction, I have been enabled to obtain an approximate, sufficiently accurate in detail. I learn from the same gentleman that before reaching the required depth of thirty-one feet below high water mark, the whole of the more recent alluvial and sewage deposits were removed down to the till and some eighteen inches of the latter also. It was indeed a most fortunate circumstance that so suitable a material should be met with almost exactly where needed.

The impervious nature of this deposit to the influence of waters is, perhaps, one of its highest recommendations. Had the required depth been reached, before striking it, there might be some danger to anticipate from the influx of water, or from springs, especially where there was any considerable thickness of silt beneath the flooring of the Dock. In order to make this clear, it would be perhaps well to enter somewhat into the theory of springs: Sir Charles Lyell says, "their origin is chiefly atmospheric," or in other words their source arises in great measure from the rain and snow falls which percolate through the more porous sub-soils, till stopped by coming in contact with some impermeable stratum. A subterranean drainage then takes place, but when impeded by projecting points or ridges of rock, or where inequalities in the stratum occur, reservoirs are formed, which on being tapped produce springs. When, however, there are no such impediments, and the surface of the substratum presents a comparatively smooth inclined plane, no quantity of water can lodge upon it "Water must find its level" underground, as on the surface.

Speaking of the causes of failure to obtain water in boring for wells, the same high authority quoted above, says: "Where natural lines of drainage exist there remains but a small quantity to escape by artificial issues." He also adds "that the dip of the strata may be such as to carry off the water from the adjacent highlands to some trough in an opposite direction, as when the borings are made at the foot of an escarpment where the strata incline inwards, or in a direction opposite to the face of the cliffs."

This is exactly what occurs here. The widest part of the harbor basin forms a deep trough, towards which all water finding its way through the more porous subsoils, must drain off. The Dock, situated as it is at the upper end of the harbor, stands on a much higher level, from which is a regular downward slope towards the deeper basin. It is also close to the escarpment of the South Side hill range, where the strata "do incline inward, or in a direction opposite the face of the hills." In view of the foregoing facts, I think there need be little apprehension of the structure ever being troubled, either by shifting quicksands or springs from beneath.

I remain,

Your obedient Servant,

(Signed), JAMES P. HOWLEY, F.G.S.

CHAPTER V.

Report for 1885.—Blocking off Land in the Peninsula of Avalon

St. John's, Feb. 4th, 1886.

The Hon. Surveyor General.

SIR,—

The following Report of the season's field operations for 1885, under my direction, is respectfully submitted:

It was the intention, as you are aware, in the early part of the season that my services and those of the party under my charge should again be devoted to the St. George's Bay District, the scene of our previous year's labors. The more urgent demand however, for the speedy completion of the Peninsula of Avalon Survey, commenced by Mr. Harvey in 1883, seemed to call for the efforts of all the available staff connected with this Department, accordingly I was instructed to prepare for a season's work in the Peninsula.

We left St. John's on the 10th of June last by Rail, and pitched our first camp at Peddleton station at the junction of the R. R. line with the New Harbor and Spaniard's Bay road; here a few days were occupied in final preparations for work in the bush.

Our first move was along the road towards New Harbor, and thence Northward to Mr. Harvey's most Northerly parallel of last year. On the 16th of June a commencement was made at the N. W. corner post of Township 17, Range XXI. East, when two lines were started, one running due North, the other West. The former was entrusted to Mr. A. White, my assistant, while the latter was under my own immediate supervision. This line was carried out to the shore of Trinity Bay at New Harbor, a distance of four miles and forty-seven chains, over a fairly wooded but uneven rocky piece of country. It forms the Northern boundary of Township 17, Range XX., East.

During the remainder of the month of June and part of July, the entire party were engaged in outlining and partially subdividing Township 16, Range XXI., the most Northerly of the series as yet blocked off. Beside the regular boundary lines the central meridian and parallel were each cut out six miles, thus subdividing the Township into four blocks of nine square miles each. By this means a good idea of the general character of the entire Township was obtained. It cannot be said to be of a very favorable nature, by far the greater portion of the surface is occupied by barrens, marshes and ponds, with frequent outcroppings of the bare rock.

The soil is poor, thin, and more or less encumbered with boulders, while the timber supported upon it is generally unfit for any purpose but for firewood. The only exception to these characteristics pertains to the extreme N. W. corner of the block, within about two miles of Witless Bay, Trinity Bay, where a ridge of very fine land, supporting a heavy growth of yellow birch, fir and spruce, occurs.

The country north of this Township presents altogether such a bleak, barren appearance, including as it does the great Heart's Content barrens that it was deemed a useless waste of time to continue the blocking off in that direction; accordingly we moved back to Harbor Grace Junction to refit for further work.

The sub-division of Township 19, Range XX., was next commenced, of which the central meridian and parallel were each run out six miles, and the Eastern, Southern and Western side lines completed, making a total of twenty-eight miles. Later on in the season Mr. W. B. Reed continued the sub-division of this Township, running out the three remaining meridian lines. To complete the sub-division only four parallels now require to be cut out. This is in all probability the finest Township of the entire series blocked off. The proportion of good land and fine timber will, I believe, exceed any of the others. It is intersected by the Railway from East to West, and by the Hodgewater and Big Barren Pond branches of the Rocky River from North to South. Harbor Grace Junction (now Whitbourne) is situated in the 33rd Section, while South from the Junction several picturesque lakes, all closely connected, spread out over a considerable area, reaching into the heart of the Township. Again, on the Eastern side the waters of Big Barren Pond, with several smaller lakes, extend down to its Southern boundary line, thus rendering almost all parts of it easy of access by water. Of the thirty-six square mile Sections six are covered by water, and six more by marshes and barrens, leaving at least twenty-four square miles or 15,360 square acres available for agriculture. So far from being a hindrance, the ponds are in every respect an advantage, affording as they do facilities for penetrating almost every Section within the Township. The soil here is frequently of excellent quality, and the timber, especially the yellow birch and fir is of fine growth.

The greater part of the months of August and September was occupied in outlining and partially sub-dividing two new Townships 18 and 19, Range XIX., E. The western portion of the principal base line from Salmon Cove, which forms the dividing line between those two Townships, was produced to Long Harbor, in Placentia Bay; the total length of this line being twenty-nine miles, two chains and seventy-five links. Thirty-six miles of line were cut out and measured in this section of the country, forming the South and West boundary lines and central meridians and parallels of the two above-named Townships.

Much of the country included within these boundary lines is barren and rocky, particularly over the Western portion of the area, which includes the bare elevated ridge known as the North-east mountain of Placentia. The more Northerly township also includes Spread Eagle Peak and another high ridge west of it. There is, however, one redeeming feature in the shape of a long, narrow, densely-wooded valley, extending in a due south line from Chapel Arm almost up to the parallel of the N .E. Mountain. This valley averages about one mile wide, the soil, particularly over the Northern part of it, is of a superior quality, and the timber supported upon it some of the finest observed during the season. The Chapel Arm River flows through it, and exhibits frequent patches of excellent interval land along its banks.

Having again returned to Harbor Grace Junction to refit for the Autumn, all our provisions, &c., were next moved by rail to Big Barren Pond, up which we proceeded, and by means of portaging and rafting over the ponds reached the most Southerly base line. From this line several meridians were produced south sufficiently far to include all land within eight miles of the Railway track, and a new base line established bounding the whole on the south side. This latter line was extended eastward to meet the first meridian line produced south from Salmon Cove, which terminated the season's work. The total number of miles cut and measured reached one hundred and thirty-seven and ten chains, (137 m., 10 chs.), inclusive of some minor measurements. The country east and west of Colinet River, as far as our survey extended, is generally well wooded, in some parts even densely so; but our lines were interrupted by an interminable network of ponds, some of considerable extent, which were met with on all sides. Towards the extreme eastern end of the base line, on approaching the Chisel Hill Range, the country becomes more open and extensive tracts of barren and marshy land intervene. Many considerable patches of good land were met with in running out these latter lines, especially in the neighborhood of Colinet River, and around the shores of some of the numerous lakes. The timber is frequently of fine size and quality, being as yet little culled out.

The vast amount of valuable timber still available over the central parts of the Peninsula, cannot fail to become a source of wealth when rendered accessible from the Railway track. There can be no doubt also, that much of the land in the region can be easily reclaimed when once the timber is removed. As a rule, it is superior to any in the vicinity of St. John's, and there seems no reason why, in course of time, it should not become the home of a busy thriving population.

I was much impressed during this season with the fact that a large portion of the country hitherto looked upon as useless marsh or swamp, could, by a judicious system of drainage, be converted into the very best hay growing lands. The surface of these marshes is generally covered with a spongy moss or coarse grass. The subsoil being composed of a soft yellow mud resembling river silt. To account for these deposits, their sites would appear to have been once occupied by shallow ponds, which gradually became silted up by the materials carried down by the rivers from the higher levels, which process is going on at the present time in many places. As a matter of fact they are alluvial deposits, and as such differ materially from the usual and more common peat bogs, which were formed by vegetable accumulations grown in situ. My attention was particularly directed to this matter during the past season by Mr. Francis Peddle, a settler upon the New Harbor line of road, who was about to make a practical experiment of cultivating such land. This man has spent many years in the Western States, particularly in Oregon and Washington Territory, where the system of drainage is much in vogue. When the surface is rendered sufficiently dry and solid to support the weight of cattle, by well placed and properly constructed drains, the plough is immediately brought into requisition, there being uo rocks, stones, or other obstructions to contend with. The mossy surface is then turned down, and allowed sufficient time to rot, helping thereby greatly to enrich the soil. The land is finally cross-ploughed, harrowed and otherwise prepared to receive the first crop, which is generally oats. Though the process of preparing and cultivating this character of land is tedious at first, the after results amply repay the labor. To demonstrate the truth of his theory, while I was in the neighborhood last June, Mr. Peddle removed the moss from a small portion of one of those marshes, and having turned up the soil, scattered broadcast some oats and turnip seed. The result was marvellous; in the space of one week the seed was all over ground, and when I saw it, looked healthy and vigorous. It left no doubt on my mind that his conclusions are correct, and that the soil in question, when thoroughly cultivated, will prove exceedingly fertile. Mr. Peddle certainly deserves every encouragement in his enterprise, which is calculated to throw much new light on the value or otherwise of our wild lands. He also considers the thinner and poorer soils, especially when encumbered with boulders, not improved by the usual mode of tillage, and hardly repaying the amount of labor expended upon them. The best of such soils, he contends, is merely the surface layer, which is only covered up, or otherwise impoverished, by bringing up from beneath the more sandy unproductive gravels, It should not be disturbed at all, but when the timber is cleared away and the brush burnt, hay seed should be scattered over it which soon takes root. Then by allowing cattle to roam at will, the soil becomes sufficiently enriched from the droppings, to furnish a constant supply of nutritious grazing. The success of these experiments is, I believe, fraught with much importance to the future farming interests of this Island, and might be applied with advantage to every district where similar conditions prevail.

I have the honor to be, Sir,

Your obedient Servant,

(Signed), JAMES P. HOWLEY, F.G.S.

CHAPTER VI.

Report for 1886—Survey at Bay of Exploits.

St. John's Feb. 25th, 1887.

The Hon. Surveyor General.

SIR,—

I beg to submit the following Report, with the accompanying plan of my last season's field-work in the Bay of Exploits, for the information of the Government.

During the last Session of the Legislature, a Bill for the Encouragement of Agriculture and the setting apart of certain tracts of country as agricultural districts for the carrying out of the provisions thereof, having been passed, I was referred to as to the most suitable localities for the establishment of such settlements as the Bill contemplated. The object being to combine small farming with fishing, and the exigencies of the people necessitating action with as little delay as possible, I was naturally led to recommend those parts of our sea-coast where good lands were known to exist, but, at the same time, removed as far as possible from the baneful influence of fogs and cold winds, while still within easy reach of the neighboring fishing-grounds. These considerations induced me to point out some of the deeper arms and indentations of our principal Bays where such conditions prevailed. Amongst the latter, the beautiful Bay of Exploits, in Notre Dame Bay, seemed especially adapted for the purpose. Its fine, clear atmosphere, excellent soil, and abundance of timber; its great extent of seaboard available for settlement; and above all, its proximity to the Shore and Labrador Fisheries, render it decidedly the most desirable locality on the Eastern side of the Island. The Government were pleased to accept these considerations, and I was accordingly instructed to proceed thither and make the necessary surveys.

Our party, consisting of eight men, two chainmen, and an assistant, Mr. Albert Bayly, arrived at Dominion Point on the 24th of June last, and no time was lost in commencing the actual work of the survey. Previous to leaving St. John's a good boat was provided for the coast survey, and others were hired, as required, during the progress of the work. Knowing, from former experience in the locality, that the Bay had been very imperfectly surveyed heretofore; in fact, that nothing beyond a mere sketch-map represented this important inlet upon our best charts; it was deemed necessary as a preliminary work, to make a thorough trigonometrical survey of the entire Bay. A suitable place having been selected on the south side of Norris Arm for the measurement of an accurate base line, and frequent observations having been taken to establish a true meridian, the work of triangulation was soon fairly commenced, and was continued throughout the month of July and part of August. Every feature of the coast-line, with its various arms, coves, islands, &c., was carefully brought in. The triangulation was connected with the Admiralty Survey of Staff-Commander Maxwell, R.N., at Northern Head and Exploits, Burnt Island, and on the eastern side it terminated at South Head. When the whole work has been projected on a large scale, I have reason to believe the result will be found a most useful and valuable addition to the manuscript-maps in the Department.

The latter part of the season was entirely devoted to the running out of Township lines and blocking off, into suitable sized farm-lots, all the available land towards the head of the Bay; the boundaries and location of all lands already granted or occupied, being, at the same time, determined. Every mile or section where not claimed, having a frontage on the shore, is now divided into eight lots, numbered from right to left, and each ten chains in width. A road allowance of one chain wide is reserved at every North and South section line, and each alternate East and West section line. All side lines and back lines of lots run either North and South or East, and West true; consequently, they are all at right angles, and there can be no conflicting of boundary lines hereafter if the system is adhered to. At the corners of every lot, posts were driven down, upon which the number, section, township and range was legibly written in red; corresponding numbers, &c., indicate each lot on the accompanying plan. Altogether, 172 lots, averaging a little over 18¼ acres each, or a total of 3,130 acres, were thus staked off, and are now ready for immediate occupation. Though apparently intricate at first sight, the system adopted is of the simplest possible nature, and will be found greatly to facilitate the issuing of Grants in this locality. The intending settler need not necessarily be acquainted with the meaning of any of the terms used; having selected a lot which he wishes to obtain a Grant for, he need only make a correct copy of the No., Range, Township and Section, as marked on the corner-posts, and present the same to the Crown Lands' Department, where the exact locality, boundaries, area, &c., are at once seen by reference to the plan. The survey of these lands is dependent upon, and made to conform with, the general system of Township Survey, commenced in 1882. During that season Mr. Harvey and myself ran out a standard meridian, and a base line, on a parallel of latitude further up the country. The former divides the country into two portions, East and West; the latter into a North and South division. Every six miles East and West of the standard meridian is a range; and every six miles North and South of the principal parallel is a Township, denominated North or South, East or West, according to their respective positions. Consequently, the land laid off the past season is all included within Townships 1 and 2, North Ranges V, VI, and VII, East.

The character of the soil in this locality varies considerably. It is, for the most part, an arrenaceous loam, with occasional patches of marsh and interval lands. Though not of first-class quality, it is, nevertheless, all fairly good, especially the patches of interval. There are places where the soil is much encumbered with boulders, but when the latter are removed, good crops can be raised here as elsewhere. This was clearly evidenced on the farm of one John Gill, lot No. 7, Section 17, Township 2, North, Range VI, East. The industry and perseverance of this individual has resulted in the possession of a comfortable home for himself and family, with a plentiful supply of the necessaries and even many of the luxuries of life. Although not a farmer in the true sense of the term, and being very deficient in the supply of proper farming implements and accessaries, he has, nevertheless, managed, by dint of hard labor, to bring under cultivation some eight or ten acres of wilderness, which supplies him with abundance of vegetables, and hay for his cattle. He has his own beef, pork, poultry, eggs, milk, butter, &c., and raises an average of 250 brls. potatoes annually, which he can readily dispose of at a good price to the inhabitants of the outer Bay. The abundant timber supply of the surrounding forests occupies his time in winter, the produce of which considerably augments his income, which he informed me was much over £100 per year. Another man named Porter, who also derives his chief support from the land, is equally prosperous. These are but a few examples of what may be accomplished even in a crude way, by persevering industry applied solely to the land. The potato crop invariably does well here, rarely ever fails, and such pests as the wireworm and potato bug are entirely unknown. Capt. James Winsor, on his extensive clearing at Dominion Point, has in a more thorough manner, demonstrated what the capabilities of the soil are. His crop of hay, oats, barley, turnips and potatoes were all very fine. Barley of good grain was fully ripe in August. He also exhibited a good grain of wheat, which he asserts, can be successfully raised every year, as he has proven by actual experiment. His kitchen-garden displayed a magnificent array of peas, carrots, parsnips, lettuce, cabbages, beet, onions, vegetable marrows, and other ordinary garden root crops, all of which were as fine as I have ever seen in any part of the country. All these facts, taken together, leave no room for doubt as to the natural capabilities of the soil under fairly skilled management. The indigenous growth of forest trees amply testifies as to the general character of the great unreclaimed region surrounding the shores of the Bay hereabout, and extending along the banks of the Exploits River for many miles up its course. There is little to add respecting this region of the country, except as to climate. During the early part of last season the weather experienced was rather wet and stormy, accompanied by frequent thunder and lightning; but the heavy easterly and northerly gales which were so injurious outside, and so greatly retarded fishing operations, had little or no damaging effect up the Bay. Fogs, such as are experienced along the sea-shore, never reach up here, and for the greater part of the season, the days are extremely bright and warm. During the latter part of the season, especially in the months of October and November, the weather was simply delightful, even exceeding that experienced on a former occasion. (See Report for 1882).

One good effect of the survey was to create an interest in the land and an impetus to cultivation amongst the settlers here, where heretofore little manifested itself. All those already settled down became most anxious to acquire titles to their holdings. Enquiries were constantly made as to the terms upon which the land could be obtained, and several applications were sent on during the summer. Some twelve or more lots on the South side of Northern Arm were no sooner staked off than they were immediately sought after by families just arrived from the French Shore, which latter place they were obliged to abandon. Late in the autumn, the people of the outer Bay began to flock up here in their boats and craft for timber. Some of these people came several miles in an open punt, and in the height of a gale of wind, to find out my camp and make enquiries about applying for land, etc. A few of the Nova Scotian lumbermen employed at the Dominion Point saw-mill, being anxious to settle down here, applied to me for information, and upon my recommendation, began to clear some vacant lots in Peter's Arm before we left. On former occasions, as in the Codroy Valley and St. George's Bay, I have seen similar indifference towards utilizing the land all at once give place to a most lively interest and activity on the part of the people as soon as they found the Government disposed to help them along, and itself exhibit a well-founded belief in the value of the lands by sending surveying parties to block them off. After the experience of this and former occasions in the Exploits Valley, I cannot for a moment doubt that the region is destined in the future to become the home of a large and thriving population. There is no possible reason that I can see why it should not be capable of supporting many thousands of our people. Of course, before any extensive settlement can take place, roads must necessarily be constructed, so as to utilize the lands in the rear, and up the river valley. I have indicated on the plan some of the most necessary roads at present required. A main line extending from Northern Arm across to Peter's Arm, thence to Dominion Point, Wigwam Point, and finally along the west side of the main river, appears to me the first desideratim. Another line from Norris Arm to Burnt Arm and Kite Cove would open up a large tract of land, and prove extremely useful to the large population in the latter locality. A line extending from the head of Norris Arm to Burnt Bay, a distance of some twelve miles through a good piece of country, would connect the settlements in that direction, viz.: At Burnt

Bay, Loon Bay, and Comfort Cove with those of the Exploits, and undoubtedly prove a valuable means of intercommunication between these now isolated settlements.

Towards the close of the season, a sad and fatal accident, resulting in the drowning of Mr. William Emerson, the assistant chainman of the party, for a while threw a great cloud over the whole staff, and greatly retarded the operations of the survey. The particulars of this sad occurrence having already been made public, it is unnecessary to detail them now; but I cannot omit remarking here that the art of swimming should be fostered and encouraged amongst our youth of all classes. It is really astonishing that for a sea-faring population like ours, so very few learn to swim. I am fully convinced that one half the annual deaths by drowning are attributable to this cause.

In conclusion, I have only to reiterate what has already been so frequently put forward, that such districts of country as the present Report refers to, if put in a proper condition for settlement, with a thrifty and industrious class of people introduced thereon, cannot fail to become an acquisition of prosperity and happiness to the settlers themselves as well as a valuable asset to the country at large. In this connection, I beg most respectfully to suggest that no time should be lost next year in carrying out the provisions of the Agricultural Bill relative to the introduction of such settlers in this region, thus rendering its practical application apparent, and not allowing it to remain a dead-letter on our Statutes.

I have the honor to be, Sir,

Your obedient servant,

(Signed), JAMES P. HOWLEY, F.G.S.

THE HON. ALFRED PENNEY, M.H.A.,
Surveyor General.

CHAPTER VII.

Report for 1887—Survey across country from Fortune Bay to Bonavista Bay, by way of Bay du North and Terra Nova Rivers.

Geological Office,
Post Office Building,
March 12, 1888.

Hon. Surveyor General,—

SIR,—I beg to submit the following Report for the past season upon the operation of the Museum and Geological Survey during that period.

THE MUSEUM.

The furnishing and fitting up the rooms provided for the collection of specimens, in the New Post Office Building, was commenced in the early part of last winter, during the interval between the completion of the previous season's field-work and the setting out upon last summer's survey. Much of my time also, since my return home last fall, has been devoted to the same purpose. I am now happy to inform you that the arrangement of the collection in regular scientific order, though far from being completed, is in a much more advanced stage than hitherto could be attempted. The room is spacious and well lighted, and affords an opportunity for displaying to advantage the various mineral, fossil, natural history, and other specimens contained therein. The furniture, which was manufactured by the Newfoundland Furniture and Moulding Company, is light and handsome, and reflects much credit upon their workmanship.

Mr. Henry Earle had the contract for the shelving, &c., around the sides of the room, which, being now completed, adds greatly to its appearance. Altogether, the Museum compares favourably with others of its size, and has been spoken of in flattering terms by visitors from the United States and Dominion of Canada. Up to the present time, such furniture only as was absolutely necessary has been ordered; but, as the collection increases, more will be required.

The time necessarily occupied in the season's field operations and subsequent plotting of the same in the office, did not admit, as yet, of giving that close attention and study to the scientific classification of the various specimens that such a subject demands. I hope, however, to be enabled now to devote the remaining months of the winter exclusively to this end, when it shall be my endeavour to complete the arrangement as far as possible.

Although the Museum was not in such an advanced stage as I should have wished, nevertheless, it was deemed advisable last November to announce the opening of it three days in each week, viz.: Mondays, Wednesdays and Fridays. The public now seem to thoroughly appreciate it, and to recognize the importance of such an institution in their midst, as a means of affording both pleasure and enlightment, especially to the youthful portion. In fact, it has come to be regarded as a great boon, judging by the eagerness displayed for admission on these open days. Thousands of persons have visited it since November, the average daily number being fully two hundred; while, on several occasions, the room has been quite crowded. I have not seen anything like the number of visitors, at any time, in any of the Museums either in the United States or Canada. As yet, however, the institution may be said to be merely in its infancy, and it is still very deficient in the Ichthyological, Ornithological and Zoological sections of our natural history. The interest attached to these most instructive and attractive objects of existing nature make it very desirable that these sections should be completed as speedily as possible. We, however, labour under great disadvantages here, owing to the absence of a regular staff of collectors and naturalists, such as are attached to most museums elsewhere, and on account of the difficulty and expense of properly preparing and preserving specimens when procured. This drawback will, I trust, to a great extent be obviated in the course of a short time. Already several young people have been actuated with a desire to collect and contribute specimens, being influenced thereto from visiting the Museum; while others, again, are practicing the Art of Taxidermy, which is one that any young man with means and leisure at his disposal would do well to cultivate a taste for. With the aid of such assistance as may be rendered in this way, and a small annual grant for the purchase of specimens, I am in hope of gradually acquiring, if not a complete, at least a creditable, exhibition of all our natural history, and other products.

The amount voted for the Museum last session of the Legislature was chiefly expended in the furniture and fittings, leaving but a small sum for such purpose apart from the maintenance of the institution. Several important additions were, nevertheless, made to the collection, chiefly gratuitous contributions of persons who felt interested therein. Foremost amongst these are their Excellencies the Governor and Mrs. Blake, who upon their arrival here last fall, presented a beautiful set of West Indian shells, corals, and sea fans, (gorgonias), which is one of the chief attractions to all classes of visitors. The good example set by their Excellencies will, I have no doubt, induce many of our citizens to follow their example.

The public are likewise indebted to the following gentlemen who have, from time to time, contributed towards the Museum. To the Hon. Dr. Winter, for a well-preserved skull and leg-bones of a Bœothuc, or Red Indian, of Newfoundland; Rev. M. Harvey, Very Rev. Dr. Howley, Rev. E. Botwood, Hon. P. Cleary, Mr. R. L. Mare, Mr. R. Bond, M.H.A., Mr. T. R. Smith, Mr. R. McCoubrey, Mr. Muir, Mr. C. S. Fowler, and many other contributors. To Captains Arthur Jackman, Samuel Blandford and James Power we are indebted for several good specimens of seals and a fine Polar Bear, brought home from the Greenland Seas by the former. Captain Jackman is also the contributor of a full-sized Esquimaux Kayak from Greenland. Professor Alpheus Hyatt, of the Boston Natural History Museum, is the donor of a fine set of photographic views of the West Coast and Labrador, and Mr. G. F. Matthews, M.A., of New Brunswick, several interesting fossils from the St. John group of the Cambrian series. A number of interesting and valuable minerals were obtained, by way of exchange, from Professor Carlos F. de Qandero, of Guadalajaro, Mexico. A valuable set of reports, bulletins pamphlets, maps, &c., have been received, from time to time, from the Smithsonian Institute, Washington, the United States Geological and Geographical Surveys, the Californian State Mining Bureau, Geological Surveys of New Hampshire, Indiana and Iowa, New York National Museum, Geological Survey and Royal Society of Canada, and many other scientific bodies. There has been acquired, by purchase or otherwise, during the past year, forty-two specimens of our native birds, two small cases of foreign birds, three native deer, (caribou), two beavers, two young black bears, two foxes, an otter and a marmot; also a number of Bœothuc ornaments.

Now that the meaning and object of the institution is beginning to be understood, especially by the people from the Outports, it is probable that during the ensuing season a great number of specimens will be forthcoming from all quarters, when I hope to be placed in a position to purchase such as are worthy of a place in the Museum.

The importance, in an educational point of view, of a well arranged and complete collection of natural history, and other interesting objects, is well recognized in every civilized community. So thoroughly are our enlightened neighbors of the United States imbued with the belief, that almost every town of any importance in the Great Republic possesses one or more establishments of the kind. The restraining and elevating influences thereby exercised, especially over the minds of the youth, is all important, as tending greatly to turn their thoughts into those higher and nobler channels which go towards building up a true and permanent civilization. Sir William Dawson, than whom no higher authority could be quoted, speaks forcibly upon this point, and expresses the greatest possible faith in the educational influence exercised through these means.

It has ever been my aim to make our Museum as complete and perfect an institution of the kind as our limited means and isolated position will admit of, and with the encouragement now given, I hope to succeed in time.

The Season's Field-Work.

The Government having expressed the desire that an exploration and survey of the hitherto little known tract of country lying between the heads of Fortune and Bonavista Bays should be made last season, preparations were begun early in June to carry out this intention. Provided with two canoes and a supply of provisions, &c., our party consisting of Mr. A. J. Bayly, as assistant, a cook. poleman and myself left St. John's in the S.S. Kite for Fortune Bay, and were landed at St. Jacques on the 25th of that month. Here we were joined by four Indian canoemen, from Bay D'Espoir.

We immediately proceeded to the head of Bay du North, and embarked at the mouth of the river of the same name. It had previously been decided to penetrate into the interior by this route. A few days were here spent in the necessary preparations for our long and arduous journey across the country. The interim was availed of to examine the shores of the Bay du North and Bay d' East*, and other parts of the adjacent coast-line. Observations were also taken to establish a true meridian, and ascertain the variation of the compass, preliminary to a regular trigonometrical survey of the river.

The ascent was commenced on the 1st. of July, and proved an easy enough undertaking for the first six miles, but after reaching this point the river began to assume a very different aspect. It became more and more broken, narrow and tortuous, walled in by jagged cliffs, interrupted by innumerable small falls, chutes and dangerous rapids, and choked with huge granitic boulders. This desperate character, increasing in ruggedness as we proceeded, finally culminated in one gigantic plunge, a little over nine miles from the coast. Here the body of water is confined between precipitous cliffs of a coarse, reddish granite, which, stretching obliquely across the channel, causes the water to fall with terrific impetuosity into an abyss below. Another spur of granite, reaching half-way across stream opposes a nearly vertical wall to the force of the current before it has room to assume a more even flow, and, casting it sideways, causes it again to dash with fury against an opposite but more inclined wall. As if maddened in their attempt to escape, the raging waters rush up the incline and break into spray, which the disturbed atmosphere whirls high above the surrounding hills and tree-tops. Seen from a distance, it presents the appearance of smoke; hence the name of Smoky Fall has been given it by the settlers. A little above the fall, the first pond is met with, of small dimensions, and for a few miles the river is tolerably smooth and regular; but beyond this again, another stretch of some two miles in extent, is nearly as rugged as that part below the fall, though the hills on either side are less

*This nomenclature is rather confusing, there being two bays of the same name, and much better known in Bay D'Espoir. I shall therefore adhere to the simple names on the Admiralty charts of North and East Bays.

precipitous. Small ponds succeed this with but short intervals of river, and at about three and a half miles, the point at which the telegraph line crosses, is reached. One mile and a half further, or about eighteen miles from the sea-coast, the first of a series of large lakes is met with. This is called Meddonegonnix by the Indians, which means the end of the portage. The distance from here to the head of Bay D'Espoir is about thirteen miles, and when entering or departing from this district of country on their hunting excursions, they make a portage by means of Little River, Conne Arm, and some other waters, to and from this lake. Up to this stage, the delay in getting our canoes and provisions along, and the immense amount of labor it entailed, greatly retarded our progress. Trails had to be cut through the wood over all the more rugged places, and everything, including the canoes, carried on our backs, frequently a distance of a mile or more, while the extreme heat of the weather rendered the labor of portaging all the more trying. Were it not that the river was at its lowest summer level, progression by its means would have been an utter impossibility. In view of this delay and excessive labor attending it, with the almost inevitable certainty of the river being flooded later on, I deemed it useless to attempt getting our remaining stock of provisions into the interior by this route. It was, therefore, decided to have them conveyed to the Telegraph Station at Long Harbour, there to be stored till a more favourable one presented itself. A messenger was accordingly despatched to Mr. Ryan, operator at the latter place, requesting him to have them brought around, which he kindly undertook to see performed. Finding also our two small canoes, not only in a dilapidated condition, but entirely inadequate for our work, I purchased another small one from an Indian at Bay D'Espoir, and had her portaged across to Meddonegonnix. The survey of this lake and several other smaller ones being completed, we arrived at another large lake called Koskæcoddee. It is the Micmac name for a species of sea-swallow, the Royal Tern, (sterna maxima), which seeks this lake every summer during the season of incubation. A long, sandy spit, projecting from the point of an island in the middle of the lake serving as a nestling place for the bird.

This lake is V-shaped, each arm being over four miles long. It contains several islands, and has a surface area of five and a half square miles. Two and a half miles further, a still larger lake, studded with numerous islands, and having a surface area of twelve and a half miles, is known to the Indians as Olamageech, or Sandy Cove Pond. I have re-named this Jubilee Lake, being engaged in the survey of it on the day Her Gracious Majesty's Jubilee was being celebrated with so much eclat in London. From the south-eastern angle of this lake a valley extends southward toward the coast. A large tributary, with several ponds closely succeeding each other, flows through it and debouches into the lake. This stream leads southward to within ten miles of the head of Long Harbor, and presenting, as it did, the most favourable opportunity for obtaining our supplies from the latter place, it was availed of for that purpose before proceeding further North. We followed its course southward, as far as practicable for canoes, and thence proceeded on foot over the barrens to Long Harbour.

The work of transportation over these ten miles of rough country was a very laborious undertaking; but in the course of a few days it was not only accomplished, but a connected survey was also made with the coast, and thence down the stream again to Jubilee Lake. Here, again, we met with another trying portage of three miles, to the next great lake above, Kægudeck, or the Upper Lake. The river between the two lakes was nearly, if not quite as bad, as anything yet encountered. It was hemmed in between slatey cliffs, rising into high bluffs on either side, forming a perfect gorge, through which the water tumbled and foamed in a series of falls, chutes and rapids, nearly the entire distance. Over these, with the greatest difficulty, we managed to get our empty canoes only; all the baggage and provisions had to be transported on our backs.

Kægudeck is not really the uppermost lake on the North Bay River, but is the last of any considerable size. It is a beautiful sheet of water, divided into innumerable arms and coves, and studded with pretty wooded islands, numbering nearly one hundred in all. Its shores are, for the most part, low and well-wooded, and in every respect it presents a very much more picturesque and pleasing appearance than those already surveyed. At the eastern end of the lake the land rises into a mountain range, with bare-peaked summits, and behind this, again, in the distance, towards the north-east, Mount Sylvester is seen to rear its cone-shaped summit high above all the surrounding country. The view looking down the lake on a calm afternoon, with its picturesque woods and islands reflected in the placid waters for a foreground, and the high mountain-ridge on the east, with Slyvester's blue outline filling in the rear, was one of the most striking landscape scenes I have ever witnessed. The survey of Kægudeck, owing to its many intricacies, occupied us an entire week. Its total surface area is ten square miles. Three considerable streams flow into this lake on the north side, besides several smaller ones. It is difficult to decide which of these is the main river, as they are of about equal dimensions. We followed that which enters at its extreme north-east angle, as leading more directly in the course we wished to pursue towards the head of the Terra Nova. The brook was small and very shallow, but a timely downfall of rain enabled us to get up, without any great difficulty, to the next pond, some four miles above. This section of the river passes on the north side of Mount Sylvester, and only a mile distant from it at one point. The circumstance was availed of to make the ascent of the mountain, which, however, had been previously accomplished, before going out to Long Harbor, when a cairn and flag-staff were erected on its summit for the purpose of triangulation.

Mount Sylvester was so named by the intrepid traveller, Mr. W. E. Cormack, in 1822, while journeying across the Island in search of the Red Indians. It was the name of his Indian guide and sole companion, Joe Sylvester. In writing of the circumstance, Cormack says, "In the whole of the savanna country, which forms the eastern central portion of the interior, there rises but one mountain, which is a solitary peak or pap of granite, standing very conspicuous about forty-five miles from the mouth of the West Salmon River, (Bay-du-Nord River) of Fortune Bay, on the south coast. It served as an object by which to check our course and distance for about two weeks. I named it Sylvester, the name of my Indian."

From the summit of Sylvester a good view was obtained. All the country south and east of the mountain is one vast rolling barrens, sparsely relieved here and there by small clumps of stunted timber, interspersed with innumerable lakes and ponds of all sizes and shapes. Much of the timber which did exist at one time has been completely demolished long ago by fires, west and north, however, the country is tolerably well wooded, but is frequently interrupted by extensive marshes and barren ridges, while lakes and ponds are equally abundant in these latter directions also. In fact the quantity of fresh water visible on every side, leads to the conclusion that nearly a third of the area bounded by the horizon, is thus occupied. About two miles east of the mountain one very large lake, having the appearance of a number of small ones, connected by short channels, so cut up is it by peninsulas, islands, etc. It is well known to the Indians as Meelpaeg*. This lake lying so exactly as it does upon the water-shed of the country, presents the unusual phenomenon of flowing over, as it were, on either side; one stream running southward joins the Long Harbor river of Fortune Bay; while an opposite branch pours its waters into the Terra Nova river, flowing northward into Bonavista Bay. The elevation of Sylvester, found by aneroid and connected by the levels brought up from the sea coast by the Railway Survey in 1875, is about 1300 feet above sea level. The fact that it rises so abruptly above the surrounding country, which averages only about 700 feet above sea level, give to the mountain its conspicuous appearance.

Beyond Sylvester the river continues quite small and shallow, but expands a few miles above into two small lakes, a little over a square mile each in area. One of these is the extreme head water of this branch of the North Bay river. I have named it Rainy Lake, owing to the continuance of wet stormy weather, which prevailed all the time we were in its vicinity. A short portage of thirty chains only forms the height of land here, between it and the first small lake on the Terra Nova. It was the first of October before we were fairly launched on our downward journey towards Bonavista Bay. At the foot of the first pond we crossed the R. R. survey line of Division C., eastern interior, of 1875. A short distance below this line, two long narrow ponds, with but a short stream connecting them, were named respectively, Stag Pond and Bayly's Pond. The first of these receives the branch stream from Meelpaeg. A mile below Bayly's Pond, another long narrow lake, nearly five miles in length, with an average breadth of three-

*More correctly "Eastern Meelpaeg," to distinguish it from the other lake of the same name mentioned in next year's report.

quarters of a mile, is known to the Indians as Kep-N-Keck or Eel Pond. Nearly twelve miles of running water now intervene between Kep-N-Keck and the next large lake, Son Batist or Lake St. John. This is a fine open sheet of water, three and a half miles long by two wide, with a long narrow arm on its eastern side, its entire surface being nearly six and a half square miles. This lake received another large tributary in its western corner, said to be the main branch of the Terra Nova. The Indians call it Cumnigewaygodde. It tends upward in a westerly direction, crosses the R. R. survey line, and finally, nearly meets another tributary, which flows into the Lake Meddomegonnix.

Six miles below Lake St. John, and after passing through several small ponds and steadies, the river again expands into a considerable sized lake called Mollyguajeck. This lake has an area of about two square miles. The river below it, now quite a large one, runs through a gorge for a mile and a half. This section is a succession of dangerous rapids and chutes, terminating in several picturesque falls. A portage had again to be made over the hills from Mollyguajeck to a point below the falls. Our measurements terminated here, a connection having been established with the survey of the lower Terra Nova river to this point, made in 1869, by the then Director of the Geological Survey, Alexander Murray, C.M.G., F.G.S.

The season being now far advanced, and the weather latterly having become exceedingly wet and boisterous, we were constrained to make all haste to get out to the sea coast again. Finding our three small, and now very much dilapidated canoes, unequal to the task of conveying our entire party with all their baggage, down the river in one trip, we concluded to construct a small deer-skin canoe, capable of taking two men and a fair quantity of camp equipage. Its construction occupied part of two days, but when completed, it proved of great assistance to us. Our journey down the river as far as Terra Nova Lake was accomplished with comparative ease, here, however, we were storm-stayed for two days, and in passing down the lake we were overtaken by such a furious gale as to compel us to beach our canoes, at the risk of being all swamped. The canoe I myself was in being completely filled with water, would have sunk or capsized in a few moments more.

From Terra Nova Lake to the sea, the river, for the most part, being now swollen by the recent rains, presented a fearful aspect, and even in ordinary times is one of the roughest rivers I have ever traversed. Four days of incessant labor were consumed in making the descent of about eighteen miles. We reached the mouth of the river, at Middle Arm, Bloody Bay* on the last day of October. From here we got a passage by schooner to Catalina, and thence home by the S.S. Plover.

General Features of the Country.

The whole of the eastern interior of the Island, through which our survey passed, is characterized by low rolling ridges and plains, "the savannas" of Cormack, composed chiefly of bare ridges and marshes with innumerable lakes and ponds dotted over the surface. The proportion of timbered lands is small, especially on the southern slope from the height of land to the head of Fortune Bay, where it is confined chiefly to the narrow valleys of the south-flowing streams. By far the major portion of this district is of an extremely barren character, and in the vicinity of the coast it is rugged and broken. There are a few small patches only of land in the river valleys, or on the margins of some of the lakes, worthy of consideration from an agricultural point of view. On the northern slope the country improves very much, wooded land becoming the predominant feature. This forest consists principally of spruce, fir and birch; pine does not make its appearance in any appreciable quantity, till the vicnity of St. John's Lake is reached. It becomes more and more prevalent as we proceed northward, and around the Terra Nova Lake, it is quite abundant; on the south side of the lake, however, and along the valley of the river, between it and the sea, fire has swept the whole country, leaving nothing but the bleached skeletons of a former valuable pine forest to attest its existence.

Many tracts of fairly good agricultural land occur along this river valley, especially in the neighborhood of Lake St. John and Terra Nova Lake. Some light but excellent soil was seen on the south side of the latter lake, stretching away towards Clode Sound and near the mouth of the river, around the head of Middle Arm, a considerable area partakes of the same character. Its good quality

*Now Alexander Bay.

has recently attracted many settlers from the outside Bay and even from St. John's, who speak in high terms of its productiveness. My attention was particularly directed, by one of the settlers, to the soil on the neck of land between Middle Arm and Troytown, and though it was not what might be termed a rich soil, it was by no means an inferior one, judging from the color, depth and freedom from stones. For root crops particularly it is well adapted, and the fine yield of potatoes last year from newly broken ground, bore ample testimony to its productive qualities.

Geological Features of the Country.

The deeply indented and extremely rugged peninsula, forming the headlands between Cinque Isle and Hermitage Bay, on the north side of Fortune Bay, is, for the most part, occupied by rocks of a gneissoid or granitiod character, intermixed with trap. They present a variety of colour, correspondent with their predominant mineral constituents. Light grey and pale reddish shades, however, seem to preponderate, the former produced from the excess of dark hornblende, or blackish mica, disseminated in fine particles all through the rock, red or flesh colored orthoclase feldspar, produces the latter variety, both these are again often much modified by the greater or less amount of vitrious quartz present. One very characteristic rock of a bright brick-red color, forms a conspicuous feature of the coast scenery in several places. It is a porphyritic variety whose ground mass consists of a bright red homogeneous feldspar, holding patches of decomposed yellowish feldspar or kaolin embedded. True granites are not abundant in the area, granulites, porphyrites, syenites, diorites, etc., are the most prevalent, while protogene, a rather rare variety, in which talc takes the place of mica, is sometimes met with. The porphyritic and granulitic varieties are, however, decidedly the prevailing rocks of the country. At St. Jacques and Beleoram the granulites form the headland between these two harbours. Specimens of this rock were brought from Belleoram in 1870. A block, now in the Museum is a fine grained compact stone, which appears to be composed principally of dull flesh colored feldspar and finely disseminated greenish hornblende, with very little quartz. Towards the head of North Bay and East Bay, especially at the mouth of North Bay river, it assumes a somewhat more crystalline character, though the constituents are much the same. However, vitrious quartz is much more prevalent in the mass, and the hornblende more sparsely distributed, but in larger crystals. It is here also frequently penetrated by dark colored bands of a greyish hornblendic trap. These then are the prevailing characteristics of the rocks which occupy the entire country up the North Bay river, as far as Jubilee Lake, and eastward and southward towards the heads of Placentia and Fortune Bays. In fact, the entire barren area, forming the southern slope of the country, is underlaid by this granitoid or gneissoid series. At Jubilee Lake, and again at the head of Long Harbour, the more granular varieties prevail, while those of a coarse and more crystalline nature, (pegmatite) seem to occupy the intermediate area. Many of these rocks are exceedingly handsome, they would furnish an infinite variety of beautiful and durable building stones, blocks of which are to be seen in the museum. There is not, as yet, sufficient data to classify them as belonging to any particular geological horizon, but their mineral constituents and general aspect, would seem to point to the Lower Laurentian series of Canadian Geologists.

Resting upon these gneissoid and granitoid rocks, and in some cases penetrated by them, are seen on the points and headlands, towards the head of Fortune Bay, patches of greenish and dark reddish sandstones and conglomerates, in a highly altered condition no doubt from their contact with the intrusive granites. A small patch of these newer rocks forms the headlands of Corbin Bay, and the islands lying off the same, also Dog Islands and Belle Island. They occupy the entire peninsula between S. E. Bight of East Bay and Belle Bay, but are here intersected by a broad belt of the brick-red porphyry. They come in again on the east side of this belt, holding the shore to Rencontre, and thence strike up into Mall Bay, in a series of sharp narrow folds. At the entrance of Long Harbor, they are underlaid by light greenish and drab felsitic slates. These latter, although so very much altered in places as to almost lose their true character, nevertheless bear such an unmistakable resemblance, not only in their mineral constituents, but in the general arrangement of the strata, to certain members of Mr. Murray's Huronian or intermediate system, that I have no hesitation in classifying them as identical with divisions *c. d. e. f.* and *g.*, of that formation.

Quartz veins are of frequent occurrence, and a set of these, near the head of S. E. Bight of East Bay were thickly impregnated with a bronze-colored mineral, magnetic pyrites or pyrrhotite Galena and zinc blende occur in a quartz vein intersecting the strata on the east side of Mall Bay, where an attempt at mining the ore was made some years ago.

Molybdenite, in a mixture of quartz and reddish porphyry, occurs near Rencontre, but the locality was not visited. These rocks do not again make their appearance until reaching Terra Nova Lake, far down the northern side of the watershed. Their further extension and distribution northward is fully described in Mr. Murray's report for 1869, and need not be dealt with here. A few small outlying patches of a more recent and unconformable formation, were recognized in 1870, on some of the extreme points of the peninsula, at the head of Fortune Bay, referred to above.

The principal localities where they were seen, are the small headlands separating Great Bay-de-l'eau from St. John's Bay; St. John's Bay from Boxey Harbor; Boxey from Mon Jambe; English Harbor from Blue Pinion, and also on St. John's Island. They chiefly consist of very coarse friable conglomerate passing into coarse grained sandstone, with a few bands of bright-red and greenish slate. At the head of North Bay a much more considerable patch occurs, occupying the entire headland between North Bay and East Bay, and running into the country on the east side of the latter bay, between S. E. Bight and the N. E. corner of the bay. Again, in its western extension, it strikes across North Bay, occupies the whole northern side of Cinque Isle Bay, and the head of the latter bay, probably reaching across the narrow neck which separates the latter from the head of Great Bay-de-l'eau. The conglomerates and slates are here supplemented with several bands of impure reddish and flesh-colored limestones. The whole are arranged in a long narrow trough, the axis of which lies almost exactly N. East and S. West true. On the northern edge of this trough, between the head of North Bay and East Bay, a well-marked fault occurs, and here the conglomerates and limestone are let down almost vertically against a wall of the reddish granitoid rock. The fault runs across the neck bearing S. 80° E. magnetic. No fossil organisms could be detected in these limestones, whereby to establish their true geological horizon, but lithologically and otherwise, they bear such a marked resemblance to the Primordial Silurian, or more properly the Lower Cambrian, as displayed so largely elsewhere in Fortune Bay, that provisionally I have classed them under this head.

On the west side of Lake Meddonegonnix, near its head, a few bands of distinctly stratified, fine-grained, grey gneiss, were seen dipping N. Westerly. Their strike would carry them N. Eastward, towards Sandy Cove Pond or Jubilee Lake, between which and Kægudeck Gospen, a very micaceous, finely laminated and much corrugated, pearly grey slate, intersected by innumerable small quartz veins, form a succession of low ridges. These are seen again in the cliffs, along the shores, and on many of the islands of Kægudeck Lake. On the south side of the lake and river below, the general dip is about north true at a high angle. Towards the N. and E. sides, the slates assume a more silky lustre, and even cleavage frequently splitting into fine laminæ. They are interrupted by great masses of compact dark grey diorite, sometimes weathering slightly brownish, and often emitting a sonorous noise when struck with a hammer. It is that variety of igneous rock, termed clinkstone or phonolite. Brown weathering dolomitic veins are also of frequent occurrence, and judging from many large blocks of the same material strewn around the shores, large bands probably occur somewhere in the vicinity. A piece of one of these brought home, is of a dark reddish color, intersected with numerous white veins, and would make a very pretty marble, closely resembling the beautiful Rosso-di-Levant of Italy. Small irregular quartz veins are numerous throughout this region, some of them contained cubes of galena, iron-pyrites and copper-pyrites. A grey sulphuret of copper was also met with in some loose boulders on the north side of the lake. The decidedly magnesian character of these rocks, together with the presence of a few boulders of impure steatite, found on the shores of the lake, leads to the supposition that they are an easterly extension of the Quebec Group, so largely displayed in the Bay East river further west (see Mr. Murray's report for 1870). Their lithological characteristics bear a striking resemblance in many respects to the metalliferous chloritic and dioritic rocks surrounding the great bay of Notre Dame, but their isolated position here, and the absence of any reliable data whereby to determine their exact horizon, must for the present leave the question unsettled. They form an elongated narrow trough, which points to the northward, and on the northern slope of Sylvestre, they are seen to rest with a high northern inclination.

Here a large belt of the brownish weathering compact phonolite intervenes between the slates and the coarse friable granite, which forms the summit of the mountain. Very little rock is exposed anywhere beyond this with the exception of a few small outcrops of similar slate, until reaching the second last pond in North Bay river. A pale reddish-weathering finely micaceous slate, in a nearly vertical position, occurs on the west side of the pond. Again, on the upper pond of all, along the south and west sides, a few exposures of pale grey micaceous and very much corrugated slate occurs, striking generally S. to W., N. to E., and inclined N. Westrly. Inter-stratified with these latter slates, are occasional small bands of very hard finely micaceous grey sandstone, approaching a quartzite in hardness. Between the first and second ponds on the head of the Terra Nova river, the coarse reddish syenite again protrudes and forms a low ridge running nearly E. and W. magnetic. It is also seen at intervals further down the steram, but the prevailing country rock is the steel grey nacreous slate, sometimes fibrous, which is largely displayed towards the foot of Kep-N-Keck Lake, and on the river below, between Kep-N-Keck and St. John's Lake. Some of these slates would make good home-stones. The porphyritic syenite is seen at the foot of Lake St. John, and on the river below towards the head of Mollyguajeck. The slates, however, occupy the greater portion of the country, interstratified occasionally with a fine greyish hornblendic gneiss, which latter rock shows itself more frequently on the shores and islands of Mollyguajeck. At the foot of this lake a very schistose micaceous slate crops out in frequent low cliffs, and holds the banks of the river below to the falls, where a considerable outcrop of the gneiss strikes obliquely across the stream in a vertical attitude. Whether these micaceous and horn-blendic schistes are the equivalents of the same formation seen at Kægudeck, or are attributable to another or older period, there is as yet not sufficient data to determine with any degree of certainty, but the inference deducible from what has been ascertained, seems to point to that conclusion. Further explorations in other parts of the same region will, however, be necessary to fully establish their true relationship.

By your request, I provided myself before leaving St. John's with a self-registering thermometer and aneroid Barometer for the purpose of keeping a record of the temperature during the season's explorations.

I append a tabular statement, which will show the result, and I hope help to dispel, in some degree, the erroneous impression with regard to the climate of the interior during summer-time.

TEMPERATURE DURING SEASON.

Date	Thermom. Max.	Thermom. Min.	Barometer.	REMARKS
June 25	68°	52°	....	Dull, close and foggy; rain showers.
26	79	48	Deg.-29.72-Min.	Bright, warm day.
27	74	43	29.70	Dull; wind N.E., but warm.
28	59	34	29.83	Wind N.E.; cool.
29	68	48	29 83	Fine, warm day.
30	76	47	29 83	Very bright, hot day.
July 1	71	50	29.75	Calm, hot day again.
2	69	52	29.56	Dull in morning; cleared up fine.
3	77	52	29.48	Dull in morning; turned out very hot day.
4	78	52	29.77	Very warm day again.
5	56	38	29.57	Rained hard all night and this morning; a single clap of thunder; cleared off.
6	66	52	29.89	Last night cool; day fine.
7	63	53	29.20	Dull, cool day, but fine.
8	75	48	29.16	Very fine and hot day
9	78	40	....	Very fine, hot day again.
10	68	44	29.44	Fine day; not so hot.
11	69	50	29.34	Very fine. hot day.
12	68	46	29.22	Very fine day; not so hot.
13	74	52	29.14	Cool in morning; turned out very hot.
14	69	46	28.71	Dull and raining hard all forenoon; cleared off fine afternoon.
15	60	39	29 77	Fine day; not too warm.
16	54	44	....	Dull; drizzling rain all day.
17	62	48	29.28	Dull, but fine day.
18	64	56	29.26	Dull, misty; turned to rain.
19	68	48	29.27	Fine, but cool; wind northerly.
20	71	42	29.34	Very calm; intensely hot.
21	68	45	29.40	Fine warm day; not so hot.
22	82	52	29.23	Calm and intensely hot all day.
23	72	58	29.26	Very fine and hot.
24	75	56	29.18	Rained during night; dull and very close all day.
25	74	62	29.16	Dull and very sultry all day; rained hard evening; heavy thunder.
26	80	56	29.00	Rained hard all night and morning; very sultry. Excessively hot in evening.
27	61	51	29.07	Dull, cool day.
28	66	55	29.03	Dull and foggy in morning; cleared off a very fine and hot afternoon.
29	62	58	29.08	Dull and foggy nearly all day.
30	70	53	29.02	Fine, warm day; wind N.W.; good breeze.
31	70	60	28.95	Close, warm day; strong S.W. wind.

TEMPERATURE DURING SEASON—Continued.

Date	Thermom.		Barometer	Remarks
	Max.	Min.		
Aug 1	78°	56°	Deg.-28.91-Min.	Very calm, warm day.
2	77	50	29.10	Calm and desperately hot day.
3	62	42	29.25	Strong breeze from N E.; quite cool.
4	70	50	29.35	Very calm, warm day.
5	68	56	29.18	Dull and cool: blowing hard West.
6	69	60	29.14	Fine day; blowing strong from West.
7	69	58	28.96	Dull, close and foggy; rained in evening.
8	63	41	28.75	Dull, cool; rained from N.W.
9	64	51	29.01	Blew very hard; quite cool. Calmed down in morning.
10	86	52	28.92	Calm and broiling hot all day.
11	74	51	29.10	Fine day; calm S E. wind. Not so hot
12	75	54	29.14	Calm, desperately hot day.
13	66	55	28.68	Blowing hard all day from West.
14	65	53	28.52	Still blowing moderate gale.
15	70	50	28.60	Still blowing gale, but much warmer.
16	69	59	28.76	Still blowing hard from W., but not so hard as yesterday.
17	68	48	28.75	Calm day; very fine.
18	69	50	28.93	Fine, calm day
19	70	58	28.74	Dull and blowing; rained a little.
20	70	49	28.74	Fine, warm day; blowing hard from Westward.
21	67	49	28.70	Cool day, but fine.
22	68	53	28.77	Calm and fine all day.
23	72	43	28.70	Rained a little during night; day very fine and calm.
24	67	45	29.59	Fine, cool day; wind N.E.
25	65	49	28.64	Dull, foggy on coast Drizzling all day at Long Harbor
26	62	52	27.90	Still dull, cool and foggy; rained hard all night.
27	66	44	28.40	Blew a gale from S W., with heavy rain all night; clear to day; wind N N W, cold.
28	63	44	28.40	Dull, cold day; blowing fresh from Westward.
29	62	44	29.03	Dull and cold; wind N.E., fresh.
30	54	35	28.97	Dull, raining; blowing a gale; cleared up in evening. Wind N.E., very cold.
31	68	46	29.28	Fine, calm day again.

TEMPERATURE DURING SEASON—Continued).

Date	Thermom-		Barometer	Remarks
	Max.	Min.		
Sept. 1	68°	54°	Deg.-29.24-Min.	Fine warm day.
2	68	50	28.70	Raining and foggy.
3	65	50	28.73	Fine warm day.
4	60	52	28.94	Calm, warm day.
5	60	52	29.06	Fine day, blowing fresh; wind West.
6	65	46	28.87	Very fine; calm and warm.
7	68	56	28.75	Very fine and warm again.
8	68	58	28.80	Foggy in morning; cleared up fine.
9	66	57	28 96	Dull, foggy and sultry; cleared off, but rained and blew hard in evening.
10	68	54	28.97	Dull, foggy, wet morning. Cleared off fine; blew strong in evening.
11	64	40	28.84	Very fine, warm and calm.
12	62	42	29 09	Fine day again; wind N.W., cool.
13	64	44	29.05	Fine day; wind West. Blew hard.
14	63	52	29 06	Fine day; wind West. Blew hard.
15	61	54	28.79	Dull and misty. W.S.W., blowing hard.
16	66	44	28 80	Dull and raining in morning. Light N.E wind; cleared up fine.
17	48	34	28.68	Wet, cold and stormy. Blew a gale from N.E.; very cold last night
18	46	38	28.63	Still blowing a gale from N.E. with cold rain; slight snow in morning.
19	66	52	28.93	Fine day again; gale over.
20	63	39	28.80	Dull and raining.
21	49	34	28 65	Fine, cool day; wind S.W
22	56	50	28.52	Dull and cool; came to blow and rain hard in after oon.
23	59	46	28.41	Dull, foggy, but sultry day.
24	56	46	28 78	Dull, stormy and foggy with rain.
25	66	55	29 08	Densely foggy, wet and stormy; thtckest yet seen.
26	60	52	28 90	Still wet and foggy; stormy.
27	58	34	28.72	Rained hard all night; cleared off, but rained again in torrents; cleared up in afternoon.
28	55	41	28.73	Fine day. Very cold all night; slight frost at side of river.
29	57	37	28.69	Fine day again. Cold last night.
30	43	34	28.75	Fine day; wind N.E.; cool.

TEMPERATURE DURING SEASON—(Continued).

Date.	Thermom. Max.	Thermom. Min.	Barometer	Remarks
Oct. 1	56°	40°	Deg.-28.72-Min	Very cold last night; turned out a beautiful, fine day. Wind W. N.W.
2	63	36	28.82	Fine, bright, warm day again. Wind changed E.N.E.
3	44	32	28.84	Wind E.N.E., very cold and raw; light squalls of snow.
4	44	33	28.76	Very cold; thermometer down to freezing for first time last night; cleared off a fine, bright day.
5	50	43	28.87	Mild day; wind S.E.; a few showers of rain.
6	52	49	28.74	Dull, foggy and wet all day.
7	59	46	28.40	Rained all night and morning; cleared off in afternoon.
8	54	42	28.37	Still dull and showery.
9	54	44	28.57	Dull, cold day. Wind N.E.
10	56	46	28.60	Blowing a gale from N.E., with fog and rain; cold and raw.
11	52	44	28.48	Dull and wet, but calm.
12	56	34	28.48	Dull, foggy and wet all day.
13	50	40	28.68	Fine, cool, bright; fresh breeze from N.W.
14	50	43	29.03	Dull and foggy forenoon; cleared off in evening.
15	52	32	28.55	Still wet, foggy and stormy; rained hard all night.
16	46	36	29.03	Fine, cool day; wind N.W., blowing fresh; cold last night
17	58	35	29.10	Very fine, bright day.
18	52	49	29.17	Fine and warm again to-day
19	54	43	29.03	Dull, wet again to-day; wind S.S.W.
20	42	40	28.96	Very wet and sultry all night; cool, N.E. wind. Foggy and wet all day.
21	51	44	29.07	Dull, foggy and raining; wind N.E.
22	57	38	28.65	Still the same; dull, foggy and misty all day.
23	51	30	28.94	Pretty fine day; occasionally light showers.
24	50	46	29.23	Fine, bright, warm day.
25	45	32	28.78	Fine and bright; blowing a gale all day from Westward.
26	48	28	29.21	Cold last night; calm morn; blew from N.W., and increased to gale in afternoon
27	38	30	29.64	Fine and calm, but very cold; froze hard last night.

TEMPERATURE DURING SEASON—(Continued).

Date	Thermom.		Barometer.	Remarks
	Max.	Min		
28	42°	20°	Deg.-29.74-Min.	Very fine day, but cold.
29	49	40	29.63	Very cold last night; hardest frost yet; 12° frost; fine, bright day.
30		....	29.46	Fine morning, but cold; showers of snow in evening.
31	....	....	....	Winterish-looking; ground covered with snow; very calm all day.

Date	Mean		Highest	Lowest	Mean of both
	Maximum	Minimum			
June	Deg.-70.6-Max	Deg.-45.3-Min.	79°	34°	56°
July	69.0	50.2	82	38	60
Aug.	68.9	50.9	86	35	60
Sept.	60.6	46.5	68	34	51
Oct.	50.8	38.2	63	20	41

REMARKS.

These readings were registered while crossing the interior, during the season, and were all above sea-level, average height about five hundred feet.

I have the honour to be, Sir,

Your obedient servant,

(Signed) JAMES P. HOWLEY, F.G.S.

CHAPTER VIII.

Report for 1888.—Survey across country by way of the Bay D'Est River, Noel Paul's and the Exploits.

Geological Survey Office,
March 15th 1889.

Hon. Surveyor General,—

SIR,—I beg to submit the following report, together with the accompanying map of the past season's field-work, also a report of the Museum, during the same period.

The Survey of 1887, extending across the country from Fortune Bay to Bonavista Bay, was undertaken chiefly to ascertain the probable eastern extension of the Magnesian group of rocks of the Bay East River region, whose existence in the latter locality was determined by my predecessor, Mr. Murray, in 1870.

During the past season a similar survey across the central interior, from Bay D'Espoir to the Exploits River, had, for one of its objects, the defining of the Western Boundary of this same group of rocks. Another object of this latter survey was to ascertain the Southern limits of the forest land of the Exploits valley, and the exploration and topographical survey of a large tract of hitherto unknown interior, lying between the Exploits on the one side, and the waters of Bay East, Little River and White Bear Bay River, on the other.

To effect these various objects in the quickest and readiest manner possible, advantage was taken of the Bay East River, already partly surveyed, as affording the easiest means of access to the centre of the island from the south side. The ascent of the latter river was commenced on July 10th, having previously portaged our canoes, baggage, provisions, etc., over some five miles of country, lying between the head of Bay D'Espoir and Long Pond; the first of the suite of large lakes on the River. This was a work of excessive labor, as the country was steep and rugged, and at the outset we had nearly our entire season's stock of provisions to carry.

The ascent of the river to Pipestone Pond occupied us till the 20th July, owing to the shallowness of the water in many places, the frequent portages and the necessity of making double and treble trips with our canoes. The weather also proved exceedingly rough and stormy for the season and was the means of greatly retarding our progress on the larger lakes.

The survey proper was fairly commenced at Pipestone Pond on the 23rd, and continued upward to Great Burnt Pond, and thence to Crooked Lake, where we arrived on the 1st August. This large lake, which is one of the principal sheets of water on the Bay East River, was, from its central position, selected to form the basis of our season's operations. Here we stored the bulk of our provisions, on an island in the lake; and having partly surveyed it, we proceeded overland, from its western extremity, to a large lake called Meelpaeg* on the head waters of Little River. The portage across was difficult and laborious, but we succeeded in fairly launching our canoes on the latter water on August 7th. The survey of this extraordinary lake occupied us an entire month, and another lake to the eastward, on the same water, was not completed till the 12th of September.

It was now time to commence our long journey to the north. We accordingly returned to Crooked Lake by a different route, taking in Island Pond, the last of the large lakes on the Bay East River. We reached Crooked Lake again on the 15th. While engaged in finishing the survey of the latter lake, we found our stock of provisions running very low, and I concluded to dispatch two of our Indians with the largest canoe to the mouth of the Exploits River for a fresh supply, which I had ordered to be sent on before leaving St. John's. They left us on the 19th September, and we did not again meet them till the 6th October. In the meantime the survey was pushed forward as rapidly as possible with our now diminished crew.

Having finished Crooked Lake, we commenced the ascent of a small and very rugged stream leading directly towards the north. With great labor we gained the height of land on the 24th Septem-

***This is not the lake of the same name mentioned in last year's report as occurring on the Long Harbor River. This is Western Meelpaeg, while the latter is called the Eastern Meelpaeg.**

ber. Here the curious phenomenon described in last year's report was again met with, of a lake so situate directly upon the summit level of the country, that the water flowed over as it were, one branch, that which we ascended, running southward to Crooked Lake, and thence by the Bay East River into Bay D'Espoir. The other flowing in the opposite direction, joins Noel Paul's River, thence flows into the Exploits, and finally into Notre Dame Bay.

The difficulty of canoe navigation, owing to the scarcity of the water, and the extreme roughness of the rivers, caused much delay in carrying out this part of the survey, which was, however, kept up continuously. Every yard of our route was carefully measured, and all the interesting topographical details sketched in as we proceeded.

We had reached within about ten miles of Noel Paul's Steady when our provisions began rapidly to fail us. Our supply of flour only held out, and this, with venison, which fortunately we were enabled to procure, embraced our entire stock.

The weather for the past month had been exceedingly wet and stormy, and did not give much promise of improving. The long absence of our two men, and the low condition of our larder at this stage of our journey, all combined to cause us no little anxiety. I began to fear something had gone wrong with the two men, and finally, when on the 6th of October they still failed to make their appearance, I decided to start with one of the two remaining Indians to look for them, and if not successful in finding some traces of them, to give up the survey and proceed forward as speedily as possible.

Leaving my assistant, Mr. Bayly, to continue the work for another day, we proceeded by canoe and on foot several miles down the river, till we reached what we supposed to be Noel Paul's Steady, still we saw nothing of the absent men. It was late at night when we regained our camp, but we were exceedingly rejoiced to find them there before us. They had returned by another route, arriving at camp shortly after we left in the morning, and bringing with them a small stock of the chief necessaries. They had only arrived the evening before at Noel Paul's Steady, where they had left the canoe and the bulk of the provisions. Their journey down to the salt water and back again had been a very trying one, and they made as little delay as possible on the way.

We were now fairly equipped for the remainder of the season, and pushed forward with renewed vigour. Noel Paul's Steady was reached on the 10th of October.

Having surveyed this beautiful stretch of the river upwards some seven miles to a large fall, we commenced the descent on the 16th and reached the main Exploits River on the 19th.

Here our season's field-work ended, having succeeded in connecting the work on both sides with that of previous years. Our journey down the Exploits River was performed with little delay, except at the portages, and a couple of days spent at Badger Brook to rest and repair canoes. We arrived at the mouth of the Exploits River on the 24th of October, and at Exploits Harbor on the 27th. At the latter place we were delayed several days awaiting a passage home; finally, we got aboard the S. S. Plover, and reached St. John's on November the 4th. Our crew, consisting of four Indians and two white men, behaved throughout the long toilsome and unusually backward season with praiseworthy energy and perseverance; and to Mr. Bayly I am indebted for the most valuable asistance in carrying out the topographical work, as well as in entering heartily into all the labor attendant on so arduous a trip across the interior wilds of this Island. He has now become quite expert in the use of the Transit and Michrometer Telescope, and performed all the river work of the season, which when plotted to scale, has proved the care and acuracy with which his bearings and measurements were taken.

Physical Features.

In his report for 1870, the late Alexander Murray, C.M.G., F.G.S., so fully described the physical, topographical, and geological features of the Bay East River Valley, that there is little to add in reference to this section of the country. It is one of the few well wooded valleys on the southern slope of the island, and though the timber is not of such large dimensions as on the Northern Slope, and is comparatively limited in extent, yet it is of the utmost importance to the inhabitants of Fortune, Connaigre, Hermitage and Bay D'Espoir. It is in fact the chief source from whence they obtain their supply of timber, for the ordinary purposes of the fisheries, and for fuel. The prevailing varieties of timber are spruce, fir, tamarack, white and yellow birch, and a fair sprinkling of pine. Material suitable for boat and schooner building, is obtained here, and small spars, booms, &c., are cut and floated down the river, while a large industry in herring barrels, and oil casks is carried on around the heads of the Bays. Unfortunately, during a comparatively recent period, a great portion of the timber has been denuded by forest fires. In one instance, an extent of over thirty miles of country has been completely devastated, and sooner or later, this would seem to be the fate to which the bulk of the timber of the Island is destined. In most cases, the origin of these fires may be attributed to sheer carelessness, and not unfrequently to wilful criminality on the part of the trappers, rinders, &c. If we wish to preserve what is still left of our valuable forests, some very stringent measures will have to be enforced ere it is too late.

The soil in many parts of the River Valley and around the shores of the Bay D'Espoir, is of fair quality, and many small patches were met with, of good interval land, along the sides of the river and shores of some of the lakes. But there are no extensive tracts of good land, nor does it offer either in an agricultural or lumbering point of view, many attractions to settlers; even were the country more accessible.

In the neighborhood of Pipestone Pond, the Magnesian dolomites peridotites and serpentines of the Quebec Group come to the surface, and give a distinctive character to the surrounding country. The debris of the rocks, containing as they generally do, an excess of Magnesian Salts is not usually productive of good soil nor one conducive to the growth of the best quality of indigenous forest trees; hence the country on the south side of Pipestone Pond is frequently quite bare, or covered only with very inferior timber.

The river from Pipestone Pond to Burnt Pond, trends more westerly, and is very tortuous in its course. It expands at intervals into small steadies with rapid broken water between. Burnt Pond is a lake three miles in its greatest width, by five in length, lying nearly at right angles to the course of the river, and has a surface area of eleven and a quarter square miles. The shores of this lake are of an exceedingly rugged character. Huge angular fragments of granite are strewn in every direction, and the country hereabout presents the appearance of a vast ruin, which is really its true character. The boulders are simply the dislodged and up-lifted fragments of the parent granitic belt, which striking east and west, forms the central ridge of country, lying between Pipestone and Crooked Ponds. Intense and prolonged glacial action, which is apparent on all sides, has been the chief cause of the destruction.

Two remarkable isolated peaks, or tolts, rise abruptly from the general level, at about three miles distant from the western end of the lake; standing monuments of the source from whence the boulders were derived. As may be judged from the foregoing description, the country around Burnt Pond, presents anything but an inviting prospect; nevertheless, there is a good deal of very fair timber, especially on the western and northern sides, and on several of the islands in the lake.

Not quite a mile of actual running water separates Burnt from Crooked Lakė. This beautiful sheet of water is nine miles and a half in length, but being very narrow, for more than half that distance is somewhat less in area than Burnt Pond, being but ten and three quarter square miles. It lies almost eactly east and west Magnetic. The ėastern end is wide and studded with numerous islands. The country around it is for the most part well wooded, but the soil is generally thin and rocky. Two rivers of considerable size flow into this lake from the north and north-east. The former, which is considered the main stream, leads upward through a ridge of wooded hills to Island Pond; the last of the larger lakes on the Bay East River proper. It is a turbulent rocky stream of about two miles in extent. Island Pond is about four miles long by one and a half wide, and has a surface area of over six square miles. As its name implies, it is studded with numerous islands. The country is again of a very rugged character, and the timber of inferior quality. The further course of the River for some five or six miles to its head waters, is characterised by a succession of small ponds, connected by short intervals of running water. The north-eastern branch, that which we ascended in our journey across the country, leads upward by a very broken and rapid stream, through several small ponds to the height of land, about ten miles by the course of the river It passes through a tract of country occupied by bare or sparsely wooded ridges, extensive barrens and marshes, studded with innumerable ponds, and tarns, strewn over the surface with granite and trapean boulders. It is the home of large numbers of caribou and offers great attractions to the sportsman.

Meelpaeg Lake on the Little River Water lies about three miles west from the extreme western end of Crooked Lake. It is an extraordinary sheet of water, spread out in a series of intricate arms, bays, nooks, &c., over a large surface of country, and broken by a perfectly labyrinthine archipelago of islands, large and small, numbering fully one thousand in all. Its greatest length is twelve miles, by an average breadth of three, and its entire surface area covers thirty-five and one-fifth square miles. The actual water surface, however, is probably not more than one half, the remainder being occupied by the islands. Several of these islands average nearly a square mile each. The picturesque beauty of this lake, together with its importance as a prominent geographical feature of the country, rather than any economic value presented by its surroundings, induced me to spend a considerable time in obtaining a correct delineation of its remarkable topography. The survey also included a suite of lakes to the west, which might almost be said to form part of Meelpaeg, as they are only separated by a few yards of running water. The last of these, called Pudops Gospen, by the Indians, is about six miles long, by an average breadth of one mile, and has a surface area of six square miles. This lake is also picturesquely dotted with islands, and has many intricate channels and deep arms extending from either side.

Time did not permit of following the course of Little River to its outlet, a distance, in a straight line, of about thirty-five miles. A splendid view of the country in that and other directions, was, however, obtained from the summit of Poctæsinny or Wolf Mountain, a high bare ridge lying to the south of Pudops Gospen. The country towards the southern sea-board, and for a long distance westward, is bare and uninviting, covered only with sparce vegetation, and occupied by extensive marshes and barrens. Several conspicuous tolts rise high above the general level toward the sea coast, especially near the head of Bay de Lievre.

The Valley of Little River downward is narrow and only fringed with a small margin of stunted timber. There are four or five considerable lakes on the river below where we turned back, closely connected with each other, and the river itself is probably one of the largest, if not the very largest, south-flowing stream of the island.

A large lake known as Poctæsinny Gospen—Wolf Pond—on the Bay de Lievre River, lies about two miles south of the mountain, and eastward, at some twelve or fourteen miles distant, another long lake, with a conspicuous mountain south of it, is known as Ebbegunbaeg. This latter belongs to the same water system, and flows into Meelpaeg on the south side.

In the immediate vicinity of Meelpaeg and Pudops Gospen, the land is low, bounded by low ridges of no great elevation, but in the distance, on either side, several elevated ridges are seen. There is a good deal of fair-sized timber around the shores of these lakes, and on many of the islands, principally spruce, fir and birch. Tamarack, of fair size, is tolerably abundant, but the soil, for the most part, is thin and much encumbered with boulders.

From this, and the surveys of former years, I am now in a position to definitely state that the entire southern watershed of the Island from Fortune Bay westward to Cape Ray, presents an almost uniform character of bare rugged granite ridges, extensive marshes, and innumerable lakes and ponds. In a lumbering or agricultural point of view, its prospects may be said to be *nil*. Yet, in a few of the river valleys, such as the Bay East River, and on the shores of some of the deeper indentations of the coast line, small patches of land capable of raising all ordinary vegetables, might be availed of in conjunction with the fisheries. This is done to a considerable extent in Bay D'Espoir, where several nice clearings were seen, and where good crops of potatoes and hay are raised annually by the settlers.

Crossing over the height of land between Crooked Lake and Noel Paul's Steady, no appreciable difference in the character of the country is met with till reaching within a few miles of the latter river. Here an entire change takes place. The timber assumes a more decided forest aspect, the trees become tall and straight. Birch and Pine begin to assert themselves more decidedly, the barrens and marshes dwindle down to small isolated patches here and there, and ponds are not nearly of so frequent occurrence, or of such large dimensions. Up and down the shores of Noel Paul's Steady there is quite a wide strip of flat or gently sloping land, covered with dense forest. Spruce and fir still predominate, but many extensive patches of white pine are met with on either side. The pine is not of large size, but quite large enough for handling with facility. Measurements were made of several sticks, which ranged from 6½ to 9½ feet in circumference at the butt. From a height on the western side of the Steady an unbroken vista of dense heavy frost extends eastward and westward, up and down the river valley, and away north toward the main Exploits River, as far as the country is visible. Frequent patches of interval land of superior quality fringe the shores of the Steady, and considerable areas of similar land, admirably adapted for hay growing, were found along the courses of the smaller tributaries, flowing into the steady, or river, below.

In descending Noel Paul's River to the Exploits proper, the country improves at every turn, and much fine land and timber were observed on both sides of the stream. The spruce and fir were particularly fine, many of the former sticks suitable for schooners' spars, were seen close to the bank. White birch is quite abundant, tamarack of good size is scattered throughout the forest, and aspen becomes tolerably plentiful on the lower reaches of the river. The stream is a fine one for driving logs, when sufficiently supplied with water in spring and autumn. The land over the greater part of the valley of Noel Paul's River partakes of the same character as that of the main Exploits valley, frequently described in former reports, especially those of 1871, 1875 and 1882. It consists of a sandy loam, underlaid generally by a gravelly subsoil. The decomposed vegetable matter derived from the dense forest, the decay of ages, intermixed with this loam, gives it a very fertile character, which is amply attested by the indigenous forest growth everywhere The interval lands, in particular, which are often of considerable extent, are composed of very superior soils, containing less sand and much more vegetable matter. They are, in fact, a dark rich mud, (not peat), only requiring a judicious system of drainage to render them some of the best hay-growing lands in the Island. Hundreds of acres of such land were met with during the progress of the survey last fall. Of course until such time as access is afforded to this remote region by means of roads or a railway, these must remain in abeyance. It is useless to talk of utilizing lands situated 100 miles from the sea coast, without such means of access, even were they composed of the richest soil on the globe.

In descending the noble Exploits River from the junction of Noel Paul's, I was more impressed than ever with the wealth of forest and land fit for settlements along this beautiful valley. In this connection I cannot do better than quote the words of my predecessor, Mr. Murray, from his report of 1871:

"No observant person, visiting the valley of the Exploits, could fail to be impressed with the manifold advantages it presents for the prosecution of industrial pursuits, such as lumbering and agriculture. With a splendid river, abundant timber, and a fertile soil, the region that is now a wilderness, might, by energy and enterprise, be soon converted into a thriving settlement, maintaining a large population."

Should the railway system now talked of, ever become a *fait accompli*, and the western extension thereof, traverse this magnificent valley on its course to St. George's Bay, then we may look forward to the fulfilment of Mr. Murray's prognostication, but not till then. It will be fortunate, in the meantime, if the wealth of timber be not destroyed by fire. It has had many narrow escapes from such a calamity in recent times, and indeed a partial fire last June, which swept several square miles near the Badger River, came very near accomplishing the total destruction of the entire forest. I have shown in a previous report for 1882, that such a calamity did, at one time, overtake the forest of this valley, nearly two hundred years ago; and that the present growth only replaces a much larger one, originally occupying this fine region.

Descriptive Geology.

Under this head I propose to give in a general way the purely geological features of the rock formations met with in journeying across the country. The plumbaginous slates steel grey finely Micaceous sand-stones, quartzites, conglomerates, serpentines, dolomites, &c., described by Mr. Murray, in his report for 1870, as occupying the Bay East River Valley, and on the shores around Bay D'Espoir, were attributed by him to the Quebec division of the Lower Silurian, now more generally included in the Cambrian formation. In their eastern extension, these rocks were met with last season, on the head waters of the Bay-de-Nord River of Fortune Bay, and were found to butt up against the coarse granitic ridge which forms the chain of hills, of which Mount Sylvester is the most conspicuous feature. In this portion of their distribution, similar fine silky bluish grey, frequently plumbaginous slates, fine grained micaceous sand-stones, quartzites, and dolomitic bands, interstratified with dark grey hornblendic diorites, were the prevailing characteristics.

Further east on the head-waters of the Terra Nova River, these again were underlaid apparently, by a light steel grey, finely laminated micaceous schist. Several great belts of granitic or gneissoid rock, apparently intrusive; though probably in some cases highly metamorphosed sedimentary deposits, strike obliquely across the general trend of the slaty formation, in a course about N. E. and S. W. true. These latter are usually coarse grained greyish hornblendic granite or gneiss. One of these great belts crosses the Bay East River at Soulis Pond, and another at Round Pond. After leaving Pipestone Pond, the course of the river towards Great Burnt Pond is frequently crossed by exposures of the more slaty portions of the formation, partaking of the same general character of those described, as occurring on the river below. At the outlet from Burnt Pond, they are interstratified with beds of fine and coarse grained bluish grey gneiss, with thin slaty divisions. This gneiss is chiefly composed of opaque white quartz and feldspar, with black mica disseminated in scales through the mass The slaty divisions consist of the fine pearly or silky bluish green variety, described before. Here the rocks are in a vertical attitude, and strike N. 40° E. magnetic, or about N. 12° E. true. This would appear to be the extreme western, or rather north-western limit of the so-called Quebec group, in this section of country. No rocks of a similar character were observed further to the westward. In their eastern extension, they strike towards the Gander River, where they were recognized in 1876, extending along the latter from Miguell's Brook, to the Burnt Hill, near the headwaters. It would be important to trace this interesting group of rocks, and have it definitely mapped out between these two points. The mineralogical character, especially of the more highly magnesian portion of the group, favors the supposition that productive deposits of valuable mineral substances may be looked for in some parts of its distribution.

A great belt of coarse grey granitoid rock, which may be a highly metamorphosed portion of the stratified deposits, extends from Great Burnt Pond to the north side of Crooked Pond, giving rise to that extremely rugged and boulder bestrewn tract of country, mentioned in the first of this report. This same granitoid ridge strikes westward from Crooked Pond, and occupies the country around Meelpaeg, including most of the islands in the lake. It is of a pale grey color, and is composed for the most part of coarse dull white feldspar, opaque white quartz and a little black mica and hornblende. It varies little in composition or color throughout its strike. On the hill-tops immediately over the eastern shores of Meelpaeg, it is flanked by a very micaceous gneiss, dipping S. 80° E., magnetic angle 62°. Poctæsinny or Wolf Mountain, situate some three miles southward from the extreme western end of Pudops Gospen, is composed of fine grained flaggy micaceous grey gneiss, in a vertical position, striking N. 70° E. magnetic. All the country, south and west from here, has the general surface aspect of a granitic or Laurentian region. On the north-side of Crooked Pond, outcrops of a fine steel grey micaceous schist are met with, very similar in appearance to that described in last year's report as occurring on the upper part of the Terra Nova River. These schists form all the hill-ranges on this side, between Crooked and Island Ponds, and striking north-easterly, extend up the country to the watershed, usually in a vertical attitude, or so much contorted and disturbed as to render it impossible to determine their true inclination with certainty. A wide belt of grey granite or gneiss again succeeds the mica schist to the north of the watershed, and extends across to within a short distance of Noel Paul's Steady. Over this tract the surface is very barren, and a vast accumulation of boulders, frequently of immense size, are strewn everywhere; while the bed of the stream we followed was choked with the same material.

On approaching Noel Paul's Steady, no exposures of rock are met with till within about a mile of the river, when some finely laminated bluish grey silky slates are seen in a vertical attitude, striking up the valley. Similar slates, with frequent intrusions of trap rock, crop out along the shores of the steady, and form a series of high ledges at the falls, where they cross the stream obliquely.

On the west side of the steady a peculiar pearly slate, passing into an impure slaty limestone, dipping south angle 47°, crops out; and on the course of the river downwards at about a mile and a half below the steady, strong bands of bluish grey limestone strike across the river. This is succeeded at intervals by bluish grey slate, but at the lower falls, about two miles from the junction with the main Exploits River, the slates are interstratified with beds of diorite and here assume a hard flint nature approaching feldsites. These again are underlaid by fine conglomerates and sandstones in massive beds. Several large boulders of a very coarse conglomerate, not seen in place, are strewn along the bed of the river. They appeared to be very similar to a coarse conglomerate seen on the shores of the Bay of Exploits. These slates and associated limestones, sandstones, etc., are clearly of one geological horizon, and correspond so closely in lithological character with those of the Exploits valley proper, that there is little doubt of their being identical. The absence of organic remains anywhere amongst the rocks seen this season renders it difficult to establish their exact age, but there are good grounds for assuming the above supposition to be correct.

The few fossils found at the mouth of the Exploits on a former occasion, and the graptolites discovered in the black shales of Little Red Indian Fall on the Main River, (Graptolithus Namosus), were referred by Mr. Billings, late Palæontologist of the Canadian Geological Survey, to indicate an horizon equivalent to the Utica Slate and Hudson River divisions of the Trenton series, at the top of the Lower Silurian formation, now known as the Cambro-Silurian. Further investigation of this region is likely to result in the discovery of other and better defined fossils, which will place the horizon beyond doubt, and probably, also lead to the discovery of other and higher measures, corresponding to the middle Silurian rocks of New World Island, and other parts of the great Bay of Notre Dame. The important bearing which the defining of these geological problems has upon the subject of the soils alone, may be gathered from the fact, that, nearly all the best agricultural tracts of the Upper St. Lawrence, and Lower Canadian provinces, are underlaid by the selfsame series of formations, the disintegration of which, has yielded the rich soils for which they are proverbial.

ECONOMIC SUBSTANCES.

In a long and extensive survey such as that of last season's, little time could be devoted to searching for minerals, which is more properly the work of the prospector, that of the geologist being to point out where the most favorable conditions prevailed, so as to be able to direct the operations of the former into the right channels.

Around the shores of Bay D'Espoir, and on the valley of the Bay East River, frequent indications of the ores of iron, galena, copper and chromite present themselves. But as these have been all treated of by Mr. Murray in his report for 1870, it is unnecessary to repeat his remarks here.

In the vicinity of Pipestone Pond, chromic and magnetic iron ores were met with, especially the latter, in such quantities, scattered about the surface, in the shape of angular lumps and fragments, as to lead to the supposition that a large deposit of this ore must exist somewhere in that neighborhood. Arsenical pyrites and pyrrhotite, or magnetic pyrites, are frequently met with sparsely disseminated, chiefly in quartz veins. Serpentines of great variety, some of which would make pretty ornamental marbles when cut and polished, are abundant; and immense deposits of white chrystalline, granular, brown weathering dolomite, are in association with the serpentines. Some of these latter might yield fairly good marbles, if worked so as to get beyond the surface weathering. Dolomite burns into a good quick lime, yielding a strong cement. It is also employed in the manufacture of Epsom Salts, or Sulphate of Magnesia. Mr. Murray mentions the presence, amongst the serpentines here, of a great amount of picrolite, and frequent fine thin seams of asbestos. The latter form of this mineral is now becoming of more general use in the manufacture of incombustible materials for roofing purposes, and also largely used for steam-boiler packing, and lining of iron safes, being suitable thereto from its slow conduction of heat.

Many of the granites distributed over this region are admirably adapted for building-stones of superior quality, and amongst the mica schists on Crooked Lake, there is much material suitable for whetstones. The sandstones and conglomerates of the Noel Paul's and Exploits River are also well adapted for building purposes, and the value of the limestone deposits on Noel Paul's and the Exploits River should the country ever become a settled agricultural region, must be clearly apparent.

THE MUSEUM.

During the past year many valuable and highly interesting specimens have been added to the collection in the Museum, and it is consequently assuming, more and more, the character of a truly representative exhibition of the natural products of the country. A great number of foreign specimens, also of more or less interest have been acquired. Chiefly the gratuitous contributions of such of our citizens as evince an interest in the institution. I am happy to state that this interest is growing with the growth of the Museum itself.

All classes of our people now visit it on every open day; but, as we have not yet arrived at keeping a visitors' book, I can only give a rough approximate of the actual numbers, I feel certain I am well within the mark when I put down the probable figures as averaging 100 persons per diem, or 1,200 per month, or say 15,000 for the past twelve months. That it is taking hold of the minds of the people generally, who highly appreciate it, the above figures necessarily imply.

There can be no question but that as an educational institution especially for the masses, a well stocked and well arranged Museum has no equal.

It contains that species of object lessons which appeal directly to the senses of even the most illiterate persons. But its value to the country is of still greater importance, as representing in a concise form its history, productions and industries, in such a manner as cannot be accomplished otherwise. The Museum is, as yet, however, very incomplete, especially in the natural history sections, and I regret to say I have been unable, owing to the insufficiency of means at my disposal, to render these latter, especially the ichthyological section, all that could be desired. Nevertheless, almost every day something new is added to the collection, and in course of time, I have no doubt of succeeding in rendering it thoroughly complete. Our late Governor Sir Henry Blake and his accomplished lady took the most lively interest in the Museum while here, nor did it cease upon their removing from our shores, for Her Ladyship arranged with Dr. Gunthur of the Natural History Department of the British Museum, to effect exchanges of specimens as soon as we were in a position here to do so. This would be a great means of enhancing our collection, and I have had several similar offers from other persons, especially in the United States and Canada, but as yet I have but few duplicates to spare, and the expenses attending such exchanges would, for our limited means, be rather heavy.

Amongst the many contributors to the Museum during the past year, besides their Excellencies Sir Henry and Lady Blake, to whom we are indebted for several beautiful choncological, entomological, and other specimens; I may mention the following: Mr. T. R. Smith, a preserved caplin, also an Eskimo stone lamp; Rev. Mr. Johnson, a miniature bone Eskimo kayak and hunting gear; Mr. Wm. Slater, several Eskimo carved ornaments; Rev. W. Pilot, some Bœthuck stone implements; Mr. Walter Clouston, a handsome collection of polished woods, and some curious Chinese nicknacks; Hon. P. Cleary, a section of floor-timber (oak), from the remains of the American privateer George, dredged up while excavating for the graving dock Riverhead; Capt. Laurie, several beautiful West India birds and snakes; the Municipal Council, the plate and coins from the foundation-stone of the old Riverhead Hospital; Mr. A. Bradshaw, mud from the Grand Bank; Mr. S. H. Parsons, one Bay Lynx (Lynx rufus); Mr. Earle of Fogo, an angler or fishing-frog (lophius piscatorius). Many smaller donations, especially of coins, were also received from various sources too numerous to specify.

There have been acquired by purchase, two cases of foreign birds, two most interesting skeletons with ornaments, of the aboriginal Bœothucks, exhibiting the mortuary customs of the tribe in a very complete manner, and the following natural history specimens pertaining to the Island only:

Zoological.

Three woodland caribou deer, stag, doe and fawn, (Rangifer Terræ Novæ); three beaver, (castor fiber); one otter, (lutra canadensis); two black bear cubs, (urus americana); one brown weasel, (putorious—?); one marmot or whistler, (arctomys pruinosus), from Labrador; two hooded seals, female and young, (stemmatopus cristatus); two bay seals, (phoca vitulina); one gray or horse-head seal, young, (halichœrus grypus).

ORNITHOLOGICAL.

One wild dove, (Zanaidura Carolinensis?). One red-headed linnet, (ægiothus linaria). One pine gross beak, (pinicola enucleator). Two cross beaks, (loxia curvirostra americana). Several snow buntings; (plectrophanes nivalis). Two shore larks, (eremophila alpestris). One clapper rail, (rallus longirostris crepitans). One American coot, (fulica americana). Bittern, (botaurus mugitans). Mud hen, (gallenula galeata). Chicken hawk, (accipeter cooperi). Great horned owl, (bubo virginianus). Snowy owl, (nyctea scandiaca). Hawk owl, (surnia funerea). Canada jay, (perisoreus canadensis).

Two pair deers' antlers locked together, were brought home last season, and a deer skin canoe, such as is generally used by the Micmacs of the Island.

I hope to obtain those specimens of our prinnipedæ, or seals, required to complete that portion of the collection, during the present season.

A little assistance from those interested in the fisheries would enable me, in a short time also, to complete the ichthyological section, which is still very much behind hand. It is to be regretted that these, our great staple industries, should not, up to the present, be represented in the Museum in such a manner as their importance demands.

Were the Museum fully equipped and arranged in all its sections, I have reason to believe the Government and country at large might well feel proud of it; while to strangers visiting our shores it would afford a most interesting and attractive spectacle.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER IX.

Report for 1889.—Carboniferous Area of Bay St. George.

Geological Survey Office,
March 6th, 1890.

Hon. Surveyor General:

SIR,—I beg to present herewith my Report upon the operations of the Geological Survey of Newfoundland during the season of 1889.

The importance of a more minute and extended exploration of the Carboniferous region surrounding the Bay of St. George than had hitherto been attempted, appeared to me to call for immediate attention, owing to the conflicting and unsatisfactory reports relative to our coal deposits in that locality. The late Surveyor General, Mr. Penney, having laid the matter before the Government, they were pleased to approve of my suggestion to devote the time of the survey to that end last season. Our party left St. John's in June last, and arrived at the scene of operations the latter end of that month. At Bay of St. George the remainder of our crew, consisting of ten men all told, were engaged, and all arrangements for carrying out the work completed. Being now provided with pickaxes and shovels for costeaning purposes, as well as all other necessary outfit, we proceeded without delay into the interior. Reaching a point on the coast, by boat, near Robinson's Head, where one of our Township lines of 1884 touched the shore near this place, we availed of it for portaging our stores inland. This line crosses Robinson's River at a distance of about four miles from its mouth. From thence we proceeded along the course of the river to a point some ten miles up stream, where our operations were to commence. All this portaging had to be accomplished on foot, and owing to the exceedingly rugged boulder-bestrewn character of the river's bed, and the extreme heat of the weather, proved most laborious work; for besides the usual paraphernalia of tent-baggage and cooking gear, our whole season's stock of provisions had also to be taken along, with the addition of a lot of heavy tools.

Considerable time was expended in exploring Robinson's River, both above and below the coal outcrop discovered here in 1873. A survey of the river, also, was carried upward from the point where it then terminated, for a distance of nearly fifteen miles, ten of which was through a gorge in the Long Range Mountains. A large tributary brook, known as the Northern Feeder, was also surveyed for ten miles along its course, and a portage road of two miles cut through the woods across to the latter from the main river. Having next moved camp to the Northern Feeder, ten days were spent in exploring and costeaning up and down this stream, where we again returned to our former camp on Robinson's River. A few days more were given to further exploration here, and in cutting a path across to the Middle Barachois River, about two miles. On the 14th of August we arrived at the latter river, where we spent over a month in close investigation. The frequent exposures of the rock formation here met with, affording the best and most accessible sections for examination anywhere in the region, and rendering this the most favorable locality visited, it was deemed advisable to make a careful re-survey of the greater portion of the river. This was accomplished in the usual manner by measuring the distances with Rochon's michrometer telescope; but instead of the prismatic compass, a small transit was used in taking the bearings. All this work has, since my arrival home, been plotted to a scale of four inches to one mile, in the office, and every particular of the observed dips and strikes, &c., of the various members of the formation, carefully laid down and studied out, so as to arrive at some definite idea of the probable extent of the productive coal measures. Our knowledge of the structure has been so far advanced thereby, and the result of the work is of so promising a character, as to leave little doubt of the existence of available quantities of coal in this region. The arrangement of the various strata, their innumerable bends, twists, folds and repetitions, presents, however, such an exceedingly complicated problem to unravel; that at least another season will be required to complete the exploration, and enable me to give a full and reliable section of the entire series. The difficulty and delay of reaching the locality, and the necessity of my almost constant presence to direct the costeaning operations, prevented my devoting as much time to exploration as I would wish; furthermore, it is only after all the results of the survey have been mapped out and studied in the office that a correct conclusion can be arrived at as to the principal points where that exploration would be best directed with the greatest prospects of good results. I think then, if I am allowed to devote the time of the survey to this end next summer, I shall have learnt nearly all that it is possible to acquire by merely surface exploration. So far as the work has proceeded, the outcome is quite satisfactory, and it can now be determined, with a great degree of certainty, what are the principal areas where the prevailing conditions present the most favorable outlook for the occurrence of workable seams of coal. On the other hand, the great extent of country spread over by the lower and unproductive members of the series, is now so clearly understood, that it would be but a waste of time to devote any further attention to the search for coal-beds of economic importance in these latter areas.

During the latter part of the season the north side of the Bay was visited and the Riviere Blanche, upon which some small outcrops of coal were observed in 1873, carefully explored. A branch of this river was surveyed upward several miles, including a considerable sized lake. The lagoon at Indian Head was also carefully surveyed, and sounded, with a view to its future utility as a boat harbor; a desideratum much felt on this side of the Bay, where a large and thrifty agricultural population is settled.

The season throughout proved an exceedingly fine one. Owing to the extreme heat, especially during the months of August and September, the country was very dry, and the rivers at their lowest summer levels. Such conditions of weather greatly facilitated our operations, but possessed the drawback of being oppressively hot, and favorable to the myriads of black and sandflies, which were a constant source of annoyance. Our crew worked well doing an immense amount of heavy costeaning, at times through from twelve to eighteen feet of tough clay, sand and gravel. My Bayly, who again acted as my assistant, performed most of the topographical work, and directed the costeaning operations during my temporary absence, while exploring, with much care and credit; and I am happy to be again able to bear testimony to his readiness and ability to help along the work on all occasions.

Previous Work Performed.

In 1873, I accompanied my predecessor, the late director of the Geological Survey, Mr. Murray, in making a preliminary exploration and survey of this region. The time then occupied in effecting the first and most necessary operations of a complete topographical survey, whereon to construct a reliable and accurate map of this hitherto little known district, precluded the possibility of closely studying out the purely structural details of the Geology. Only a few coast and river sections could be examined and measured that season. Mr. Murray, however, visited the only coal outcrops then known to exist, on the Middle Barachois and Riviere Blanche. The former were the two seams close together, the one called the Jukes Seam, after Mr. J. B. Jukes, F.G.S., who examined it so far back as 1840; the other since named the Cleary Seam, after the Hon. P. Cleary in whose lease it occurs. Both seams at their outcrops are described in the report for 1873. Later on the same season, another promising coal seam was discovered on the Robinson's River, which Mr. Murray then named the Howley Seam. The following year 1874, I was engaged in surveying Port-a-Port Bay, but on finishing the latter work, I returned to St. George's Bay, continued the measurement of the coast line to the base of the Anguille Range, and also ascended and surveyed the Crabb's River, or First Barachois.

Nothing further was accomplished towards exploring this region till 1884, when in carrying out the township survey, and fixing the boundaries of the coast settlers; the opportunity was availed of to pay a hasty visit to the three coal seams already mentioned, and procure some good specimens of the mineral.

The Carboniferous Trough of Bay St. George.

It has been commonly held that the Carboniferous area in Western Newfoundland is an extension of that of Eastern Cape Breton Island, which to a certain extent is probably true, though not exactly in the sense generally understood. There can be little doubt, that at one period a vast coal field, occupying the lower Gulf of St. Lawrence, extended in an unbroken sheet from the shores of New Brunswick, Nova Scotia, and Cape Breton to Newfoundland. Mr. Murray in his report for 1873, compares it to a great elliptical-shaped trough, the centre of which is now concealed beneath the waters of the Gulf. This is attested by the presence of the lower members of the formation coming to the surface in mid-channel, and forming the present Magdalen Islands. This immense area, at one time occupied by the great Carboniferous series, was to all intents a separate trough from that of Eastern Cape Breton; so well known for its valuable coal deposits. It is true they are both connected still on the south, by the extension of the lower measures across the Gut of Canso into Nova Scotia; and may even have been similarly connected to the north of Cape Breton Island, by measures filling up the Strait of Cabot, between Cape North and Cape Ray. It is probable, however, that the older crystalline belt forming the Cape Ray or Long Range in Newfoundland, and St. Ann's Mountains in Cape Breton, were in pre-Carboniferous times a continuous chain, separating the two great troughs. Be this as it may, they were virtually distinct, and I have little hesitation in pronouncing the Carboniferous area in our St. George's Bay District, as rather the prolongation of the Western or greater trough, than of the lesser or Eastern. The latter, pointing as it does towards our Southern seaboard, might more reasonably be looked for in that direction, if it reached our shores at all, and it is not improbable that some small outliers of a very coarse conglomerate found near the head of Fortune Bay in 1870, resting unconformably upon Laurentian and Cambro-Silurian rocks, may represent the basal conglomerate of the Cape Breton series. In this view of the structure Sir William Dawson of McGill College, Montreal, the eminent Acadian Geologist, coincides, in a letter received from him last May.

The true significance of this theory will be better understood, when it is explained, that in Western Nova Scotia and New Brunswick, the lower and unproductive measures of the Carboniferous series, do not attain to anything like the enormous thickness they are shown to possess in Cape Breton. It would be but reasonable then to expect that here in Newfoundland, the conditions of deposition would assimulate more to those of other parts of the greater trough to which they belong, than to a different and almost distinct area, though ever so closely related.

According to the reports of the Dominion Geological Survey, and the admirable work on the "Cape Breton Coal Fields" by Mr. Richard Brown, F.G.S., the lower measures in that island reach the immense development of between 10,000 and 11,000 feet in thickness. This includes the so called "millstone grit," lying immediately below the middle division, or true coal bearing zone. Though the "mill-stone grit," which of itself is represented in Cape Breton by 5,706 feet of strata, is not considered the horizon of available coal seams; it, nevertheless, contains several small irregular beds, and at least one, (the Tracy Seam) of workable dimensions. In Great Britain, more especially in Scotland, much coal is extracted from this member of the series. Sir William Dawson has, moreover, pointed out in the supplement to the second edition of his Aadican Geology, page 50, that, "in Eastern America as in Great Britain, the conditions of coal accumulation would seem to have set in earlier to the Northward," and again, "It would seem that in Newfoundland as in Scotland, the workable coals extend farther down in the series than is the case to the Southward." I must confess that the dividing line between the two great coal producing members of the formation, appears to me a very arbitrary one, and while it may hold good as regards the distribution in certain localities, is not at all applicable to the system as a whole. I think the points of demarcation ought more properly be made to coincide with the lowest and highest known coal beds of workable dimensions in the series. Here in Newfoundland as elsewhere in America, there appear strong grounds for believing that in some cases the middle coal measures rest unconformably upon the Carboniferous limestone series, without the intervention of the mill-stone grit at all; but this is a point not definitely determined as yet. All of these suppositions once fairly established, have an important bearing on the question of the extent and productiveness of our coal deposits, and when sufficient data is collected, upon which to construct a complete section of the entire formation as here displayed, this will be made quite apparent.

Mr. Murray, in his Report for 1873, gave an approximate section from such data as was then in his possession, wherein he represented the probable thickness of the formation as 6,450 feet. I find this to be considerably below the reality; in all likelihood, little more than one-half.

Result of Costeaning Operations, Character of Coal Deposits, &c.

On arriving at the outcrop of the Howley Seam, on Robinson's River, we immediately commenced uncovering it. Having cut away the timber from the steep, sloping bank on the left side of the river, we then removed the sand, gravel, clay and boulders concealing the surface of the rocks, from the base to the summit of the bank, which here rises about sixty or seventy feet in vertical height. Towards the top the surface accumulation of drift material was so great, and contained such a number of huge boulders embedded in its lower portion, it was found useless to attempt following the outcrop further in that direction. About one hundred and thirty feet of the coal seam was thoroughly uncovered and exposed along the slope of the hill, with the following result: In the bed of the river, where first seen, the dip is N. 40°, W. magnetic angle of 57°; the thickness here could not well be ascertained, but it appeared to be about four feet and a half. Ten yards on the strike, where it enters the base of the sloping bank, it had thinned to one foot eight inches; but this was subsequently found to be the effect of a very sharp bend in the strata, which had here compressed the seam into these narrow limits. Beyond the turn in the strata, the seam assumes a nearly horizontal attitude for about twenty yards, when it again begins to curve upward till hidden beneath the great deposit of drift on the top of the bank. It increases rapidly in size beyond the bend, at first to two feet and a half, then three feet, three and a half feet, and at its thickest part shows the following section:—

	Ft.	In.
Underclay	0	1
Solid, good coal	3	0
Good coal in thin layers	1	0
Coal and shale, mixed	0	4
Shale and Clay	0	1
	4	6
Coal	4	2

The coal appears to be of an excellent quality throughout. It is of a close texture, dull black color, breaking into square or oblong blocks, and comparatively free from pyrites* The surfaces are much stained with per-oxide of iron, but this is, I believe, derived

*In structure it resembles the English so-called "Splint Coal."

not from the coal itself, but from the overlying drift, which contains much magnetic iron ore, in the form of disseminated sand and grains, and still oftener as pebbles and boulders of that mineral. The rain-water and drainage of the country, percolating through this gravel, has partially decomposed the iron contained therein, and deposited it on the surfaces and in the cracks of the cleavage planes of the coal deposit. The discoloration disappears where the coal-bed has been washed by the river water, and is not seen to penetrate into the blocks of the mineral to any depth. It was found to burn well in the open air, is a bituminous caking coal, apparently well adapted for steam and household purposes.

All our attempts to trace the seam on the opposite side of the river failed. The bank here for a considerable distance is low and swampy; and, though several deep excavations were made, the enormous accumulation of sand and gravel, encumbered at the bottom with huge boulders, and the rapid influx of water, effectually baffled us. Our attention was next directed to costeaning along the main river, above and below this outcrop; wherever the rocks exposed, seemed to give promise of further deposits. Several bands of shale and bluish fireclays were thus uncovered, only a few of which showed layers of impure coal and carbonaceous shale, with a few inches of coal in one or two instances. On a little tributary stream, near our camp, two pretty wide beds of clay and shale occur close together, the lowest of which contained about one foot four inches of soft, shaly coal, with four inches of good coal at the bottom and two and a half inches at top. The upper bed contained about one foot of impure coaly shale.

Robinson's River is very unfavorable to exploration, owing to the general low character of its banks, and the comparatively few exposures of the rocks along its course For several miles they are entirely concealed, and the river's bed is choked with a great accumulation of boulders, chiefly derived from the Laurentian Range of hills to the eastward.

In the meantime, a new seam was discovered some two and a half miles to the Eastward upon a tributary Brook, the Northern Feeder, and having moved camp to the vicinity of this outcrop, we commenced uncovering this seam. A man named Shears having claimed to have previouly discovered it, I have named it after him, the Shears Seam.

Here again we found the country bordering on the river, flat, with few exposures of the rocks for long intervals along its course. In the immediate vicinity of the coal outcrop however, low ledges of nearly horizontal, or gently undulating strata cross the river in several places. These consist chiefly of strong beds of a rather coarse greenish gray conglomerate, characterised by an abundance of opaque white quartz pebbles, usually waterworn, and averaging about the size of an almond nut. This is overlaid by fine grained, finely micaceous, greenish gray sandstone, in which some stems of fossil trees, like *sigillaria,* are occasionally embedded. The coal is brought to the surface on the axis of a low anticlinal fold in these latter beds, the exposure being for the most part concealed beneath the water of the river, and the great thickness of overlying drift. It was only on the apex of the fold, that a clear section of the seam could be obtained, after considerable labor in removing the drift above. Here it gave the following section:—

	Ft.	In.
Underclay	0	3
Hard, bright, clean coal	1	2
Clay and shale	0	2
	1	6
Coal	1	2

On the opposite side of the brook several deep cuttings were made, which only resulted in finding a soft blueish fireclay, lying on the flat surface of the rock, and holding fragments of coal and some coaly shale. It was evident that the outcrop of the seam here, had been broken up, and most of the coal swept away by glaciation.

The quality of this coal is of superior excellence. It has a brilliant black color, is entirely free from pyrites or other impurities, and nearly approaches anthracite in hardness; being however, more bituminous. It ignites readily, gives off but little smoke ,and burns with a bright clear flame. When thrown into a glowing fire it at first decrepitates slightly, but this ceases upon its bursting into flame. I have rarely seen a cleaner or more beautiful looking coal, and though the seam is of such small dimensions where uncovered, I believe were it to maintain its thickness of one foot six inches ,and its superficial area prove extensive, its superior quality would render it of economic importance.

A considerable amount of costeaning was accomplished along this brook both above and below the Shears Seam. Several under-clays and beds of impure shaly coal and Carbonaceous shale were come across, a few only showing any real coal. One bed about twenty-five chains further up stream, contained about four inches of slaty coal, and two others a mile below, exhibited a foot each of soft shaly coal, with a few hard layers running through it. Owing to the flat nature of the country, little can be done here by merely surface exploration, but the indications are such as to warrant the application of a boring rod to determine the character of the underlying deposits.

Returning to Robinson's River, and thence portaging across to the Middle Barachois, where the most complete sections of the coal bearing rocks in the Island occur, a long and close investigation of this important locality was entered upon, with very promising results.

In the Report for 1873, Mr. Murray has shown that a narrow trough of the middle coal measures occupies a position about ten miles from the seashore, and comes to a point here, where the Jukes' coal seam outcrops on the river. The structure, as then laid down, was very correct, and our investigation of last season not only confirmed the existence of this trough, by finding the coal outcrops on either side dipping towards each other, but has also been the means of greatly extending it, by the discovery of several seams lower down than those hitherto known to exist.

The Jukes Seam, and the Cleary Seam, above, were first uncovered on the right bank of the river, where a landslip has exposed a considerable portion of the cliff. The Cleary Seam was traced downward from the top of the bank till it was found to be suddenly cut off by a downthrow fault near the axis of the synclinal curve. It was found again in its normal position one hundred and thirty feet beyond, where it is broken by a parallel fault. From this latter it curves upward with a gentle sweep to the top of the bank, forming the eastern side of the trough. Later on, the broken portion of the seam in the middle was discovered some thirty feet below, just at the base of the cliff, and partly concealed beneath the waters of the river. Three measurements, one at either side of the above mentioned faults, and one of the portion of the seam thrown down were made, which gave the following sections:—

Cleary Seam East Side of Eastern Fault.

	Ft.	In.
Underclay	0	1
Coal—hard and good	1	10
Clay	0	2
Clay, with coaly streaks	0	4
Shale and clay	1	2
Carbonaceous shale	0	5
	4	0
Coal	2	0

Cleary Seam, West Side Western Fault.

	Ft.	In.
Underclay	0	1½
Coal—hard and good	2	1
Clay and shale	0	5
Coal	0	1
Clay and shale	0	5
Carbonaceous shale	0	2
Shale and clay	0	4½
	4	0
Coal	2	2

The broken part of the seam let down by the faults measured, as well as could be ascertained, four feet eight inches, with two feet six inches of good solid coal at bottom, and about two inches of Carbonaceous shale at top.

The Jukes Seam is situated between ninety and one hundred feet lower down in the section. It was first uncovered on the side of the main river, on the west side of the trough, where it was seen and examined by Mr. Murray in 1873. This is also supposed to be the point where it was originally seen by Mr. J. B. Jukes, F.G.S., in 1840. The bank of clay and gravel overlying it here was first removed to such an extent as to afford a good, clear section of the coal, which was traced outward to the water of the river; and a pit being sunk through the gravel, on the opposite side of the river, in the line of strike, it was again met with. We next ran a line through the woods on the strike of the seam Northward, and sunk several trial pits along this line, which in every case resulted in finding the coal at greater or less depth, according to the thickness of the surface deposits. At a distance of eleven chains on the strike, it crosses a deep ravine, through which a small tributary brook wends its way. The banks on either side the ravine being very steep, and rising some sixty feet above the river's bed, afforded, when stripped, splendid sections. On the eastern side, near the top, a sudden swelling out of the seam takes place, caused by the occurrence of an intercalated mass of sandstone, partially splitting the seam in two; but it comes together again lower down, and assumes its normal proportions, which it maintains up the opposite slope. The strike of this seam is exceedingly straight so far as traced, and the average angle of inclination, which also varies but little, is about 59°.

Four different measurements, or cross sections, at right angles to the inclination of the bed, were made, two at the first outcrop on the main river, one at the wide part of the seam, east side of ravine, and one on the west side of the ravine. Later on, when this same seam was recognized amongst those uncovered on the eastern side of the trough, on the main river, another measurement was made; being five in all. The openings at the two extremes, following the strike of the seam, are situated just twenty-four chains apart, which should afford a fair average of the character, and thickness, throughout, and the details of each measurement, as given below, which were very carefully taken, can be relied upon for accuracy. Taking each measurement in the order in which they succeed each other, and beginning with the last-mentioned, they exhibit the following sections:—

Jukes' Seam, East Side of Trough.

	Ft.	In.
Underclay	0	1
Good, bright, clean coal	2	6
Clay, with soft, shaly coal	1	0
Coal, shale and clay (mixed)	1	3
Clay, with thin strings of coal	0	4
Clay and shale	0	4
	5	6
Coal	4	4

Jukes' Seam, West Side of Trough.

	Ft.	In.
Underclay	0	2½
Coal—hard and bright	1	8
Clay	0	5½
Coal—soft, shaly, with clay streaks	0	9
Clay, with thin coal layers	0	4½
Clay	0	2½
Clay, shale and coaly matter	0	8
Carbonaceous shale and clay	0	4
	4	8
Coal	3	0

Jukes' Seam, Second Measurement.

	Ft.	In.
Underclay	0	2½
Coal—hard and bright	1	8
Clay	0	1
Coal—good	0	2
Clay	0	4
Soft, shaly coal, with clay streaks	0	9
Clay, with thin coaly layers	0	8½
Clay, shale and coaly matter	0	10
	4	9
Coal	3	2

Jukes' Seam, East Side of Ravine, at its Widest Part.

	Ft.	In.
Underclay	0	1
Coal—hard, bright and good	3	0
Clay	0	5
Coal, clay and shale (mixed)	0	9½
Clay, with thin coal layers	0	7
Coal—hard and bright	0	4½
Clay, shale and rock	1	0
Good, bright coal	1	4½
Shaly coal	0	4
Clay with thin coal layers	0	5
Good, bright coal	1	5½
Clay, shale and coaly matter	1	8
	11	6
Coal	8	0

Jukes' Seam, West Side of Ravine.

	Ft.	In.
Underclay	0	3
Coal—hard and good	2	8
Clay	0	2½
Coal—good	1	3½
Clay	0	5½
Shaly coal	0	2
Clay and shale	0	4½
	5	5
Coal	4	2

It will be seen from the above measurements that the mean average thickness of the Jukes Seam reaches six feet four inches, carrying four feet six inches of coal. The close proximity of the Cleary Seam above, and another, named the One-and-a-half Foot Seam, below, all of which might be worked conjointly, together with the character of the coal, which is of a very superior quality, should render this a most valuable deposit.

The coal in the Cleary Seam closely resembles, in external appearance, that of the Sydney mines, Cape Breton. It is bright, tolerably hard, and breaks into square and oblong blocks, with smooth, glossy cleavage faces, which occasionally exhibit thin scales of iron pyrites. It is a bituminous caking coal, burns well in an open grate, and leaves a nearly white ash. That of the Jukes Seam is entirely different, and unlike anything, so far as I am aware, in the Cape Breton coal field. It presents a brilliant glistening black appearance, breaks into small fragments, and is very brittle, resembling in this respect some of the Welsh coals. Parts of the bed exhibit a smooth slicken-sided surface. Although it contains, apparently, very little pyrites, yet it is much stained, or rather tarnished, with oxide of iron, presenting a most beautiful irised coloration, resembling, and almost rivalling, the Cape of Good Hope erubescite in brilliancy. It burns freely in the open air, giving off but little smoke, and leaves a white ash residue. Though very bituminous, it does not clog the bars of a grate, and altogether seems remarkably free from impurities, thus classing it amongst the very best qualities of household coals.

A vast amount of costeaning was carried on along the slopes and near the water's edge on both sides of the river, both above and below the outcrops already described. This resulted in the uncovering of twelve other seams on the western side of the trough, and eight on the eastern side, the latter being repetitions of the former, with an opposite inclination. Most of these are small seams containing but little coal, and are chiefly made up of shale and clay. One section of about eighty feet in thickness, immediately below the Jukes Seam, contains four separate seams, of the following dimensons, taken in descending order:—

One and-a-half Foot Seam.

	Ft.	In.
Underclay	0	3
Good coal	1	6
Clay, shale and coaly matter	0	8
	2	5
Coal	1	6

Slatey Seam.

	Ft.	In.
Underclay	0	2½
Coal—hard and brittle	0	4
Soft shaly coal and clay	0	6
Clay	0	3½
Impure coal and black carbonaceous shale	1	6½
Shale and clay	0	6½
Carbonaceous shale	0	2
	3	7
Carbonaceous shale and coal	1	4

Clay Seam.

	Ft.	In.
Underclay	0	1
Impure shaly coal	0	2
Soft coaly clay and shale	1	6
Shaly coal	0	2
Clay and coaly matter	1	6
Good coal	0	3
	3	8
Coal	1	8

Rocky Seam.

	Ft.	In.
Underclay	0	3
Clay and impure coal streaks	2	0
Shale and soft sandstone	1	10
Good coal	0	5
	4	6
Coal	1	5

Below this, in a section of about 2,600 feet, five or six small seams, showing more or less coal, coaly clay and shale occur; but none of them are worth particularizing. At 2,200 feet below the Jukes Seam, a new seam was discovered, which I have named after the late Director of the Survey, Alexander Murray, C.M.G., F.G.S. The frequent occurrence of extensive land-slides laying bare the cliffs along the river's banks, afforded good opportunities for examining sections of the rocks, all of which were availed of. At this particular point, an immense amount of sand gravel boulders, with the heavy surface growth of trees, had been precipitated into the river; forming a barrier nearly half across its course. A high steep cliff had been laid bare thereby, the appearance of which near the top, attracted my attention. It was a very difficult place to reach, and this could only be acomplished by digging foot-holds in the steep face of the bank. Coal was seen in several places, and what appeared a very wide seam was come across in one place. Having moved camp to this locality, we began to strip the face of the cliff downward on both sides of the river. On the right side, the seam was uncovered for forty or fifty yards on its strike. Here it dips exactly East magnetic, at an angle of 38° and the following section was obtained:—

Murray Seam, Right Side of River.

	Ft.	In.
Tough underclay	0	3
Coal—very hard and tough	1	1
Tough shale and clay	0	10
Coal—hard and tough	0	10
Shale and clay	1	3
Coal—tough	0	4
Clay, shale and rock	0	4

Alternate layers of coal, carbonaceous shale, and clay	2	0
Tough, shaly rock	0	9
Coal, shale and clay (mixed)	1	6
Clay and shale	1	0
	10	2
Coal	4	9

Section on Left Side of River.

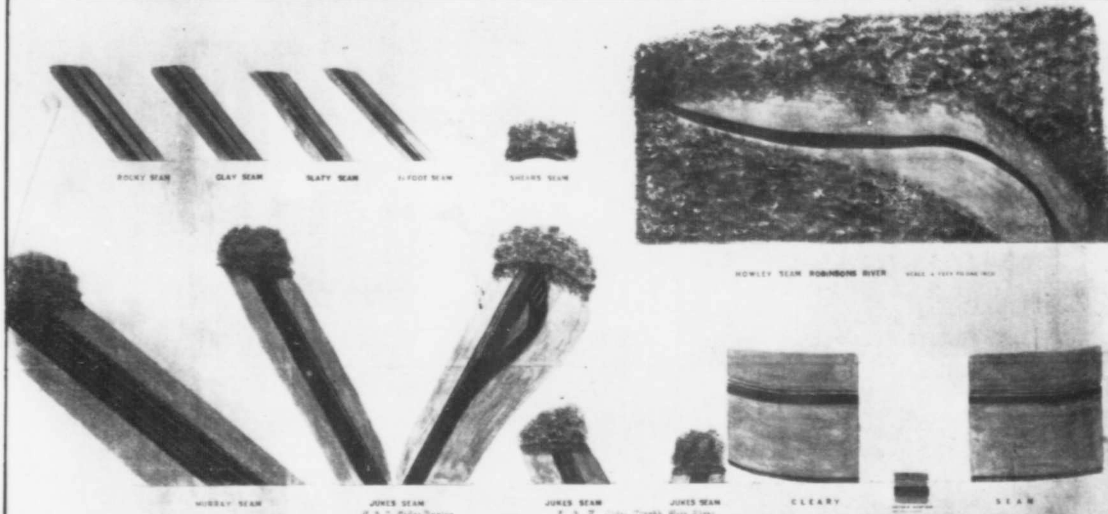
	Ft.	In.
Tough, shaly underclay	0	3
Coal and carbonaceous shale	0	10
Stiff clay and shale	0	9
Soft coaly layers and thin coal streaks	0	9
Stiff Shaly Coal	0	7
Impure shaly coal, with layers of good coal	0	11
Stiff clay and shale	0	11
Soft shaly coal	0	4
Shale and soft sandstone	0	3
Impure shaly coal, with thin layers of good coal	1	3
Rotten shaly rock	1	6
Soft shaly coal	1	3
Rotten, rock, shale and clay	1	0
	10	0
Coal	5	4

The quality of this coal is somewhat inferior. It is of a dull earthy color, much stained at the outcrop with oxide of iron. Though not hard, it is very tough, as are also the shaly divisions.. It required considerable labor to remove the latter with a pick, so as to obtain good specimens of the coal. On testing it in the open air, it was found, nevertheless, to burn quite freely, and make a good fire, leaving a considerable amount of ash.

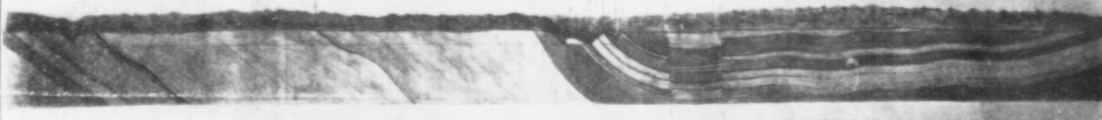
Immediately beneath the Murray Seam, on the left side of the river, another small seam of one foot in thickness, showing about seven inches of soft coal, occurs; and on the right side, two small seams—one about the same dimensions, and the lower one about a foot and a half. This latter is chiefly composed of a very black glistening carbonaceous shale, like a graphite, with a few thin layers of real coal running through it. About 250 feet lower down in the section, a seam of three feet of soft shale and clay, having six inches of soft coal in middle, was uncovered. Only two other shaly beds, showing any sign of coal, were observed below this.

On the eastern side of the trough, up the river, as already mentioned, the Cleary, Jukes, One-and-a-half Foot, Slaty, Clay and Rocky Seams were all recognized again, in their regular order of succession. Here, also, two other small seams, not seen on the west side, were uncovered—one between the Cleary and Jukes, measuring one foot seven inches, with but a few inches of soft coal, and the other between the Jukes and One-and-a-half Foot Seams, also showing a few inches of bright, hard coal. Three quarters of a mile further up stream, two thick beds of tough ferruginous shale crop out, close together—one, five feet thick; and the other, three feet. Both contain coal, in thin layers and irregular patches. Two more similar beds occur half a mile above this, one of which is six feet thick, with one and a half feet of impure shaly coal, and about five inches of hard coal in thin layers. Still further up, a few thin shaly beds contained a trifling amount of coal, also. The aggregate thickness of all these seams on the west side of the trough, gives between eighteen and twenty feet of coal. If we add to this the seams on Robinson's River and the Northern Feeder, we have a total of about twenty-seven feet altogether, which is about ten feet less than that of the North Sydney section. There are good grounds, however, for believing that other seams not yet discovered exist in this neighborhood, especially in the central part of the trough. Many fragments of loose coal were observed in the gravel overlying the highest seam (the Cleary), which, judging from their character and position, were apparently derived from a still higher seam. The enormous thickness of gravel, sand and boulders, forming the surface deposits of the country here, rendered all our efforts to reach the position such a seam would be likely to occupy, unavailing.

On visiting the Riviere Blanche on the north side of the Bay the McGrath Seam was first examined. It is described by Mr. Murray in the Report for 1873, as an "imperfect bed of coal intercalated into a mass of coarse sandstone," but as it has no proper underclay or roof of shale, and thins out entirely in a few yards on the strike, he did not consider it a true coal seam. It presents the appearance of a mass of vegetable matter washed together in a



SURFACE OUTCROPS OF PRINCIPAL COAL SEAMS ON MIDDLE BARACHOIS & ROBINSONS RIVERS



OF THE CARBONIFEROUS TROUGH MIDDLE BARACHOIS RIVER SHOWING POSITION OF COAL SEAMS

LONGITUDINAL MEASUREMENT 1385 FEET VERTICAL & HORIZONTAL SCALE 100 FEET TO ONE INCH

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hollow of the ancient surface, in the manner of some alluvial deposits of the present time. Its greatest thickness does not exceed fifteen inches. Although it burns fairly well and makes a good fire in an open grate, it contains a considerable amount of iron pyrites. Another small seam occurs some twenty chains further up stream, which has a thick layer of a dull whitish underclay, but contains only about six inches of coal and coaly shale. The roof of this bed is filled with most beautiful impressions of fossil ferns, in an admirable state of preservation. Sections of large fossil trees are also quite abundant embedded in the coarse sandstones both above and below Some times, they are seen lying prostrate on the worn surfaces of the bedding, while quite frequently, they are found standing upright as they grew, but the roots generally, appear to be wanting.

No other coal seams were seen in place anywhere along this river, yet loose fragments were picked up, or found embedded in the overlying gravel at several points. The country generally is pretty flat, and the few exposures of the rocks, indicate a nearly level or gently undulating section; probably not exceeding six or seven hundred feet in thickness altogether. The application of the boring rod, might, however, reveal the presence of other seams of more importance in this locality, and the indications are certainly sufficiently promising to warrant a fair trial. A small seam of coal was reported as occurring on the Romains or Kippins River some miles further west, but I had not an opportunity of visiting it.

Other Economic Substances of the Region.

Coal is by no means the only valuable economic material which this district of country is capable of producing, though undoubtedly second to none in point of importance.

Iron Ores.

An immense deposit of magnetic iron ore has been recently discovered in the Long Range of Mountains, some eight or ten miles from the head of St. George's Bay. It is quite evident also, that this discovery is but the precursor of others of a similar characte. Ore, apparently of the same quality, is found abundantly scattered through the surface deposits overlying the Carboniferous series, especially along the courses of the principal rivers. On the Middle Barachois, the loose boulders and pebbles of this ore were so abundant ,as to lead to the supposition that the gravel deposits might almost be worked economically. At all events the source from whence it has been derived cannot be far distant, while it is certainly presumable, that so much loose material indicates vast deposits of the ore somewhere in the Mountain Range to the eastward. In the neighborhood of Cairn Mt. at the head of Flat Bay River, Magnetite has been long known, and good specimens were shown me last fall said to have been procured on the North side of the Bay.

Pyrites.

This mineral is not common amongst the Carboniferous rocks of Bay St. George (proper), though quite abundant in the Lower Silurian shales of Port-a-Port Bay. A deposit which is represented of a very promising character has been discovered in the East Bay of Port-a-Port. Specimens of this mineral sent to New York for analysis yielded 64 per cent. of sulphur. It is the variety known as Marcasite containing arsenic. Pyrites has recently attained considerable prominence in this country, as a valuable commercial poduct. The immense deposit at the pyrites mine on Pilley's Island, Notre Dame Bay, which has been very successfully mined for some years past, has created quite a boom. The ore is all shipped to the United States, where it is used in the manufacture of sulphuric acid and green vitriol, or copperas. Quite recently, I understand, the iron residue of the ore, hitherto considered valueless, has been found to possess qualities rendering it especially adapted for the manufacture of the best varieties of steel. This discovery will of course greatly enhance the value of this class of ores in the future.

Copper.

The green Carbonate of copper was observed in one or two places forming a coating on the carboniferious sandstones, and in one instance the surface of a piece of coal was similarly stained. The late Mr. Hugh Fletcher, mining engineer, reported in 1874 having seen a thin vein of sulphuret of copper on the Middle Barachois River, but too small to be of any importance. The ores of copper, as well as native or metallic copper, were shown to exist in several places further north, on the shores of Port-a-Port, and Bay of Islands; see Reports for 1873-74.

Lead.

Galena or sulphuret of lead is also referred to in the above Reports as one of the mineral products of Port-a-Port Peninsula, and I understand it has recently been discovered on the mainland east of Port-a-Port Bay. No indications of this ore were come across this season, anywhere amongst the Carboniferous deposits of St. George's Bay.

Baryta.

Good specimens of this mineral, also derived from Port-a-Port Bay, were shown me by Mr. G. McKay who had been prospecting in that locality. I have not heard of its existence anywhere in St. George's Bay.

Gypsum.

Mr. Murray in the Report for 1873, gives it as his opinion, that there is probably no equal area in Noth Ameria, which exhibits a greater volume of this mineral than that surrounding St. George's Bay, and in the Codroy Valley. The principal localities where it occurs in great masses were then pointed out. Further deposits were observed this season on the upper reaches of the Middle Barachois River. Here it was seen to strike along the course of the stream in low outcrops, near the water's edge, for a considerable distance. At some points it formed thick deposits of a soft plastic, but very tenacious nature, and frequently pure white in color. Some of this, dried in the sun, became very hard. It is necessary, however, to calcine and grind the mineral before using it for stucco purposes. The impure and inferior varieties are useful when ground for improving the fertility of soils, and is thus a most valuable adjunct to agriculture. I have not the latest Reports of the Inspector of Mines of Nova Scotia at hand to refer to, but I find in his Report for 1887, that the Province exported during that year, no less than 116,346 tons, valued at $110,635; this was for the crude material. Were is calcined, and ground on the spot, and exported in that condition, ready for immediate use, its value would be greatly enhanced.

Mica.

Mica in fine particles, and, as micaceous sand, is very abundantly distributed through the carboniferous deposits, and in the overlying drift. In costeaning for coal at one place on Robinson's River, a thick bed of this very micaceous sand was met with, of a golden yellow color, which when rubbed or brushed over any flat surface, produced a perfect bronzed coating, and appeared to me as though it might be utilized in that manner. As a sand, it is very beautiful. Plates of the same mineral, of several inches in length, have been procured amongst the Laurentian rocks of the Long Range Mountains, and it is reported that some of a much greater size had been seen.

Building and other Useful Material.

The lower measures of the carboniferous formation, especially, are prolific in admirable building material—sandstones, freestones, grindstones, whetstones, limestones, &c. The sandstones present a variety of color and consistency, from dark brick red, through various shades, till it merges into yellowish, greyish, greenish and white, and from coarse grit to very fine-grained freestone. Some of the grindstones used by the inhabitants are pronounced much superior to those imported. In 1887, the latest date in which I have any returns from Nova Scotia, that province exported $32,669 worth of grindstones alone. The limestones, which abound in this portion of the formation, are well adapted for burning into quicklime, and are often suitable for building purposes. The Laurentian Range would afford an infinite variety of granite, syenite, &c., many of which are very beautiful. Brick clays and others well adapted for the manufacture of coarse pottery abound, more especially along the shores of Flat Bay and at Bank Head. The frequent occurrence of brine-springs leads to the supposition that deposits of mineral salt may be looked for here. These brine-springs are usually found in the vicinity of the great masses of Gypsum, and as Mr. Murray has pointed out, would appear to be in some way connected with the latter deposits.

Soils.

In a paper published by me last June on the above subject, it was pretty clearly demonstrated, why the soils of this district of country were believed to be of such a superior character. I have seen nothing during the past season to alter the views there set forth, but everything to confirm them. I can therefore add nothing, even were it necessary, to strengthen the position then taken, beyond the fact, that the rich intervale lands, especially on the upper reaches of Robinson's, Middle Barachois, and Riviere Blanche, are much more extensive than I had supposed. Unfortunately, none of these tracts are accessible to settlers at present, and must remain in their useless condition, until the construction of lines of road renders them available. Without these necessary aids to agricultural settlement it is useless to speak of utilizing our waste lands, except indeed such as are situated immediately on the seaboard, or on the estuaries of the larger rivers; nearly all of which are already occupied.

Conclusion.

There can be no doubt that the district surrounding the Bay of St. George contains more tangible elements of wealth, and more decided inducements to settlers; provided the proper facilities are afforded for utilizing these resources, than any other district of the Island. The possession of coal and iron in available quantities, are in themselves a basis of prosperity second to none other. The immense importance of their development, and the impetus they will undoubtedly give to other industries following thereon, must exert a most benefiicial effect; not only upon this district, but upon the whole Island. Much of Britain's prosperity is certainly due to her possession of large supplies of coal, and on this side of the Atlantic, it has been one of the greatest factors in the building up of the gigantic prosperity of the United States. Nova Scotia's coal has been the backbone of her existence, and even little Cape Breton Island, which without it would be but a very insignificant Province, bids fair to become one of the chief centres of the manufacturing industry of the Dominion. As an instance of the influence coal mining has been known to exert upon other industrial pursuits, and the increase of population, I quote the following from Brown's "Coal fields and Coal trade of Cape Breton":—"Lancashire, which a few centuries ago was looked upon as a kind of morass or waste, and one of the poorest counties in England, now, owing to its coal mines, has a population of 1,280 persons to the square mile; while the principal agricultural counties have only from 148 to 230 persons to the square mile."

To come nearer home Cape Breton Island itself has an area of only 4,375 square miles with a population in 1888 of 84,500 or a fraction over nineteen to the square mile, while Newfoundland with its great area of 42,000 square miles, shows only a proportion of four individuals.

THE MUSEUM.

The interest manifested in this institution, shows no signs of abating. In my last year's Report I pointed out the advantages already accruing to the public through its means, especially to the younger portion of the community, in an educational point of view I am happy to say the Government so far recognized its importance, as to increase the appropriation for its maintenance to $800. This sum has enabled me to make many valuable additions to the collection, which is yet, however, far from being a complete exhibit of all the varied resources of the country. The natural history sections are very meagre in specimens, still a constant addition to the latter from various sources is taking place, and I expect in the course of a year or so to make those very interesting and attractive sections of the museum, objects of pleasure and instruction, to visitors. The cases containing the ornithological portion of the collection are entirely unsuited for the proper and systematic arrangement and preservation of the specimens. They are those which were used at the Fisheries Exhibition in London, and were never intended for their present purpose. It will be necessary to have them altered or replaced by new ones.

Although the exhibits from the museum sent to the Barcelona Exhibition, were not by any means as good or comprehensive as could have been shown, were sufficient time and means placed at my disposal, they were nevertheless, awarded two diplomas and two medals for merit; which are now to be seen in the museum. It is to be hoped when next we are called upon to take part in a similar exposition, the museum will be in a position to supply a very much more elaborate and creditable display of the country's mineral and other resources.

Many of the visitors to the museum during the past year have contributed articles of more or less value to the collection, for which I now beg to tender my thanks on behalf of the public. To His Excellency Sir Terence O'Brien, who has evinced great interest in the institution since his arrival amongst us, we are indebted for a most interesting addition to the numismatic section, in the shape of a very complete suite of Russian, German, Austrian and East Indian coins. The Prefect of the West Coast, Very Rev. Dr. Howley, has also loaned a number of coins, some which have quite an historic interest. He is the donor, also, of an old medal, dug up at Ferryland, supposed to be a relic of Lord Baltimore's colony, a pair of wooden shoes or sabots and a Chinese opium pipe. Mr. T. D. Scanlan contributed an Indian clay pipe, and some arrows of the Modoc tribe picked up on the battlefield where General Custer of the U. S. army, was slain in 1870. Mr. Richard Walsh, of Little Bay, has presented two finely-wrought Zulu assagais, an arrow, and wooden staff, or wand, from South Africa. Mr. Richard Meagher, an Irish pike head; Mr. J. Ryan, a copper plate from the Arctic regions, with an inscription recording the death of a seaman of H.M.S. *Enterprise,* in 1849; Mr. Joseph Francis, a large hermit crab from Hermitage Bay; Mr. Walcott, of the U. S. Geological Survey, who visited this country a few years ago to study the Lower Cambrian formation here, has presented the museum with a number of most interesting fossils of that epoch, chiefly from the shales of Manuel's Brook, near Topsail, in Conception Bay. They are comprised in the following species:

Hyolithes princeps—Billings.
Hyolithes impar—Ford.
Hyolithes Terranovicus—Walcott.
Agraulus strenuus—Billings.
Scennella reticulata—Billings.
Kutorgina Labradorica—Billings.
Obolella Atlantica—Walcott.
Helenia Bella—Walcott.
Stenotheca rugosa, (var.)—Walcott.
Ptychoparia attleboroughensis—S. & F.
Michrodiscus bella-marginatus—S. & F.
Solenopleura bombifrous—Matthew.
Olenellus Broggeri, (fossil and photo)—Walcott.

Conocoryphe trilineata, Washington County, N. Y.—Emons.
Mesonacis Vermontana, Georgia, Vermont, (cast)—Hall.

There has been acquired, during last season, the following natural history specimens, all pertaining to the country:—

Zoological and Ornithological.

One yellow fox, *vulpes fulvus;* one pine martin, *Mustela Americana;* one Arctic hare, *Lepus glacialis;* two loons, *Colymbus torquatus;* a small hawk, *Accipiter* (?); a Carolina mourning dove, *Zanaidura Carolinensis;* a shore lark, *Eremophila Alpestris;* a golden-winged woodpecker, or flicker, female, *Colaptes Auratus;* an orange-crowned warbler, *Helminthophila celata.*

Ichthyological.

One cod-fish, *gadus morhua;* herring, *clupea harengus;* capelin, *mallotus villosus;* squid, *Loligo Pealii.*

The collection is now assuming such an intrinsic value, apart altogether from its utility and the general interest it excites, that I would beg to draw your attention to the advisability of effecting some insurance upon it. It is true no amount of money could replace it thoroughly were it destroyed by fire, or otherwise; yet, as it has cost the Colony a considerable sum up to the present time, it would be a satisfaction to know that this expenditure was secured by insurance, at least to some extent. Hoping the above suggestion may meet with the consideration it deserves,

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

Since writing the above report, I have been favored by the Hon. Philip Cleary with the analysis of three of the principal coal seams on his leases. These analyses were made by Mr. Andrew McCreath, of Harrisburg, Penn. Considering the specimens submitted were all taken from the surface outcrops of the seams, and were consequently much weatherworn, and otherwise injuriously affected, the result of the test may be considered very favorable, showing a good average coal:—

	Cleary Seam	Jukes Seam	Howley Seam
Water	3.548	3.036	2.784
Volatile Matter	30 897	30.344	29.271
Fixed Carbon	55.229	60.142	54.468
Sulphur	3.946	1.963	3.047
Ash	6.380	4.515	10.430
	100.000	100.000	100.000

JAMES P. HOWLEY.

CHAPTER X.

Report for 1889, on Crown Lands, by the Surveyor General—Preliminary Survey across the Island from the Exploits Valley to the West Coast, for the purpose of ascertaining the feasibility of constructing a Railway to connect the Eastern and Western Sections of the Country.

To His Excellency Lieutenant-Colonel, Sir J. TERENCE N. O'BRIEN, *Knight-Commander of the Most Distinguished Order of Saint Michael and Saint George, Governor and Commander-in-Chief in and over the Island of Newfoundland and its Dependencies.*

May it Please Your Excellency,—

I have the honor to submit, for Your Excellency's information, the annual report of the Crown Lands Department, with the usual tabulated statements and accounts for the year ending 31st December, 1890:—

MINERAL LANDS.

There were filed during the year twenty-one notices of staking, one license to search for gold, one application for a gold mining lease, and four applicttions for leases of mining locations of one square mile each. The fees on these applications amounted to one thousand one hundred and twenty-five dollars. Particulars are fully shown in returns marked Nos. 1 and 2.

TIMBER LANDS.

Six leases of timber limits were issued during the year for four hundred and eight square miles, as shown in return marked No. 3.

AGRICULTURE LANDS.

Returns marked Nos. 4, 5 and 6 show operations in agricultural lands. There were issued during the year two hundred and ninety-six grants, containing one thousand two hundred and twenty-six acres three roods and twenty-eight and three-quarter perches;

four free grants, containing forty-two acres one rood and thirty-three perches; and three location tickets for homestead grants for three hundred and eighty acres.

Under the Acts for the promotion of agriculture, there were received two thousand one hundred and twenty-five applications for licenses to clear land, making in all, during the existence of the Acts, a grand total of eight thousand two hundred and two applications, and five thousand three hundred and seventy-five acres one rood and thirty-five perches were certified to have been cleared and made ready for cultivation on four thousand five hundred and forty-two certificates, upon which the sum of sixty-five thousand eight hundred and twenty dollars and fifty-one cents was paid, a detailed statement of which is submitted herewith marked Nos. 6 and 7.

In the early part of the year suspicious circumstances in connection with certain claims for land-bonus led to the necessity of making special surveys for the purpose of verifying the reports on which these claims were based.

I regret to state that in one district very extensive frauds were discovered, by which persons in collusion with a dishonest surveyor, under the Act, had wrongfully obtained large sums of money from this Department; but, as these parties have been brought to justice and duly punished, it may not be expedient to record their names in this report.

In view of this discovery I thought it my duty to make a full investigation of the lands recently cleared and paid for under the Act, and it affords me pleasure to report that, with very few exceptions, in cases where errors arose from ignorance of the law, the lands have been well and faithfully cleared—this is especially true with regard to Belle Isle in Conception Bay, and the West Coast, from Cape Ray to Bay St. George.

The large amount expended in the payment of bonus the past year is accounted for by the desire of the people to take advantage of the Act before its expiry in December last; but I have no hesitation in asserting that this money has been well spent, and represents a large increase of prosperity to those who have thus been aided in the cultivation of the ground. At the same time I am of opinion that an Act having the same object in view, but with provisions somewhat different, should be formulated and placed upon the statute-book at the next session of the Legislature, an essential feature of which should be the encouragement of continuous cultivation of the soil, extending over a period of several years. In this connection I would strongly urge the appointment of competent district surveyors, paid by the Government, who could also be called upon to report on applications, and furnish surveys of mining locations at less cost to the people who, in many cases, are debarred from access to our mineral lands by want of means to provide the needful survey.

Turning from this subject to the equally important one of our mineral lands, I would most respectfully call the attention of your Excellency to the limited number of "staking mining locations" during the past year, which, taken in connection with the fact that large sections held by various parties for a number of years under licenses, the conditions of which have not been fulfilled, will be set free and revert to the Crown in September next in accordance with notices served upon them, points to the necessity for an amendment of the present Mineral Act, that will render our mineral lands more accessible to the people generally throughout the Island. There can be no doubt whatever, from the information already in our possession, that our mineral resources are far in excess of their present development, and capable of largely supplementing other industries of the country if vigorous measures are taken to bring them under the notice of foreign capitalists. It is my intention, with the permission of the Government, to offer some amendments to the Crown Lands Act for the purpose of encouraging the search for minerals on the part of our people, and, by carefully guarding their rights, assist them to find the capital they require in order to test the value of their claims.

Geological Survey.

In connection with this survey, Mr. James P. Howley, F.G.S., was instructed to survey and explore the country westward from the Exploits Valley to the Bay of Islands and Bay St. George, for the purpose of ascertaining the merits of that route for railway extension across the country. I have much pleasure in referring to his very able and exhaustive report, which confirms the contention of those who hold that this country abounds in agricultural and grass lands capable of supporting a large population from this resource alone: especially would I point out the testimony of Mr. George Nichols, a successful farmer at the head of Deer Lake, that both the soil and climate are better than those of his native province of Nova Scotia.

I have the honor to be,

Your Excellency's most obedient servant,

H. J. B. WOODS,

Surveyor General.

Preliminary Survey across the Island from the Exploits Valley to the West Coast, for the purpose of ascertaining the feasibility of constructing a Railway to connect the Eastern and Western Sections of the Country.

Geological Survey Office,
St. John's, March 24th, 1891.

Honourable Surveyor General:

SIR,—I have the honor to furnish you, for the information of the Government, with the following report of the past season's survey operations.

You are aware that the Government decided in the spring, on having a survey and exploration made of the country westward from the Exploits Valley, lying between it and the Humber Valley, and thence by the latter valley to Bay of Islands, and by way of Saint George's Lake and Harry's River Valley to Bay Saint George. The survey was undertaken chiefly with a view of ascertaining the feasibility of that route for the extension of the railway system to the western side of the island. The selection of the staff of the Geological Survey to perform this work necessitated some delay at the outset, owing to the changes requisite on the alteration of the route of the survey. In order to carry out, as far as possible, the lesire of the Government, it was deemed that the work might be facilitated by a division of our party, one half, under the charge of Mr. Albert J. Bayly, Assistant Geological Surveyor, was despatched westward with the greater portion of the season's outfit.

Mr. Bayly had instructions to land at the Bay of Islands, proceed up the Humber River, portage across to the Grand Lake, and thence ascend the Sandy Lake River to the latter lake, where the provisions, etc., were to be stored for the convenince of both partis.

The second, under my own immediate charge, proceeded northward in the S. S. Conscript, landed at Botwoodville (now Botwood), Bay of Exploits, and with all possible dispatch proceeded in canoes up the Exploits River to the junction of the Badger Brook. At this point a transit line, running north forty degrees west, magnetic, was commenced and continued across country in the direction of Kitty's Brook, a tributary of the upper or eastern branch of the Humber, flowing into Sandy Lake. In the meantime Mr. Bayly, after reaching the Grand Lake, commenced a line at the exit of Junction Brook from that lake, and continued running south-eastward, across the head of Grand Lake and the Sandy Pond River valley, till a junction of the two parties was effected. This work, as well as the laborious journey up from the Bay of Islands, he performed with the most praiseworthy diligence and perseverance.

My own party, necessarily a small one, consisted of only three axe-men, an assistant, Mr. Thomas Thorburn, a cook, Indian boy and self. We commenced running our line north-westward on the 16th of July, and continued our course N., 40° W., till July 31st, when we had a first sight of the three remarkable tolts of the White Hill plains, known as the Three Topsails. In order to pass between these, the course was slightly altered to N. 36° W., and on the following day, August 1st, having obtained a nearer and more distinct view of the country ahead, the course was again changed to N. 29° W., so as to take the lowest part of the summit level, of which the three tolts above-named form the most prominent projections.

On the 8th of August, after crossing a steep wooded ridge on the west side of Rowsell's Brook valley, we entered upon a vast tract of barren country known to the Indian hunters as the White Hill plains. The small stock of provisions which we had carried along with us from the Exploits being now nearly exhausted, I was obliged, on the 11th, to despatch one of the Indians ahead to look for Mr. Bayly's party, and procure a fresh supply. He returned to us on the 13th, with a small stock of flour and a few other necessaries. He had had a very long toilsome tramp, had not seen anything of Mr. Bayly's party, but succeeded in finding his cache, and brought back as much as he could carry. During his absence we had pushed forward about ten miles, had been reduced to a very small daily allowance of food, there were no deer to be had on the open country at that season, and very little game of any kind. One of the other men fortunately shot half-a-dozen young geese, which kept us from actual hunger. We now pushed on rapidly, but on the 19th our stock of flour again gave out. We had reached the head waters of Kitty's Brook, but being now run out of all sorts of provisions and not knowing exactly where we might meet Mr. Bayly's party, I concluded to go in search of them, in order to obtain a sufficient supply to enable us to complete this section of our line, and to direct the operations of both parties so as to effect a speedy junction. Two days excessively hard travelling, chiefly through burnt woods, brought us to Sandy Lake, where we found them encamped. Having arranged with Mr. Bayly to run a line up Kitty's Brook Valley towards my line, and made all other necessary preparations, my party returned with a fresh supply of provisions to resume our work inside. The weather having now set in extremely wet and boisterous, we were greatly delayed at this juncture and did not succeed in effecting a final connection of our lines till the 8th of September; thenceforth, we worked conjointly for the remainder of the season. After selecting a suitable crossing of Kitty's Brook, near a picturesque fall on the river, we soon gained the flat country of the Upper Humber or Sandy Lake River Valley, whence the line was continued down towards the head of Grand Lake. From the outlet of the latter lake, or Junction Brook, we struck across for the head of Deer Lake, following the telegraph line for the greater part of the distance. The south side of Deer Lake and the Lower Humber were followed, thence to the Head of the Humber Arm, Bay of Islands, and an admirable site selected for a terminus, near Corner Brook, exactly 100 miles from our starting point at the Badger River. From Corner Brook, the further extension towards St. George's Bay was continued through a break in the coast hills, and a level lead of country towards St. George's Lake on the Harry's River. We had reached within two miles of the latter river, when we were beset by extremely severe winterish weather for the season. Our provisions also began to fail us again; but, above all, the sudden death of one of our party, Michael Cole, picket-man, effectually put a stop to further operations. This melancholy event taking place as it did, without any premonition, at such a distance from the water-side, threw a cloud over the whole party, and was a sad termination to our season's work. He had been at work the day before his death, apparently in the best of health and spirits, took sick during the night and was dead at four o'clock next day, November 13th. He was a good, sober, willing and thoroughly reliable man, never murmured or shirked his work, active and alert on all occasions; and was, without exception, the best picket-man I ever came across. He had been with me for the past six years and always gave the utmost satisfaction. This small tribute is due to the poor fellow's memory. It took five days of excessive labor to get his body out to the sea-shore, where it was laid at rest in the little grave-yard in Birchy Cove on the south shore of the Humber Arm.

The weather had now become settled down to regular winter, for which we were in no way prepared; consequently the continuation of the survey, under such conditions, was out of the question, accordingly we availed of the arrival of the S. S. Volunteer on the 21st of November to return home.

It had been a very trying season throughout. The months of July and August proved excessively hot and dry. The country was parched with the heat and we suffered extremely thereby, as it was during this very period the heaviest work of packing and cutting our way through the dense forest was accomplished. The flies of all sorts were never found more annoying, and to add to our other discomforts, we were surrounded with forest fires, from the first to the sixth of August. One of these especially, which overtook us in the valley of Rowsell's River, caused us much anxiety and extra labor. We were driven from our camping place, barely succeeding in saving our clothes and provisions, which had to be buried in a small swamp not more than an acre in area, in which we spent one very wretched night without covering or sleep. The fire raged fiercely on all sides of us during the whole night. As soon as there was sufficient light next morning, we packed up and make all haste ahead, so as to gain a position to windward of the fire. In doing so, we had to run the gauntlet several times through the still blazing timber, our clothes and boots narrowly escaping destruction once or twice. Even then our trouble was not ended, for a change of wind next day caused the fire to sweep down on us again. We had to run before it a second time, nor did we feel thoroughly secure till we reached the great open barren tract already alluded to. All this trouble and great destruction of valuable timber was ascertained to have been caused by the culpable negligence of two individuals travelling from the direction of Halls' Bay, who had killed a deer near where our line crossed Rowsell's River, roasted some of the meat, left the rest to rot, and walked off without any attempt to extinguish their fire. Who the individuals were we could not ascertain, but we saw all the evidence of their careless and wanton action. No doubt some of the other great fires which raged furiously away to the south and east of our position, in the Valley of the Exploits, had a somewhat similar origin. A vast amount of valuable timber must have been destroyed in this manner during the past season; which, together with previous destruction by forest fires, is rapidly depleting the great forest wealth of the colony. I would venture to say that nearly a third of the timber of the island is now destroyed in this manner. Can nothing be done to put a stop to this wholesale demolition?

The latter part of the season, especially the months of September and October, proved excessively wet and boisterous, and we had the misfortune, just at that time, to get into the low flat country of the Humber Valley. All the brooks and streams became swollen to the dimensions of rivers, the marshes became almost ponds; and, of course, travelling was of the most toilsome and wretched character imaginable. Later on, it set in very cold and winterish, rendering it still more trying, especially under canvas.

Although some twenty-three miles of the line to Bay St. George remain unfinished, still all the more difficult part of the route is surveyed and a previous knowledge of the country along the Harry's River Valley enables me to state that little or no difficulty presents itself on that section, in the way of railway construction. The country from St. George's Lake is very level, much of it being occupied by large marshes, but of good character—that is, shallow, with solid clayey bottom, very little of it partaking of the nature of swampy land.

General Character of the Line of Route Followed.

On leaving the Badger River, the first mile of the line runs over a very level tract on the west side of the Exploits River, It then begins to ascend a long heavily wooded ridge for a distance of two miles further, when the country assumes a tolerably level or rolling aspect, chiefly well wooded, which it maintains for the next five miles. Within this distance there are several extensive tracts of prairie land, often supporting a fine crop of wild grass. Very little of the soil on these tracts comes under the true designation of peat; it partakes rather of the character of mud, or clay and vegetable matter, mixed in about equal proportions. I believe a judicious system of drainage would render these exceedingly valuable pasture lands; and the labor attending their cultivation would not be nearly so great as that required to remove the timber, stump, and clear the more densely wooded areas. Between the tenth and twelfth mile, a ridge of heavy burnt timber is crossed. The soil here is good, though sometimes rocky. Extensive marshes intervene between the twelfth and fourteenth miles, when another burnt ridge was crossed, extending beyond the fifteenth mile. The wide valley of the main branch of Rowsell's River, flowing into Hall's Bay, is here crossed; reaching to the nineteenth mile. At this part the country is poor, with a good deal of marsh and protruding low granitic ridges, where the soil is thin; yet there are small areas of good land, especially along the margin of the rivers. A high wooded ridge, with one bare-topped summit, intervenes between the nineteenth and twentieth mile, which latter is the commencement of the great barrns. For ten miles further there is very little woods, except in isolated groves and patches; and this chiefly of a stunted growth. The surface is strewn with boulders, in all directions; sometimes piles of huge masses of grnite are congregated in immense quantities. The bed rock, which consists entirely of granitoid varieties, frequently crops out on the surface, forming low rocky ridges, while occasionally, as in the case of the Three Topsails and several other similar tolts, it rises in sharp peaks several hundred feet above the general level. Much of the lower grounds of these plains, however, consists of alluvial deposits of fair soil; and I was surprised to find here, in many places, considerable tracts of good grazing ground. The vegetation consists of a short thick grass mixed with sedge (Sheeps fescue), and seems well adapted for food for cattle of any kind. Should it prove to be so, there is ample pasturage for at least five months of summer, for a large stock of cattle and sheep over these plains; and they possess this advantage, that nowhere are there any dangerous swamps or bogs in which cattle would run the risk of becoming mired. The soil is not deep, and in all cases it rests on a solid foundation of rock or stiff clay. At the thirty-fifth mile the head waters of the eastern branch of Kitty's River were struck, when timber again became more abundant; still, this valley is a poor one. The timber is generally small; there is a good deal of barren and marsh land, and as it cuts through the great hill-range bordering the Humber Valley, it is pretty rugged and uneven throughout. After crossing the main branch of Kitty's River at the forty-fourth mile, we soon entered the Humber Valley proper. A long sloping wooded ridge, which forms the south side of the valley, and extends from Kitty's River Fall to the south-eastern angle of the Grand Lake, afforded a good sidling line whereby to ease the grade down from the higher land. The northern slope of this ridge was followed westward till the lower ground was reached, thence the line struck across the valley towards the Sandy Lake River, and on across the head of Grand Lake to the outlet of Junction River. Most of this section of country is extremely flat, and is composed of low wooded ridges, interspersed with numerous marshes and ponds, and several stout brooks—all tributaries of the Humber—Kitty's River and Goose Pond Brook being the two largest of these. The latter makes a suite of large ponds, occupying a considerable portion of the area. The soil on the higher wooded ridges is very sandy, and contains many boulders; but its character improves on approaching Sandy Lake River. The marshes are however, for the most part, very soft, and are not of as good a character as those towards the Exploits side. There is a good deal of fine interval land along the main river margins, and about the head of Grand Lake. From Junction River towards Deer Lake the country is again quite flat and, for over half the distance across, very marshy; but beyond that it is densely wooded to, and around the head of Deer Lake. The land here is of excellent quality. Both sides of Deer Lake are thickly wooded with a fine growth of forest timber, extending away to the tops of the hill ranges which bound the valley on either side. Nearly all this wooded tract where not too steep to be availed of for agricultural purposes is occupied by a superor soil, very free from large boulders or rocks, and is well adapted for settlement. The average breadth available on the south of the lake is about one mile; while, on the north side, towards the head of the lake, it extends back over two miles. The Main Humber River flowing into the head of the lake, and extending upwards towards the bottom of White Bay, has, in former reports, been shown to contain many large areas of fine land; a great deal of which is interval. A good test of the capabilities of this soil is to be found on the farm ot Mr. George Nichols, a little above the head of Deer Lake. Mr. Nichols is a Nova Scotian lumberer, who has been settled here for some fifteen or twenty years past. He has an extensive clearing, keeps a fine stock of cattle and sheep, and, from all appearances, is in very comfortable circumstances. His vegetables, especially root crops, some of which we had the pleasure of testing last fall, amply prove the adaptability of the soil for such crops. Mr. Nichols informed me that, not only is the soil much superior to that of his native province, Nova Scotia, but that the climate is better; that he can raise any kind of root and grain crops without difficulty. He has annually grown a small quantity of wheat, which yields a fine grain; and considers he could easily raise enough for home consumption had he the means of grinding it into flour. The mutton raised by him was of a superior character. The wool, too, is of the very best quality which Nichols' family spin and weave nearly every article of clothing worn by themselves, besides disposing of a large amount of woollen goods of home manufacture. If one industrious family can do this, and make a comfortable livelihood so far from the seaboard (some thirty miles), there can be no reason whatever why hundreds of others might not do likewise. Nichols assures me that he would rejoice at the prospect of a railway and the speedy settlement of this valley by a large population.

The valley of the Humber below Deer Lake is narrow, and, towards the mouth of the river, is hemmed in by lofty hills of slate and limestone; yet there is a considerable margin of available land on either side, more especially along the steady portion of the river below Deer Lake, which is about eight miles in extent. This marginal fringe is particularly good, perhaps some of the best land seen. I estimate roughly that the main Humber Valley including Deer

Lake and the river above, but excepting Grand Lake and the Sandy River branches, must contain nothing less than 100 square miles, or 64,000 acres of good land, suitable for agricultural purposes, and it is, without exception, one of the most favorable locations for settlement in this Island. The beautiful Deer Lake, sixteen miles long, affords an open coast-line of some thirty-five miles, and a highway, easily accessible from the seaside, not equalled in many places.

Around the head of Bay of Islands and mouth of the Humber the country is pretty rugged, but extremely picturesque; perhaps some of the finest scenery in the Islands is to be found in this bay. About the most difficult part of the entire route for railway construction presents itself here. Getting down to the waterside at the head of the Humber Arm, and up again over the coast hills, though not at all impracticable, will be decidedly the heaviest work on this western extension of the railway system.

Although the coastline is so broken about the Humber Arm, still there are many small patches of fairly good land; that about Corner Brook being considerable. The settlers here are beginning to take a lively interest in the cultivation of the soil; and the opening up of a few lines of road, extending inland from the shore, has proved an incentive to many to settle down in earnest and carve out homes for themselves from the wilderness. The people, on the whole, appear to be fairly prosperous; and, indeed, most of them are quite well-to-do. There was no poverty or dread of hard times during the coming winter expressed by any one whilst we were in the bay. After leaving the coast hills to proceed towards St. George's Lake, we found the country to the south of the Humber Arm very hilly at first, but nearly all densely wooded. Our line followed the narrow valley of Bell's Brook till the summit level was reached; here we found a level lead stretching away toward the latter lake which gave us a fine line for several miles till approaching the lake, when a pretty high ridge had to be surmounted before the lake itself could be reached. The soil along the level is of a very fair quality, tolerably free from rocks and boulders. The slopes of the hills also present a fair quality of soil, in most instances. There are several small marshes on the lower ground, but most of these are grassy. The timber here, as well as all along the route, consists chiefly of spruce, fir and birch. Pine was once abundant on the lower reaches of the Humber and around Deer Lake, but it is now nearly all culled out. Numerous stumps, often of immense size, were come across. I measured some, four and five feet in diameter, and was informed trees even reaching six feet in diameter were at one time found here. Most of the spruce and fir are of fine size and good quality; but the birch scarcely equals that of the Exploits Valley. Witchhazel, or yellow birch, also occurs and is fairly abundant; it, however, does not attain such large dimensions as at Bay St. George, Codroy, or other places further south. Of the less frequent varieties of timber, tamarack, mountain ash, black or swamp ash, aspen, poplar, &c., there is a fair sprinkling. The black ash only grows on the shores of the lake and river. The inhabitants of Bay of Islands avail very much of their splendid timber supply for all purposes connected with their fishery, especially of the fir for making herring barrels. During our traverse down Deer Lake and Humber River last fall, we met them at every turn, passing up or down, encamped in some favored spot cutting timber, making staves, hauling out logs, &c. I noticed that there is an immense amount of waste going on, and vast destruction of valuable timber, especially by the stave-makers. They frequently cut down dozens of fine fir trees, saw off one, or at most two, stave lengths, and leave the remainder to encumber the ground.

The timbered portions of the Grand Lake country and Sandy Lake River are still nearly untouched; but much of the latter country has been overrun by fire. There is still a good deal of green pine about Goose Brook, where also was seen some of the red variety (pinus resinosa). Some magnificent tamarack were observed about the forks of Kitty's River—I think the finest I have ever seen. The timber on the Exploits side is again chiefly spruce, fir, pine, tamarack and white birch; yellow birch being absent altogether. Pine is scattered all along the route for the first eight or ten miles, but is not very abundant anywhere after leaving the valley proper, except on the shores of Lake Bond, on the eastern branch of Rowsell's River where pretty fair groves were observed. As already referred to forest fires are doing a vast amount of damage to our timber resources, each successive year witnessing the destruction of miles upon miles of our forests. The past season has been a more than usually destructive one. Owing to the great heat and long-continued drought, everything in the country was rendered most inflammable; even the very moss and grass on the marshes, usually so moist, were seen to burn like tow. I very much fear that the entire destruction of our forests in this way is only a question of a short time.

Geological Notes.

In an extensive instrumental survey such as that of last season, and for a purpose so opposite to that of a purely geological exploration, it was impossible to devote much attention to a subject which is sufficient to occupy all the time and thought of any individual. My time was necessarily so fully devoted to the work in hand, and my constant presence at the instruments almost precluded any attempt at geological investigation. In any case, the country traversed offered few opportunities of studying the rock structure, it being for the most part hidden by the subsoil and encumbered by forest. Very few exposures of rock were met with at all before reaching the bare granitic region. A tough, bluish slate-rock occurs in a little brook near the third mile; and again, on the shores of Lake Bond a few outcrops of altered slate, with trapean intrusions and much scattered debris of red slate, were come across. These all appeared to correspond with the slates of the Exploits Valley, described in former reports, evidently of lower silurian age. In the Rowsell's Arm valley the granitoid rocks first made their appearance. A conspicuous tolt, about two miles to the left of our line, sends a spur down the valley, which we crossed. It is composed of a coarse, friable, flesh-colored pegmatite. A ledge of similar coarse pegmatite crops out on the ridge forming the eastern slope of the main valley of Rowsell's River, near the fifteenth mile. Altered slate was again seen in the bed of this brook, while the bare-topped ridge on the west side of the valley is composed of contorted mica schist. A great ox-bow bend of the river takes palce here. It sweeps around the ridge near the nineteenth mile, and is crossed again near the twenty-first. Here the bed of the river is occupied by massive beds of a beautiful red granite, eminently suited for ornamental or monumental purposes. It struck me as being almost identical in color and consistency with the celebrated red granite of St. George, New Brunswick, which latter is of very considerable economic importance.

This beautiful rock is worth from $10 to $18 per ton at the quarries, or about $1 per cubic foot in the rough state. The total value of granites worked in the latter Province in 1887 was estimated at $48,281.00. The total value of Canadian granites manufactured and marketed in that year sold for $350,000.00.

All over the barren tract of country, extending from the twentieth to the thirty-fourth or thirty-fifth mile, innumerable outcrops of granite and syenite occur, presenting a variety of building and ornamental material not often surpassed in beauty or durability. Rocks of similar character occur on the Kitty's River; and, at the fall, immense cliffs of syenite bound the river on either side. In the low country of the Humber valley little rock is exposed anywhere. The country is known to be occupied by the carboniferous formation, which spreads out over a very large area, extending from the shores of Deer Lake up the main valley of the river to Addies' Pond, and reaching within a short distance of the head of White Bay; and, on the other hand, across to the Grand Lake, along its shores as far as the eastern end of Sir John Hawley Glover's Island, and up the Sandy Lake River to Sandy Lake—comprising, in all, a total area of not less than 500 square miles. So flat is this district, and so few and far-between are the exposures of the carbonferous strata, that it is difficult to form any conclusion as to the prospects of workable seams of coal occurring within this area. It would take an extended and close investigation of the entire region, the mapping out of every detail of the structure possible to ascertain, before a decided pronouncement on that head would be warranted. It is true, during the years 1879 and 1880, a small section near the head of Grand Lake was partially tested by boring, and the result did not prove satisactory—only four small seams of coal, the largest but sixteen inches thick, were met with. Two others were uncovered, on the surface, on a small brook flowing into the south-eastern corner of the lake, known as Coal Brook; one of these was 11 inches, the other 14 inches in thickness. I can scarcely conceive that in such an extensive area of over 500 square miles, where the presence of coal is indicated at all, there should not be some more promising deposits; and I think it well worthy of consideration as to whether this great central carboniferous trough does not warrant such an extensive exploration as that hinted at above. While on this subject, it may be as well to remark that, previous to last year's investigation of the St. George's Bay carboniferous area, it was generally thought that the latter also was destitute of workable coal seams. It had been regarded as occupied almost entirely by the lower unproductive measures of the formation, viz.: the carboniferous limestone and millstone-grit formations. I now have the satisfaction of informing you that, upon referring the fossil plants then collected to Sir William Dawson, Principal of McGill University, Montreal, and one of the most eminent authorities upon fossil botany in North America, he has, in one of his letters to me, made the following reference thereto: "I may say that the specimens now sent indicate a development of "the coal measures not unlike that of eastern Cape Breton, with "which, I fancy, your beds may be connected under the Gulf. This "is much more evident in the specimens you have sent than in "those previously collected by Mr. Murray, which had the aspect of the lower coal measures, or even of the millstone-grit series."

This is a most important announcement, coming as it does from so distinguished a source. In a later letter, Sir William adds: "Your Government might make a point as to the West "Shore, by informing the English Government of the value of the "coals on the West Coast, and their prospective importance to "Britain and Newfoundland, as well as to the other colonies. *You "have the nearest coal to England on this side the Atlantic."*

A thorough investigation then of this central trough, might have the result of proving that here also the measures are not entirely confined to the lower portion of the formation. This supposition is further borne out from the fact that some at least of the latter, especially the gypsiferous strata, are not known to exist at all so far as the central trough has been examined up to the present time. In traversing the shore of Grand Lake, many fragments of good coal were observed strewn about the beaches which may, or may not, have been derived from those small seams, whose existence was ascertained by the boring operations.

The hills around Deer Lake and the lower valley of the Humber are chiefly composed of a finely micaceous slate rock, interbedded with greyish quartzite, through which numerous quartz veins penetrate; some of these look as if they should carry gold, traces of which, along with silver, were shown, by analysis, to exist in some quartz specimens from Humber Arm, procured by Mr.

Murray; though none was observable by the naked eye. A little over a mile from the mouth of the Humber, the great deposits of marble, so frequently referred to, occur. Until the past season I never had an opportunity of examining this marble before, and certainly had no idea of its enormous volume. There are many varieties of shade and color, ranging from black to pure white; the latter greatly predominating. It rises on either side the river to heights of over 1,000 feet, forming conspicuous and most picturesque scenery. In fact this part of the river presents some of the grandest scenery in this Island. On the left bank an enormous mass, which I have named Marble Head, towers above the river. It is merely the shoulder of a lofty range, extending across to Wild Cove, and how much further I cannot say. The river cuts through this range in a deep narrow gorge, but the hills rise again on the right side, forming an immense bare cliff of white marble, which strikes inward in a south-westerly direction. It has never been traced out, nor is it known how far it extends either way; fragments of white marble were, however, met with on some of the small brooks towards St. George's Lake, ten miles to the westward. That this enormous development of beautiful marbles can fail to become of economic importance some day and form the basis of a great marble industry, it is difficult to believe. Mere surface specimens, such as have hitherto been tested, cannot, in my humble judgment, be accepted as a fair criterion of the character of the deposit throughout. Some purplish slates were observed on the shores of the Humber Arm, which appeared well adapted for roofing purposes. Limestones of various qualities abound, and good building material, with admirable whetstones and grindstones, can be procured amongst the lower carboniferous strata on Junction Brook, or the shores of Grand Lake.

Feasibility for Railway Construction.

With the exception of three or four places, the entire route offers every facility for railway construction, and no insuperable difficulty presents itself. The rise over the wooded ridge, after leaving the Badger River, is somewhat steep at first, being about 250 feet in the first two miles; this gives an up-gradient of about 1 in 42. It can be considerably eased, however, by taking the rising ground obliquely as shown on plan, and then sweeping around the summit with a wide curve; moreover, as there is a fall of twenty feet in the next quarter of a mile, a cutting of ten or twelve feet at the highest point would still further lessen the grade. After surmounting this ridge the country is gently undulating for the next five miles to the head of Lake Bond, the highest level being about fifty feet. Lake Bond is 257 feet above the Badger, or only seven feet above the summit of the ridge at the second mile. Between the seventh and eleventh miles the surface is more uneven, there is a rise, by aneroid, of 170 feet in the first mile-and-a-half, or about 1 in 46. Then a fall of eighty-three feet to Rowsell's River (East Branch), in a distance of fifty-five chains. This equals a down grade of about 1 in 44. The summit of the ridge on the west side of the valley, one-and-a-half miles further, gives a rise of 195 feet, or about 1 in 40. I believe this section can be greatly modified and sufficiently easy gradients obtained, by locating the line more to the left, winding around the hills as shown on the plan, so as to take the lowest elevations of the ridges and a somewhat higher level in crossing Rowsell's River Valley. For the next two miles the country is fairly level till reaching the ridge on the east side of the valley of the main branch of Rowsell's River, where a considerable fall occurs of 321 feet down to the river, in a distance of one mile and three-quarters. Here again a tract of level country intervenes a mile-and-a-half in extent on the opposite side of the river. A still higher ridge with bare summit forms the west side of the valley, which attains to a height of 558 feet above the level of the brook, with a fall on the opposite side of about 207 feet. All these very considerable elevations and depressions occur within a total distance of only five miles, and would appear to present almost insuperable obstacles, were it not possible to avoid or lessen them in some measure. This, I conceive, can be effected by making a considerable double curve, beginning about the tenth mile, and at an average distance of a mile to the left of our line. Such a curve, winding around the two steep ridges of the eastern valley, would bring the line out through a gap in the hills of the main valley at a point higher up, and directly opposite which on the west side is a gorge, through which the Main River sweeps around the higher hill at a much lower level, probably little less than 200 feet below the summit of the ridge. An examination of this latter route convinced me that it is decidedly the most feasible, although another might be found to the right of our line if it were considered more direct on actual location. From the commencement of the barrens at the twentieth mile, the country assumes a more evently rolling aspect, with no very considerable elevations or depressions, along the immediate route followed. Isolated tolts rise here and there on either side, the most conspicuous of which are the so-called Topsails, which lie in a direct line, at nearly equal intervals apart on the central ridge or summit level of the country, trending nearly east and west magnetic. This ridge was crossed between the twenty-seventh and twenty-ninth miles, at an elevation of 1,036 feet above the Badger River, or about 1,380 feet above sea level. The nearest or main Topsail, distant about a mile and a half to the east of our line, rose above this point 306 feet, which gives it an elevation of 1,686 feet above sea level. Once past this dividing ridge, a regular down grade takes place to the headwaters of Kitty's River, about the thirty-fifth mile. The total fall in a distance of eight miles only amounts to about 200 feet, that is, 1 in 211 —a very easy gradient. From the thirty-fifth mile the fall down Kitty's River valley becomes more and more rapid. It reaches 130 feet at the first crossing of the river, just at the thirty-seventh mile, making a down grade of 1 in 81. In the next four miles, which reaches just below the fork of the river, a fall of 235 feet occurs, equal to 1 in 90, and in the next three miles, to the crossing of the main branch above Kitty's Brook Fall 344 feet, or about 1 in 46. From Kitty's Brook to the commencement of the flat country bordering the main river, or Sandy Lake branch of the Humber, there is a fall of some 200 feet in a distance of about three miles, or about 1 in 80. The total fall from this to the head of Grand Lake is not much over 150 or 160 feet more in about nine miles. Here a choice of several routes may be selected across this valley; but that represented on the plan is the most direct. It passes inside the suite of ponds on Goose Brook, and strikes across the head of the Grand Lake in a nearly straight line, avoiding, as far as possible, the more marshy or swampy ground. Sandy Lake River is crossed about one mile from its entrance into the Grand Lake just beyond the fifty-fifth mi,le of distance. Five miles more reaches across the head of Grand Lake and the outflowing, or Junction River. The line over this section is made to curve slightly to the left, so as to avoid some very extensive and heavy marshes further inland, and also to touch the shore of the Lake at a convenient point for a station. The crossing at Junction River is also well adapted for a stopping place, forming as it does a convenient and safe harbor of refuge for boats or other craft which may be employed on the lake. The country between Grand and Deer Lakes is extremely flat and occupied by extensive marshes, to avoid which as far as possible, and at the same time make the most direct course, the line is located on the plan to the west of the telegraph line, which latter was here followed; and not far from the base of the high wooded ridge of hills forming the neck of land between the two lakes. The distance from lake to lake is just nine miles, with a total fall of not much more than 100 feet. An almost perfectly level line might be constructed here, if required. The sixty-ninth mile nearly touches the shore of Deer Lake close by the present telegraph station. Between the seventy-second and seventy-third miles there is a most eligible site for a railway station, at a place called Little Harbor, which affords a safe refuge for boats or small craft. The line extends along the south shore of the lake to this point at a short distance back, but beyond the seventy-third mile a pretty steep ridge, with a considerable fall to Pinn's Brook necessitated striking more inland. It would cross the latter brook about a mile and a half from the lake side, and, with a wide, gentle curve, sweep out towards the lake, tapping it again at the eightieth mile. From this point another sweep inland is required to cross the low valley of South Brook. The shore is tapped again at the eighty-third mile and followed thence closely to the foot of the lake, two miles further. The gradients along the side of the lake, with a few exceptions, are quite easy, and there is ample room to locate the line anywhere between the shore and the base of the wooded ridge, extending along its course at an average distance of about a mile back. From the foot of the lake the south side of the lower Humber is followed, at a short distance from the river, to the end of the Steady Water, eight miles below. Here the hills begin to close in, and the valley becomes very narrow and precipitous. After vainly seeking for an opening through the hills leading out to Humber Arm, we were compelled to follow closely the river bank as the only practicable line at all offering at this point. From the ninety-third to the ninety-sixth mile will be a most difficult section. The river bank must necessarily be closely followed, and at two points considerable rock cutting will be required; first, near the niety-third, and again between the ninety-fourth and ninety-fifth miles. At the latter point a sheer precipice abuts the river, leaving no margin at all for about 60 or 70 yards. The face of this cliff will have to be cut down some 30 or 40 feet; but I think tunnelling would be much preferable. In the former case a dangerous cliff would remain above, always menacing destruction to a passing train; and in any case there would be a very sharp curve required to get around the cliff. By tunnelling all danger from the falling debris would be avoided and the sharp curve almost if not entirely removed. The cliff is composed of a rather soft mica slate and as the tunnel need not exceed 100 yards in length I do not think it would be a costly undertaking. Once beyond this, a fairly good line is found down to the mouth of the river; but there is a pretty steep up-grade at one part, near the ninety-sixth mile. Fo rthe next two miles, where it sweeps gently around the point of land at the head of Humber Arm, between the main river and Corner Brook, it is excellent. On approaching the latter, however, a very considerable difficulty again presents itself. The land falls quite suddenly from a height of about 100 feet above H. W. M. to a little over 20 or 30 feet. The valley of Corner Brook is very uneven, with several isolated hills and deep depressions succeeding each other at short intervals. To overcome these difficulties it was found necessary to make a short backward curve running up the side of the deep valley, then another sharp curve around the head of the valley, so as to gain the opposite side, and then run down to Corner Brook, which was crossed about a mile from its outlet, where still another sharp curve is necessitated. To some extent the curves might be lessened, and grades eased, by a heavy trustle-work across the first ravine, or possibly the line might be located further out towards the shore. Another possible route, which is indicated in a broken line on the plan, may be found by going back to the ninety-fifth mile, or perhaps to the tunnel, and beginning to rise from thence, with a pretty stiff up-grade, so as to gain the top of the ridge above Brake's Landing, and thence come down inside the outer range of hills, crossing Corner Brook at the position of the present mill-dam. The distance would be about three miles and a half, and the total rise and fall about 300 feet. After crossing Corner Brook the line runs up a gap in the hills, along the valley of a small tributary known as Bell's Brook, where a rise of over 600 feet takes place in about three miles. This would give a very steep grade of about 200 feet per mile. It will be seen from the above that getting down to the water side at Humber Arm, and up again over the hills in the direction of St. George's Lake, present the greatest engineering difficulties met with on the entire route. A much more extended examination will be required at this point before it can be satisfactorily determined as to whether these difficulties can be sufficiently modified to admit of a feasible line here. At present, the only way I could see of partially overcoming this was by means of a Y line, to run out along the shore, after crossing Corner Brook, for about a mile and a half thereby gaining some 100 or more feet in rise; then back with a curve around the side of Bell's Brook valley, with a steep upgrade till the height of land is reached, about the hundred and third mile. The Y would also reach the shore of the Arm at an admirable point for a terminus, where the water is deep close to the shore, and a projecting point affords shelter for a wharf. This terminus is just beyond the hundredth mile from Badger Brook. Provided the difficulty at Corner Brook can be surmounted, and the height of land rendered accessible, no other presents itself till nearing the end of our line, or the one hundred and thirteenth mile. From the one hundred and third to the one hundred and twelfth is an admirable line, almost level; but it then begins to rise rapidly, and reaches a height of over three hundred feet where we left off. I believe the grades here can be rendered sufficiently easy by crossing the valley at the head of Cole's Pond, taking the rising ground near the eleventh mile or further back, and thus climbing gradually the side of the hill, so as to distribute the rise over some two and a half or three miles. On the other side of this ridge there will probably be a fall again to St. George's Lake of from 200 to 250 feet; but beyond that, in the further extension to the head of St. George's Bay, I do not anticipate any very heavy gradients, considering the total fall from St. George's Lake is not much over 600 feet in a distance of twenty miles.

The bridging along this route is comparatively light—no very heavy or expensive structures being required. For the first thirty-seven miles from the Badger to the crossing of the eastern branch of Kitty's Brook there will be scarcely one structure worthy of the name. The line, as located on the plan, passes round by the great bend of Rowsell's River, thus avoiding entirely two considerable bridges. The east branch of Kitty's Brook, where crossed, presents very steep banks on either side, where some heavy abutments will be needed; but the actual span in the centre will not exceed 100 feet. There is a low, rocky islet at this point, which might be utilized for a central supporting pier. The crossing of the main brook above Kitty's Fall is admirably situated. A high wall of solid syenite rises on either side, forming natural abutments, with a span across the top of only 86 feet. If, upon further survey, a more favorable line were found down this valley by following the south side of the eastern branch and crossing the main river above the fork, the necessity for the first of these bridges would be entirely obviated. Two branches of Goose Pond Brook are crossed, but the bridging of these will be light work. The two most extensive structures on the line are at the crossing of Sandy Lake River above Grand Lake, and the Junction River near its exit from the Lake. The former gives a span of about 300 feet, and the latter about 550 feet. In each case, however, the water is shallow, the bed of the river hard gravel, and no danger need be anticipated from ice, as it does not raft here as elsewhere on our rivers. Owing to the flat nature of the country, the comparatively even flow of the water, and the great expanse of the Grand Lake, the ice breaks up gradually, or rather thaws out slowly. No indication of rafting, such as the barking of the trees close to the water's edge, as is seen on the Exploits and other large rivers, was observed anywhere; consequently, these two rivers can be bridged with piers erected on their beds, with short spans between, thus rendering the construction really more feasible than on many smaller but more turbulent streams. None of the numerous small streams crossed between Grand Lake and Bay of Islands have spans of over 100 or 150 feet; but in many instances they have cut so deeply through the heavy clay and gravelly soils as to leave deep ravines often 100 yards or more wide at the top. All these can be filled in from either side or crossed by means of trestlework with short central spans. Corner Brook will require one of the heaviest structures on the entire line; but a good deal will depend upon the actual site selected. Should it be desirable to bridge the river at the place where the present mill-dam is situated, a very sharp bend just above will necessitate three spans, close together, of considerable extent. In this case, I would recommend cutting across this bend, diverting the course of the brook into one straight channel, and then filling up the portion drained. It would be easy to accomplish this, and only means a matter of dollars and cents as to which would be the least expensive course or most durable work.

So far as the line has been surveyed towards St. George's Lake, but few bridges, all light structures, are required. On the unfinished part of the section towards St. George's Bay, there will be two bridges of considerable size—One over the Harry's River below St. George's Lake and the other across the Bottom Brook, or St. George's River, at the Head of the Main Gut. This latter will be a pretty expensive structure, as the river here is wide and rather rough. Two other small structures will be required at the crossings of the Spruce and Trout Brooks, tributaries of Harry's River; but the span over these latter will be short, probably not over fifty or sixty feet in each case. Should the line be continued to the Seal Rocks, south side of Flat Bay, and the latter made the terminus on the West Coast, another bridge of large proportions will be necessitated at the crossing of Little Barrachois River.

Nowhere along the route does any scarcity of material eminently suitable for a road-bed exist. Building-stone for abutments and culverts can be procured in abundance, especially over the granitic region, and there is ample timber for sleepers and all the lighter wooden structures required, except over that section of barren country between the twentieth and thirtieth miles.

The Museum.

This institution continues to maintain its attractiveness, and is the constant resort of a large concourse of visitors on every open day. During the past summer it was deemed advisable to keep it open every week day, to accommodate the many strangers coming here from abroad, at that season of the year. Many additions have been made to the collection of specimens, chiefly the voluntary contributions of those who take an interest in the institution. Others were acquired, as usual, by purchase. Amongst those who have presented valuable and interesting specimens, I may mention the following:—Rev. M. Harvey, a skull of the bottle-nose whale; Mr. Adolph Nielsen, two small bottles refined cod-liver oil from Norway; Mr. John Martin, one grenadier fish; Mr. W. W. Bonnyn, C. E., several interesting coins; Mr. Golder, Harbor Grace, a fine sturgeon; Hon. James Pitts, one porcupine fish; Mr. Eugene Forsey, Grand Bank, a young crab in the shell of a *Lunatia heros;* Mr. John Burke, Little Placentia, head of an orc, *Delphinus orca;* Mr. Jas. Murray, M.H.A., one golden-winged wood-pecker, *Colaptes Auratus;* Mr. Studdy, M.H.A., some eggs of the same bird; Mr. McNeil, some bird's eggs from Labrador; Captain Delaney, an Esquimaux stone pot, from Labrador; Mr. Gibson, Canada, a splendid specimen of Canadian asbestos; Mr. Brockington, several articles of manufactured asbestos, by Chalmers, Spence & Co., of Boston, from specimens of Newfoundland mineral. A case of stuffed native birds; also one young horned owl, *Bubo virginianus;* one shrike, *Lanius borealis;* one Canada jay, *Perisoreus Canadensis;* one rusty grackle, *Selecophagus ferrugineus,* and one walrus skull, *Trichechus Rosmarus,* were purchased, besides two beautiful models, in alabaster, (selenite or crystalized gypsum) of an Italian gun-boat and steamer.

Having been supplied during the past season, in the field, with a camera and photographic outfit, I was enabled to obtain several very interesting views of the scenery in the interior, which are now on exhibition in the museum. This mode of illustrating the scenic and economic resources of the country is a great acquisition, and had I been placed in the same position years ago, I should now have had an exceedingly interesting and valuable collection of photographs of native scenery. There can be no doubt that such a means of exhibiting the internal resources of the Island to the public generally, would have conveyed a more adequate idea of what these resources really are, than all that has hitherto been written or published in the way of reports, &c.

In conclusion, I would again respectfully beg to draw your attention to the necessity of effecting some insurance upon this now very valuable collection.

Hoping this suggestion will meet with favorable consideration,

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XI.

Report for 1891 and 1892, on the Humber Valley and Central Carboniferous Area of the Island.

Geological Survey of Newfoundland,
March 31st, 1892.

Honourable Surveyor General,—

SIR,—I have the honor to submit the following report of the operations of the Geological Survey during the season of 1891.

Acting upon a suggestion contained in the report for the preceding year, with reference to the possible existence of valuable coal deposits in the central Carboniferous area of the island, the Government were pleased to direct that a more minute investigation of this region be undertaken. Accordingly, as soon as the necessary preparations for the season's work could be completed, our party started for the Bay of Islands, embarked at Humber Arm, and proceeded up the Humber River in a boat and canoes; our objective point being the Grand Lake valley, or southern branch of the Humber River. As a considerable delay had necessarily to be incurred in getting all the season's provisions, boats, camp gear, &c., over the Grand Lake portage to the latter lake—a distance of about eight miles—I availed of this delay to make a flying journey up the main Humber towards White Bay, in order to investigate a rumour relative to the existence of coal in that direction. In the meantime, Mr. Bayly had instructions to proceed to the Grand Lake, and when everything was safely portaged, to store our provisions in huts—one at the outlet of the Junction River, and one at the mouth of the inflowing Sandy Lake River—so as to have them convenient for use while working around the shores of the lake. This being accomplished, he was further instructed to sink a series of pits along the north shore of the lake, at points indicated, where it was hoped the underlying bed rock might be reached, and a clue to the structure thereby obtained; with what result will appear later. Taking along with me two Indians and a single canoe, I continued up the Main River, investigating the structure as I went, whenever an opportunity presented itself. Having reached the great bend, where the river forks and forms two considerable streams, the one known as Birchy Pond Brook, leading up north-easterly, in the direction of our route, was then followed. Birchy Pond is a shallow, sandy lake, surrounded by low land. A beautiful steady, winding about through a fine tract of flat intervale, extends beyond the lake two or three miles; then the river approaches the surrounding hill ranges, where it is split up into several smaller streams, which are of two rocky and turbulent a nature to admit of further progress by canoe. Selecting one of these, which led upwards in a general course about east-north-east, and being provided with several days' provisions, &c., we proceeded on foot, following the course of the stream, until it became so exceedingly rugged and walled in by cliffs of greyish gneiss, as to compel us to abandon the brook and take to the forest. Our progress was necessarily slow, and it took three days to reach the point aimed at. This was a suite of long, narrow lakes situated in a deep gorge, hemmed in by lofty hills—which upon the north side of the upper lakes rise directly from the water's edge. On the last lake of the suite, a gigantic cliff of light-coloured rock formed a perpendicular wall of great height all along the north side. This proved to be composed almost entirely of white, or light-coloured marbles, similar to those at the mouth of the Humber River. All the surroundings, together with the situation of the lakes, and the remarkably conspicuous feature presented by the marble cliffs, left no doubt as to the identity of the place described to me. Similar marbles had been previously recognized in journeying up the brook, though not in so great a volume. The existence of these deposits had been hitherto unknown, and probably might have remained so for many years to come, but for the accidental circumstances which led us to explore this particular locality the present season. On ascending the high land to the northward of the lakes, in order to better define our position, we found that but a comparatively short distance separated us from the waters of White Bay. Several large bergs of last season's ice-floe still floated about on the bosom of the placid waters. Partridge Point, forming the entrance to the Bay was clearly visible away to the eastward, while the deep, sombre valley intersecting the hill range, apparently almost alongside, indicated the position of Sopp's Arm on the north side of the bay. As, however, our time was limited, and we had no particular object in visiting the shores of White Bay, we began to retrace our steps, closely scrutinizing our surroundings as we journeyed along. It soon became quite evident that, while the information furnished relative to the physical features of this part of the country was exceedingly accurate and reliable, yet, in the more important point: that of the existence of a coal deposit hereabouts, the imagination of the informant had been drawn upon too extensively. Not only was there no probability of coal occurring in the neighbourhood, but the entire absence, even of a single member of the Carboniferous series, was most apparent. In fact, the surrounding country was constituted of rocks clearly belonging to the great Laurentian and Lower Silurian epochs. We had left the basic conglomerate of the Carboniferous basin, of the Humber Valley, far down the river on our first day's journey.

Being quite satisfied of the inaccuracy of the information furnished me with regard to the existence of a coal deposit here, no time was lost, therefore, in useless search. An immediate retreat was commenced down the Humber to Junction Brook, whence we portaged across to the Grand Lake, where we rejoined Mr. Bayly and party. They had been so far unsuccessful in their operations at the head of the lake, being met everywhere by such an immense superficial deposit of sand, gravel and boulders, as to utterly preclude the possibility of reaching the bed rock, by means of surface cuttigs. Nevertheless they came across numerous loose fragments of coal scattered through the gravel, and also some pieces of rock containing fossil plants, of a character which indicated pretty clearly that true coal measures lay beneath. Having spent a few more days in a further attempt to reach the latter, we then moved camp across the lake to the mouth of Coal Brook. Here a regular system of costeaning was carried out along both sides of the brook, as far as the measures were accessible. Later on, we again moved camp two miles westward, to a small brook called Aldery Brook, where good sections were exposed in like manner. Some considerable work was also accomplished on two other small brooks flowing into the lake on the south side—one about midway between Coal and Aldery Brooks, and the other about a mile still further west. The sections exposed on these latter, were not, however, nearly so extensive or easily reached as on the former brooks, owing to the great depth of the surface acumulations. Details of the sections uncovered on Coal and Aldery Brooks, will be found further on, under the head of Geological Structure.

While these costeaning operations were in progress near the head of the lake, Messrs. Bayly and Thorburn, with an Indian, ascended Sandy Lake stream, and make a survey of the Goose Pond tributary, where it was hoped some rock exposures, affording a clue to the structure in that direction, might exhibit themselves. In this, again, we were disappointed; no such exposure of the bed rock occurring so far as the survey extended. Later on, an expedition was undertaken to the extreme western end of the Great Lake, partly to investigate another rumor referring to a coal seam having been seen in that direction, but chiefly to make a re-survey of the lake itself; more especially the southern reach inside Sir John Hawley Glover's Island, a portion not hitherto finished. It was now well up in October, and the weather, which all throughout the summer had been of an exceptionally favorable character began at last to break. The prospect of accomplishing any more work here for this season, with pick and shovel, was at an end. We accordingly packed up and got across the lake again, being delayed several days, owing to the stormy character of the weather. Before leaving the portage we experienced some slight snow showers, and for days the distant Bonne Bay hills to the north wore quite a winterish aspect.

On arriving at the marble cliffs near the mouth of Humber River, it was the intention to spend several days there, endeavoring to procure some good specimens of the rock; but almost immediately I received your telegram, requesting me to visit and inspect the asbestos deposits near St. George's Lake. The time intervening till the arrival and departure of the mail boat, left me but three or four days at the outside to accomplish the journey in, consequently I had not a moment to spare. Leaving Mr. Bayly to procure the marble specimens, I started on foot with two Indians, from the Humber Sound, and after a day and a half of exceedingly hard travel arrived at the place. Capt. Prideaux, in charge of the works at the time of my visit, kindly housed me while there, and showed me the various openings and outcrops in the vicinity of the mine. In the meantime the weather had set in wretchedly cold, wet and stormy. Seeing that I now ran a great risk of missing the steamer were I to return to Bay of Islands, I concluded instead to continue on to Bay St. George, which course would give me at least an extra day. Another object was held in view by the adoption of this route, viz.: to acquire a more accurate knowledge of the country hence, such as would enable me to lay down, with tolerable certainty, the route of that portion of the western extension of the Railway, which circumstances prevented our completing last season. Two days' journey took us out to Sandy Point, where we found that a steamer had not yet arrived coming west, having been greatly delayed on her passage up by the extremely boisterous character of the weather of late.

THE HUMBER VALLEY.

It may seem needless on my part to enter into a lengthened description of the topographical and physical features of the lovely Humber Valley in the present instance. The subject has been so frequently treated of before in previous reports, letters, papers, etc., that there would appear to be nothing further to add on this head. As, however, each season's exploration tends to extend our knowledge of the country generally, and as there still lingers in the minds of many persons a considerable amount of scepticism as regards the truth of these reports, especially in reference to the existence of good agricultural lands, extensive timber forests, and valuable mineral deposits, etc., a certain amount of repetition is clearly unavoidable.

The introduction of the camera into our survey outfit during the past two years, has done much to dispel these doubts; but, in order to render this means of appeal to common sense and reason more effective, I have prepared a series of views illustrative of the scenic beauty of the splendid valley to accompany the present report. They will convey a far better idea of what this section of country is really like, than anything I could write on the subpect.*

For the first two miles of its course the Humber River runs in a deep, narrow, crooked gorge, or canyon, where during the lapse of ages it has cut a passage for itself through the lofty coast range into the Humber Sound. Beyond this, the river expands into a wide stream with smooth flowing current which is unbroken by

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*Could not succeed in having the engravings done in time.

rapids or rough water for nearly eight miles. This is called the Lower Steady of the Humber. The valley continues narrow, but gradually increases in width, and the marginal fringe of low land on either side becomes more level, and covered with very superior soil as Deer Lake is approached. Though still densely timbered along these lower reaches by spruce, fir, yellow and white birch, etc., yet all the available pine which once grew here in great luxuriance, and of excellent quality, has long been culled out. Nothing but the stumps are now left to testify to the size and character of this particular timber. The beautiful Deer Lake, sixteen miles long, is separated from the steady by about one mile of running water, terminating with a short, strong rapid, known as Fisher's Rapid. On either side the lake, the hills recede further and further back, till on approaching the head, a very wide area of low wooded country extends away from its shores, and stretches far to the eastward up the Main River Valley. Several beautiful patches of good intervale land occur wherever any tributary brook flows into the lake. Those on the valley of South Brook, near the south-west corner, and North Brook, near the head of the lake, are of considerable extent. A small section near the mouth of the former has been partially cleared, and has yielded excellent and abundant hay crops for many years past. Nichols' farm, about a mile above the lake, on the main river, has been frequently adverted to, especially in last year's report. I doubt if the soil here could be surpassed by anything in the Lower Provinces of Canada, certainly not, so far as I have had an opportunity of comparing them. The dense forest surrounding Deer Lake has also long since been culled of its pine, but there is much valuable spruce and fir, especially the latter, still intact, while white and yellow birch are very abundant and of fine size. Here also grows, more profusely than I have seen it elsewhere, the black ash (*Fraxinus Sambucifolia.*)

From the head of Deer Lake, the Valley of the Humber extends for miles to the north, east and south, bounded only in the far distance by the hill ranges, which constitute its marginal out line. The extent of this part of the valley is not less than (20) twenty miles wide by about (25) twenty-five long, including an area of 500 square miles. The narrow valleys of the Lower Humber and Grand Lake, and also that above Sandy Lake on the southern branch added to the above give a total of about 800 square miles as comprising the area of the Humber Valley proper. Two parallel water systems constitute the main drainage of the region. They might almost be considered distinct, were it not that they are connected by Junction Brook, running almost at right angles to either, through which the Grand Lake discharges its waters into the main Humber. It would appear as though, at no very remote date, the Grand Lake waters really had their outlet at the western end of the lake, and discharged into St. George's Bay, nor would it be a very difficult feat of engineering skill to cause the waters again to resume their old-time channel.

The ascent of the main branch above Deer Lake for some five miles, to where it is joined on the south side by Junction Brook, is quite easy—the river being wide and smooth, with a deep, gently-flowing current. The country on either side is very flat and densely timbered, the land being all of superior quality. At the mouths of some of the smaller tributaries there are extensive tracts of magnificent intervale. A mile above Junction Brook the first bad rapid occurs upon the river, and from thence to Willow Steady, some two miles further, a succession of low, rocky ledges strike across, causing shallow bars and broken water; many portions also being encumbered with boulders. Willow Steady is a beautiful spot. The broad expanse of smooth water is studded with well wooded islands, the timber being chiefly birch and poplar, while the land on either side of the Steady is level, densely wooded, and the soil exceptionally good. A long interval of some twelve miles of more or less broken water and occasional strong rapids, but with frequent shoal, sandy bars and smooth current, intervenes, between Willow and the Upper Steady of the Humber. Low ledges of sandstone, shales, marls, etc., crop out along this section, and at two points produce falls, one of which (the Big Fall) has a jump of ten or twelve feet over a ledge of coarse conglomerate which strikes directly across the river. The entire country along this section is again well wooded, though some of the coarser sandstones coming to the surface produce at times patches of more or less barren land, covered only with a thin soil. In the vicinity of the Big Fall fire has laid bare a very extensive tract of country on either side of the river; but there is a vigorous growth of young timber, chiefly birch, rapidly taking the place of the denuded forest. Four miles above the Big Fall commences the beautiful Upper Steady of the Humber, extending, with little interruption, to the great bend and fork of the river nine miles above. This section of the valley is very low and flat, and chiefly composed of aldery intervale land. The river is here split up into several channels intersecting the low ground, and cutting it up into numerous flat islands or intervales, elevated only a few feet above the ordinary summer level of the water. The soil of which this intervale is composed is exceedingly rich, deep, and free from stones, and undoubtedly ranks amongst the very best in the island. It is usually a dark, rich-brown loam, containing much vegetable matter, together with other elements eminently calculated to produce fertility. Owing to its slight elevation above the river, it is periodically covered by the overflow during the spring freshets. This only tends to further enrich and add to its productiveness by depositing from the surcharged waters a thin stratum of silt each time. Whenever these lands are brought under proper cultivation, I have no hesitation in pronouncing the opinion that they will produce the finest hay or cereal crops with the minimum of labour or use of artificial fertilizers. From the forks the intervale land was found to extend up the Birchy Pond Branch some four miles further, being especially of excellent character around Birchy Pond. On the other branch, which runs directly west from the fork, and at ten miles above expands into Adie's Pond, there is also a good deal of fine intervale land and much heavily-timbered country. Along these upper reaches of the river the timber is still almost untouched. Only now are the proprietors of the Humber saw-mill beginning to push forward in this direction, and as there is a very considerable quantity of pine (besides the spruce, fir, and birch) covering a large area on this branch of river, there seems every prospect of the mill-owners finding ample material to prosecute their lumbering industry here for many years to come.

Turning now to the southern branch or Grand Lake valley of the Humber, we find an immense plateau lying between the two waters covering an area of over one hundred square miles, which is more or less densely timbered, but interspersed throughout with marshes and ponds. Much of the surface soil covering this large tract of country appears to be rather sandy; but there are also extensive patches of good land and marshy intervale, especially along the numerous small tributary brooks. Exactly similar lands in New Brunswick, when properly cleared and cultivated, make good farms and bear excellent crops of hay and cereals. The southern or Grand Lake basin includes the whole of the long, narrow valley which embraces the Grand Lake and the country extending eastward up the Sandy Lake river to Sandy Lake, and the valley above the latter to the Upper Birchy Pond, which forms the headwaters of this branch of the Humber. The area of this latter valley is about 150 square miles. With the exception of a narrow fringe along the shores of the Grand Lake, which in most cases might be availed of for cultivation, most of the surrounding country is very high and mountainous, especially on the upper and western half of the lake. Very much of the low country north and east of the Grand Lake, and between it and Sandy Lake, is marshy or otherwise composed of low, barren, sandy ridges, and it was proven by the boring in 1879, and by our subsequent excavations, that this character of superficial deposit attains a great depth all over the region. It cannot be called a good soil by any means, though capable of much improvement by cultivation and blending of its various elements. Those portions more densely timbered, as along the shores of Grand Lake and on the Goose Brook Valley, show a better quality of soil; and there are many tracts of intervale on the Main Brook and tributary streams. The densely-timbered slopes along the margin of Grand Lake exhibit all the usual variety of forest-growth, common to this island, in great profusion. White pine is particularly abundant in some places, and is pretty fairly distributed throughout as far as the eastern half of Sir John H. Glover's Island. Eastward from the head of the lake most of the timbered parts of the country lying between Grand and Sandy Lakes display a fair proportion of pine. On the Goose Brook tributary, near Sandy Lake, some good specimens of the red pine (*pinus resinosa*) were observed last year. Up to the present this section of the Humber Valley has scarcely been encroached upon by the lumber men, who found the difficulty and danger of running logs down Junction Brook too much to cope with. Here, too, so far, the forest has escaped destruction from fires, though much damage was done thereby near Sandy Lake and above some years ago. The wealth of the timber resources still available on the magnificent Humber Valley, together with the superior quality of soil covering so large an area and capable of being cultivated to advantage, far exceeds anything on the eastern side of the island. It may safely be estimated that at least four hundred out of the eight hundred square miles which comprise the entire valley are of this favourable character, while I have little hesitation in saying that half the remainder would compare favorably with most of the land cleared and cultivated on the eastern seaboard. Its capabilities have been fairly tested at one or two points, notably Nichols' farm, Deer Lake, so frequently alluded to. Nichols is quite confident of his being able to raise wheat crops every year without difficulty, and, in proof thereof, furnished me with an excellent sample of grain grown on his farm last season.* The picture of Nichols' clearing will afford a good idea of the country there about, while those of Willow and Upper Steady will convey a much better conception of the flat, timbered country and extent of intervale land, than any written description. In point of scenic beauty, however, the views on the Lower Humber and along the Grand Lake are much to be preferred, especially those charming cascades of which there are probably a hundred or more around the shores of the Grand Lake and on the Great Island. The beauty and variety of the scenery alone is likely to attract many tourists to this region in the near future, so soon as better facilities for reaching it than those at present existing are afforded. In this connection I would strongly urge that, in the meantime, the Grand Lake portage be improved, and rendered somewhat more passable than it is. The expenditure of a couple of hundred dollars in clearing, stumping, and draining the track would prove a great benefit to wayfarers crossing this part of the island, especially to the telegraph people at Sandy Lake station.

GEOLOGICAL STRUCTURE

The hill ranges which form the marginal outline of the Humber Valley are, as might be expected, composed of various geological formations, or portions thereof, but as these have been frequently treated of in former reports, it is not my intention at present to

*Since the above was written, Nichols was presented with a small sample of the Ladoga Russian wheat, introduced here by His Excellency Sir Terence O'Brien, K.C.M.G. It grew most luxuriantly last season, 1892, and the grain raised from this sample (some of which is now in the museum) has been pronounced, by those competent to judge, of a very superior quality.

enter into details of their structure. A general outline of their distribution and chief characteristics, as observed at various points, will sufficiently indicate their prevailing geological features. The gorge of the Lower Humber is walled in by immense cliffs of bluish gray mica slate, interstratified with grey quartzites and immense beds of limestone. All these rocks are greatly crumpled and folded into huge, billowy undulations. They have apparently undergone much metamorphism, and the limestones in particular have nearly all lost their original character. They now constitute a variety of beautiful marbles, ranging from pure, white statuary, through various shades of yellow, red, drab, grey, etc., to black. This is the well-known Humber marble deposit, a good idea of which may be gathered from the views of Marble Head, and the marble cliff, nearly opposite; while the bird's-eye view down the gorge fairly illustrates this interesting portion of the river.

These valuable marbles have never as yet been properly tested, nor has their distribution been followed out beyond a very limited extent. Their strike, which is nearly at right angles to the course of the river, or N. 25° E., S. 25° W., magnetic, would carry them in the one direction, towards the head of Adie's Pond, where they pass beneath the overlying Carboniferous series, which latter rest for a long distance directly upon the Laurentian gneiss of the Long Range Mountains. The slates with their accompanying marbles reappear, as already shown, towards the shores of White Bay, on a small tributary of the Humber, and in the same general line of strike. In all probability their equivalents will be found on the sea shore of Little Coney Arm, White Bay, amongst the rocks described by Mr. Murray, in his Section (page 16) Report for 1864, and again in the marble deposits of Canada Bay. In their western extension, all we know as yet is the occurrence of altered limestones on the headwaters of Harry's Brook, and also the brook flowing into the extreme western end of the Grand Lake, which, from certain resemblances, and their position in relation to the mica slates and general strike of the beds, would seem to indicate that they are the same. Some thin, impure beds of dirty white and flesh-colored, coarsely crystalline marbles, with thin strings of mica running through them, arranged in parallel layers, were met with near the extreme western end of the Grand Lake this season, dipping toward the S. Eastward. This rock exactly answers the description of a limestone or marble identified by Mr. Murray at Hauling Point, White Bay, in 1864, which he believed then to be the equivalent of those at Coney Arm, on the north side of the bay. No doubt, should these immense marble deposits ever become utilized for building or ornamental purposes, and prove of sufficient economic importance, the work of tracing out their distribution more thoroughly will soon follow. In all probability it will be found almost continuous between the two extreme points at which they have been recognized—a distance of over one hundred miles.

Slates, quartzites, &c., similar to those described above, form all the hill ranges along the Lower Humber, and the shores of Deer Lake for some three miles, or up to the point opposite Burnt Island. They are much folded and contorted, and have evidently undergone considerable metamorphism. The same strata, very much broken and faulted, are repeated over and over again. Numerous quartz veins intersect these slates throughout, and at Burnt Island, on Deer Lake, some of these have been found to contain small quantities of molybdenite in specks or thin plates. An attempt at mining this ore, under the impression that it was galena, was made here some years since, but soon abandoned on finding it so sparsely disseminated through the quartz. In a cove just beyond Burnt Island, the slates and quartzites strike inland, and are succeeded at a short interval by the basic members of the Carboniferous series. In their southerly extension, the same rocks continue to form the marginal fringe or lip of the valley, sweeping around the eastern foot-hills of the Laurentian Ridge, which occupies the tongue of land between the two great lakes—Deer Lake and Grand Lake—they strike all along the north side of the latter a short distance back, and run out to the shore near the eastern end of Sir John Hawley Glover's Island. From thence to the extreme western end of the lake they occupy both shores, and the greater part of the island also. In this direction they appear to have been subjected to even a still greater degree of disturbance than elsewhere. Huge masses, chiefly of dark gray and greenish trap, disrupt the strata in all directions. One of these forms an immense headland on the southern reach, inside the great island, which, towering above the surrounding country, becomes a most conspicuous object, distinctly visible, even from the extreme head of the lake. A reddish syenite, chiefly composed of feldspar, occupies much of the central portion of the big island, and is seen to strike into the mainland of the southern reach. Towards the western end of the lake the slates in many instances are unmistakable mica schists, frequently characterized by numerous embedded coarse garnets, while many of the more compact beds are not to be distinguished from ordinary gray gneiss. On the south side of the Great Lake, proceeding eastwardly or towards the head, the Carboniferous series occupy most of the shore line from the eastern end of the island; but at one or two points, as in the vicinity of Old Harry Mountain, and again, about a mile west of Hind's Brook, bands of red and green jaspery slate, intersected by trap dykes, crop out on the shore for short intervals. They were met with again on Aldery Brook and Goal Brook about a mile from the shore, greatly disturbed and altered, and resting upon a long ridge of Trapean Hills, which form the rearground or southern rim of the valley, and run up and down the country nearly parallel with the shore of Grand Lake, striking away to the eastward in the direction of the falls on Kitty's Brook. Thus we have the outline of the Humber Valley pretty well defined on three sides, north, west and south; but so far the eastern margin has not been closely examined, nor is it certain what are the chief characteristics of the prevailing rocks in that direction. The relative position of all these sedimentary strata places them between the recognized Laurentian and Carboniferous series, in all cases where the contact with either has been observed. They are probably all referable to the lower portion of the great Silurian and Cambro-Solurian Formations, but their highly altered condition, and the absence of organic remains, renders it difficult to assign to each set of strata their exact geological position. The presence of the trilobite *Olenellus Vermontanus*, and a *Lingula* allied to *Lingula Prima*, observed by Mr. Murray at Canada Bay, in 1864, in close proximity to, if not actually amongst, the marble beds there, and also the finding of some fossils on the head of Harry's Brook, all of recognized Potsdam types, leaves little doubt that much of the strata in various parts of the distribution are referable to that and associated divisions of the Lower Silurian formation. Towards the westward similar rocks occupy much of the peninsula between the Humber Sound and the north side of Bay St. George. They are succeeded toward the shores of Port-au-Port Bay by higher members of the same great series, including all the members of Sir Wm. Logan's

Quebec group, largely displayed and clearly defined by their profusion of well-preserved, organic remains. Such, then, are the principal series of rocks which compose the rim or margin surrounding the great plateau of the Humber Valley, and, no doubt, also forming the floor upon which the Central Carboniferous basin of the island rests.

CARBONIFEROUS SERIES

As indicated at the commencement of this report, the immediate object of last season's investigation was to examine more particularly into the structure and distribution of the Carboniferous series of formations, already known to occupy a large area of the Humber Valley. The possible occurrence of some more promising coal deposits than those hitherto revealed by the boring operaitons of 1879-80, having impressed itself forcibly upon me during the preceding season's survey, it was strongly urged that a more close and extensive exploration of the region should be entered upon. The Government were pleased to approve of the suggestion, and the result of the work has been already laid before them in a short preliminary report, furnished immediately after our return home last autumn. It is now pretty clearly established that the entire plateau, comprised within the valley of the Humber proper, is occupied almost exclusively by the Carboniferous series of rocks. They are spread out in nearly horizontal strata, or in low, wave-like undulations, stretching across the valley from north to south, while in their longitudinal extent they are bent so as to conform generally with the contour of the country; but, on the whole, they may be said to lie very flat, and, as a consequence, the lower members hold the surface over a considerable area. In this manner the whole of the main river valley is now known to be entirely occupied by the unproductive lower series, the highest strata observed on this part of the valley being clearly of the millstone grit formation, many hundred feet below, even the commencement of the true coal measures. It is then toward the south, in the direction of the general incline of the strata, we have to look for higher accumulations, and where the prospects of any portion of the true coal measures occurring might be reasonably expected; but before proceeding to detail the result of the work in that direction, a short outline of the general distribution on the main river valley will be necessary. On the shore of Deer Lake, about three miles from the outflow, the first outcrop of the Carboniferous series is met with. It is an exceedingly coarse conglomerate, similar in most respects to that at the base of the series in St. George's Bay. Here as there, it forms the lowest known strata of the Carboniferous series. It rests upon the mica slates, described above, on the north shore of the lake, but a similar conglomerate on the south side, near the head of the lake, rests upon gneiss. This basal conglomerate has been traced pretty continuously throughout the greater part of its extension. It was found on the one hand to strike inland from the north shore of Deer Lake, in the direction of Adie's Pond, and it was met with in considerable volume the past season on a tributary of the Humber, above Birchy Pond, and on the same strike. Here the conglomerate rests upon gray hornblendic gneiss. Sweeping around easterly and southerly, it turns into the country towards the head of White Bay, or between it and Sandy Lake, in which direction it has not as yet been followed out. Succeeding it, all along the main branch of the Humber, and in their regular order of sequence are the sandstones, shales, marls, &c., of the next division—the Carboniferous limestone. This latter presents some peculiarities here, not met with elsewhere in the Carboniferous series of Newfoundland. Though called the Carboniferous limestone formation, yet in this section the limestone proper constitutes but a very small percentage of its bulk. The entire absence of gypsum, which forms such a distinctive feature of this division in the St. George's Bay trough, is rather remarkable, not one particle of that mineral substance was observed anywhere throughout this central region. What would appear to be the position of the gypsiferous strata here, is occupied by a considerable mass of dark, grey shale, with thin irregular calcareous layers near the base. Some portions of these shales are highly bituminous, and on exposure to a sufficient heat ignite and burn with a clear flame, giving off the odor of naphtha. They are largely displayed on the main river, between the two falls, where they form a low, nearly flat, anticlinal fold, passing beneath heavy beds of coarse, red sandstone and conglomerate at either side. It is this overlying sandstone, &c., which, striking across the river in flat ledges, gives rise to the falls in question. The relative position of these shales in the series, together with their bituminous character, seems to corelate them with the pyrochists of the New Brunswick Carboniferous basin, in which the remarkable mineral substance albertite was found. These shales are not actually met with again on this side of the trough, but they are known to occur in considerable volume on some of the smaller tributaries flowing into the Humber on the north side, above Deer Lake. This enables me to follow out their distribution and lay them down on the map with little difficulty. Resting upon these pyrochists, as already stated, on either side of the anticlinal fold, a great mass of heavy-bedded sandstones and rather coarse conglomerates, all more or less red in color, form the cliffs and ledges along the river above and below the falls. In the former direction, they are met with up to the beginning of the Upper Steady, where they disappear beneath the surface, and for a long distance no rock is exposed. This is where the flat intervale land occurs. Toward Adie's Pond on the main river, a few low, flat outcrops of red sandstone and conglomerate occur, and on the south side of that lake some thin beds of reddish limestone were seen, interstratified with the sandstones, &c., in 1879. On the south side of the anticlinal, a similar set of sandstones, marls, &c., occupy the bed of the river, forming numerous flat ledges, stretching across its course, down to within a mile of Junction Brook, where they again disappear. Some coarse-grained, grayish sandstones on this section of the river are probably referable to the succeeding millstone-grit formation; but there is little doubt that the bulk of the strata exposed on the main branch of the Humber is included in the Lower Carboniferous limestone and conglomerate divisions. Following the structure southward in the direction of the Grand Lake Basin, or southern branch of the Humber, the basic conglomerate first seen on the south side of Deer Lake, sweeps around the eastern base of the dividing ridge, towards the former lake, and thence follows its northern shore westward to the eastern end of the great island. The conglomerates and sandstones outcrop in considerable volume near Whetstone Point, about seven miles up the lake, and again opposite the island, where bare cliffs, including much of the brilliant, red, marly strata are exposed. A considerable portion of the eastern end of Sir John H. Glover's Island is also composed of these lower strata, and they again crop out on the south side of Grand Lake in great force, a little to the eastward of the Island, where beds of red and drab-colored limestone are of more frequent occurrence than at other points of their distribution. Nowhere on the shores of Grand Lake were the calcareo-bituminous shales met with in place; they were, however, seen on the Junction River, at a rapid called Kill-Devil, about two miles and a half from the outlet. Last year some shales, bearing a strong resemblance to them, were also observed on Glide Brook, near the crossing of the telegraph line, two and a half miles from the head of Deer Lake. At Kill-Devil they are, as usual, overlaid by coarse, red sandstones, conglomerates, and marls, answering in every respect to those seen on the main river. From the last-mentioned outcrops on Junction Brook no rocks are exposed in place, in a southerly or easterly direction for a long distance. In the latter direction a great flat plane stretches away for fifteen or twenty miles up the valley of Sandy Lake river, and some distance beyond Sandy Lake, covered with deep deposits of clay, sand, and gravel, which effectually conceal the strata beneath. Again in the former direction, that in which the accumulation of higher measures might naturally be looked for, nearly eight miles intervene, including the breadth of Grand Lake at its widest part, between the last-mentioned outcrop and the next succeeding it to the southward. We are thus to a great extent left entirely to conjecture what may be the subjacent structure of this great superficial mantle extending over so large an area of country. It is true the boring operations undertaken here in 1879-80, along the side of the Sandy Lake river, clearly revealed the existence there of at least a portion of the upper or true coal-bearing measures, with a few small included coal-seams. Whether these measures continue to increase towards the south and bring in any appreciable thickness of this valuable member of the Carboniferous series, or whether the lower unproductive divisions come again to the surface, between this and the south side of Grand Lake, are questions which at present cannot be answered with any degree of certainty, nor will it ever be possible to do so without resorting to the further and more extensive use of the boring rod. All the evidence which can now be brought to bear seems to point to the strong probability of higher measures existing near the centre of the upper end of Grand Lake. Much will depend upon the angle of inclination at which such beds incline to the horizon, as to whether any considerable thickness ensues or otherwise. Should the boring operations be resumed, and the result prove the existence of higher coal measures containing valuable coal seams, then their extent in an east and west direction, along the line of strike, would be a matter of the utmost importance to determine. Turning now to the southern side of the Grand Lake, we find several small patches of Lower Carboniferous strata, resting against the metamorphic and trappean hill range bounding the valley on this side. Beginning with the limestones and marls opposite the eastern end of the great island, and following the southern shore eastward, towards the head of the lake, higher and higher strata are brought in at each succeeding outcrop, until undoubted millstone grit, gray sandstones and fine gray conglomerates prevail. Near Hind's Brook these measures are well seen, and what appears to be the uppermost strata of the formation, coarse, thick-bedded, friable, gray sandstones and fine conglomerates characterized by numerous small, white quartz pebbles, are seen at the mouth of a small brook, two miles east of Hind's Brook, dipping S. 10° E., at a high angle of inclination. The next exposure of the rocks in place on the lake shore, takes place some two miles still further eastward. Here fine-grained, finely-micaceous, greenish-gray sandstones and loose, shaley layers just protrude above the surface, striking up and down the shore in an extremely straight line, bearing N. 60° E., S. 60° W. magnetic. These latter clearly represent a portion of the true coal measures. They dip at an angle of between 60° and 70° southward, and their strike eastward would carry them into the flat country at the head of the lake. No rock is exposed beyond this anywhere around the head of the lake, but on ascending any of the small brooks flowing into the lake on this side, exposures of the coal measures were invariably met with in greater or less volume, and at various distances from the shore. In each case they were found to dip south, or S. by E. invariably at a high angle and always ending abruptly against the trap and metamorphosed slates of the older formation, at an average distance of about one mile back from the Lake Shore. It was afterwards clearly ascertained, that the coal measures here, formed a deep narrow trough, with strata repeated on the southern side by a slightly overturned dip, so as to give the appearance of a continuous southerly inclination. The best and most extensive exposures of the coal measures were found to occur upon two pretty stout brooks, viz., Aldery Brook, two miles and a quarter from the head of the Lake, and Coal Brook, near its S. E. corner. On the former, the first exposures occur just twenty chains in a direct line from the shore of the Lake, or by the course of the stream about thirty-five chains. The following section is then brought in to the south or up the stream:—

Section of Coal Measures on Aldery Brook.

				Strata.		Coal.	
				Ft.	In.	Ft.	In.
	Chiefly red and brown shales mottled with green occasional bands of coarse sandstone			272	0		
	Greenish grey, coarse and fine grained sandstones with red and greenish arenaceous shales			112	0		
	Thick and thin, coarse and fine grained greyish sandstones and loose arenaceous shaley beds a good deal concealed, some heavy beds of coarse whitish grit towards the top			230	0		
	Clay bed with thin dirt streak			1	0		
	Thick and thin sandstones, shales and clay alternating, some reddish and brownish strata a good deal concealed			163	0		
		Ft.	In.				
No. 1.	Tough underclay	4	8				
	Impure slatey coal	0	4				
				4	8	0	4
	Chiefly loose, rotten, shaley rock, with occasional beds of coarse grey sandstone and clayey layers a good deal concealed			140	0		
	Red and brown arenaceous shales and sandstones with occasional claybeds			70	0		
	Greenish grey, loose shaley rock with about 30 feet of massive whitish sandstone or fine grit towards the top			70	0		
	Fire clay with dirt streak			2	0		
	Greenish grey sandstones and shale alternating			73	0		
		Ft.	In.				
No. 2.	Shaley underclay	4	0				
	Coal	0	2				
	Tough clay with coal streaks	0	7				
	Coal	0	2				
	Carbonaceous shale and clay	0	4				
				4	9	0	6

	Loose shaley rock with clay layers and ocsional thin bands of sandstone			42	0		
		Ft.	In.				
No. 3.	Unledclay	2	0				
	Coal	0	2				
	Impure coaly clay	0	4				
	Coal	0	3				
	Clay with coal streaks	0	3				
	Carbonaceous .shale	0	6				
				3	6	0	7
	Loose, shaley rock, thin sandstone bands and clay layers alternating			158	0		
		Ft.	In.				
No. 4.	Underclay	1	0				
	Soft shaley coal	0	7				
				1	0	0	7
	Loose shaley rock with thin sandstone layers, several bands ironstone in irregular nodular layers, and some continuous beds of two and three feet thick			124	0		
		Ft.	In.				
No. 5.	Dirty band with shaly coal	1	2				
				1	0	0	2
	Loose shaley rock with ironstone bands ..			20	0		
		Ft.	In.				
No. 6.	Tough underclay	2	0				
	Coal	1	2				
	Shale and clay	1	0				
	Coal	0	4				
	Clay and shale	1	2				
	Coal and clay mixed	0	6				
	Shale	2	6				
	Coal	0	2				
				6	10	2	0
	Coarse and fine grained grey and whitish sandstone or fine grit with shaley partings, more shale towards top, several clay bands and dirt streaks			103	0		
	Thick band chocolate colored, arenaceous shale			17	0		
	Loose shaley bands with thin sandstones and clay partings three dirt streaks ..			49	0		
		Ft.	In.				
No. 7.	Underclay	0	3				
	Coal, bright and hard	0	9				
	Carbonaceous shale, with thin						

	streaks and layers of coal	2	8				
	Coal, bright, hard and black	0	8				
		———		2	10	1	6
	Heavy bedded grey sandstones or grit			5	0		
	Carbonaceous shale and coal, much confused apparently a slip in strata here with a repetition of No. 7			2	0	1	0
	Loose shaley sandstone, with thin layers of clay			30	0		
		Ft.	In.				
No. 8.	Coal	1	2				
	Loose shale	0	10				
	Coal	0	6				
		———			10	1	8
No. 9.	Shale and clay			2	0		
	Thin bed of sandstone and shaley rock, with clay intercalations			19	0		
	Bed of dirty fire clay, containing six inches good coal				9	0	6
	Thin layers sandstone and shale			5	6		
No. 10.	Fire clay, containing six inches of coal ..			1	0	0	6
	Loose shaley sandstones, with shaley and clay partings, two dirt streaks in middle, with just a sign of coal in each			21	0		
No. 11.	Dirty clay band, with three in. hard coal ..				7	0	3
	Sandstones and shales, with one dirty clay band, containing streaks of impure coal			10	0		
		Ft.	In.				
No. 12.	Fire clay	0	2				
	Coal	0	3				
	Clay	0	1				
	Coal	0	4				
	Clay	0	1				
	Coal	0	6				
	Clay	0	3				
	Coal and clay mixed	0	4				
	Clay	0	2				
		———		0	11	1	3
	Sandstones and shales in thin layers, one thin coal streak in middle			8	3		
		Ft.	In.				
No. 13.	Coal and carbonaceous shale mixed, 6 in. good coal at bottom	1	9				
		———		1	3	0	6
	Sandstone and shale alternating, bed of fire clay mixed with coal			3	6		

	Ft.	In.				
No. 14. 6 in. fire clay	1	2				
				8		6
Alternations of shale and sandstone			27	0		
	Ft.	In.				
No. 15. Carbonaceous shale, with thin layers of coal	2	0				
Loose shaley rock	0	10				
Carbonaceous shale, with thin layers of coal	1	4				
Loose shaley rock	0	10				
Soft coal and shale mixed	0	6				
Loose shale and clay	1	2				
Coal	1	0				
Drab fire clay	2	6				
Coal	1	2				
			8	4	3	0
Heavy bedded, coarse grey sandstones, becoming thinner towards top, with shaley and clayey partings			46	0		
	Ft.	In.				
No. 16. Dirty shale and clay	2	8				
Coal	0	6				
Wedge of shaley rock	1	6				
Good, bright coal	1	3				
Shale	0	3				
Good coal	0	8				
			4	5	2	5
Tough, shaley rock, with arenaceous layers			8	6		
	Ft.	In.				
No. 17. Coal, hard and bright	0	10				
Shale and clay	0	5				
				5	0	10
Thin sandstones and shales			7	3		
No 18. Shales and clay, mixed with 3 layers of coal, 2 in., 4 in., and 1 in.			2	0	0	7
Sandstones and shales			3	3		
	Ft.	In.				
No. 19. Coal, hard and good	0	2				
					0	2
Shaley sandstones and clay layers			4	0		
	Ft.	In.				
No. 20 Carbonaceous shale and clay, with 8 in. good coal at bottom	1	2				
			0	6	0	8
Sandstones, shale and clay parting			8	6		

	Ft.	In.				
No. 21. Carbonaceous shale and coal mixed	1	0				
			0	9	0	3
Sandstones and shales, one thin dirt layer near top			3	0		
No. 22. Coal and clay mixed (2 in. coal)	1	2				
			1	0	0	2
Shale and clay alternating			5	0		
No. 23. Loose shaley rock and clay	1	0				
Carbonaceous shale	0	2				
Coal	0	6				
			1	2	0	6
Shales and sandstones in thin layers			4	8		
No. 24. Loose shale and clay, 3 in. coal at top, 1 in. in the middle	1	0				
			0	8	0	4
Sandstones and shales, with clay layers alternating			19	0		
No. 25. Thick bed of fire clay, with 3 thin coal layers, 2 in., 6 in., and 6 in. coal and carb. shale	7	0				
			6	2	0	10
Loose shaley rock, with thin sandstone layers			4	6		
No. 26. About 5 ft. fire clay, with 10 in. dirty clay and coal	5	0				
			4	7	0	5
Soft sandstone, shale and clay partings			10	0		
No. 27. Three feet of fire clay, with 3 thin dirty layers, about 1 ft. apart, averaging about 2 in. of coal	3	0				
			2	6	0	6
Sandstones, shales and clay to end of section			5	0		
			1970	05	22	06

Between this and the Junction with the trap rock measures 450 feet horizontal distance where the strata was but little seen. It is probably all a repetition of the measures already given, and judging from the angle of inclination, would bring in about 400 feet extra. Close to the Junction, in a small exposure of the rock, is another seam, No. 28, which is a bed of bluish fireclay 1 ft. 10 in. thick, with ten inches carbonaceous shale at bottom, containing two thin coal streaks about 1 and 2 inches respectively. One other thin dirt streak occurs between this and the Junction.

Coal Brook, two miles further East, exhibits the next most important section of these same measures, yet exposed. A few low outcrops were uncovered on a small brook about half-way between these two, where some thin coal seams and underclays, showing coaly detritus were come across, apparently representing some portion of the Aldery Brook section, but they could not be sufficiently seen to enable me to identify them exactly. Their presence, however, indicates the continuity of the measures, which upon Coal Brook, gave the following section.

Section of Coal Measures on Coal Brook.

Average Angle of Inclination is about 50° dip South Megnetic.

				Strata.		Coal.	
				Ft.	In.	Ft.	In.
	Coarse grey grit and fine conglomerate ...			20	0		
	Strata concealed			200	0		
	Fine grained, finely micaceous, greenish grey sandstones, not well seen			50	0		
	More or less concealed, partly exposed in costeaning, consists apparently of grey, fine grained sandstones, grey and red arenaceous shales, and fire clay, with dirt streaks, showing signs of coal			190	0		
		Ft.	In.				
No. 1.	Tough, shaley, underclay	2	0				
	Coal, pretty solid, partly shaley ...	1	1				
	Clay, with coal streaks	0	3				
	Rotten shale and clay	1	2				
	Clay with coal streaks	0	4				
	Clay and shale	0	4				
				3	10	1	4
No. 2	Rotten shale and clay			22	0		
	Thick bed fire clay, containing a little coal			3	0	0	2
	Loose rotten shaley rock with several clay beds, and dirt streaks, a good deal concealed			92	0		
No. 3.	Thin, impure shaley coal and clay			1	0	0	6
	Hard, thick bedded, grey sandstones			8	0		

	Ft.	In.				
No. 4. Tough, shaley underclay	4	0				
Coal, somewhat shaley but good quality	1	8				
Drab clay with coal streaks	0	10				
Coal, compact and good	1	4				
Clay	0	8				
Impure coaly clay	0	3				
Drab clay and shale	0	3				
			5	7	3	5
Alternations of thick bedded, coarse, grained, grey sandstones, greenish grey, fine grained micaceous sandstones and shales, more or less concealed			73	0		
	Ft.	In.				
No. 5. Loose shaley underclay	1	0				
Coal, impure shaley	0	6				
Drab clay or shale	0	2				
			1	2	0	6
Alternations of thick and thin greenish grey, fine grained sandstones, and arenaceous shales			15	0		
Dip here S. 18° E. Angle 40°						
Greenish and greyish sandstones and shales partly concealed			36	0		
Much concealed, a few outcrops of greyish and greenish sandstones and arenaceous shales			141	0		
More or less concealed			53	0		
	Ft.	In.				
No. 6. Tough shaley underclay	3	0				
Shaley impure coal	0	2				
Coal, fairly good	0	10				
Tough shale and clay with coaly streaks	0	9				
			3	9	1	0
Loose, shaley rock and clay			9	0		
	Ft.	In.				
No. 7. Underclay	0	4				
Shaley coal	0	6				
Clay	0	2				
Thin sandstones and loose shaley rock ...			11	0		
Fire clay with thin dirt streak			2	0		
Loose shale and clay			7	0		
	Ft.	In.				
No. 8. Coal and clay mixed	1	0				
			0	6	0	6

No. 9.	Grey sandstone beds			2	0		
	Wide band of shale and clay, with three thin coaly layers, the lowest being six inches			6	6	0	6
	Loose, rotten shaley rock and thin sandstones			13	0		
		Ft.	In.				
No. 10.	Thin coaly layer	0	4				
	Shale and clay	1	0				
				1	0	0	4
	Loose, shaley rock, succeeded by heavy beds of grey coarse grained sandstones			23	0		
	Thick bed of coarse grey sandstone			4	0		
No. 11.	Alternations of thin bedded sandstones, arenaceous shales, and underclays, with five dirty coaly streaks, showing signs of coal, not well seen. This occurs in centre of a sharp synclinal			25	0	1	6
	Grey sandstones again (repetition), underlaid by thin sandstones and shales			21	0		
	Tough, blue clay			2	0		
	More or less concealed, heavy beds grey sandstone on top			50	6		
	Coarse grained grey sandstone			9	4		
	Greenish grey, thin bedded sandstone			11	2		
	Greenish and reddish, shaley and slaty bands alternating			56	4		
	Bands of loose, reddish arenaceous shaley rock			16	0		
	Finely micaceous, fine grained greenish grey sandstone			14	2		
	Alternations of coarse grey sandstone, greenish and reddish rotten shaley rock			52	0		
	Alternations of greenish and grayish, and yellowish sandstones, thick and thin bedded, coarse and fine grained			47	6		
	More or less concealed; some layers coarse sandstone at base			28	0		
	Thick bed of coarse grained yellow weathering sandstone			8	0		
	Thick and thin beds of grey sandstone			10	0		
		Ft.	In.				
No. 12.	Clay with coaly streaks	0	3				
	Solid good coal	0	10				
	Drab clay and wedge of rock, thin coal streaks	1	9				
	Coal somewhat slatey, but good	1	3				

	Coal, shale and clay mixed	0	2				
	Underclay and shale	2	0				
		——		3	11	2	4
	Rotten shaley rock and sandstone beds ..			6	10		
	Carbonaceous shale and clay band			2	7		
	Rotten shaley rock, with clay bands and and thin layers sandstone			28	0		
		Ft.	In.				
No. 13.	Clay	0	1				
	Coal	0	1				
	Carbonaceous shale	0	9				
	Coal, somewhat shaley	0	6				
	Carbonaceous shale	0	6				
	Underclay shaley	5	0				
		——		6	4	0	7
	Grey sandstones			12	0		
	Loose shaley rock			3	6		
	Bed coarse sandstone			1	9		
	Thin sandstones and loose shaley bands .			9	4		
	Thick and thin bands grey sandstone			6	10		
		Ft.	In.				
No. 14.	Loose rock, clay and coaly streaks	1	2				
	Fire clay, with thin streaks of coal and black carbonaceous shale ..	1	6				
		——		2	2	0	6
	Loose shaley rock, with sandstone layers			12	2		
	Bed of hard grey sandstone			1	6		
	Loose shaley and clayey beds			12	0		
		Ft.	In.				
No. 15.	Bright shaley and clay mixed	2	0				
		——		1	0	1	0
	Loose rotten shaley rock			1	9		
	Hard fine-grained sandstone bed			0	10		
	Broken loose shaley rock, alternating with greenish grey sandstones in thin layers			10	0		
	Fire clay, with coaly streaks			3	6		
	Loose shaley rock			3	6		
	Fine-grained grey sandstones			5	2		
	Loose shale and clay			3	6		
	Fire clay, with coaly matter			1	3		
	Shale and clay and thin sandstones			6	6		
	Grey sandstones			3	6		
	Loose shaley rock			1	10		
		Ft.	In.				
No. 16.	Dark fire clay, with coaly matter ...	2	0				

Bright shaley coal	0	6				
Carbonaceous shale	1	0				
			3	0	0	6
Rotten rock and clay			3	6		
Shaley sandstones, &c.			6	10		
Greenish grey sandstones			1	0		
Loose shaley rock			3	6		
Alternations of loose sandstones, shales and clays, thick and thin bedded, greenish micaceous, and coarse grey and whitish sandstones, with fine conglomerate beds predominating towards base, a good deal concealed, down to junction			390	0		
Total			1907	11	15	2

Of course, owing to the doubling up of the strata in both the above sections, which in reality represent a long, narrow, sharp, synclinal trough, there is, a considerable amount of repetition. The actual vertical thickness of the coal measures exposed is little more than half the above total, reckoned from the centre of the trough each way, the section on Aldery Brook includes all that of Coal Brook, and probably some both superior and inferior strata not seen on the latter. We may, therefore, take it to represent the greatest development of coal measures actually exposed in this region. From the centre of the trough to the lowest outcrop on Aldery Brook we have then a continuous section, in regular succession, of coal measure strata amounting to about 1740 feet. It is almost certain that the low ground between the shore of the lake and the first rock exposure on Aldery and Coal Brooks is also underlaid in part, if not wholly, by strata belonging to the same measures. Their attitude, of course, cannot be determined, but, presuming they continue to dip southward at about the same average inclination, there should be at least 800 feet extra, making a total thickness of 2,500 feet. Whether that represents the entire development of the coal measures in the Central Carboniferous basin or not, can never be determined by mere surface exploration. Eastward from Coal Brook no exposures of the Carboniferous series were met with anywhere, notwithstanding a most diligent search along all the small streams, and on the shores of the numerous ponds distributed over this great plain. Neither was the survey of the Goose Pond tributary, so far as it was prosecuted, successful in revealing a single outcrop of the rocks in place. The flat character of the surface would in itself seem to indicate that, in all probability, some portion at least was underlaid by the soft, easily disintegrated shales and clays of the coal measures proper. This fact, together with the actual presence of numerous small fragments of coal washed up on the shores of Grand Lake, especially on the N.E. side, near the mouth of the inflowing river, lead to the conclusion that seams of coal must underlie this part of the country. It was with a view to ascertain whether such were the case, and what might be their value, that the boring operations of 1879 and '80 were entered upon. Four bore holes were put down altogether, along the Sandy River Valley, at sufficiently distant intervals to afford a fair idea of the structure. In only one of these, viz.: bore A, near the mouth of the river, were any actual coal seams struck. The section bored through, for 250 feet in depth, is given in detail in Mr. Murray's report for 1879. After passing through 50 feet of sand, gravel and clay, the first rock, a white sandstone, was struck, and at a depth of 129 feet from the surface, a seam of coal, 1 ft. 4 in., and, again, at 134 feet, another small seam, of only 5 inches, were met with. Still lower down at depths of 170 and at 222 feet from the surface, beds of Carbonaceous shale and fire clays, with thin coal streaks, were bored through. At bore B the rock formation was only pierced for 75 ft. and here again fire clay, containing thin coal streaks, was found. Bore C, which, in point of position, lay a mile further to the north, was sunk 113 feet, 94 feet through rock, but no coal showed itself, and only a few dark shaley bands or dirt beds were come across; while at D, the furthest up the valley, but 24 feet of rock was pierced, showing no signs of coal either. Thus the result of this boring experiment may be said to have failed in its main object, that of revealing the presence of workable coal seams. Yet it was not without its value, and has afforded a clue, which, together with what has been ascertained by the present season's operations on the south side of the Carboniferous basin, enables me to form a pretty clear conception of the whole structure. The strata passed through by the boring rod can scarcely be referred to any other than the true coal measures, and this is confirmed by the character of the loose debris in the vicinity, which often contained fragments of fossil plants, such as *Lepidodendron, Calamites* and *Neuropteris,*

&c., characteristic of that series. The conclusions come to, then, from a study of all the facts gathered, are as follows:—The boring rod struck only the extreme northern edge of a low, flat trough, having an inclination southward at an angle of not more than four or five degrees. Possibly this angle may increase, causing greater depression towards the south, and this seems borne out by the comparatively high dip of the strata met with on Coal Brook and Aldery Brook, but I am at present inclined to the belief that between these points there is an anticlinal fold bringing some of the lower measures again near the surface, and that the Coal Brook section is but a repetition of that underlying the head of the lake. At all events, between the most southerly bore hole A and the first rock outcrop on Coal Brook, a horizontal distance of two miles and forty chains intervenes, across the head of the lake, where no positive knowledge of the underlying strata is yet within our reach. Should the low angle of inclination, indicated at the bore holes, prevail, and no anticlinal fold occur to the southward, there would still be a thickness of superior strata of some 1133 feet. If such be the case, there is a strong presumption that one or more coal seams, other than those found at A, occur within that thickness. Of course, much of the above is merely conjectural, but it is founded upon pretty strong circumstantial evidence—evidence which, it appears to me, amply warrants the further application of the boring rod to this important and interesting coal field. There is no other means of so inexpensive a character by which a definite conclusion on this head can be arrived at. Should the Government deem it a matter of sufficient importance to carry out this suggestion, I would strongly recommend that a small hand-diamond boring drill be used, capable of taking up a core, and thus affording a complete section of the strata pierced through. It would also have the advantage of portability, a matter of weighty consideration in a country where the difficulty of transporting heavy material is so great. I do not think the cost of such an apparatus should deter us from employing its use, for were it the means of revealing but one workable coal seam, not known before, that, in itself, would amply repay the outlay. Then, again, it may be remembered that the coal area of St. Georges' Bay, as shown in my report for 1889, calls particularly for the use of such an apparatus. Nor are these the only localities in the island where the boring rod might be applied with advantage.

Materials of Economic Value.

Little more can be said of the coal deposits here, 'till a much more minute examination takes place. Altogether sixteen actual outcrops were seen on Coal Brook. Indications of at least six on a small brook west of it, and twenty-eight on Aldery Brook. Of course most of these represented but thin unworkable seams of coal, often of an inferior character. Nos. 4 and 7 of Coal Brook section; 6, 7, 15 and 16 of Aldery Brook, are about the largest and best seams. Of these four average over three feet of coal each, while the fifth and sixth contain about two feet each of a very superior quality. But though most of the seams are of smaller dimensions, yet I take it that their peculiar position and attitude in the sections, greatly enhances their value as a whole. For instance, in the section on Aldery Brook, in a horizontal distance of only 335 feet across the centre of the trough, which in reality represents only 167.7 feet vertical thickness, nine distinct coal seams are recognized on one side, only two of which have as yet been clearly seen and measured on the other side. The remaining seven are also there beyond question, though not uncovered, yet sufficient coal detritus was met with in costeaning to indicate their presence. Hence we have at least eighteen layers of coal succeeding each other, in a nearly vertical attitude within a total horizontal distance of 335 feet leaving an average of less than nineteen feet of strata between each layer. Such being the case, it appars to me, all these seams could be worked from one opening, especially as they approach each other nearer and nearer in descending. Beyond the ordinary test of burning in an open grate, the quality of none of this coal has as yet been proven, but specimens are now in the hands of Analysts, whose report may at any time be looked for.

The loose fragments of coal picked up on the north shore of the lake indicate a good average quality of bituminous coal, whatever may be the value of the deposit from which it is derived.

Bituminous Shale.

The calcareo-bituminous shales or pyrochists described as occupying a position near the base of the Carboniferous Limestone series may yet prove of economic importance should they be shown to contain any appreciable percentage of bituminous matter. It is such shales which furnish the Rock Oil of commerce, and have been largely used for that purpose in Scotland, &c. The remarkable mineral Albertite, so valuable as a gas producing substance, and which sold at from $15 to $20 per ton in New Brunswick a few years since, appears to have been derived from just similar shales, and in about the same horizon.

Clay Iron-stone.

The clay iron-stone bands interstratified with the coal measures on Aldery and Coal Brooks are to all appearances similar to those found in most other coal fields. In England, this ore has been the principal source of the iron of commerce for which that country has been so far famed. It has been said that "England's greatness was chiefly due to her coal and iron. Judging from external appearances, the ore here is of a fairly good quality, and there can be no question that the deposits are very extensive. It occurs as usual in the form of irregular nodules, nodular bands and compact solid bands, intimately associated with the principal coal seams. Its prospective value on that account to the future development of large industries in this section of the island can hardly be realized now.

Molybdenite.

The occurrence of this mineral in small quantity on Burnt Island, Deer Lake, has been already mentioned, but it is of little importance.

Asbestos or Chrysotile.

This peculiar and important mineral substance, which has only recently begun to attract attention in this country, has been known to exist amongst the magnesian group of rocks for a long time. It is, however, only within a year or so that the attention of capitalists from outside has been directed to Newfoundland, as likely to become a source of future supply. The Province of Quebec, in the Dominion of Canada, is at present the chief centre from whence American manufacturers of asbestos goods derive their raw material. But the comparative scarcity of the mineral, together with the increasing demand, seems to point to a possible failure of this source in the near future. It was known through the operations of the Geological Survey, that extensive areas in this Island were occupied by the magnesian group of rocks, similar in all respects to those of Canada, from whence the asbestos was obtained. This led to prospecting for the mineral with the result, that specimens showing an excellent quality of fibre, were found at several points amongst the serpentines on the West Coast, chiefly in the vicinity of Port-au-Port Bay. The first attempts at actual mining, however, were only made during the past summer. A company of American capitalists having leased a mining property in the vicinity of St. George's Lake, situated between St. George's Bay and Bay of Islands, were the first to commence active operations, and it was this property which was visited during the latter part of last season. It is situated so far from the sea-board, and the difficulty and delay in getting materials wherewith to begin work on the spot caused so much loss of time at the outset, that little more could be accomplished last season, than a mere surface exploration over a limited area. At the time of my visit in October, all that had been done consisted in an open cut of some fifty or sixty yards into the side of a low bare ridge of serpentine, and a few surface openings here and there to ascertain the strike of the serpentine belt. The open cut, however, afforded the only satisfactory exhibition of the rock and contained mineral. It consisted at the base, of a thick mass of very loose, shaly, dark green serpentine with scaly layers and strings of very pure, amber-yellow and oil green steatite. Caught up in this shaley mass, and apparently surrounded by it; a great horse or boss of hard, dark, bottle-green serpentine, presenting highly polished and fluted surfaces is seen; and the whole is capped by large disconnected blocks of hard, dark-gray diorite. The mineral appeared to follow closely the outline of the harder serpentine, frequently penetrating it, but almost invariably splitting up into innumerable ribbon-like strings, which finally become mere threads. The best fibre and most persistent veins followed the outline of the harder serpentine or occupied the position between it and the overlying diorite. Where the two approached each other nearest so as to squeeze up the intervening rock, appeared to be the point exhibiting the greatest amount of asbestos. One band at such a point measured nine inches wide, consisting of several rudely parallel layers of fibre divided by thin layers of serpentine. The fibre varied in length from one half to two inches and was of fairly good quality. Specimens of beautiful fibre of about an inch long, and still others of from 2 to 3½ inches were shown me as having come from a lower part of the cut, at a place not then visible, being covered with the debris from the mine, &c. The character of the deposit, judging from what little could be seen was, as is usually the case, exceedingly irregular and confusedly jumbled up. According to the experience in Canada, where asbestos mines have now been in active operation for ten or twelve years, there is apparently nothing to act as a guide in determining the value of a deposit except actual mining. No two properties present exactly the same features, and what may be found to hold good in one locality, proved entirely at fault in others, hence the difficulty in arriving at any conclusion as regards an undeveloped property, such as that described above. The indications are certainly good, the quality of the fibre excellent, and should the serpentine deposit in which the mineral occurs be found to occupy any considerable area, there is a reasonable prospect that asbestos will accompany it. At present the situation of the mine and character of the surface deposits, renders prospecting a tedious and expensive operation. The absence of some more feasible means of getting material on the spot, was sorely felt by those in charge last year, every pound of food consumed and every item of mining tools, &c., had to be carried on men's backs from the seashore through the woods, a two days desperate drag. Few men could be had to perform such labor, and these only at a high rate of wages. In order to facilitate the development of this and neighbouring properties, I would suggest the advisability of speedily opening up communication with the sea-shore by roads or other means. The Hon. P. Cleary had men at work all the summer prospecting a property of his near Bluff Head, Port-au-Port Bay, the result of which I am informed is of a very favourable character. The serpentine here is apparently more massive and forms extensive cliffs, exhibiting several small rudely parallel veins of asbestos. The fibre ranges from one quarter to about one and a half inches in length, and some of the specimens shown me from the locality were of excellent quality. Further up the coast at Lewis Brook and about two miles inland Mr. Hayes of Bay St. George holds a claim, from which a very fine sample of silky fibre about two inches long has been exhibited, but no prospecting of any consequence has taken place here as yet.

In view of the foregoing facts and the knowledge that the mineral is chiefly derived from the magnesian group of rocks, so familiarly known in Canada as Sir Wm. Logan's Quebec Group, which have been shown to occupy extensive areas in this island, both along the coast and in the interior, it is unlikely that the next few years will witness a great amount of activity in prospecting for this substance. Newfoundland is already regarded in Canada as likely to prove "Quebec's greatest rival ere long." Should this valuable material be found in available quantity in this country, as there is every reason to expect, its development is likely to prove one of the most important and remunerative mining industries in the near future.

Building and Other Useful Materials.

Amongst the Carboniferous series, particularly the lower divisions, good sandstones, suitable for building purposes, abound. Grindstones, whetstones, flagstones, limestones, &c., occur in many parts of their distribution, and fire clays are found in beds of varying thickness, from one to six feet, amongst the coal measures, chiefly underlying the coal seams. Of course the value of this latter clay depends greatly upon its adaptability to the manufacture of refractory bricks for furnace lining, coke ovens, &c., where it has to withstand a great degree of heat. While judging from external appearances, this clay seems to be exactly similar to those used for that purpose elsewhere, yet it must always be understood that nothing but an actual practical test can satisfactorily prove its capabilities. Fine sand, of a character admirably adapted for mortar for bricklaying, &c., forms an immense deposit around the head of Grand Lake. In some places banks of fifty or sixty feet in height are exposed on the lake shores. Some of this sand, it appeared to me, might be found applicable for moulding purposes, which would greatly enhance its economic value. Here, again, nothing but a practical test will suffice to prove its utility.

Marbles.

The Humber River marble deposits have been especially referred to in former reports, particularly so in Mr. Murray's report for 1866. Nothing has been done since that date to prove the quality of the rocks, beyond the dressing and polishing of a few surface specimens. It was the intention last season to endeavour to procure some better specimens than those hitherto obtained, if possible, by clearing away the debris and blasting into the solid rock below, but, upon reaching the locality, it was found so encumbered with debris, fallen from the cliffs above, which would take weeks of great labor to remove. We had to content ourselves, therefore, with selecting specimens from the loose blocks only, which are, as might be expected, much weather-worn and stained. Some small pieces of the white marble are certainly of a very fine grain, and appear well adapted for statuary purposes, should the same rock be found in sufficiently massive beds, and free from cracks. The variety of colours displayed in other specimens is very considerable, and often very beautiful. It has been now shown that the extent of this deposit is enormous, and it would indeed be very remarkable if somewhere throughout their range it was not found that they were more compact and less affected by atmospheric action.

The Museum.

There has been no falling off in the number of visitors who continue to be attracted by the collection in our museum. Many additional specimens have been acquired during the past year from various sources. I am greatly indebted to Sir Wm. Dawson, K.C. M.G., &c., Principal of McGill University, Montreal, for his uniform kindness in furnishing me with any information asked for, but more especially in his undertaking to examine and name all the fossils collected from our Carboniferous series from time to time. He has, during the past summer, returned to the museum the collections submitted to him from the St. George's Bay trough, all named and labelled, and has kindly offered to do the same with those collected last season at Grand Lake, as soon as I can send them on to him in the spring. The whole, when properly classified and arranged, will form a valuable and interesting collection of the Newfoundland Carboniferous fossil, fauna and floral. Amongst the other additions to the museum the past year may be enumerated an embryo white whale and dolphin, a couple of soles, a nice collection of West Indian shells from Lady Blake, a beautiful specimen of the Roseate Flamingo, presented by Captain Collins, and a peacock by Donald Morison, M.H.A. Amongst the mineral specimens, coal, clay-ironstone, fireclay, gypsum, asbestos, actinolite, tremolite, serpentine and marble have been added by the survey; while a sample of crude petroleum from Parson's Pond, West Coast, was presented by Mr. Muir. Mr. White, manager of the Newfoundland Consolidated Copper Mining Companys' Works at Little Bay, has kindly, in compliance with a request from me, furnished the museum with a complete suite of specimens illustrative of the smelting industry—from the crude ore through its various processes of manufacture up to the final result, pure metal, or ingot copper. This is a very valuable and interesting collection, and conveys in iteself, a concise history of the copper mining industry of the island. The collection is now assuming such proportions, and is so much appreciated by the public, that it becomes quite evident, should it go on increasing at the same rate, and it be desirable to maintain it efficiently, a larger apartment will soon have to be provided in a more central part of the city.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

Report for 1892.—Continuation of Coal Exploration near Grand Lake.

Geological Survey Office,
St. John's, Newfoundland,
January, 1892.

The Honourable Surveyor General,—

SIR,—The delay in the publication of the Report of the Geological Survey operations for 1891, caused by the great conflagration of July last, in which the manuscript copy of that report, then in the printer's hands was destroyed, having necessitated the rewriting of it, it was deemed advisable to incorporate that of the past season with it also. This course is all the more desirable, since the work performed last season was a continuation of the exploration of the Central Carboniferous basin of the Humber Valley.

The importance of the previous season's work, especially as regards the discovery of so promising a coal field near the head of the Grand Lake, amply warranted the further prosecution of the investigation during the season just past. As stated, however, in the preceeding year's report, it was doubtful whether much more could be accomplished by mere surface exploration, and the desirability of testing the ground more thoroughly, by means of a diamond boring machine, was then strongly urged. In the absence of such a machine, the only available course to pursue was that already adopted of costeaning the surface with pick and shovel. While the prospects of other valuable finds resulting therefrom appeared small, at all events, the coal seams already seen could be more thoroughly uncovered and their character and probable value more definitely determined. With this object in view, our party started for the Humber about the usual date in June last. A family bereavement prevented my accompanying them at the time, Mr. Bayly was, therefore, entrusted with the charge of the party until I could join them later on. He was instructed to proceed direct to the Grand Lake, and there to commence work on the section of the coal measures occurring on Aldery Brook. The entire face of the steep bank along the west side of the brook, having first been cleared of the timber, was to be stripped from top to bottom. All the clay, gravel, loose rock, &c., encumbering the surface was to be removed, so as to lay bare the whole face of the cliff beneath, and thus afford a continuous section of the measures where the coal outcrops exhibit themselves. By the time this was accomplished I expected to be with the party and direct the subsequent operations.

The great conflagration of July 8th, already alluded to, in which, amongst so many others, my own residence was destroyed, materially interfered with all our arrangements for the time being, and delayed my departure till the middle of August. Further instructions were, however, sent to my assitant for his guidance in the meantime.

On my arrival at Bay of Islands, on the 20th of August, I at once proceeded up the Humber, and having reached the portage at Junction River, commenced a survey of this important stream. It had never previously been measured, owing to its exceedingly rugged character, and the difficulty of following its course on foot. The excessively dry season now being experienced, having caused its waters to shrink to an abnormally low level, presented a most favorable opportunity for carrying out this survey. It might be many years before another such occurred.

This river forms the important connecting link between the main and eastern, or the Grand Lake branch of the Humber. Its measurement would be the means of completing the connection of the two great water systems, and be also an important addition to the topography of the region. Another object held in view, was to ascertain the true position, together with the dip and strike, of certain rock outcrops known to occur along its course. These being the nearest exposures of the Carboniferous series to the sections of the coal measures on Coal and Aldery Brooks, though distant therefrom in a direct line eight miles, it was hoped they might afford some clue to the structure underlying the great flat intervening area. The rocks proved to be all low down in the series, apparently belonging to the Carboniferous limestone, or base of the Millstone Grit formation. They consisted chiefly of heavy bedded red sandstones, grits and fine conglomerates, with occasional bands of light-red marl. At one point near the Kill Devil Rapid, a set of drab shales with thin calcareous layers outcrop in the bed of the river, and form low cliffs along the east side for some distance. The latter point could not be reached owing to the impossiblity of getting across. I have little hesitation, however, in referring these latter to the Calcareo-bituminous shales or pyrochists, and they are most probably the equivalents of the Horton Series of Acadian Geology.

It was the first of September when I joined the party at Aldery Brook. My instructions had been faithfully carried out, and an immense amount of work had been performed in the interim. The quantity of debris covering the surface of the rocks greatly exceeded what we were led to expect, especially towards the base of the slope, and the dense compact nature of much of it, rendered its removal a most laborious undertaking. Thousands of tons of earth, gravel and rock, had been thrown down from the steep bank and shovelled into the brook, and the cliff laid bare for a distance of several hundred yards. All the coal seams seen last year were now thoroughly exposed to view, and were found to maintain pretty much the same character throughout. Some few exceptions, however, occurred. While Nos. 6, 8, 15 and 16 seams showed little variation from what has already been described in the previous report, some of the smaller seams rapidly decreased in size and, in some instances, thinned out. No. 7 seam was cut off by a slip of the strata, which caused much confusion just at this point. No. 16 is decidedly the best in the section. It was uncovered for over sixty feet up and down the bank; its attitude being nearly vertical, with a bend over towards the top. It averages two feet of good, solid coal throughout; but, owing to occasional intercalations of shaley or clayey wedges, frequently widens out to double that thickness.

Four other small seams, not clearly seen last year, were uncovered between Nos. 6 and 7. Towards the southern end of the cutting the surface accumulation was so deep and tough, that it was found useless to attempt penetrating it.

In order to verify the strike and continuity of the coal seams, and still further prove their character, we next commenced costeaning along the opposite or eastern side of the brook. Here, again, all the same seams were met with in their regular positions, but they were found to vary considerably. In almost every instance they had improved much in quality, and assumed larger dimensions. No. 1, 2, 3, 4 and 5 seams were pretty much as already described. No. 6 had widened out to eight feet, with about two feet of coal of good quality. Nos. 7, 8 and 9 were not quite so large as before, but Nos. 10, 11 and 12 had run together, forming one wide seam with alternations of coal and clay measuring twenty-two feet across. Only two feet of coarse sandstone separated this from another seam of five feet, supposed to represent No. 13. All these might be here considered one seam having a total breadth of twenty-seven feet and containing altogether fourteen feet of coal.

The following are the details of the section of this seam exposed to view:—

	Ft.	In.
Underclay	2	0
Soft, impure coal, with clay streaks	0	10
Clay shale and thin coal streaks	3	0
Impure coal and shale mixed	0	7
Clay and carbonaceous shale	2	10
Soft coal	0	4
Coal with clay streaks	2	0
Shaley clay	0	8
Coal, soft and shaley at the top, more compact towards bottom	4	6
Carbonaceous shale	0	3
Coal and clay mixed	0	6
Shaley coal	0	4
Impure coal	0	6
Clay and shale	0	3
Soft, shaley coal	1	2
Clay, shale and thin coal streaks	1	0
Band of coarse grey sandstone	2	0
Clay	0	2
Coal, hard at bottom	1	2
Clay	0	2
Coal, soft and shaley	0	10
Clay	0	2
Soft coal	0	10
Clay	0	10
Total	26	11
Coal	14	0

As may be judged from the above section, most of the coal contained in this large seam was soft and impure, being much mixed with dirty fireclay and rotten shale. The seam was also found to contract in width towards the bottom of the slope. The quality of the coal, however, improved much in character, and became more compact, on drifting in a few yards upon the strike of the seam. This would clearly indicate that upon getting away from the surface drainage, when it comes to be further developed, a really good seam of coal may be expected. Its outcrop is situated in a depression containing much moisture, and, in consequence, the exposed edge of the seam is greatly water-soaked. This absorption of water along the weathered edges of the seams has, in nearly every instance, greatly changed the character of the contained coal, so that its true quality cannot be properly determined from the specimens obtained so near the surface of the ground. Some of the coal from this large seam was intensely black, and appeared to be highly bituminous. Fine specimens were taken out from the bottom of the cuttings, but on exposure to the sun, they nearly all crumbled into small fragments. Ten feet beyond this, another seam, supposed to represent No. 14 of opposite side, gave the following section:—

	Ft.	In.
Loose, shaley underclay	1	0
Thin coal streak	0	1
Clay	0	10
Impure coal and carbonaceous shale	1	6
Drab clay and shale	1	0
Impure coal and shale	0	8
Clay and shale	0	8
Shaley coal, some good at bottom	0	9
Clay and shale	0	8
Fairly good coal	0	6
Shale on top	2	0
Total	9	8
Coal	2	10

No. 15 seam consists of two layers of soft coal, divided by about two feet of sandstone. The top layer is one foot six inches thick, and bottom layer eight inches; altogether two feet two inches of coal. No. 16 maintains pretty much the same character as on the west side of the brook, but contains thin, lenticular wedges of clay-ironstone. It here measures three feet seven inches, having two feet nine inches of excellent hard, bright, black coal, divided by five inches of tough, shaley clay, thus:—

	Ft.	In.
Tough underclay	0	3?
Hard, black, bright coal	1	4
Tough, shaley clay	0	5
Hard, bright, solid coal	1	5
Shale on top	0	2
Total	3	7
Coal	2	9

No. 17, 18, 19, 20, 21, 22, 23 and 24 are all small, several of them being mere dirt streaks with but little coal in them. No. 25 had greatly improved, and on this side of the brook has widened out to six feet six inches, containing about one foot seven inches of exceedingly tough, solid, bright coal. It gave the following section:

	Ft.	In.
Tough, carbonaceous shale	0	3
Coal, very hard and bright	0	6
Tough, carbonaceous shale	0	4
Hard, bright, good coal	0	8
Tough, carbonaceous shale	0	6
Coal and shale mixed	0	3
Shaley rock and ironstone	3	8
Carbonaceous shale and coal	0	4
Total	6	6
Coal	1	7

Three small seams, containing a little coal each, and one band of fire-clay, with four inches of coal, were uncovered between Nos. 20 and 28 of last year, making a total of thirty separate outcrops of coal in the entire section. Little room for doubt now remains of the doubling up of the strata in the form of a sharp, synclinal trough, as set forth in last year's report. It follows, then, that the actual number of separate and distinct coal seams is in reality fifteen, all of which are repeated by being again brought to the surface. What the actual depth of this trough may be, can only be judged approximately from the angle of inclination on either side. The lowest seam probably reaches 500 feet below the surface, at a point where the strata begins to turn upwards. Of course, as we approach the centre of the trough, the depth of each individual seam becomes less and less.

One point of much importance in connection with the actual working of these coal seams, is the facility of reaching the mineral contained therein. While much of the coal is above the surface of the river's level, the comparatively little depth of the remainder renders every ton worth extracting, easily accessible.

While the costeaning operations on Aldery Brook, were being carried out, Mr. Bayly was despatched to survey and explore another small stream near the head of the lake, known as Kelvin Brook. The work had been partly accomplished last season, but so far as explored no rock outcrops had been met with. The brook was very small, and so overgrown with dense alder beds, as to completely choke up its channel, rendering the further following out its course a matter of extreme difficulty. As, however, there still appeared a prospect of finding some outcrops further up the stream, towards the base of the mountains on the south side of the valley, it was determined to make another effort to complete the measurement. The alder beds had to be cut through with axes for some considerable distance, when the brook was found to widen out somewhat, and become more accessible. It was then followed up to the point where it debouched from the Laurentian range, a distance of two miles and a half to the Eastward of Coal Brook. Here, close up under the hills a few small outcrops of the coal measures, containing indications of the presence of one or more coal seams were come across. Upon receipt of this information, we moved camp to the locality, having first cut a portage road about two miles in from the head of the Lake. Three weeks were spent in costeaning and exploring along this brook, which resulted in uncovering some half dozen coal seams. The rock exposures were of a very limited extent, the banks on either side being almost entirely composed of deep deposits of sand, gravel and boulders. Altogether eleven different outcrops, showing coal were uncovered along the eastern side of the brook, all close together. They were situated so near the waterside, and at so low a level, that in almost every instance the water came in and flooded the openings, before we could obtain perfectly satisfactory measurements, &c. As well as could be determined, we have here again a sharp narrow synclinal trough, clearly a continuation of that previously observed on Coal and Aldery Brooks. Immedicately beneath the coal measures here, and resting directly upon the Laurentian gneiss, a set of coarse and fine reddish conglomerates and grits are seen, which strongly resemble the basic conglomerates of the series. Their relation to the over-lying coal measures would indicate that some great want of conformity, such as a tremendous upthrow fault, had brought them into this anomalous position. As no such disturbance of the strata was at all visible, and there appeared to be a perfect and regular succession from the lowest beds upwards I cannot but conclude (putting lithological resemblances aside), but, that these conglomerates and grits are in reality the summit of the Millstone grit formation.

The following is the section of the rocks here displayed beginning at the Junction with the Laurentian up stream:—

			Strata.		Coal.	
			Ft.	In.	Ft.	In.
Coarse, reddish conglomerate, grits and sandstones, with some thin, bluish arenaceous bands, a good deal concealed			594	0		
Coarse and fine, greyish sandstones, shales and some clayey bands, showing a little coaly matter. Rotten shale and clay towards top			260	0		
	Ft.	In.				
No. 1. Underclay	1	0				
Soft, earthy, impure coal	1	2				
Drab fire clay	1	6				
Soft, earthy, impure coal	1	2				
Clay, with coal streaks	1	0				
Coal and clay mixed	1	1				
Carbonaceous shale and ironstone	0	4				
Soft coal	0	4				
Clay	0	5				
Coal and clay mixed	0	10				
			5	2	3	8
Thick and thin sandstones, with shaley layers			17	0		
No. 2. Bluish fireclay, with coal streaks			1	0	0	3
Sandstones and shales			8	0		
No. 3. Fireclay, with a little coal			1	4	0	2
Sandstones, shales and clay layers			36	0		
Dirt Streak			1	0		
Rotten, shaley rock and clay, with a few thin layers of sandstones			5	0		
No. 4. Thin coal streak in fireclay			1	0	0	3
Coarse sandstone and shaley rock			5	0		

		Ft.	In.				
	Clay	1	0				
	Shaley coal	1	2				
No. 5.	Fireclay	1	6	3	6	2	6
	Layer coarse sandstone	1	0				
	Impure, coaly layer	1	4				
	Coarse, gritty sandstone			2	0		
	Tough, shaley clay	2	0				
	Good, solid coal	3	6				
No. 6.	Carbonaceous shale	1	0				
	Good coal	2	8	6	2	7	0
	Carbonaceous shale and coal, with clay layers	4	0				
				946	2	13	10

The uppermost seam in the above section has the appearance of being doubled over upon itself, thus causing the coal to assume twice its actual thickness, which would be about three feet six inches. This is not by any means certain, as the situation of the seam is at such a low level, and the influx of water was so great, as to prevent our studying it out thoroughly.

The quality of the coal in this latter seam was excellent, being bright black, clear, and very free from impurities.

Several attempts were made to reach the bed rock at points on the brook both above and below this outcrop, wherever the banks of gravel and clay seemed to offer some prospect of doing so. In no case were we successful, such was the depth and toughness of the superficial deposits. Numerous loose fragments of coal were met with in all these cuttings; and at one or two points, a very tough clay, which formed the base of the bank, contained many angular fragments, apparently not far removed from their parent bed. All these could scarcely have been derived from the few outcrops seen, furthermore, as some fragments were picked up in the bed of the brook further up stream, it is but fair to assume that other coal seams than those already discovered exist here.

In my last year's report it was intimated that eastward from Brok, confirms the supposition then set forth, that the coal measures out-cropping on the surface appeared at all probable, and that consequently we were left to conjecture only what might be the structure in that direction. This latter discovery on Kelvin

Brook, confirms the supposition then set forth, that the coal measures did underlie, at least some portion of the flat country to the eastward. It is now pretty clearly established, that the long narrow trough containing the coal seams, extends longitudinally from Aldery Brook to Kelvin Brook, a distance of over four miles on the line of strike. How much further eastward it may yet extend will necessitate the use of the boring rod to determine, as I do not think there can be any other outcrop of the measures in that direction. A close investigation of the Goose Pond and Kittys' Brooks this season, revealed one small exposure on each, of a coarse reddish conglomerate and grit rock of carboniferous age; identical with that described at the base of the section on Kelvin Brook. Both these occur far up the streams at the foot of the hill range, and rest in each case upon Laurentian gneiss. Whether as already hinted, these latter rocks are of millstone grit age, or brought into their present position by an upheaval, there is still ample room between them and the Sandy Lake waters to bring in some portion of the coal measures proper.

Turning again to the western end of the trough on the south side of the Grand Lake, a few small outcrops of a coarse whitish grit and fine conglomerate, were observed at the mouth of a small brook, one mile west of Aldery Brook; and a similar rock occurs upon another small Brook, still a mile further west. On the former of these some costeaning, immediately above the rock exposures, uncovered a few bands of loose shale and clay, one of which showed some four inches of coaly matter with some thin strings of real coal. Nodules of ironstone were also met with in the shale. No costeaning was performed on the further brook, but a few loose fragments of coal were picked up along its course. There can be little doubt that these latter rocks are referable to the true coal measures, and that they probably extend to Hinds Brook, another mile west, where they most likely run out to a point. At all events, between the two extreme east and west points where coal has been actually seen, and where there is no doubt of the trough being continuous, a distance of six and a half miles intervenes. As nothing further could be accomplished with pick and shovel on Kelvin Brook, we moved back to Coal Brook, and spent the short remainder of the season in more thoroughly uncovering the section exposed here last year. Three new coal outcrops, not then seen, were come across; but they were all of small dimensions; one showing about one foot of impure coal, the second ten inches, and third about six inches.

While encamped here, Mr. Bayly and I, with one of our Indians, paid a flying visit to Hind's Pond, situated away up in the mountain range to the southward, and nearly midway between the Grand Lake and Red Indian Lake, on the Exploits. Rumours of coal having been picked up here, in which, however, very little reliance was placed, led us to make the journey. Like all other rumours of the kind, I have so far investigated, this, again, proved to be without the slightest foundation. The country, so far as could be judged from the few rock exposures on the shores of Hind's Pond, and the vast amount of boulders strewn over the barrens, is occupied exclusively by the Laurentian system.

The season for satisfactorily prosecuting geological research being now at an end, we began to make a move homeward, having first carefully packed all our specimens and transported them across the Great Lake. The heavy undertaking of portaging across to the Main Humber was effected in a few days. Meanwhile, Mr. Bayly, with part of the crew, began to run a new line, backwards from the Humber side, to ascertain whether a shorter and better route for a portage might not exist, with a view to its eventually becoming a roadway connecting the two waters. In this he was quite successful, so far as he went, in finding a tolerably level line almost out to the great marsh, by which the distance was greatly reduced. As the traffic across here is every year increasing, I would again strongly urge the appropriation of a small sum of money annually, to opening up and keeping in repair this very necessary highway. I believe, were a good wagon road once constructed over this section, the Grand Lake would soon become a place of considerable resort for tourists and others. The extra expense involved in getting anything over the portage in its present condition, would go a long way towards making it passable for wheeled vehicles. It is the only available means of reaching the Grand Lake from the Humber side, and sooner or later, the opening up for settlement of this magnificent valley, will render the construction of such a highway a matter of absolute necessity.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XII.

Report for 1892.—The Mineral Resources of Newfoundland.

St. John's, May, 1892.

As a mineral producing country, Newfoundland has only sprung into notoriety within the past quarter of a century. Previous to that date, in fact, from its very earliest history, there appears to have been a vague suspicion of its containing rich mineral treasures, for we find that Sir Humphrey Gilbert, who took possession of the island in the name of Queen Elizabeth, in 1583, had with him a mining expert, a native of Saxony, whom Sir Humphrey despatched upon a mining exploration along the coast. He is said to have gathered many specimens of ore, supposed to be rich in copper, iron, lead, silver, &c. To quote from the narrative of the voyage: "One Daniel, a native of Saxony, a very expert miner and assayer, brought to the General a piece of ore, of which he said that he would stake his life that it contained a considerable quantity of silver."

Sir Humphrey was greatly elated at the prospect of rich mineral wealth in his newly-acquired possession; but fearing lest the numerous Basque and Portuguese fishermen present should get wind of the find, he ordered all the specimens to be concealed on board ship till they were again at sea, when he would cause assays to be made. "So confident was he of the value of this ore, that he boasted to his friends that on the credit of the mine, he did not doubt of obtaining from Queen Elizabeth the loan of ten thousand pounds to defray the expense of another similar enterprise*

But the mines of the waters laving the shores of Newfoundland, which were pronounced by Sir Francis Bacon, in 1610, to contain "richer treasure than all the mines of Mexico and Peru," and whose inexhaustible stores of wealth continue to this day as

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***The poor mining expert, with most of the crew, and all his precious ores, was afterwards lost in the Delight, one of Sir Humphrey's ships, on Sable Island.**

productive as ever, soon completely eclipsed all other enterprises, and obliterated even the very recollection of the island's more problematical mineral resources. A few desultory attempts at mining were, however, made from time to time, where indications of various minerals presented themselves in the sea cliffs. The most noted of these was at a place called Shoal Bay, twelve miles south of St. John's, where a copper mine was opened up more than a century since, or about 1778. What the result was, cannot now be ascertained, but I believe operations ceased owing to the scarcity of the ore. It was however, re-opened by Captain Sir James Pearl, R.N., in 1839, and worked for a short time. No records of the shipments, if any, are extant. Quite recently I have seen very good specimens of grey copper ore from this same locality.

Other attempts at mining of much more recent date were made at various points on the Peninsula of Avalon upon small veins, both of copper and galena, but in most cases they were attended with but poor success. The ores, especially those of copper, were usually of a very rich quality, being chiefly variegated, such as copper glance, erubescite, bornite, covelline, &c., and generally contained in quartz veins, but sometimes in broken killas rock, filling small cracks or fissures. The galena, also, frequently occurred in quartz, but more usually in calcareous spar; the La Manche lead mine, Placentia Bay, being a good example.

In 1864, the present Geological Survey of the Island was established, coincident with the opening up of the Union Copper Mine, Tilt Cove, N.D.B. The labors of the one, and success of the other soon created a lively interest in mining enterprises, which at one time reached to fever heat, and then again gradually subsided. At the present time, mining has settled down to a sober, steady industry, slowly but surely advancing in importance with the growth of the country, and increase of our knowledge of its resources. It is not at all chimerical to look forward to a time when mining and the manufacture of metals, &c., will rank second to no other industrial pursuit in this island.

As a preliminary to entering more into detail of the various mineral substances now known to exist in the Island, I presume a short general description of its principal geological features will not be out of place.

The appellation of "Terra Nova," or New Land, given to this Island by the early navigators is one of the most ridiculous misnomers conceivable—at least, in a geological sense. It is in reality a very old land, and had an existence, in large part as dry land, when but one small rock in the North-east corner of Great Britain represented that island. The 42,000 square miles comprising the total area of Newfoundland, are composed chiefly of the oldest known geological series, beginning with the Laurentian and endng with the Carboniferous. Not one of the higher or more recent Mesozoic systems, known to geologists, have any existence here, always excepting the superficial drift, chiefly made up of glacial debris, river-silt and ordinary clays, derived from disintegration of the rock surfaces. Much vegetable matter, in the form of peat, is found to occupy a large portion of the surface, especially over the less wooded areas of the interior.

The great Laurentian system, so largely developed in Canada and on the Labrador, occupies a very extensive portion of Newfoundland. The southern coast line of the island, from Bay d'Espoir to Cape Ray, presents one bold front, 150 miles in extent, consisting of granites, syenites, mica, schists, &c., all referable to this period. They extend inland for many miles, and then branching out from the base into several great tongues, stretch across the island, forming the chief elevated ridges of the interior. One of those tongues or belts, commencing at the head of Fortune Bay, strikes in a northeasterly direction and comes out to the shore again on the north side of Bonavista Bay, forming most of the coast line between the latter and Gander Bay, in the great bay of Notre Dame. It also constitutes nearly all the numerous outlying islands, rocks and reefs, lying off this portion of the coast. The Funk Islands, a group of small granitic rocks, forty miles from the land, form the extreme north-east outlyer of this tongue. A second great ridge of granitoid and gneissoid rocks trending in the same direction strikes away from the base to the westward of Bay d'Espoir, and forms the beight of land between the two great valleys of the Gander and Exploits Rivers, narrowing towards the north-east and terminating in a point near the shores of Dildo Reach, Notre Dame Bay. The third and most extensive belt of Laurentian trends away north-easterly from Cape Ray, and passes between the Exploits and Humber Valleys, being split up in the latter valley, where it is overlaid by the central Carboniferous trough of the island. One branch of this latter ridge runs out towards the extremity of the peninsula separating Notre Dame from White Bay, while the other continues northward through the Northern Peninsula, or "Petit Nord" of the French, nearly to the extreme north point of the island. This ridge is termed the Long Range Mountains, and is in reality the backbone of the entire structure of the island. One small isolated patch of the same system forms the nucleus of the Peninsula of Avalon. Surrounding this nucleus on the extreme eastern seaboard, and the shores of Conception and St. Mary's Bays, we have a set of ancient sedimentary strata consisting of:

(*a*) Diorites and quartzites, with jaspery bands.

(*b*) Slate conglomerate.

(*c*) Greenish, purplish, pinkish or red slates, often approaching in hardness jasper or chert. These have sometimes been called feldsite slates, or hornstone.

(*d*) Dark brown or bluish black slates, with thin layers of hard fine grained sandstones toward the top. This has been named the St. John's slate, or Aspidella slate, from the occurrence in it of an obscure fossil organism peculiar to these rocks in Newfoundland. It has been named by Billings Polaeontologist of the Canadian Geological Survey, *Aspidella Terranovica.* There is also another obscure form *Arenicolites,* which appears to be almost identical with *Arenicolites Spiralis,* a fossil occurring in Sweden in a formation lower than M. Barrande's Primordial.

(*e*) Greenish and greyish, very hard quartzose sandstones or whinrock, in massive beds.

(*f*) Dark red fine grained sandstone, nearly as hard as preceding, passing into fine conglomerate towards the top.

(*g*) Heavy beds of coarse, reddish, conglomerate or pudding stone.

This formation has been hitherto designated Huronian, from its striking lithological resemblance to a similar series of strata, in about the same horizon, known by that name in Canada. It forms the greater portion of the Peninsula of Avalon, also the two long projections between Trinity and Bonavista, and Placentia and Fortune Bays, while much of the country stretching inland from the heads of these great indentations is underlaid by the same series. In Conception, Placentia, St. Mary's, Trinity and Fortune Bays extensive patches of a more recent and unconformable formation fringe the shores on either side, resting upon both the Laurentian nucleus and the various members of the preceding Huroian. The three islands in the first-named bay, also Random Island in Trinity Bay, and the Island of Langley, off the entrance to Fortune Bay, are occupied by this same formation. Some of its strata, more particularly the slaty and calcareous beds, are crowded with fossil organisms. Red sandstones, conglomerates and quartzites predominate at the base. Red, purple and greenish slates, with limestone beds, form the central portion, and towards the top dark colored shales and grey sandstones are the prevailing rocks. The chief organisms are trilobites, near the base, and lingula, zoophites, and worm tracks, &c., towards the summit. It has been named Primordial Silurian and Lower Cambrian; but the latter name is that by which it is more generally recognized now. Sir William Dawson, K.C.M.G., the great authority on Acadian Geology, considers this series the equivalent of his "Acadian Group," and also of the Longmynd, Menevian, and Lower Lingula flag groups of Britain.

Large tracts of country on the eastern, northern and southern side of the island are occupied by a great variety of metamorphosed rocks, exhibiting a vast amount of disturbance. These rocks are twisted, distorted, upheaved and faulted, penetrated by numerous dykes and masses of intrusive trappean, granitic and other disrupting elements, and have undergone so much change as entirely to lose their original character. Quartzites, diorites, feldsites, porphyries, &c., form a large portion of the mass, while chloritic, talcose and plumbaginous slates and shales are not infrequent. Innumerable quarts, calcareous and other vein rocks, penetrate all alike, running in every conceivable direction, most of them holding some or other metallic substance. That some portion of these metamorphic rocks are referable to either or both the preceding Huronian and Lower Cambrian series there can be little doubt. Again, in the Bay of Notre Dame, the principal Cuperiferous district of the island, another great set of metamorphosed formations occurs. These are characterised by large patches of peridolite, steatitic, serpentinous and dolomitic bands, while felspathic ashes, with a very considerable portion of chloritic slates, diorites, quartzites and red jaspery bands, besides a variety of other more or less altered strata, constitute the bulk of the series. Similar rocks occupy very extensive areas of the Northern Peninsula and the western side of the island, being especially well displayed over the country lying between Bonne Bay and the Bay of Islands, and the latter bay, Port-au-Port and St. George's Bay. Another very extensive tract in the interior, lying between the head waters of the Gander and Bay d'East River, exhibits all the characteristics belonging to the same horizon.* This series of metamorphic deposits has obtained the name of the metalliferous zone of North America, owing to its highly mineralized character throughout its entire range. Here in Newfoundland it has been proven well deserving that title. The great Silurian series of formations are all represented here in greater or less volume. The valleys of the Exploits and Gander Rivers are chiefly underlaid by Lower Silurian slates and sandstones, &c. Middle Silurian organisms are abundant on some of the islands of Notre Dame Bay, and still more so on the Port-au-Port Peninsula, on the western side of the island. Lower, Middle and Upper Silurian strata frequently crop out along the Northern Peninsula, and on the shores of White Bay. In this latter bay, also, occurs the first appearance, so far as yet known, of the succeeding Devonian or Old Red Sandstone series. The two small projections or peninsulas of Cape Fox and Cape Rouge, and a portion of the Groais Island, near the north-east extremity of the island, are the only other points at which this latter formation exhibits itself in Newfoundland.

The Carboniferous series occupies two extensive areas of country, one bordering on the West Coast surrounding the Bay St. George, the other in the valley of the Humber River. As this series is more particularly referred to under the head of Coal, it is needless to enter into any deails here.

Precious Metals—Gold.

Rumors of the existence of gold in several parts of the island had been long circulated, but up till about ten years ago, no *bona fide* find of this noble metal, that could be thoroughly relied upon,

*The Quebec group of Sir William Logan.

came to our knowledge. Previous to that date, traces of gold were detected by analyses in specimens of quartz from Humber Arm, Bay of Islands, and also in an arsenical iron ore from Bonavista Bay. In 1880, some genuine specimens of free gold were discovered in quartz veins in the vicinity of Brigus, Conception Bay. Upon an investigation by the Geological Survey into the geological and mineralogical characteristics of the district, it was found that the quartz usually occurred in small irregular patches, or veins of segregation, cutting bands of hard felsitic slate and whin-rock, near the base of the so-called Huronian formation. Though a few larger veins of a more persistent character were met with in the same neighborhood, the gold appeared to be confined entirely to the smaller patches of quartz, which reticulated through the hard slate rock. The investigation resulted in the finding of several promising sights of free gold, in the form of small isolated nuggets, frequently deposited in little drusy cavities, surrounded by decomposed feldspar. On removing this soft material, the gold would fall out, being unattached to the quartz. In some cases, however, it was attached to, or disseminated through, the quarts itself and accompanying chlorite, which frequently composed a large part of the lode rock. It was found, however, on further investigation, that very few of the numerous small veins of quartz contained the gold, and that the body of the rock showed no gold, not even a trace, on being subjected to the usual tests. The veins, or patches of quartz, containing the metal were rarely of any extent, and a few blasts not infrequently resulted in the disappearance of the lode rock. Some considerable prospecting, and an attempt at mining, by crushing and washing the quartz, was entered upon, but failed in bringing to light any more promising indications. About the same time, gold was discovered in two other localities far removed from each other, and from the former. Some free gold was obtained in quartz veins at Bay of Islands, where it had previously been detected by analysis; but by far the most promising specimens yet discovered, were obtained at a place called Ming's Bight, on the north-east side of the island, situated on the peninsula of land separating Notre Dame Bay from White Bay. The proprietors of the Bett's Cove Copper Mine had commenced mining here on a copper deposit, and when about thirty or forty feet down, came across some thin veins of quartz and bitter spar penetrating the chlorite rock of the lode, which were found to be well charged with gold. I am unable to say what quantity of gold was extracted from this mine, but have been informed that quite sufficient to prove it a rich lead was taken out; at least, one nugget of several ounces in weight was obtained. A specimen now in the Museum is about two inches square. It consists mainly of bitter spar, very much cleaved and jointed. One side of it has a dull leaden hue, and contains a mineral, supposed to be Tellurium. The gold is profusely distributed through the central part of the specimen in thin plates, surrounding the crystals of dolomite on all sides. It presents the appearance of being electroplated. It is seen to penetrate the cleavages of the rock, often showing through the thin transparent crystals. It also runs into the grey metal on one side, while on the opposite side there are numerous small crystals, of arsenical pyrites or mispickel. No returns have ever been made, either of the quantity of gold or copper yielded by this mine. Work thereon was suspended in a short time, owing, it is said, to some litigation and the interference of the French ships of war—the mine being situated on what has been called the French Shore of Newfoundland, or that portion over which the French nation exercises certain treaty rights. The presence of gold in most of the copper ores of Notre Dame Bay, had been detected by the color of the flame in smelting the ores several years since. More recently, quite an appreciable quantity of the precious metal was ascertained to exist in the low grade ore from the Union Mine, Tilt Cove, and it has lately transpired that gold to the value of £10,000 Stg. was extracted from this ore, in the process of refining, during the past twelve months. I am also informed, that free gold in small quantities has been met with in thin quartz veins cutting the lode rock. So promising has this yield proven, that orders have been given the manager of the mine to carefully examine all the refuse slag, &c., in the dumps, with the result that paying quantities of gold have been found therein. Several specimens of mispickel (ansenical pyrites), from the same bay, have yielded, on analysis, a greater or less percentage of the precious metal. Though the above is sufficient to indicate the actual presence of gold on three sides of the island it, perhaps, scarcely warrants us in calling it an auriferous country. Still, its presence at all, and the fact that the nearest neighbouring province—Nova Scotia—has proven eminently auriferous, leads us to hope that, upon further development of this island, and a more systematic search for the precious metal, gold discoveries of more importance may result therefrom. This hope is strengthened by the fact that the Pre-Cambrian, Cambrian and Cambro—Silurian formations, (the same which hold most of the gold of the Globe) are so largely developed here, and in an unusually disturbed, altered and mineralized condition. It has not, I think, been definitely decided as yet whether the Nova Scotian gold-bearing rocks are of Pre-Cambrian (Huronian) or Lower Cambrian age; but it is pretty certain, whichever they may eventually prove to be, their equivalents are to be found on the eastern seaboard of Newfoundland.

SILVER.

Many years since, a deposit of galena, in a gangue of greenish and pinkish flourspar, was discovered at a place called Lawn, situated on the extremity of that long, narrow peninsula separating Placentia from Fortune Bays. Mining operations were commenced here by a local company, and under the management of a Cornish mining captain. In following the lode at one point near the shore, they struck a small vugh or cavity, filled with what appeared to the miners to be a dirty sand or gravel. It was shovelled out and thrown on one side, where it became washed by the rain-water, when several lumps and strings of dark-colored metal appeared, which proved to be native silver, mixed with other ores unknown to the miners. Specimens were saved and brought to the notice of chemists, who pronounced them to be chloride of silver (horn silver), native silver, and ruby silver, or rather what would appear more to resemble proustite (light red silver ore). As soon as the miners became cognizant of the value of the ore it is said they appropriated most of it and sold it to jewellers and others of St. John's and St. Pierre. That there is some truth in the latter part of the story, would appear, from the fact that I have been shown specimens in one of those shops, purporting to have come from the locality in question. From some cause I am not sufficiently acquainted with, the mine was abandoned after a short while. It may be that the galena, for which it was worked, proved very sparsely disseminated through the gangue, or the fact that they did not succeed in finding a second vugh containing those rich silver ores. I understand, also, a large portion of the cliff had foundered, completely burying up the workings. All this occurred long before the institution of the present Geological Survey. Shortly after my predecessor, the late Alexander Murray, C.M.G., taking this work in hand, he procured a specimen of this ore from one of the original proprietors of the Lawn Mine and sent it to Canada, where it was analyzed by the then chemist of the Canadian Survey, Dr. T. Sterry Hunt, who pronounced it a sulph-arseniuret of silver (ruby silver?), yielding 65.28 per cent. of metal. It was encrusted with chloride of silver (horn silver). A recent attempt was made to re-open this mine, which failed, as I presume, from want of sufficient capital. Native silver, in thin films or plates, was found encrusting the cleavage planes of a mineralized slate, on the Fortune Bay side of the same peninsula. An attempt was made at mining here, but soon abandoned as unremunerative. Nearly all the galena ores occurring on every side of the island contain a greater or less percentage of silver. One deposit at Little Placentia, in Placentia Bay, yielded specimens showing as high as 356 ozs. to the ton of ore, thus proving it an eminently argentiferous galena. A mine was opened here, known as the Silver Cliff Mine, and worked vigorously for a few years, but subsequently abandoned. The ore did not prove so abundant or rich in silver throughout as the work progressed; but there is reason to believe, from certain facts ascertained, that the true or mother lode of this property was never discovered, and that the small veins actually opened up are but leaders or stringers to a more important deposit. This supposition is borne out by the finding of large blocks of prill ore, several hundred pounds in weight, unearthed amongst the loose gravel near the surface, while costeaning for the lode. No such blocks as these were found in the actual workings.* The same specimens of quartz from Bay of Islands, mentioned as containing traces of gold, also showed a small percentage of silver. None of the other noble metals have yet been detected in the island.

*What appears to be the main lode has recently been discovered, and specimens from it look very fine and contain a large percentage of ore.

THE MORE COMMON METALLIC SUBSTANCES

RUTILE.

Rutile occurs in large embedded crystals in a vitrious quartz, at White Bay.

TIN.

1.20 per cent. oxide of tin was found to be contained in a specimen of Columbite, from Labrador, also in an ore of galena from Notre Dame Bay. [See Analysis, No. 11.]

MOLYBDENITE.

This is a mineral which occurs in many places around the shores of this island and in the interior. Quite a considerable deposit was found a few years ago, in Fortune Bay; but the demand for the substance being so very limited, no attempt has been made at mining the ore. Good speimens have also been exhibited from Hamilton Inlet, Labrador.

TELLURIUM. (?)

Already mentioned as occurring with gold, in bitterspar, from Ming's Bight.

BISMUTH.

Traces of, in galena, from Little Lawn. [See Analysis, No. 1].

ANTIMONITE (STIBNITE).

This mineral occurs at one or two localities, chiefly in the great Bay of Notre Dame. A deposit, which gives promise of developing into a paying mine, occurs at a place called Moreton's Harbor, on New World Island, in that bay. Some desultory mining has been carried on here, for some years back, with fair prospects. Not having seen the deposit, I cannot speak of it, except from specimens exhibited, which look very favorable. Other specimens were procured on an island called Duck Island, near Badger Bay, Notre Dame Bay. The Customs Returns, appended to this paper, show a small export of this ore during the past two years.

IRON ORES.

Ores of iron are very common in many parts of the island, and comprise nearly all the usual varities: magnetite, hematite, specular iron ore, limonite, ilmenite, chromite, siderite, vivianite, clay ironstone, brown and yellow ochre, iron pyrites, pyrrhotite, mispickel, &c. Of these, magnetite, hematite, chromite, clay ironstone and pyrites are the most abundant ores. The former occurs in large masses, in the vicinity of some of the copper mines, notably the Union Mine, Tilt Cove. An immense body of magnetite was discovered a few years since in the Laurentian Range, near St. George's Bay, on the West Coast. It was found on analysis, however, to contain a large percentage of titanic acid, which greatly militated against its usefulness. That there is an abundance of a similar ore in the same range, is indicated by the large quantity of debris found in the beds of most of the streams issuing from the Long Range Mountains. Megnetic iron sand is of very common occurence, both in this island and along the Labrador coast. Hematite occurs with the magnetite at Tilt Cove and elsewhere. Chromite is found, generally, associated with serpentine group of rock wherever displayed in the island; and there would appear, from the loose debris scattered about, to be a considerable deposit of this ore in the vicinity of Pipe Stone Pond, on the head of the Bay d'East river. The clay ironstones are confined to the coal measures of Bay St. George and the Grand Lake region. In the latter, extensive beds were come across during the past season (1891), consisting of irregular nodular or lenticular masses, arranged in layers of stratification, with also some solid bands of from two to three feet thick. The common yellow pyrites (mundic) occurs all over the island, and is found, more or less, disseminated through every formation that goes to constitute its rock crust, but its chief value consists in the immense massive deposits associated with the copper ores in Notre Dame Bay and elsewhere. At the Terra Nova Mine, Bay Verte (not at present in operation), Mr. Murray, in 1867, speaks of the deposit as consisting or "an enormous mass of iron pyrites, with an occasional admixture of yellow sulphuret of copper." Again at the Union Mine Tilt Cove a mass of this ore, said to be over 200 feet thick, was driven through a few years since, on the east of the original copper workings. It is very hard and compact having a close, even texture, and contains, on an average, about two to four per cent. of copper. At the Tilt Cove, Bett's Cove and Little Bay copper mines, large quantities of this same ore have been mined with the copper; probably one-third of the bulk of ore raised, most of which was thrown aside in the dressing. Another immense deposit is now being extensively mined at Pilley's Island, Notre Dame Bay. The lode is said to average sixty feet in width, and contains 52 per cent. of sulphur.* This mine is now in a flourishing condition, employing some hundreds of men, and shipping large quantities of the ore each year to market, principally to the United States, to be used in the manufacture of sulphuric acid, copperas, &c. It has been ascertained, within the past year or two, that the refuse cinder left after the extraction of the sulphur is of a very superior quality for the manufacture of certain grades of Bessemer. The quantity of ore shipped from Pilley's Island mine, as taken from the Customs Returns, will be found in the tabular statement. Quite recently, the enterprising proprietors of this mine have introduced the electric light underground, which enables them to work continuously day and night. This is the first instance in which this light has been employed in mining in Newfoundland. The enormous deposit of Red Hematite on Bell Island, C. B. had not been discovered when the above was written.

Columbite.

Obtained from the Labrador coast. [See Analysis, No. 11].

Manganese.

Ores of manganese have been observed in several localities, but, as a rule, not of a rich quality. One massive black oxide comes from the south side of Conception Bay, where quite an extensive deposit occurs as a contact lode. It contains about 51½ per cent. oxide of manganese, the residue being chiefly iron and earthy impurities. Wad, or bog manganese, is a very common ore, found as a surface deposit in many localities. A carbonate of manganese of a pure white color, probably a variety of rhodochrosite of rare occurrence, is found in the neighborhood of St. John's, usually as an incrustation on decomposed slate rock. It appears to be a rare variety, as I do not see it described in any work on mineralogy.

Chrome.

Besides the chromic iron already alluded to, I have seen chomate of lead from the west side of the island. The presence of

*Prof. Holloway has obtained as high as 55 per cent. from some specimens submitted to him for analysis.

chromium is also indicated by the frequent stains of green oxyd of chromium, either on the surfaces or impregnating many of the rocks of the magnesian series, especially some of the dolomitic or bitterspar bands.

NICKEL.

Nickel has been detected by analysis in several of the serpentine and dolomitic rocks of the island. Quite an extensive deposit, consisting of several varieties of the ore, viz.: Copper-nickel, cloanthite, millerite and gersdorffite, were found in a vein of dolomite, or bitterspar, intersecting the chloritic lode rock of the Union Copper Mine at Tilt Cove. Between the years 1869 and 1876, both inclusive, 411 tons of nickel were shipped from Tilt Cove, valued at $32,740. Since that date, no returns of any ore having been shipped are on record.

COBALT.

Cobalt occurs, sparingly associated with the nickel ore, at Tilt Cove. Cobalt bloom was observed at one or two places, as a stain or incrustation on the rocks.

ZINC.

Ores of zinc, including most of the more common varieties, viz.: blende, zincite, and calamine, occur in several localities, as at Tilt Cove, Placentia and Lawn. Nowhere, however, as yet, has it been found in any considerable quantity, such as to render it worth mining for itself alone. Red oxide of zinc, from the Lawn mine, yielded on analysis, traces of bismuth and cadmium.

CADMIUM.

Traces of, in zinc blende, from Little Lawn. [Analysis, No. 5].

LEAD.

The ores, of lead, chiefly galena, are disseminated throughout almost every rock formation in the island, generally in quartz and calcspar veins. Numerous small quartz veins containing this ore occur on the Peninsula of Avalon especially in the Huronian formation. Several attempts at working these ores were made many years ago but in most instances with but poor success. The most promising and best conducted mine yet opened is situated at a place named La Manche at the head of Placentia Bay, the property of the Telegraph Land Company, now the Newfoundland and Canadian Trust Company. Operations were commenced in 1857, and for a time the mine was vigorously worked. It changed hands two or three times. Finally, the work began to languish, and the mine was closed about 1870. Recently, the original owners have recommenced operations here, and are now getting it in workng order. From 1857 to 1868, some 2,375 tons of galena were extracted altogether from excavations, amounting to about 1,000 cubic fathoms, equalling an average of 2.37 tons per cubic fathom. The vein stuff consists chiefly of calcspar, with a mixture of quartz, sulphate of barytes and a little fluorspar. It averages about three feet thick, but often widens out to six or seven feet. It is a regular well-defined lode, filling a fissure in the slate rock. It is in a nearly vertical attitude, and runs very straight, with great persistency, for a long distance. The country rock consists chiefly of a set of greenish, very hard and brittle, compact cherty or jaspery slates (Division C of Huronian Section), which cleave exactly with the bedding. The vein material is frequently tinged with a pale purplish color, and beautiful amethystine quartz crystals are often found lining the sides of small vughs or cavities in the lode rock. The ore is distributed irregularly through the whole thickness of the vein, in patches and isolated crystals, but there appeared to be a pretty regular and continuous string of ore near the middle, of from one to four or five inches in thickness. Large quantities of what the miners term "prill ore," in blocks of many pounds weight, were found in the vughs and pockets at intervals throughout the workings. The only other lead mine which gave promise of considerable value, was the Silver Cliff Mine, at Little Placentia Sound, already referred to under the head of Silver Ores. Assays of this ore gave over 70 per cent. of metal. A very peculiar deposit of galena occurs in Port-au-Port Bay, on the West Coast. The matrix of the lode consists chiefly of crushed Lower Carboniferous limestone, filled with its characteristic fossil shells in great profusion and well preserved. It would appear to have fallen into a fissure, or rather collapsed, by the undermining and crumbling away of the subjacent Lower Silurian limestone, masses of which, containing its characteristic fossils, are caught up in, and confusedly blended with, the Carboniferous. In the broken, crushed rock, much calcspar ocurs, in which the galena is thickly disseminated.

An attempt at mining this ore here, which gave much promise, was stopped some eight or ten years since by the interference of the French fishery protection squadron, on the ground that it would clash with their fishing privileges. Numerous other indications of galena are reported, and many specimens of beautiful, clean ore exhibited from this western side of the island, chiefly from Silurian rocks. A pale, yellow chromate of lead has also been exhibited from that side. The oxyd of lead is only found as an incrustation, resulting from decomposition of galena in some of these localities, while I have never yet seen phosphate of lead in the island. Nearly all the galena ores contain more or less silver, and sometimes traces of other metals. Galena also is shown as a product of the Labrador, but merely as specimens, so far as yet known.

Copper.

Perhaps of all the mineral substances known to the island, copper ranks first in point of importance, and certainly does in development. It is, at least, a century since the first attempt at mining this ore was made at a place called Shoal Bay, near St. John's. The ore found was chiefly yellow sulphuret, mixed with a little green carbonate, but the deposit consisted merely of a few small strings and nests of ore, in a very hard sandstone or whin-rock. The work was soon abandoned, as there was not sufficient ore to render it remunerative. Quite recently, some very rich specimens of grey copper, tetrahedrite, have been procured in the same neighborhood. Beautiful rich variegated ores, including several varieties, such as erubescite, or bornite, copper glance, covelline, red copper ore, malachite, &c., have been found in a great many places, especially in the Peninsula of Avalon, and several attempts to mine these richer ores were made from time to time, attended with varying success. Generally, the hard intractable nature of the enclosing rock, and the character of the vein material—usually quartz—rendered the extraction of the ores difficult and expensive. The discovery of the deposit at Tilt Cove, in Notre Dame Bay, in 1857, since named the Union Mine, gave a new impetus to copper mining in the country, though mining operations were not actually prosecuted there till 1864. The deposit consisted chiefly of yellow sulphuret of copper, and iron averaging about 12 per cent. of copper, though it has reached as high as 30 per cent. Tilt

Cove soon sprung into notoriety from the enormous deposit of ore laid bare in the various openings. The Mine Bluff as it was termed or real lode rock, consisted chiefly of a compact chloritic slate, very ferruginous, containing thin seams and threads of serpentine, and having enclosed huge intercalated masses of hard, compact, gray and greenish crystaline rock, probably dolomite. This rock is slightly calcareous, and weathering on the surface a pale yellowish color. The lower part of the lode rock is chiefly of a soft steatitic character, which occasionally contains masses of serpentine and soap-stone, magnetic iron being disseminated through it in grains and crystals. Overlying, and in front of the mineralized band, is a mass of hard gray diorite, or trap, probably intrusive, containing epidote in strings and patches, and scattered through it are minute crystals of bitterspar. A great body of serpentine succeeds this rock on the north. Underlying the lode the rocks consist chiefly of diorites, black and dark green slates, quartzites, bands of red jasper, and jaspery iron ore, patches of dolomite and serpentine, all confusedly jumbled up together, still preserving a rude arrangement resembling layers of stratification. Such is the general character of the country in the immediate vicinity of Tilt Cove—a description of which will apply generally to all the other localities in the Bay of Notre Dame, where copper has been mined. In almost all cases the lode rock is more or less chloritic, and diorites are present, either in the lode or over and underlying it; but in some instances the steatitic and serpentinous strata are not present, except, perhaps, as mere threads and strings, or in small patches.

The Union mine continued in active operations up to a few years since, when the decline in copper took place, and a change of ownership caused the working to languish for a while. It is now in the hands of an energetic mining company,* who are pushing on the work vigorously, and have raised a large quantity of ore during the past year. The mine is situate on the north side of Notre Dame Bay, about ten miles from Cape St. John, which forms the extreme north point of the great bay.

In 1875 the Bett's Cove mine was opened. It lies further in the bay, on the same side; distant from the former eight miles.

*The Cape Copper Mining and Smelting Company.

This mine was worked with extraordinary activity for ten years, during which period 130,682 tons of ore and regulus were exported therefrom, besides 2,450 tons of iron pyrites. The ore, as at Tilt Cove, occurs in a mass of mixed chloritic slate and diorite. In the course of the excavating some enormous pockets of ore were come across. Work was suspended on this mine about 1885, owing to the great depreciation in value of copper, and from the caving in of the mine-bluff—a great boss of mineralized rock capping the mine—which had been completely honey-combed by the excavations. It is thought the ore was far from being exhausted at the time. Several other copper mines were opened up during this period, and more or less ore derived from each. The principal localities which gave most promise were Burton's Pond, the Colchester mine, S. W. Arm, Shoal Arm, Little Bay, Lady's Pond, Whale's Back, Hall's Bay, Sunday Cove Island, Rabbitt's Arm, and Thimble Tickle, Seal Bay—all within the great bay of Notre Dame. But the most celebrated of all the copper mines yet developed in this region is the Little Bay mine, which has been in constant and active operation since 1878, though it has, during that period, changed its ownership. Operations were only commenced here in August of the above year, yet, before the end of the season, some 10,000 tons of ore were raised and shipped to Swansea. Between 1880 and 1885, 61,796 tons were shipped from this mine, and since that date to the end of last year, over 40,000 tons of ore, regulus and ingots of copper are given in the Customs Returns. Between 1880 and 1882, the South-West Arm mines yielded 490 tons; Hall's Bay, 240 tons, while Rabbitt's Arm mine—wheih was only worked for one year—yielded 1,260 tons of ore, averaging 28 per cent. copper. This latter mine forms rather an exception to the others. While chloritic slate is the prevailing rock, containing strings and nests of ore, with at least one solid band, most of the copper was derived from a set of large parallel bands of quartz, varying from three to five feet wide, richly impregnated with ore of a higher percentage than ordinary. Grey copper, containing a considerable percentage of silver, is sometimes associated with the other ores in this mine. At Lady Pond mine the ore is a rich yellow sulphuret, with a large proportion of beautiful purple and bluish erubescite, generally occurring in pockets.

Some of the copper deposits in this bay, notably those of Sunday Cove Island, consist of wide bands of fine, soft, shelley chloritic slate, impregnated with iron and copper pyrites, and containing bands of yellow copper ore, varying from mere strings to layers of several inches thick. Here, also, very beautiful arborescent filaments, of native copper are found on the cleavage plains of the lode rock. Metallic copper occurs at the Union Mine, Tilt Cove, in thin sheets or plates, lining the walls of cracks or slips in the lode rock. It has been found on the west side of the island, in Port-au-Port and Bay of Islands. In the latter instance it forms strings, nests and small pockets, scattered through an amygdaloidal trap, but more especially confined to small veins of bitterspar, intersecting the same rock. Also on Oderin Island, Placentia Bay. The other localities where ores of copper have been found are too numerous to mention. It will be sufficient to state that the indications of these ores occur on all sides of the island, and in every one of the great bays at hundreds of localities. During the past six months a new discovery of copper has been made at South-West Arm, Green Bay, near the old Colchester mine. This lode is said to average six or seven feet wide, with two feet of solid ore.

Labrador—of which we know but little mineralogically—is, in all probability, a cuperiferous region also; many rich specimens of copper ores have been brought from various parts of the coast, and a mine was actually worked there, at Black Island, several years ago, with what success I am not in a position to say.

Coal.

There are two distinct carboniferous basins in this island—on its western side. The first is known as the St. George's Bay trough. It occupies a fringe of the south side of that bay, about sixty-eight miles long by twelve wide, comprising an area of about 816 square miles. Other small outlying patches on the north side of the same bay and again in Port-au-Port Bay, would probably bring the total area up to 900 square miles. The second, called the central carboniferous trough, is situated in the valley of the Humber River, which flows into the Bay of Islands, at the head of the Humber Arm. Although lying in a direct line from each other, and corresponding with the general trend of the physical features of the country, the two areas are separated by between sixty and seventy miles of distance, though they were at one time probably connected. The central basin comprises a superficial area of about 500 square miles. By far the greater portion of both basins is occupied by the lower and unproductive portions of the series, especially the carboniferous limestone and millstone-grit formations. The entire southern side of St. George's Bay exhibits the above strata, frequently broken by faults, and repeated again and again. One great anticlinal fold running parallel with the shore, extends up and down the coast, with a westerly dip on the outside, towards the waters of the Gulf of St. Lawrence, and an opposite dip inland, where the strata which hold the coast are repeated, and at a distance of some six or seven miles from the shore, the middle or true coal measures are exposed on the surface. A long, narrow trough, of some three or four miles wide, is here brought in, which holds several fairly good seams of coal. The lower measures come again to the surface on the inner side of the trough, where they finally rest against the Laurentian Mountain Range in the rear. What the longitudinal extent of this coal trough may be, has not yet been definitely ascertained, and it can only be determined with certainty by the use of the boring-rod. Coal was known to exist in this region for a long time; but the difficulty of exploring it thoroughly, and the large display of the lower formations, barren of coal, on the coast, seemed to convey the general impression that no coal of any consequence existed here. In 1889 a more thorough investigation by the officers of the Geological Survey, resulted in the finding of several seams of good coal, which were uncovered at their outcrops, and traced for some distance, so as to obtain accurate and reliable measurements, and good average specimens of the quality of the mineral. Referring to the report of that year, it shows that, altogether, fourteen seams of coal, of a varying thickness, from a few inches up to six feet, were uncovered on one small brook; three seams on another, two miles distant, and four small seams on a third brook, still further eastward some two and a half miles. Of these, the following are the best and most promising:

	Ft.	In.
Cleary seam	2	2
Juke's seam	4	6
18-inch seam	1	6

Slaty seam	1	4
Clay seam	1	8
Rocky seam	1	5
Murray seam	5	4
Howley seam	4	2
Shears seam	1	2

These, with some smaller ones, aggregate a thickness of twenty-seven feet of coal in the section, which is repeated by being brought again to the surface on the other side of the synclinal trough. There is reason to believe that these do not represent all the seams in this section.

In the central carboniferous trough, which was the object of special investigation last season, several seams of coal were found in the region of the Grand Lake, occupying another long, narrow, synclinal trough. Two sections cross this trough, and at two miles distant from each other on the strike, were measured, with the result that, in the first one, sixteen outcrops of coal were observed, and in the second, twenty-eight outcrops. These are not separate and distinct seams, but the same seams repeated by the doubling up of the strata. So sharp is this trough in one case that twenty-four of those outcrops are crowded into a horizontal distance of 600 feet. None of the seams are large; only a few averaging three feet of coal each. Many of the smaller seams of good coal are so close together, being divided only by five or six feet of loose, shaley strata, and all in vertical position—that I believe several of these could be worked as one seam by a single drift along the strike. All the coal as yet discovered in this island is of the soft bituminous variety; some of it approaches cannel coal. One seam in St. George's Bay, "the Shear's seam," has a very clear, shining black lustre, and hardness approaching the softer kind of anthracite. A few tests of the Bay St. George coal have been made, showing a good average coal; but, up to the present time, the result of specimens sent home from Grand Lake is not known.* Neither of these coal areas have been thoroughly explored, as yet; and the difficulty of carrying out a close investigation, where so much of the surface is covered with loose debris, renders the use of the

***The analyses of these were received since the publication of this paper, and some of them proved fairly good, considering they were only surface specimens.**

boring-rod absolutely necessary to further prove the character and extent of these coal deposits.

Graphite (Plumbago.)

Graphitic, or plumbaginous slates and shales, are common to several formations, particularly the Cambrian and Cambro-Silurian. Impure deposits of plumbaginous clay, or pulverized slate, filling fissures, frequently occur in these rocks, and the material has been used by the inhabitants in the neighborhood as stove polish. Much purer specimens of graphite come from the Laurentian formations, on the south side of the island, and in the Long Range Mountains.

Bitumen, Petroleum, &c.

A small piece of black, hard, glistening bitumen, apparently identical with the New Brunswick Albertite, was found in the gravel in Bay St. George, near the Murray coal seam. Bituminous shales and limestones occur both in the Lower Silurian, or Cambrian, and Lower Carboniferous formations, on the western side of the island, and more recently on the north side of Deer Lake. In Port-au-Port Bay, and at Parsons' Pond, Sandy Bay, crude petroleum is frequently found floating on the surface of the water, and collected in little cavities in the rocks. An attempt to bore for oil was at one time made near Cow Head, West Coast, but was unsuccessful—it is supposed from not having pierced the true oil bearing strata. The bituminous shales in the Lower Carboniferous series on the Humber River, after being exposed to sufficient heat, ignite and burn freely, with a yellow flame, giving off a strong odour of petroleum. Shining black crystalline bitumen, resembling jet, occurs in small quantities in an amygdaloidal trap rock, in Port-au-Port Bay.

Salt and Brine Springs.

Brine springs are quite common in the vicinity of the gypsiferous deposits of the Carboniferous series in St. George's Bay, and the rocks are frequently found coated with deposits of fine white salt. It is not at all improbable that these indicate here, as elsewhere in the same series, underlying beds or masses of rock salt.

Mineral Fertilizers.

Limetones suitable for the manufacture of lime are abundant in many parts of the island. Shell marls occur in a few places in St. George's Bay. While gypsum is one of the most extensive and abundant products of the Carboniferous formation in the same region. Besides its use as a fertilizer, much of this gypsum is of the snow white variety, admirably adapted for stucco-work. Only last season was the first attempt made to work and ship to market this crude material. An American Company, which uses large quantities of the finer qualities of gypsum, for such purposes as dressing the surfaces of writing paper—giving it a fine white gloss—and the adulteration of flour in the manufacture of confectionery, &c., where only the very purest snow-white gypsum would be applicable, have leased one of the gigantic masses which appear near the shore, and are working it vigorously since then. Veins of beautiful selenite—alabaster—frequently penetrate the masses of gypsum, and in Codroy Valley considerable quantities of it are found. The presence of phosphate of lime, Apatite, has as yet only been recognized as mere specimens; there is good reason to suspect its occurrence in more pronounced deposits, amongst the Laurentian series of formations, so extensively distributed in this island. Specimens indicating its presence on the Labrador, are to be seen in the Museum.

Mineral Pigments.

Barite, both white and of a pink shade, is a pretty abundant mineral, being found accompanying other vein stuff in many of the localities where galena and zinc occur. It also occurs in distinct veins free from other minerals, but usually discolored. Large blocks of pure white sulphate of baryta come from Labrador. Earthy materials, such as yellow, red, brown and various other shades of ochres, are abundant throughout the lower carboniferous deposits. These, mixed with oil, make fairly good substitutes for paints, and are often used by the inhabitants. Red ochres, resulting from the decomposition of iron ores, are met with on every side of the island; and it is this material the aboriginal inhabitants (The Red Indians of Newfoundland), made such extensive use of, and from which they derived their appellation. Not only their persons and clothing, but every implement, weapon, culinary utensil, or ornament they possessed, was smeared with a mixture of oil or grease and ochre, *odemet* as they termed it. Besides the red and brownish clays and marls, I have frequently seen very fine clays of bluish and drab colors, which would, I have no doubt, make excellent pigments. Whiting could easily be obtained from the deposits of shell marl mentioned above. I have seen a deposit of fine white gypsum in a plastic state, which, when taken out and moulded, then dried in the sun, become quite hard. This material should, I think, be very applicable for whitewashing or liming purposes.

Refractory Materials.

Graphite and plumbago have already been mentioned. Very pure steatite, talc, soapstone, and other varieties of rocks, suitable for furnace lining, are abundant. Good specimens of these are to be seen at the Museum here, as also ground steatite, applicable as a lubricant. No *bona fide* attempts at working any of these materials have yet been made. Mica is quite a common mineral throughout the Laurentian Series, but nowhere in Newfoundland, so far as I am aware, has it yet been come across in plates large enough to be of much economic importance. It is, however, known to occur in abundance, and in large sheets, on the Newfoundland portion of Labrador; good specimens of which are in our Museum. Steatite, also, comes from the same region, and a very good variety of potstone. Asbestos, or chrysotile, deserves special mention, as it is likely to prove of very considerable economic importance ere long. This mineral has been recognized amongst the serpentine deposits of the island in many localities. It occurs in strings and threads of fine silky texture, traversing the masses of serpentine in all directions. Not until quite recently, however, has the attention of capitalists been called to its existence here, and fairly enlisted in its development. The comparative scarcity of good material in America and the not distant prospect of the Canadian deposits of this valuable material giving out led to the large manufacturing firms of Chalmers Spence & Co. of Boston and the John's Company of New York in sending persons to prospect in this country. Certain properties known to contain asbestos in the vicinity of Port-au-Port and Bay of Islands were leased by them and operations commenced by costeaning the surface, laying bare the deposits, and running open cuts into the side of the serpentine ridge.

A good deal of excellent fibre was obtained thereby, though the deposit is exceedingly irregular. The fibre varies from less than half to about five inches in length, averaging about two inches. So far as quality goes, it is, I believe, all that is requisite for ordinary use. Other parties opened up deposits of serpentine nearer the shore, showing abundance of short fibre, in numerous small veins. Some of this is 2 to 2½ inches long, and is of a beautiful fine and silky texture, approaching amianthus in purity. It is believed the coming season will witness great activity in exploration for this mineral substance, as its greatly enhanced value of late years, and its comparative scarcity in the market, render it material much sought after. Serpentines and their associated rocks, identical in character with those holding the material in Canada, occur abundantly in many parts of Newfoundland, which is already regarded in Canada as, in all probability, "Quebec's greatest rival" in the near future, in the production of this valuable commodity. Other varieties of this mineral, not considered just now of any commercial value, are found accompanying the former, such as actinolite, tremolite, pyroxene, horn-blende, &c. Fire clays are abundant in the coal measures, both as distinct deposits and forming the floors of many of the coal seams. Their adaptability to the manufacture of fire-brick has not yet been tested. But a small specimen sent to the copper smelting works at Little Bay, has just been pronounced of excellent quality.

Materials for Grinding and Polishing.

Abundance of material exists in many parts of the island, admirably adapted for all purposes of grinding and polishing. Good whetstones for edged tools may be procured from the Huronian slates, near St. John's, and in many parts of the Peninsula of Avalon, also among the talcose slates of Placentia Bay. Admirable scythe stones are procurable amongst the mica schists, while the Carboniferous series would afford an unlimited supply, as well as grindstones, of any degree of coarseness or fineness. Infusorial earths, and earthy marls, which would probably answer the purpose of tripolite for polishing, are not rare. Staurotide and coarse garnets are so abundant as to be available when pulveried, as a substitute for emery powder. Quartz is abundant all over the island. A very fine white silicious sand is found on some parts of the Labrador coast, well adapted for the manufacture of sand-paper. I believe it would also be suitable for the manufacture of glass.

Building and Ornamental Materials.

An infinite variety and abundance of admirable building stones, &c., is to be found all over the island. Granites, syenites, porphyries, of every shade of color and consistency, abound. Sandstones, from hard whin-rock to freestones, range from the Huronian to the Carboniferous formations, the latter, in particular, affording an abundance of the softer sandstones and grits. Limestones, capable of being used in the rough, or as marbles when cut and polished, exist in great profusion. Immense deposits of pure white and mottled statuary marbles range from the mouth of the Humber River northward, towards White Bay, and are again met with in Canada Bay. Amongst these are beautifully veined, pale, pinkish, bluish, drab, yellowish and some black varieties, all of which take a high polish. Beautiful specimens of serpentine, mottled dark and light green, from the neighborhood of Tilt Cove, are to be seen in the Museum at St. John's. But serpentine is by no means confined to this locality; there are large areas occupied by similar rocks on the Northern Peninsula, on the western side of the island and in the interior. Many of dolomite bands accompanying the serpentines present a variety of colors, rendering them very beautiful and applicable to ornamental or monumental purpoes. A dark red variety, veined and spotted with white bitterspar from the interior, greatly resembles the "Rosso di Levante" of Genoa. The hard grey and reddish whinrock of the Huronian formation, known locally as the Signal-hill sandstone, is much used in St. John's for building purposes. The Episcopal Cathedral of St. John the Baptist and St. Patrick's Church, afford good examples of it. But the principal use it is put to is for the foundation of houses, bridge abutments, retaining walls, &c. The rock is not easily cut, but can be readily dressed into blocks of any size or shape by the hammer, while the numerous cleavage planes afford, frequently, two or more sides perfectly shaped, as though from the chisel. The same material or debris from it, is also much used, when crushed small, for laying the street and road beds of the city. Even the worn oval beach stones, derived from this source, are brought into requisition in large quantity for paving the surface drains, and as borderings for ornamental flower-beds in gardens, &c.

The Government House at St. John's, a handsome building, is chiefly constructed of the red sandstone, or whinrock, from Signal hill, as are also many of the old fortifications near the entrance to the harbor of St. John's, all derived from the neighboring hills. The rock generally, but especially the greenish grey variety, is of so intractable a nature that the action of the weather seems to have no appreciable effect whatever upon it; while, on the other hand, imported stones, especially limestones and soft sandstones, do not stand our climate at all well. The Roman Catholic Cathedral of St. John the Baptist is chiefly constructed of a sandstone from Kelley's Island in Conception Bay, belonging to the succeeding Cambrian formation. It is a good rock but not so durable as the former. One of the Convents at St. John's is built of a pale flesh red syenite from Conception Bay, and is a very handsome structure. A grey close-grained granite, from Rose Blanche, on the southern side of the island, has been used to some extent in the construction of Lighthouses. It is a durable and excellent building material.

Slates of superior quality occur in nearly every formation, but by far the best yet produced are derived from the Lower Cambrian of Smiths' Sound, in Trinity Bay, and also from Paradise Sound, Placentia Bay.

Quarries were opened at the former locality several years ago, and a considerable number of slates shipped to the United States, Canada, and elsewhere, besides supplying the local market of St. John's and Harbor Grace. The slate is generally of a dark purplish color, but sometimes light bluish green. It cleaves readily in slabs of any thickness desired, and is pronounced by the Welsh quarrymen of the place, in every respect, equal to the Carnarvon slate (being probably in almost the identical same Geological horizon). The limited local demand, and substitution of so many other roofing materials, rendered the quarrying of this slate non-remunerative and at present nothing is being done towards utilizing it. Flagstones of every variety may be had in abundance, in almost any district of the Island. The slates above mentioned can be dressed to any thickness desired, and would, if planed, be admirably adapted for bedding of billiard tables, &c.

Under this head may also be included limestone, for burning into lime, which is in abundance. The lime produced from the Topsail Head limestone, Lower Cambrian, and manufactured on the spot, is said to possess superior qualities as a good lime for masonry.

As there are many dolomitic and magnesian limestones scattered throughout the metamorphic and Lower Silurian formations, there is every reason to believe that good hydraulic lime can also be reckoned upon. As no attempt has ever been made to test these latter, I cannot speak with certainty.

Under the head of building materials may also be reckoned brick-clays. Clays of several varieties are abundant; the most common being a nearly white or pale drab colored, very plastic clay, apparently suitable for brick making, and for the coarser kinds of pottery. They usually underlie the peat bogs, and are termed by the people, pipe-clays. Immense deposits of it are found on some of the river valleys, notably the Exploits River. A dull brownish drab stratified clay, derived from Lower Cambrian rocks in Smith's Sound, Trinity Bay, has been utilized for brick-making for a long time, and seems well adapted to that purpose. Overlying the Carboniferous Series, in Bay St. George District, extensive deposits of fine clay, ranging in color from pale drab to bright red, may be found almost anywhere. These latter are surface deposits, and distinct from the regularly, stratified fire-clays of the coal measures, though some of them may prove equally valuable as such.

Kaolin clay is known to exist as a result of the decomposition of feldspar, chiefly in the granitoid districts. A considerable deposit of it occurs in Bonavista Bay, and is believed to be of excellent quality. It received some attention a few years since, but I presume the demand was not sufficient to call for any great outlay upon the deposit; at all events, it has been abandoned for some time past.

Lithographic Stones.

Although as yet no specimens have been submitted to any test for this purpose, there are, nevertheless, amongst the Silurian limestones of Port-au-Port and the Lower Carboniferous of St. George's and Humber Valley, many fine, close-grained compact beds, which would give the impression, from a superficial examination, of being suitable for such a purpose. Those of the Carboniferous Series are usually thin bedded, cleaving into slabs of various thickness. Their color is pale drab, and the texture exceedingly fine and close, apparently free from crystals of calcite or other coarse material which would render them unfit for such a purpose. Red, brown and yelowish jaspers are abundant, capable of taking a high polish, and often of deep rich colors, adapting them to the purposes of jewellery. Pebbles of many materials, and much beauty and variety of color can be procured in some localities. Some of the greenish banded fluorspar from Lawn is very pretty, also banded amethystine quartz. Beautiful amethystine crystals were found lining the vughs in the La Manche lead vein. In this mine was also found a good opal. Rock crystal, chalcedony, agate, &c., are common. Opalescent quartz, in the form of loose boulders, occurs in some localities on the surface. Several large pieces were met with last year on the Humber Valley. Labradorite is very common in the Laurentian series; some specimens showing these briliant chatoyant reflections in great perfection. The most beautiful specimens, however, come from the Labrador coast. Garnets, usually coarse and dull, are very profusely distributed through some of the mica schists and gneissoid rocks. A few, showing very considerable depth of color, have been met with. Some very minute garnets, of a clear transparent lustre and fine color, were seen at Bay d'Espoir. Jet black tourmalines are common. Mr. Milne, M.E., mentions having seen rubelite on the southern coast, Beryl, of a pale green color, but too dull to be of use in jewellery, has been met with sparingly.

Other Mineral Substances.

There are many such not enumerated above, as of little economic value at present, and which, consequently, have received little or no attention. I have seen a brecciated conglomerate, filled with various colored pebbles, in a dark greenish matrix, holding many blood-red jaspers. It attracted my attention as resembling very much the beautiful rock forming the supporting pillars of the Dome of the Capitol at Washington. The variety of ornamental building stones in the country can never be known or appreciated until the demand for them calls for more attention being directed to their utilization. The absence of many important groups of minerals from the above list does not necessarily indicate their non-existence. Hitherto all the attention of explorers has been directed to the more valuable metallic deposits, the earthy minerals being all but ignored; no systematic collection by a mineralogist, for purely scientific purposes, has ever been attempted. I have little hesitation, however, in expressing the opinion that most of the metallic ores, not yet enumerated, will, in course of time, be added to our list. While very many of the more common non-metallic substances are almost certain to occur. I base this opinion on purely geological grounds. First, from the fact that the rock formations of the island are the same which comprise the chief mineral bearing zones of our globe; secondly, that they are in an unusually disturbed, shattered, altered metamorphosed and highly mineralized condition, eminently indicative of the presence of metalliferous deposits.

The possession of so many useful minerals and economic substances, should, I imagine, point to Newfoundland as a country most favorably situated for mining and manufacturing industries second, indeed, to none of the other British American possessions. The construction of main lines of railway through the island, now being vigorously pushed forward, must, in the near future, result in bringing about a greater activity in this direction. Already (though the immediate coast line only is accessible to mining capitalists), Newfoundland ranks as one of the chief copper producing countries of the globe. Yet, even this industry may be said to be merely in its infancy. Though possessing coal and iron deposits of undoubted value, not one ton of either has yet been mined for market, while our own importation of the former most necessary material, amounts to fully 100,000 tons per annum, and is rapidly on the increase. The local market alone should prove a sufficient incentive to making the mining of coal a promising investment. The softer varieties of coal, those principally used here, stand the consumers on an average of $4.50 per ton, while they frequently range as high as $6.00 and $7.00.

A great advantage in the way of mining in this country is the fact that so little of its area is occupied or held in exclusive possession as yet. The lumbering licenses though extensive give no claim either to the surface soil or the mineral contents which may occur beneath. The same applies to agricultural grants. Mining licenses only which are held for one year and can be renewed twice for a similar period, on payment of an extra fee, are exclusive as regards minerals during their continuance. They are limited to one square mile of area. A mining lease or grant, with fifty acres of surface free for mining plant and erections, &c., can be obtained upon payment of a further fee and fulfilment of certain conditions as regards working and expenditure thereon, extending over a period of five years, but the owner can at any time during that period obtain his grant in fee on giving satisfactory proof of having complied with the conditions and having expended the required sum in working the mine &c.

The accompanying tabulated statement of minerals taken from the Customs' returns will, I have no doubt, prove of interest in connection with this paper. These returns are not, however, by any means as complete as they might have been, and both the quantity of ore shipped and value thereof are much underestimated. Even for last year I find that while but 19,150 tons of pyrites are set down in the table of exports, in reality some 30,000 tons were shipped from the Pilley's Island mine. Again, between 1865 and 1867 but 38½ tons of copper are returned as exported. I learn from other sources that in reality it amounted to 6,580 tons. There is no return at all for 1868, yet several large cargoes of copper were shipped during that year from Tilt Cove.

ANALYSIS.

No. 1 **Galena** **Little Lawn.**

Sulphuret of Lead P. b. S.

Analysis..................Lead and Sulphur
Copper—nil.
Silver—nil.
Bismuth—traces.

Cryst.=I. Cleavage on cube H=2.5 Sp. G.=7.2.

By RICHARD COLB'T. HENNESSEY.

No. 2 **Galena** **Lawn.**

Sulphuret of Lead P. b. S.

Analysis..................Lead and Sulphur
Copper—nil.
Silver—nil.
Cadmium—traces.

Cryst.=I. Cleavage on cube H=2.5 Sp. G.=7.2.
Gangue Fluorspar.

By R. C. HENNESSEY.

No. 3 **Galena** **Bay D'Espoir.**

Sulphuret of Lead P. b. S.

Analysis..................Lead and Sulphur
Silver—none.

By R. C. HENNESSEY.

No. 4 **Galena** ———?

Sulphuret of Lead

Analysis..................Lead and Sulphur
Silver—none.

H=2.5 cryst. I. Cleavage on cube.

By R. C. HENNESSEY.

No. 5 **Zincite** **Little Lawn.**

Sulphuret of Iron Zinc, Cadmium

Analysis..................Iron.
Zinc.
Cadmium.

Cryst. ½ I. H=3.5—4. Sp. G. 3.9—4.2.

By R. C. HENNESSEY.

Quantity and Value of Minerals Exported from Newfoundland to end of 1891, taken from Customs Returns as Published in Journals of House of Assembly. J. P. Howley, 1892.

Years.	Copper Ore tons.	Regulus, tons.	Ingots, tons.	Value of Ore, in dollars.	Value of Regulus and Ingots in dols	Total value Copper Ores, &c., in dols.	Nickel Ores, tons	Value of Nickel Ore in dollars.	Lead Ores—tons, cwts.	Value of Lead Ores in dollars.	Iron Pyrites Ores, tons.	Value of Iron Pyrites in dollars.	Other Minerals and Ores, tons.	Value in dollars.	Total values of Ores, &c., exported
				$	$	$		$		$		$		$	$
1854 to 1864	627½			22,980		22,980								1,240	112,980
1865	236			8,496		8,496			2,250.0?	90,000			slate 31,000		24,772
1866	283½			10,206		10,206			313.5	15,036					10,446
1867	79			2,370		2,370			5.0	240			do., tons 50	600	2,970
1868	None								4	8			do., tons 101,000	2,020	2,028
1869	3,422			100,504	(?)	109,504	2½	600	2	4					110,104
1870	5,226			167,232		167,232	38	9,120							176,352
1871	1,407			45,024		45,024	7	700							45,720
1872	4,955			588,560		588,560	8	2,560							591,120
1873	5,553			194,355		194,355	120?	3,600							197,955
1874	5,052			121,248		121,248	98	4,704					do. 6,000	120	132,312
1875	10,018			370,666		370,666	17½	5.520	130.0	6,240			do. 6,000	120	378,865
1876	25,134			614,700		614,700	28	2,800	95.0	4,560					619,324
1877	47,454			1,264,004		1,264,004			38.0	1,824					1,265,396
1878	35,823	750		788,106	34,500	822,606			10.0	1,392					822,706
1879	28,405	1,112½		511,290	44,500	555,790			2.0	100					555,790
1880	22,042	21		440,840	840	441,680									441,680
1881	27,351			547,020		547,020									547,020
1882	19,004	260		456,096	12,480	468,576									468,576
1883	11,989	353		239,780	16,944	256,724					10?	72			256,796
1884	4,079	385		73,422	25,795	99,217					950?	7,600			106,817
1885	4,401	300		88,020	14,400	102,420									102,420
1886	235	6,678	24½	3,760	242,390	246,150									246,150
1887	7,491½		120-10	119,864	49,000	168,864			10.0	400	410	8,200	mica, lbs. 12	240	117,304
1888	3,322	1,290	1,205¾	66,440	749,946	816,386					1,850	37,000			853,686
1899	2,306	761	1,343	46,120	310,250	356,370					7,530	64,000			420,370
1890	400	1,236	609	3,400	223,392	226,792					8,670	72,315	antimony	1,200	300,307
1891	7,060	3,626	1,139	63,540	502,510	565,850					19,150	57,900	do	1,000	624,750
	283,355½	16,772½	4,441-10	6,967,043	2,226,747	9,193,790	319	29,604	2,853.11	119 804	38,570	247,087?	slates 114,000	6,540	9,594,717

No. 6
S.G., 4.5

No. 7

An

H.

No. 8

Cr

No. 9

No. 10

No. 6
S.G., 4.5

Moreton's Harbor Ores.

Blende.
Galena.
Mundic.
Mispickel.
Manganese.
Sulphide.

By BARCLAY.

No. 7

Magnetic Pyrites.

Sulphuret of Iron. (Fe. S.)

Analysis..................Sulphur.
Iron.
Copper—none.
Silver—none.
Cobalt—none.
Nickel—none.

H.=4, Sp. G.=4.4, Cryst. IV., magnetic.

By R. C. HENNESSEY.

No. 8

Iron Pyrites.

Sulphuret of Iron.

Iron.
Sulphur.
Copper—none.
Silver—none.

Cryst. I., H=6.5, Sp. G.=5.

By R. C. HENNESSEY.

No. 9

Arsenical Pyrites.

Round Pond, Bay d'East River.

Sulphuret of Iron and Arsenuret of Iron.

Fe. S2 x Fe. As2.

No Nickel.
No Cobalt.

By R. C. HENNESSEY.

No. 10

Hematite. Tilt Cove.

Si O2 per cent.	.33
Fe2 O3	99.16
S	.17
P2 O5	99.66

By BARCLAY.

No. 11 **Columbite. Labrador.**

Oxide of Columbium 76.85
Wolfram 73
Oxide of Tin 1.20
Oxide of Iron 17.34
Oxide of Manganese ... ... 4.62=100.83

No. 12 **Vivianite. Hirkeen, St. Mary's Bay.**

6 (P O5 Fe3 O3x3 H2 O) x P O5 Fe3 O3 x 8 H2O.)

Phosphate of Iron and Water.

Analysis..................Phosphorus.
Iron.
Water.
Silver—none.
Copper—none.

Cryst.=V Sp G=2.66 H=1.5—2.

By R. C. HENNESSEY.

No. 13. **Cromic Iron Ore. Pipestone Pond.**

(Fe O Mg O) Ch2 O3 Al2 O3.)

Chromate and Aluminate of Iron and Magnesia.

Analysis..................Iron.
Magnesia.
Cromium.
Alumina.

Cryst. I Sp G=4.3—45 H=55
Streak brown. By R. C. HENNESSEY.

No. 14 **White Nickel Ore. Tilt Cove.**

As2 (Ni Co Fe.)

Arseniuret of Nickel, Cobalt, Iron.

Analysis..................Cobalt, 8—12 per cent.
Nickel, 28—32 per cent.

Cryst. cube H=55, G=6.9—7.

By R. C. HENNESSEY.

No. 15 (1) Gersdorfite (yellow) Tilt Cove.
(2) White Nickel Ore (blue).
(3) Copper Nickel (red).
(1) Nickel, Arsenic, and Sulphur.
(2) Nickel, Cobalt, Iron, Arsenic.
Nickel, 28 per cent.—30 per cent.; Cobalt 10 per cent.—12 per cent.
(3) Arsenic, Antimony, Nickel, Cobalt and Iron.
Nickel, 38 per cent.; Cobalt, 46 per cent.

ANALSIS OF COAL FROM THREE SEAMS, BAY ST. GEORGE.

No.	Cleary Seam.	Juke's Seam.	Howley Seam.
Water	3.548	3.036	2.784
Volatile Matter	30.897	30.344	29.271
Fixed Carbon	55.229	60.142	54.468
Sulphur	3.946	1.963	3.047
Ash	6.380	4.515	10.430
	100.000	100.000	100.000

No. 17 **Fireclay, From Coal Measures, Grand Lake.**

Analysis:	(Silica)	S2 O2	81.86 per cent.
	(Iron and Alumina)	Fe2 Os & Al2 O3,	8.42
	(Lime)	Ca. O	0.31
	(Sulphur)	S	0.25
	(Combined moisture)	Combined H2 O	9.00
			99.84

Arsenical Iron Pyrites. Bonavista Bay.

Silica	5.0
Iron	39.0
Arsenic	33.0
Copper	0.8
Lime	1.0
Sulphur	20.0
Silver	2.72 oz. to the ton.
Gold	a trace.

ANALYSIS OF COAL SPECIMENS FROM GRAND LAKE, OR CENTRAL CARBONIFEROUS AREA.

By Wm. H. Fitton, F.G.S., F.S.Sc., Mining Engineer, England.

Aldery Brook, Grand Lake.

Analysis No. I.	No. 20 Seam.
Moisture	7.41
Volatile Matter	30.73
Fixed Carbon	53.49
Ash	7.71
Sulphur	.66
	100.00

Coke (in closed vessel)	61.86	per cent.
Colour of Ash		light pink.

Aldery Brook, Grand Lake.

Analysis No. II.	No. 15 Seam.
Moisture	15.78
Volatile Matter	30.30
Fixed Carbon	45.29
Ash	8.08
Sulphur	.55
	100.00

Coke (in closed vessel)	53.92	per cent.
Colour of Ash		light grey.

Aldery Brook, Grand Lake.

Analysis No. III.	No. 16 Seam.
Moisture	5.82
Volatile Matter	33.62
Fixed Carbon	55.28
Ash	4.49
Sulphur	.79
	100.00

Coke (in closed vessel)	60.56	per cent.
Colour of Ash		brown.

Aldery Brook, Grand Lake.

Analysis No. IV.	No. 6. Seam.
Moisture	5.80
Volatile Matter	31.44
Fixed Carbon	57.86
Ash	4.08
Sulphur	.82
	100.00

Coke (in closed vessel)	62.76	per cent.
Colour of Ash		light pink.

Coal Brook, Grand Lake.

Analysis No. V.	No. 4 Seam.
Moisture	5.02
Volatile Matter	31.25
Fixed Carbon	54.03

Ash	8.66
Sulphur	1.04
	100.00

Coke (in closed vessel) .... 63.73 per cent.
Colour of Ash .... light red.

Aldery Brook, Grand Lake.

Analysis No. VI. No. 17 Seam.

Moisture	4.32
Volatile Matter	16.84
Fixed Carbon	72.66
Ash	5.33
Sulphur	.85
	100.00

Coke (in closed vessel) .... 78.84 per cent.
Colour of Ash .... light brown.

Coal Brook, Grand Lake.

Analysis No. VII. No. 3 Seam.

Moisture	9.93
Volatile Matter	24.01
Fixed Carbon	49.15
Ash	16.14
Sulphur	.77
	100.00

Coke (in closed vessel) .... 66.06 per cent.
Colour of Ash .... grey.

Aldery Brook, Grand Lake.

Analysis No. VIII. No. 7 Seam

Moisture	10.77
Volatile Matter	16.55
Fixed Carbon	33.89
Ash	37.86
Sulphur	.93
	100.00

Coke (in closed vessel) .... 72.68 per cent.
Colour of Ash .... grey.

Aldery Brook, Grand Lake.

Analysis No. IX. No. 2 Seam.

Moisture	10.22	
Volatile Matter	24.39	
Fixed Carbon	48.51	
Ash	15.72	
Sulphur	1.16	
	100.00	
Coke (in closed vessel)	65.39	per cent.
Colour of Ash		light pink.

Aldery Brook, Grand Lake.

Analysis No. X. No. 9 Seam.

Moisture	13.71	
Volatile Matter	26.83	
Fixed Carbon	51.06	
Ash	7.56	
Sulphur	.84	
	100.00	
Coke (in closed vessel)	59.56	per cent.
Colour of Ash		light grey.

Aldery Brook, Grand Lake.

Analysis No. XI. No. 23 Seam.

Moisture	12.11	
Volatile Matter	19.53	
Fixed Carbon	44.70	
Ash	22.33	
Sulphur	1.33	
	100.00	
Coke (in closed vessel)	18.36	per cent.
Colour of Ash		grey.

Little Brook, Grand Lake.

Analysis No. XII. No. 1 Seam.

Moisture	8.44
Volatile Matter	28.54
Fixed Carbon	50.07

Ash	11.53
Sulphur	1.42
	100.00
Coke (in closed vessel)	63.92 per cent.
Colour of Ash	red.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XIII.

Report for 1893.—Coal Boring Operations at the Head of the Grand Lake.

Geological Survey Office,
St. John's.

Honourable Surveyor General,—

SIR,—The following report upon the coal-boring operations at the head of the Grand Lake is respectfully submitted.

The necessity for the application of the boring rod to further test the carboniferous area at the head of the Grand Lake having been strongly urged in the two preceding years' reports, the Government were pleased to authorize the purchase of a diamond boring machine for the purpose. Negotiations were accordingly entered into in the early part of last season with the Sullivan Machinery Company, of Chicago, for the purchase of one of their "S" core-drills and the services of a competent engineer to work the same.

Owing to a series of unavoidable delays in the shipping of the apparatus, and the unfortunate circumstance of having the boilers requisite for obtaining the necessary steam power smashed up in a railway collision while in transit, the season was far advanced before we arrived at the scene of operations.

Finding that it would facilitate the work by sending on the crew and outfit under Mr. Bayly's charge, to the Humber while awaiting the arrival of the machine, they were despatched west by the boat leaving here on June 17th. Mr. Bayly was instructed to proceed up the river, make a portage of all the provisions, etc., to Grand Lake, there to store them at a convenient point on Kelvin Brook, where the first trial was to be made. In the meantime, the long delay caused by the accident above referred to, and the detention by the railway authorities in Halifax of such portions of the machine as had been sent on, necessitated my visiting the latter city and personally attending to the further transportation. I left here on June 30th in the S.S. Bonavista for Cow Bay, Cape Breton, where we arrived on Sunday, July 2nd. The same afternoon I proceeded overland to Sydney, and spent two days closely inspecting the coal measures there, in order to institute a comparison between them and our own deposits at St. George's Bay and Grand Lake. I then proceeded on to Halifax by rail. Matters were soon satisfactorily arranged there, and the apparatus, consisting of the drilling machine, pump, rods, stand-pipe, forge, tool-chest and drive-block, were all removed to Messrs. Pickford & Black's wharf for transhipment per S. S. *Harlaw* to Bay of Islands. I cannot but express my thanks to the members of the above firm for their uniform kindness, and the obliging manner in which they undertook the labor and responsibility of removing all the heavy material and putting it safely on board the steamer. The *Harlaw* was ready to sail on July 11th but still neither the drill-man nor boilers had turned up, and in reply to a telegram sent the firm the Sullivan Machinery Company the ycould only inform me that both were on their way to Halifax and should be there by that time. They did not, however, arrive up to the time of sailing; consequently I was obliged to go on without them, leaving orders with Messrs. Pickford & Black to forward them by next boat.

We arrived at Bay of Islands on July 15th, and made all possible haste in getting up the river. At the portage we were met by some of the crew sent over by Mr. Bayly to assist in landing the machinery. Seeing that it would take the entire crew, together with a horse and dray, to drag such heavy material across to Grand Lake, I proceeded on to Mr. Bayly's camp at Kelvin Brook and made arangements for getting them all back to the portage. They had been employed up to this time in clearing away the surface preparatory to boring, building a store-house, and quarrying out coal for the furnaces from No. 4 seam, Coal Brook. They had about three tons mined, and most of it brought to the bank of Kelvin Brook to a convenient point, where it could be easily reached by boat. The coal had to be carried in bags on the backs of the men over a mile, which was pretty laborious work.

Having moved back to the Grand Lake end of the portage, several days were spent in improving the trail. The softer portions were corduroyed, rocks and stumps removed, and the road-bed raised and levelled in some of the worst places. Several of the larger boulders had to be blasted before it was possible to move them. It would have been next to impossible to transport the heavy machinery over without undertaking this necessary work. The machine proper, which is estimated to weigh 880 lbs., took two whole days with the horse and dray and all the men to drag it across. While still engaged in this work, the *Harlaw* again became due at Bay of Islands. I went down to meet the drill-man, Henry Cossette by name, and see to getting the boilers up stream. It was with no little dismay that I found each case containing a single boiler marked 1,750 lbs. gross weight. How to transport such cumbersome articles as these to Grand Lake in the present condition of the portage, and with the means at our disposal, caused me no little anxiety. Still an effort had to be made, or otherwise the work of the season abandoned. With great difficulty they were shipped on board a large boat in charge of Watson, an experienced river man, and after two days hard rowing and polling, the portage was reached and the boilers safely landed. To attempt portaging these heavy cases as they were would have been quite beyond our resources. It was therefore found necessary to divest them of all superfluous weight by separating the body of the boilers from the cast-iron base and top and removing the outer shells, thereby reducing the weight of the cast-iron internal rings to about half a ton each. After several days desperate drag, these were successfully landed at the Grand Lake side. It was 11th of August before we had the whole apparatus boated across the lake and in position at Kelvin Brook. Mr. Bayly had purchased a good, stout boat at Bay of Islands on his arrival there, which he had carried up the river and over to the lake when he came up first. Had it not been for this boat, we could not have succeeded in getting the machinery across the lake at all.

By August 14th we were ready to commence operations, having the boilers and drill set in position, and all necessary connections made and tested for working.

When fully equipped, the whole arrangement presents a striking and picturesque appearance. The two vertical boilers, consisting of a series of hollow cast-iron rings, surrounded by wrought iron shells, are bolted together by long iron rods passing through bosses, where the rings come in contact with each other. A space of a couple of inches intervenes between the rings through which the smoke and flame from the fires pass, thus effectually reaching all the surface required to be heated. The rings rest upon a cast-iron base fitted with a circular grating to receive the fuel, which is passed in through a door in the front of the metal shell. Another cast-iron cap, with a hole in the centre to give egress to the smoke, rests on the top of the boilers, to which again the smoke-stacks are fitted. The steam from the boilers circulates through the hollow rings, passes upwards through the pipes at the top, which connect with a horizontal pipe over the boilers. This latter projects a little on either end, where it is turned off and upward, terminating in two safety valves. A large metal T-shaped piece forms the central portion of this pipe, from the top of which another short piece rises upwards and then turns off, connecting with the main steam conduit. This is a long pipe passing over the boilers in a horizontal position, and stretching towards the pump and boring machine. It is connected with the former by a vertical pipe let down to the pump, and to the latter by a piece of stout rubber hose. From the bottom of the metal T above mentioned, a short piece of pipe leads downward between the two boilers, to which is attached the inspirator, an ingenious contrivance which acts as a feeder to the boilers. A short pipe leads from this to the rear and into a barrel which is kept filled with water, from which the boilers are supplied. When steam is let on to the inspirator it has a syphon action drawing the water from the barrel, which then passes downward through another small pipe and into a larger one at the base, which is in turn connected with the boilers. A steam gauge is screwed on at the top of each boiler, and water gauges at the sides. There are also taps to determine the quantity of water therein at any time.

To the left of the boilers, some three or four feet distant, a platform of hewn sticks of about twelve feet square, rests upon four stout logs partly imbedded in the soil. Upon this platform stand the pump and machine proper, the former nearest the boilers. Steam is let on to the pump by turning a valve in the pipe leading from the main steam pipe above. A long suction pipe extends from the pump towards the water supply passing behind the boilers, to the outer end of which is attached a stout rubber hose with a copper strainer, which is let down into the water Another small pipe rises vertically from the pump, and has a small rubber hose attachment connected with the top of the drill rods; when in use, by a swivel-headed joint. By this means the water is driven from the pump to the rods, which are hollow, and thence down inside to the bottom of the bore hole, for the purpose of washing up the loose material, and also to act as a lubricant to ease the friction and keep the rods and diamonds cool. A long exhaust pipe stretches away from the rear of the pump to carry off the superfluous steam.

The drilling machine stands on the centre of the platform, and consists of a stout wooden frame upon which rests the metal work. At the rear is a small vertical piston, which turns a horizontal bar extending to the front of the machine. This bar carries a drum, around which is wound the wire hoisting rope. The horizontal bar terminates in front with a crown-wheel. The swivel head which contains the feed piston, into which the drill rods fit, is secured to the front of the machine with clamp screws in such a manner that it can be set in any position, so as to bore vertical, horizontal, or angular holes—the whole arrangement being set in motion when the steam is turned on, and the rods revolved by means of the above mentioned crown-wheel. Both the drum and swivel head can, however, be disconnected at will by means of levers, so that either can be revolved irrespective of the other. When not required for boring, or when in the act of driving the stand pipe, the swivel head is unshipped and laid aside, and the machine slid back on its frame to make room for the pipes and drive block. A square hole of about two feet is cut through the platform in front of the machine, to allow for putting down the pipes. Over all is erected a tripod of stout sticks, about thirty-two feet long, bolted together at top, upon which two platforms are fastened, where a man stands to aid in hoisting and lowering the rods, screw the joints together, and attach the blocks or water swivel, &c. A large sheave wheel hangs from the apex of the tripod to receive the wire rope from the drum. A hook attached to the end of the rope hangs down immediately over the hole used in hoisting the rods and driving block. Another long exhaust pipe extends from the back part of the machine similar to that from the pump.

When fully equipped ready for work, steam is let on, the pump set in motion, and all the various connections, etc., tested until everything is found to work satisfactorily, precautions being taken to see that each part performs its functions properly. Then commences the first operation of driving the stand pipe through the surface deposits. This pipe is three inches in diameter and in ten feet lengths, each pipe fitting the other with a screw joint. Before placing the first pipe in position, a hole is made for a short distance through the gravel with one of the drill rods having a chopping bit attached to the lower end. This is revolved by placing the drill rod in the feed piston of the swivel head, while water from the pump is kept circulating all the time through the hollow rod, which gushes out at the bottom, thereby washing away the loose material dislodged by the bit. The swivel head and rod are now removed, the machine slid back on its frame, and the first, or drive pipe placed in position. A thick steel drive shoe having a bevelled cutting edge is screwed on to the lower end of the pipe and let down in the hole, while another stout steel ring, the drive head, is screwed on at the top. The pipe is now set up vertically and securely wedged in place. A couple of drill rods, with chopping bit attached, are let down inside, the heavy metal driving block is hoisted up so as to rest on the top of the pipe. A groove in one side of this block fits over the rods and keeps the block in position. It is now hoisted by means of the wire rope and let drop on the pipe head. By alternate hoisting and dropping, the pipe is forced downward as in pile-driving. All this time a plentiful force of water is kept flowing through the hollow drill rods to the bottom of the hole, effectually washing up all the loose material which flows over from the top of the pipe. After driving a few feet, or when an obstruction is met with, the drill rods are kept constantly in motion by hoisting and dropping, so as to chop away the material or break up the gravel in advance of the drive shoe, and cut a way for the pipe to pass downward. When one length of pipe is down, the drive head is removed, another length screwed on, and the driving continued till the solid rock formation is reached. When this is accomplished, the rock is cut into a few inches, the pipe driven well home, then a smaller, two-inch casing pipe is let down inside, joint by joint, till the bottom is reached, when the hole is thoroughly washed out and all loose gravel or sand removed therefrom. All this must be accomplished before the diamond bit can be brought into requisition, as it is only when the bed-rock is reached that the diamonds can be used. Were any attempt made to bore through the gravel or coarse sand, they would soon be destroyed or torn out of the bits and lost.

Having once reached the solid rock strata, the swivel head is again replaced, the machine pushed forward so as to bring the feed gear immediately over the pipe. Now the drill rods, with the diamond bit and core-barrel screwed on, are lowered down to the bottom, the uppermost being firmly clamped in the feed piston by means of a chuck at its lower end. Next, the water swivel is screwed on to the top of the rod, and all is in readiness for actual boring. Steam is let on, the drill rods rapidly revolved, water poured in copiously from the top, and the work of boring continued until the core-barrel is filled. The rods are then hoisted up, taken apart joint for joint, and when the last one is brought to the surface, the core-barrel is unscrewed and the core removed and examined. The same process of lowering the rods, boring and hoisting out, is continued so long as no obstruction is met with, or until the required depth is reached. It occasionally happens, however, when cutting through soft-shaly rocks, that the force of the water so loosens them as to cause a cave in of the broken material, which jams the rods and endangers breaking the bit. When this occurs, the rods are all hoisted out, and the hole has to be reamed with a larger bit set with diamonds to a size sufficient to allow of the casing pipe being let down below the interruption.

By far the most serious difficulties in getting down a bore hole are those encountered while driving through the surface deposits, especially when these latter accumulations are of great depth, and composed of coarse sand and gravel; but when boulders of large size and of hard, intractable trapean or granite materials are met with, the difficulties are increased tenfold.

These cannot be chopped through or broken up, and the only resource left is to try and remove them aside by continuous washing and driving. Should the drive shoe take them near the edge, and they be surrounded by sand or gravel that will wash away, it is quite possible to move or pass them. When, however, they are of extra large size, firmly embedded—or worse still, resting on the rock-bed—there is no dislodging them, especially should the shoe strike on the top of the boulder. As will appear in the sequel, we were met almost everywhere with such difficulties, and completely baffled, except in one instance, in our endeavours to reach the subjacent rock formation.

Our first trial was at a point on the right bank of Kelvin Brook, about three-quarters of a mile from the mouth, where bore A, of 1879, is situated. We commenced driving the standpipe on

August 14th, making nine or ten feet, and on the 15th seven feet, when we met with some tough, hard gravel, which delayed us considerably trying to chop and drive through it. We were delayed again all the forenoon of the 16th repairing one of our grates, which had given out; but by the afternoon we had reached a depth of twenty-seven feet. We drove twenty-one feet on the 17th, making forty-eight feet in all. On the 18th we made twenty-one feet again—sixty-nine in all—and by the evening of the 19th we had reached ninety-eight feet, having driven twenty-nine feet on that day. Our stand pipe, of which we were only provided with one hundred feet, was now all down, and still we had not reached the bed rock. Here we were met with an entirely unlooked for and unforseen difficulty. It was never contemplated we should find over one hundred feet of superficial drift in this region. On the 21st we made an attempt to drive the smaller casing pipe inside the stand pipe, and succeeded in reaching to a depth of one hundred and thirty feet in all. Here we struck some very hard gravel, and after three days chopping and driving only made two feet more, or one hundred and thirty-two feet in all. Finally we struck a boulder, apparently resting upon the solid rock below. After a vain attempt to chop or move the boulder, we only succeeded in smashing up our pipes, which telescoped at one of the joints some twenty feet from the bottom, causing the loss of two lengths, which remained in the hole. The smaller pipe is not provided with a drive-shoe or head, and is not at all calculated for such work, being too weak at the joints to withstand the force of the blows from the heavy drive block. It was useless to make any further attempt at this particular point, so another was selected about a mile farther up the stream to the southward, where it was hoped the drift deposits would not be so great. We began to withdraw our pipes, and had all removed, set in place, and ready for work again by the 25th. The following day, after erecting our tripod, etc., we commenced to drive again, and got down seven feet. On the 29th, at a depth of ninety-two feet, we struck a boulder. Tried hard to remove it by chopping and pumping, but could not succeed. We broke our rods and lost the chopping bit, and had to withdraw our stand-pipe again. It was so difficult to start it this time, we were two days getting it all up. The machine, platform and all, was now moved some three feet, and driving begun again. On September 1st we drove seventy-nine feet, and on the 2nd we got down one hundred, using all the stand-pipe without reaching the rock formation, but the deposits of tough, marly clay at the bottom seemed to indicate we were not far from it. The casing pipe was again resorted to, and by careful handling we succeeded in reaching the rock surface at a depth of one hundred and six feet. The uppermost strata consited chiefly of a fine, bluish, arenaceous shale, with thin layers of fine-grained very micaceous sandstone. Boring with the diamond bit was at once commenced, and by the 5th a depth of one hundred and twenty-one feet was reached, and several cores taken up. Owing to the soft, shaly nature of the rock pierced, much of it was ground to a fine powder and washed away. We continued boring till the 28th, with occasional interruptions to effect repairs, re-set diamonds, ream the hole when caves in occurred, etc.

We had now reached a depth of three hundred and thirty-five feet, three hundred of which was through the solid rock, the general character of which clearly indicated that we were below the true coal-bearing part of the formation, and that it was useless to penetrate further at this particular point. The angle of inclination, as ascertained from the cores taken up, averaged 50°, but the direction of the dip remained an uncertainty, though there is reason to believe it corresponds prettly nearly with that ascertained previously in the section exposed on Coal Brook, a mile further south, which is S. 10° E. magnetic.

The following is a detailed section of this bore-hole, distinguished by the letter F from those already reported upon, which range from A to E:—

SECTION OF BORE F, KELVIN BROOK.

From.	*To*	*Strata*	*Formation.*
....	8	8	Sand and gravel.
8	70	62	Sand.
70	94	24	Gravel
94	100	6	Clay.
100	106	6	Clay.
106	115	9	Clay and shale.
115	120	5	Sandstone.
120	130	10	Arenaceous shale.
130	151	21	Arenaceous shale.

151	155	4	Arenaceous shale.
155	156	1	Shale
156	158	2	Arenaceous shale.
158	160	2	Arenaceous shale.
160	162	2	Shale.
162	171	9	Arenaceous shale.
171	174	3	Arenaceous shale .
174	178	4	Arenaceous shale.
178	188	10	Arenaceous shale.
188	190	2	Arenaceous shale.
190	194	4	Arenaceous shale.
194	206	12	Arenaceous shale.
206	217	11	Sandstone.
217	219	2	Black carb. shale with thin coal streaks.
219	225	6	Shale.
225	235	10	Sandstone.
235	241	6	Arenaceous shale.
241	247	6	Sandstone.
247	249	2	Red shale.
249	253	4	Red shale.
253	264	11	Red shale.
264	267	3	Arenaceous shale.
267	273	6	Arenaceous shale.
273	281	8	Sandstone and shale.
281	293	12	Arenaceous shale.
293	300	7	Sandstone.
300	305	5	Sandstone.
305	314	9	Red shale.
314	320	6	Red shale.
320	328	8	Sandstone.
328	335	7	Arenaceous shale.
		335	

It was now decided to move back again towards the mouth of the Brook, to within a quarter of a mile of bore A, where it was hoped the same coal seams ascertained to exist there might be struck, with possibly some in a higher position, but with a view more particularly of ascertaining the true direction of the inclination of the underlying strata. Great difficulty was experienced in drawing the stand-pipe this time. It appeared to have been nipped at the bottom and held fast by boulders, which must have slid down against the pipe and caught it just above the projecting drive-shoe. Two jack-screws and four powerful levers of long sticks, two on either side, were fixed under the clamps at top, and the combined weight of all the crew brought to bear thereon; nevertheless, for two whole days we could not start the pipes. We had almost despaired of doing so, when at length the obstruction at bottom gave way, and the pipes started with a jerk several inches. After that they soon began to draw with comparative ease. On the 2nd of October we had all up and removed down stream, and by the 4th were again under weigh driving the stand-pipe at bore G. At a depth of forty feet we struck a boulder, but succeeded in moving it aside. At sixty-five feet we met with very coarse, hard gravel, which caused much delay. On the 6th, at a depth of seventy-one feet, we struck boulders again, which could not be moved or broken up. We had to withdraw, move a few feet, and make a fresh trial. This time we struck boulders again in about the same position, and in an attempt to drive through them, our pipe became so badly bent at bottom as to prevent the rods passing through. We withdrew a second time and moved several feet further in, but with no better result. On the 13th, between forty and fifty feet down, we struck a boulder, which we passed; but the next day, at sixty-five feet, we met others, and for the second time bent up our pipe, which necessitated withdrawing. The pipes were straightened as well as could be effected with the means at hand, and let down again in the same hole. When the boulders were reached, the small casing-pipe was put down inside, with which we succeeded in reaching a depth of sixty-nine feet, when another lot of boulders were struck and our pipe badly broken, compelling us to abandon the attempt. It would appear as if an extra number of boulders had been accumulated at this particular point. Most probably it formed the edge of an ancient glacial moraine, where the erratics, carried or pushed along by the ice-stream, had been shoved on one side and left behind—arranged, as is usual in such instances, in long lines closely packed together and piled on each other. It was now too late in the season to move to a new locality, where the prospects of finding a lesser accumulation of drift material were more favourable. Judging from our previous experience, we could only hope to find such a place further back from the Lake shore. But in order to reach such a point and remove all the heavy machinery thither, it would be necessary to clear a roadway, lay rails, and construct trolleys for transportation. We were not provided with any means of doing so, even did time permit. The weather also had set in cold and stormy, with frequent hard frosts at night, greatly endangering the steam pipes; it was therefore deemed advisable to abandon any further attempt for this season.

The machine was taken to pieces, well cleaned and oiled, and carefully stored in a good log-house erected for the purpose. When all was made secure to stand the winter weather, we began our homeward journey, and arrived at Bay of Islands on October 27th, where we were detained several days awaiting the steamer, and did not reach St. John's till the 8th of November.

During the progress of the boring operations, two expeditions were undertaken by myself in person. One up the Birchy Pond stream beyond Sandy Lake, to ascertain how far the carboniferous series might extend to the eastward up the river valley. The second expedition was up the Grand Lake as far as the Narrows on the southern reach between Sir John Hawley Glover's Island and the mainland, to make a further and more minute investigation of the lower members of the formation extending in that direction. In the former instance, no rock exposures were met with till the Laurentian gneiss was come across on the first Birchy Pond near Mount Seemore, but the debris scattered along the river bed above Sandy Lake indicated that the carboniferous formation does not extend much more than about one mile beyond the latter lake. Outcrops of grayish slate, probably of Silurian origin, are seen on the eastern shore of Sandy Lake towards its northern angle, and it appears quite evident that the overlying carboniferous strata, after crossing Kitty's Brook below the falls, sweep around the head of the lake a short distance inland, striking out again in a great bay on the eastern side. They continue across the lake into the country on the western side till they butt up against a tongue of Laurentian forming the hill range between the two branches of the Humber River.

On the north side of Grand Lake and eastern end of the great island, the lower members of the formation are well displayed, forming extensive cliffs for a considerable distance along shore. These comprise the basic conglomerate pyrochists or Horton series and carboniferous limestone series. The latter are chiefly made up of bright red marly sandstones, thin limestones, and occasional pretty coarse conglomerate. The absence of gypsum is remarkable, considering the vast display of this rock in the Bay St. George and Codroy troughs to the southwestward. Not one particle of gypsum was come across anywhere in the region of the Grand Lake. The pyrochists or bituminous shales occupy a considerable strip of the shore on the north side of the lake, and extend back a mile or so. They are arranged in the form of a long, narrow trough much broken and disturbed. On one small brook flowing into the lake, a mile above Whetstone Point, a considerable body of these shales are exposed in the bed of the brook, tilted up at a high angle and folded over several times. Amongst these, several bands of very black carbonaceous shale, with impure coaly streaks, are seen crossing the brook. It is not improbable that some of these shales may prove to be sufficiently bituminous to produce mineral oil in more or less available quantities if treated in the proper manner by distillation. So closely do these pyrochists, with their inter-stratified, finely-micaceous, thin-bedded, greyish sandstones resemble the core taken up from bore hole F this season, that I am strongly impressed with the idea that the latter are belonging to the same horizon. Should this prove to be the case, then it follows that we hit upon a portion of the formation several hundred feet below the true coal measures. Their occurrence in the position found can only be accounted for either by supposing a fault to bring up the lower members, or what is more probable, a sharp anticlinal fold striking up and down the lake, which is borne out by the high angle of inclination. The coal found at bore A in 1879 would then, of necessity, lie in a separate trough from that occurring on Coal and Aldery Brooks. This view of the structure lying beneath the waters of the lake, and great superficial mantle spreading over the country to the eastward, has already been foreshadowed in my report for 1891, as the following quotation will indicate:—

"I am at present inclined to the belief that between the two points (viz.: bore A and Coal Brook Section) there is an anticlinal fold bringing some of the lower measures again near the surface, and that Coal Brook section is but a repetition of that underlying the head of the lake."

Where this anticlinal fold would be situated beneath the drift deposits could never be accurately determined without the aid of the boring rod. Now that it has actually been struck in the only successful attempt to pierce the rock formation this season the difficulty of determining the true position of the more northern trough is removed. Had we succeeded in reaching the rock-bed in our first and last attempts, I doubt not the whole problem would have been solved. In all the holes put down, but especially in the two latter mentioned places, numerous small fragments of coal were brought up from the gravel in the washings. The sharp, clean, angular appearance of these fragments would sufficiently indicate that they had not been far removed from their parent beds. They had apparently not undergone such attrition as would result had they been transported from a distance.

From all the facts gathered during this and the two preceding seasons, it seems pretty clearly manifest that the entire carboniferous basin of the Humber Valley has undergone a series of wave-like foldings, the outcome of some great earth movements of a subsequent period—the chief agent in bringing about which was, there can be little room for doubt, the irruption of the trappean hill range to the south, which intervenes between the carboniferous and Laurentian systems. As stated in previous reports, this igneous mass has produced the effect of doubling up the strata and folding them over upon themselves where the contact is observed, while in a few instances, as at Hind's Brook, the two are so intermixed, and the reddish carboniferous sandstone so altered, it is difficult to distinguish the one from the other. What lends much further force to this view of the structure is the fact that upon the north side of the Humber Valley the lower carboniferous strata are comparatively undisturbed, and lie so flat, or with such gentle undulations, that these members hold the surface over a very extensive area. On approaching Grand Lake, the undulations become more frequent and the strata more highly tilted; while up and down both sides of the lake wherever any exposures occur, they are sharper still, but seem to have attained their greatest intensity as the trap range is approached. Of course it follows that the deeper the undulations are, the greater the thickness of strata to be looked for. It is for this reason we now find in the long, narrow troughs on Grand Lake a sufficient accumulation of higher strata to admit of a certain portion of the true coal measures being brought in with their included beds of coal. Whether more than two of these troughs exist will be a matter for the future to determine. That there are at least two, there is no reason to doubt. The first having been struck in 1879 near the mouth of Sandy Lake stream, by the boring operations then caried out, while the numerous fragments of coal constantly being washed up on the shores of the lake near this point are further evidence of its extending out under the waters of the lake. The second or more southerly trough, is that examined and reported upon within the last two years as occupying a strip of the shore on the south side, and extending easterly towards Sandy Lake. It is the dividing ridge between these, where, as has been shown, an anticlinal fold brings lower and unproductive members of the formation to the surface, which was struck in the present year's operations. It will be absolutely necessary to continue the boring over an extensive area to fully determine the extent and character of these two troughs. Now that the apparatus is on the ground, the heavy cost of purchasing and transporting it thither will not require to be met again. The few extras in the way of piping and outfit required in future operations should not deter us from giving the place a thorough trial. The experience of the past season will also enable us to avoid, to a great extent, many of the difficulties met with, and be the means of ensuring a greater measure of success another time.

In conclusion, I would add that the machine is admirably adapted for such work, and is a most ingenious contrivance. Our drill-man, Henry Cossette, who has had eleven years' experience in the employ of the Sullivan Machinery Company, and has bored for various purposes all over the United States, proved himself a thoroughly competent drilling engineer, and gave the utmost satisfaction. None but a practical man with such an experience as he has had could successfully cope with the many difficulties encountered. An ordinary engineer without such experience would be completely nonplussed on many occasions. The act of setting the diamonds in the bit alone is not easily accomplished, requiring such delicate handling that the utmost care has to be exercised to avoid breaking them, while at the same time they must be very securely embedded in the soft steel to prevent their being dislodged. All our crew worked well, and some of them soon became quite expert in the manipulation of such portions of the work as were allotted to them. Mr. Bayly has paid special attention to the whole process of drilling, and has acquired a knowledge of the machine and its working which will be of much value in the future.

The Museum.

The occupancy of the Museum by the Customs Department since the great fire of last year necessitated closing it to the general public for a time. The cases containing the specimens had to be moved aside to make room, and consequently they could not be kept in proper order. Since the transfer of the Customs Department to their present quarters, and our own return home last fall, Mr. Bayly and I have been busily engaged in re-arranging the collection, and have succeeded in putting it in fairly good order again. Unfortunately, owing to the accumulation of dust and increase of moths, which could not be kept under during that interval, many of the natural history specimens were so far destroyed that they had to be condemned and thrown out.

So far as the collection goes, it is now in good condition and rapidly increasing, so much so that the room at our disposal is fast becoming overcrowded. Many additions have been made recently, greatly enhancing the value of the collection. An effort is being made to complete the ichthyological section by obtaining all possible specimens of our fish and fish products. So far we have been kindly favored with specimens from the following mercantile firms, namely: cod and cod-liver oils from Messrs. Thorburn & Tessier and Messrs. John Munn & Co.; whale and porpoise oils from the firm of Edwin Duder; seal oils from Job Brothers & Co.; fish glue, mucilage, and fertilizer, from John Munn & Co. Other specimens have been promised by the same and other firms later on. A few natural history specimens have been procured, either as donations or by purchase. Mr. Wm. Sclater presented a blue heron (Ardea Herodias); Mr. McNamara, an osprey or fishing eagle (Pandion Haliaetus); Mr. John Messer, a Labrador porcupine

(Erethizon dorsatus). There were purchased one bald eagle, young (Haliaetus leucocephalus); three Greenland gyr-falcons Falco Islandicus); one Fulmar petrel (Fulmaris glacialis); one horned owl (Bubo Virginianus).

Several mineral and rock specimens have also been added to the collection from various sources.

I have the honour to be Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XIV.

Report for 1894.—Geological Exploration along the Northern and Western Railway.

St. John's,
March 20th, 1895.

The Hon. Surveyor General,—

SIR,—I have the honor to submit, for the information of the Government, the following report of last season's operations of the Geological Survey.

As you are no doubt aware, owing to the delay in passing the necessary appropriations for the public service, consequent upon the political events which took place last spring, the season was far advanced before anything definite could be arranged as to the field-work of the survey.

The continuation of the coal-boring operations of the previous season in the central carboniferous area would have been advisable, had not the time now at our disposal been so restricted as to preclude the possibility of effecting much work of a valuable character. Under these circumstances it was deemed advisable to allow the coal-boring to remain over till another season. A suggestion was made to the Government that the staff of the survey be utilized for the short time remaining in an exploration along the route of the Northern and Western Railroad. It was urged that, owing to the facilities afforded by the railway for moving about, much more ground could be covered in the short space of time still available than otherwise. The numerous rock-cuts along the route would furnish valuable clues to the geological formations intersected thereby, and, in fact, form a key to the structure of a great portion of the island.

Should any of these formations in the vicinity of the railroad afford indications of possessing minerals of value, the mapping out of such area as a guide to the prospector was deemed a matter of no small importance to the future success of that enterprise.

The locating of lands suitable for agricultural settlement, which should also form part of the season's exploration, was in itself a matter of much moment.

The Government having signified its approval of these suggestions, preparations were immediately made to carry them into effect. On the 20th of August our party started by train for Shoal Harbor, head of Smith's Sound, Trinity Bay—this being considered a convenient point from whence to commence the exploration. An examination of the immediate vicinity was begun right away, and extended along the railway route north and south, as well as over the surrounding country. While encamped here, the occasion was availed of to visit the head of Trinity Bay and examine a small valley said to contain good land, extending southward from Chapel Arm towards the junction of the Northern with the Placentia line of railway. A report upon the character of this valley was immediately forwarded, as requested, to the Acting Colonial Secretary.

The line between the junction and Come-By-Chance was traversed partly on foot and partly by rail. In the meantime, Mr. Bayly and party had explored and surveyed that portion between Come-by-Chance and Shoal Harbor.

On my return to the latter place, an examination was made of the western part of Random Island and the shores of Smith's Sound as far as Smith Point, and a section of the Cambrian series, which constitutes the underlying rock formation of this part of the country carefully measured. This section, from a scientific point of view, was one of great interest. The shales and limestones of which it is composed are crowded with organic remains peculiar to this ancient series, a number of which were collected. Since our return home, these fossils have all been submitted for identification to Mr. G. F. Matthew, F.R.G.S., of New Brunswick, who is a noted authority upon the peculiar fauna of this particular period. Mr. Matthew has on this, as on several previous occasions, most obligingly examined, named and returned the specimens. While rendering these valuable services gratis to our survey, he has been chiefly actuated by a love of science and a desire to acquire all additional information upon this particular geological horizon, the study of which he has made a specialty. We next moved to Clode Sound, from whence the country north and south along the railway, and the shores of the Sound as far as the Narrows were carefully examined.

On arriving at Terra Nova River a stay of several days was made, during which time the surrounding country was explored and the river ascended for several miles above Terra Nova Lake. George's Pond, to the west of the former, was also visited.

Maccles Pond, a large lake situated about midway between Terra Nova River and Gambo, was explored in canoe, and the country around traversed on foot in various directions.

A week was spent at Gambo. The river and lakes were ascended some twenty miles, and the railway line traversed each way from Maccles Lake to Suley's Brook, flowing into the east end of Gander Lake, close attention being directed to the geological and other features of all the intervening country.

While camped at Glenwood, at the crossing of the main Gander River, the great lake was visited and the two large inflowing rivers were ascended for several miles. A journey was made to Mount Peyton to the west of the lake, and the railway route east and west was carefully examined.

By this time the season was growing late, and the prospect of being prevented by bad weather from visiting and examining the high land near the end of the track being highly probable should we leave it much longer, we therefore concluded to move right on to head-quarters and work backward. We found the cars situated near Mary March's River, a tributary of the Exploits flowing into the N. E. Arm of Red Indian Lake.

From here to the height of land and for several miles around, and along the line eastward, the country was traversed on foot, and when the cars were moved further on to the neighborhood of the Gaff Topsail, beyond the summit level, Mr. Reid very kindly took us up with all our camp equipage and transported us thither. By that time the irons were laid about six miles beyond this point. After our examination of the surrounding country, an expedition was undertaken to the Grand Lake on the Humber Valley, for the purpose of enquiring into the alleged report of new coal finds, and also to ascertain the condition of the boring apparatus for future operations in this region.

During the summer various rumours had reached us relative to large seams of coal having been discovered on Grand Lake other than those already uncovered by our explorations of previous sea-seasons, and to test the same Mr. Reid had obtained the use of the diamond drill from the Government. Having entertained a doubt, amounting almost to a certainty, that the alleged find was a false rumour, the doubt was confirmed upon meeting Mr. Reid, from whom I learned they had been boring on the north side of the lake near the outlet of Junction Brook, and had not succeeded in striking any coal. To any person having the least knowledge of the geological structure, or at all conversant with the character of the different members of the carboniferous series, this would not be a matter of surprise. The north side of the lake is occupied by the lower carboniferous formations only, at a horizon many thousand feet below the productive coal measures. Upon learning these facts, I recommended Mr. Reid to try at several points on the south side of the lake, where the prospects of finding coal were at least probable.

On arriving at Grand Lake we found the boring party camped near the mouth of Coal Brook, one of the points recommended. They had sunk a pit through the gravel and sand some eighteen feet till they struck the bed rock preparatory to commencing boring here. The rock was a fine-grained, finely-micaceous, greenish-gray sandstone, apparently belonging to the true coal measures. It would have been interesting had they succeeded in boring in this locality, as there was certainly a prospect of striking coal. It was lower down in the section than the position of any of the seams previously uncovered, and were it proved that it existed in this lower horizon, the increased value and importance of the coal measures here would thereby have been greatly enhanced. We were afterwards informed that they abandoned the attempt without any effort at boring at all. Where they had bored on the north side of the lake a depth of 105 feet had been attained, chiefly through coarse, red sandstone and grit, either belonging to the carboniferous limestone or base of the millstone grit formation. What could have induced Mr. Reid to expend time and money upon such a useless undertaking I fail to comprehend, when the least enquiry as to the prospects of finding coal in this particular part of the series would have at once convinced him of its futility.

On our return from Grand Lake we began to work eastward again. Moving first back to Joe Gload's Pond, the country east and west from here was explored; we then moved to Badger River at its junction with the Exploits and having examined the country along the line either way and up the main Exploits River for several miles, it was now time to abandon the work and return home. We arrived in St. John's by rail on Nov. 6th. The season had been favourable for exploration all through. It was comparatively free from wet, broken weather, and the oppressive heat was pretty well over before we set out.

To the great kindness of the Messrs. Reid we are particularly indebted in affording us every facility for moving back and forth along the line whenever opportunity offered. We also found the train hands, as a rule, most obliging on every occasion. We were thus enabled to get over an immense area of country which, under other circumstances, would have taken years of hard labor to accomplish. Our examination was, of course, a very cursory one, and was more particularly directed to the immediate vicinity of the line. Since returning home, the result of the season's work has been mapped out and the various rock formations distinguished thereon by suitable colors. The lands adapted for cultivation are colored green on plan, and large sections of these, showing how they may be best laid off for settlement, are now furnished with this report.

General Features of the Country.

In order to render this portion of the subject more specific, I shall divide the route into sections, beginning at the junction of the Northern with the Placentia line, or where the Northern and Western line branches off, which is about seven miles beyond Whitbourne. The first section, extending from here to Come-By-Chance, runs through the narrow neck of land separating Placentia from Trinity Bay known generally as the Isthmus of Avalon, though, more properly speaking, the isthmus is the narrowest portion of this neck dividing Come-By-Chance water from that of Bay Bulls Arm. This section undoubtedly possesses the least value of any along the entire route. It is broken, hilly, barren and rugged throughout—the surface, for the most part, being covered only with a thin, gravelly soil encumbered with numerous boulders, and supporting here and there very scant patches of stunted timber or mere scrub. The bare rock protrudes through the superficial drift in many places, giving rise to short, irregular ridges, divided by narrow, crooked ravines, which left but little room for choice in the location of the line; hence the numerous short, sharp curves, high gradients, and the many heavy cuts and fills found here. In the vicinity of Rantem, in particular, this broken character of the country is extreme.

The district is not, however, entirely destitute of natural resources. Mention has already been made of a small valley extending northward from the junction to Chapel Arm, Trinity Bay, where the soil is of excellent quality and adapted to a high state of cultivation. The valley is well wooded throughout, and were it opened up, as recommended, by a good road with suitable-sized lots laid off on either side, it might be readily availed of for settlement. The uplands also in its vicinity, and for several miles around, would afford good grazing for quite a number of cattle and sheep during the summer months.

The second section extends from Come-By-Chance to Shoal Harbor, head of Random Sound, Trinity Bay. After leaving Come-By-Chance and entering upon the main body of the island, the line strikes more inland, but on aproaching Random Sound it again comes out to the coast and reaches the water's edge at Shoal Harbor. This section is very varied in character. At first it runs up the valley of Come-By-Chance River about seven miles. This valley is well wooded and the soil fairly good, especially on the bottom lands. Much of the latter appears to be adapted for cultivation. The clearings near the head if Come-By-Chance inlet show pretty clearly what the character of the soil is. A family named Adams have quite an extensive farm here, and keep a large stock of cattle, &c. Were this valley opened up by a road running through it in a similar manner to that recommended for Chapel Arm Valley, to connect with the railway line, I see no reason why an industrious population might not form a successful settlement therein.

After leaving Come-By-Chance Valley the country again becomes rugged and barren, covered only with scanty timber and much peaty soil, interspersed with bare ridges and numerous ponds.

Towards the head of Random Sound it is very rugged, the hill-ranges running out of the water side are cut up by deep ravines, through which flow considerable streams. Upper and Lower Shoal Harbor, as well as Clarenville, are thriving settlements. Although the soil is not very good, still the clearings of the settlers here afford them a good stock of vegetables and hay for their cattle. On Random Island, opposite Shoal Harbor, and again down along the north side of Smith's Sound, the country partakes of a very much better character. The soil, for the most part, is much superior to any yet seen. This district of country has been frequently reported upon, especially in the years 1869-70. In the latter report it was shown that, owing to the manner in which these lands were being squatted upon and the absence of any systematic plan of settlement, all the frontage was being occupied without leaving any reserves for roads; consequently the lands in the rear were rendered inaccessible, and it was strongly urged that something should be done to remedy this evil ere it was too late. During the present season another equally reprehensible practice was brought under my notice by some of the settlers, viz.: that certain parties had succeeded in obtaining grants, or otherwise claimed, all the available land fronting on the shore without apparently any intention of clearing or occupying the same—thereby shutting out many would-be settlers who were desirous of going into the cultivation of the land. These and other similar draw-backs have been the means of effectually precluding settlement on any extensive scale, and it appears to me a matter well worthy the attention of the Government to remove, if possible, all such barriers. There can be no question were such action to take place, and were the rear lands rendered accessible by roads leading from the shore at suitable points, this fine tract of country would soon be occupied. A little industry on the part of the settlers would, in course of a short time, render it a thriving and prosperous locality. The facilities which the Northern and Western Railway now offers for marketing surplus produce could not fail to prove a great incentive to the utilization of all the ground capable of cultivation. The timber trade, fisheries, slate quarries, brick-making, lime-burning, &c., with possibly other industries likely to spring up in this favoured locality, could scarcely fail in time to add greatly to the prosperity of the inhabitants, and render their position a highly satisfactory one.

The third section extending from Shoal Harbor to the head of Clode Sound, passes up through a picturesque gorge forming the narrow valley of Shoal Harbor River. The hill-ranges rise very steeply on either side of the gorge, but especially on the western side, where perpendicular cliffs form a wall-like parapet for several miles. Emerging from this gorge and crossing the river, the line comes out upon a more open country, fairly well wooded, and skirts around a pretty sheet of water called Thorburn Lake. The outlet from this lake flows in a small, rugged and short stream into the Southwest River of Clode Sound. The line now follows the valley of the latter on its south side down to the mouth of the river, which is crossed by a magnificent iron bridge resting upon solid granite piers, having two spans of 125 feet each. Thence it winds around the head of the Sound to Port Blandford, where a long pier some 700 feet is constructed, out to a dee pwater terminus, where large steamers can load and unload with ease. This section of the line is for the most part well wooded, except where fire has denuded the forest, as in the vicinity of Shoal Harbor and Clode Sound. In each case fearful devastation of fine timber has taken place, and large areas of country are swept clean. At Shoal Harbor much property, including several of the settlers' houses and the Methodist church, were demolished in 1892. There appears to be a very extensive tract of green timber of fair size still available further up the valley of Shoal Harbor River and to the westward of Thorburn Lake, also on the upper portion of the S. W. River of Clode Sound. The entire country around the head of Clode Sound and for many miles back has been overrun by the fiery element several times in succession. There is not much land fit for cultivation on this section. Some small patches along the margin of Shoal Harbor River would if cleared yield good hay crops; again near Thorburn Lake there is some fairly good soil. Much of the land along the lower reaches of S. W. River and around the head of Clode Sound might be reclaimed to advantage. The soil here is light and sandy and would require much manure, but I believe is capable of yielding fairly good crops. The importance of this place as a shipping port has already been recognized by the Messrs. Reid, who have frequently loaded and unloaded large steamers at the pier here. All the lumber from Suley's Brook and Glenwood mills has been shipped from here the past season, and several cargoes of coal, railway iron and other requisites for the construction of the N. and W. line landed. The bold, deep water of the Sound, and its freedom from dangerous rocks or shoals, renders it a most advantageous point for such purposes. One can scarcely fail to be struck with the admirable situation of this place as a most desirable one for a town site; and in view of future progress, Clode Sound is certainly destined to become a place of much importance.

The next section, extending from Clode Sound to Terra Nova River, is a short one. Following up the valley of the N. W. River, the line crosses it about two miles above its outlet and then takes a northerly direction till near Pitts' Pond, the western side of which is followed to its foot, where the water flows out into the Terra Nova River. This latter is crossed just at the foot of the long steady below Terra Nova Lake by a fine, iron bridge of two spans. Here, near the bridge, the Campbell Lumber Company have a fine establishment, including a large, well-equipped saw-mill. Most of the timbered areas between Clode Sound and Terra Nova River have been swept by fire, and the country presents a very uninviting appearance. There is, however, a considerable area of light, sandy soil along the slope towards Pitts' Pond worth cultivating. The shores of Terra Nova Lake and the valley above are pretty generally wooded, and there are extensive flats along the river side covered with a dense growth of wild grass. These, with a little judicious drainage, could be converted into good hay meadows, the periodic inundations of the river being sufficient to keep them in fertility. The next section extends from Terra Nova River to Gambo, head of Freshwater Bay. The country along this section is, for the most part, rugged, and has been greatly denuded by fire. About midway between these two points a large lake, Maccles Pond, occurs. The line trends around its eastern end. The timber in the vicinity of this lake has all been destroyed, and the country now presents a very bleak aspect. Towards Gambo it improves considerably and there is still a large area of well-wooded country. Some very good patches of land occur on this portion of the line on the slope towards Gambo Valley. Near the latter river extensive marshes occur. A fine, iron bridge spans the river. The valley of the Gambo River has been of late years denuded of much of its timber, owing to extensive milling operations and having been partly swept by fire; still there is much available timber on the upper reaches, and Mr. John Murphy is doing quite an extensive lumber trade. His fine mill at Mint Brook affords remunerative employment to a number of people, who have made quite a thriving little settlement here. Mr. Murphy has recently, since the advent of the railway, erected a large hotel near the mouth of the Gambo River, which is fitted up with offices, stores, and rooms for the accommodation of travellers by the line on an extensive scale. It is quite a handsome building, and very conveniently situated for a station-house.

There is a good deal of land available for cultivation around the Gambo Lakes and up the valley of Triton River, flowing into the upper lake. Between Gambo and Suley's Brook, near the eastern end of the Gander Lake, the country is varied, being rather broken and hilly, though not rugged, and there are extensive lakes, especially upon the Middle Brook of Freshwater Bay. Nearly all this tract has been despoiled of its timber by fire, but a young, vigorous growth, chiefly of birch, is rapidly taking the place of that destroyed. Near the head of Gander Lake the country is again more or less marshy and barren but towards Suleys' Brook it becomes well wooded. The Messrs. Reid, the contractors of the line, have established a splendid mill here at Benton, and are pushing forward their lumbering business with great vigour. Last season, as I understand, they disposed of all their lumber to advantage. Most of this was shipped to England *via* Clode Sound. This mill is one of the best equipped in the island. There is little land available for cultivation along this section, except a few small patches. From Suley's Brook to the crossing of the main Gander River the line runs very straight for a long distance; there is one tangent of over seven miles—I believe the longest on the entire line. Extensive marshes occur on this section, but towards the shore of Gander Lake there is a good deal of timber. Mr. Sterritt has a fine, new saw-mill at Glenwood, just at the crossing of the Gander, and quite a nice, little settlement is springing up here. The lumbering operations carried on at Glenwood have been begun but a short time since, and give promise of developing into a thriving industry ere long. Already several cargoes have been shipped to the English market *via* Clode Sound, and the timber produced here is said to be some of the best from the island. Gander Lake region will afford an abundant supply for many years to come. This beautiful sheet of water possesses many attractions, is well timbered all around, and the soil in many parts, but especially on the islands and intervales along the main inflowing rivers, is of excellent quality. It would be an admirable place to form a settlement. A large portion of the country above the lake had been swept by fire many years ago, but is being rapidly re-occupied by a young and vigorous growth of timber. The scenery around Gander Lake is of a very picturesque character, and no doubt will soon be a source of attraction to tourists when it becomes more generally known.

From Gander River to Norris Arm, Bay of Exploits, the country is again much varied. Numerous lakes occur, and timber of fair size is pretty well distributed, though here again fire has produced much havoc. There are several patches of nice land along this section. At Norris Arm and along the estuary of the Exploits the country is very attractive. It is all well wooded, and has a fairly good soil. Extensive settlement has taken place here within the last half dozen years. The establishment of the saw-mill at Botwood and the large lumbering operations now carried on in the Exploits Valley, with the advent of the railway, has given an impetus to the settlement of this district which is destined ere long to be one of the most flourishing parts of the island. It is a pity the idea of aiding settlement in this favoured locality, as proposed by an Act of the Legislature of 1886, had not been carried into effect. In that year the lands all along the estuary from Northern Arm up to the head of navigation, including Peter's Arm, Burnt Arm and Norris Arm, were all laid off in convenient-sized lots, and staked out so as to give every lot a frontage on the water side, with ample road allowances to the lands in the rear.

It was proposed by the then Government to assist any *bona fide* settler who would give satisfactory evidence of his intention to enter upon the cultivation of the soil, either as a sole means of livelihood or as an auxiliary employment to the fisheries, and to further stimulate agriculture in such settlement a bonus of twenty dollars for each of the first five acres cleared and cropped, and ten dollars for each succeeding acre up to ten acres, was to be given.

Roads were also to be constructed through the district, in the making of which the settlers were to be employed. The Act was a good one and it is doubtful if any country in the world offered anything like such inducement to settle on its wild lands. This district being so admirably situated in every respect for trying the experiment was selected and laid off as mentioned above but here the whole thing seems to have ended, and up to the present time nothing further has been done in the matter. That the land is of good quality and capable of yielding excellent crops has been amply verified long since by the settlers who have made their homes here, all of whom are in prosperous circumstances. There is no reason whatever why a much larger number should not succeed in the same manner, if only industry and perseverance were brought to bear. The facilities the railway now affords for reaching the markets on the eastern coast should be a great inducement to settlement. There are few more favored localities in the island. A very few years should suffice to render it one of the most prosperous localities in Newfoundland. Norris Arm is at present the terminus of the subsidized portion of the Northern and Western Railroad, and also the principal point for the accommodation of mail and passenger traffic for the whole of the immense district of Notre Dame Bay. The Messrs. Reid have erected an hotel and station-house here, also a wharf for landing coal, iron, and other requisites for the construction of the railway. After leaving Norris Arm the line now runs up the valley of the Exploits, following the south side of the river to Bishops' Fall, where it is spanned by a magnificent iron bridge, probably as fine a one of its kind as any in North America. It has three spans supported upon solid granite piers. One span is 200 feet long, the others about 150 feet each. Altogether, it is a splendid piece of workmanship, and gives ample evidence of the thorough manner in which the Messrs. Reid are carrying out their contract. Having crossed the river the line continues along the north side, passing inside the Grand Fall and coming out occasionally to the river's bank beyond. It crosses the Badger at its confluence with the Exploits forty-five miles from the mouth of the latter. Here, again, there is a fine, iron bridge of substantial structure. Along this section the line is tolerably level with very easy gradients. Fire has again, within a very few years past, laid waste a vast area of the country on the lower valley of the Exploits, and an immense amount of fine timber has been destroyed. Much excellent land occurs along this section, notably near Rushy Pond and towards the Badger Brook. The scenery on the Exploits River is very picturesque, numerous glimpses of which are had from the passing train. The confluence of the Badger is a pretty spot, and is now selected as a depot for storing provisions, &c., for the lumber-men engaged logging in the surrounding country. This industry has grown rapidly of late years; several hundred men are now employed cutting and driving the logs to the mill at Botwood. At the time of our visit last autumn some $15,000 worth of supplies were stored at the Badger for winter use. Last season 60,000 pine logs were cut on this valley, and during the present season the drive is expected to reach about 80,000. The lumbering industry, both here and elsewhere, is now thoroughly established on a sound basis. Capital and experience combined are at length rendering our long-neglected timber resources available and it is a matter of congratulation to know that the business is thriving and giving remunerative employment to many of our people. That there is room for it to greatly expand is no longer a matter of doubt. Irrespective of milling and the manufacture of lumber, the business of pulp-making should soon take root here so as to utilize the vast amount of timber not suitable for sawing into lumber which exists in many districts of the island. It is to be hoped that ere long this new industry may be established and thus afford another source of employment for our people. Attention has been over and over again directed to the fearful destruction of our forests by fire, caused in most instances by wilful carelessness or even worse; still there appears to be no remedy applied, and every year sees the area of destruction greatly enlarged.

After leaving the Badger the line strikes west or rather a little north of west, till the valley of Rowsell's River is reached, near Skull Hill. This section, westward from the Badger River as far as Lake Bond, is fairly well wooded, but there are several extensive areas of marsh land after rising out of the valley of the Exploits, some of which marshes yield good crops of wild grass, and are capable of being greatly improved by draining.

Beyond Skull Hill the line trends away southwesterly to avoid the broken, hilly country westward, and, sweeping around again, comes out on the great, open, rolling plain which extends over the height of land or summit of the Long Range Mountains at this part of their trend. The most southerly part of the great bend is reached at the crossing of Mary March's River. This section of the line crosses several extensive marshes and the country for miles around is but sparsely wooded, except in the vicinity of Joe Gload's Pond, a pretty sheet of water near the 240th mile. Beyond this the timbered areas become more and more restricted. From Mary March's River the line begins to sweep around northward, and gradually climbs the central ridge or roof of the country known as the Three Topsail Ridge or White Hill Plains. It takes its name from three remarkable "tolts" lying in a nearly straight line and at about equal distances apart. These conspicuous features of the landscape are supposed to bear some resemblance to the topmast sails of a ship when seen from a distance and the names are not inappropriate. The country is exceedingly bare about the height of land and bestrewn with a vast accumulation of boulders of all shapes and sizes. Innumerable lakes and ponds dot the surface for many miles around. No timber, except mere dwarf scrub in isolated patches, exists. Over this great plain, however, many extensive patches of grassy land are met with, and cattle might find ample grazing here in summer time. Mr. Reid informed me that his horses throve well on this barrens all last summer. Horned cattle and sheep in large numbers would, I imagine, find sufficient provender for at least four months each season on this upland country. The Gaff Topsail, another of those isolated tolts, so named during the preliminary railway survey of 1890, lays westward of the Main and Mizzen Topsails about two miles. From the summit of this latter a depression in the hill-range, away to the northwestward, shows the gap formed by Kitty's Brook, which is the gateway, as it were, to the Humber Valley and the western side of the island. In the vicinity of the Gaff Topsail the country is still barren and boulder-bestrewn but a few miles beyond, or towards the headwaters of the Eastern Branch of Kitty's Brook, timber again begins to assert itself, though of a poor, stunted growth. It, however, improves greatly as the valley is followed downward, and about the junction of the east and south branches and down the main valley there is a good deal of timber suitable for railway ties, fire-wood, &c. The work of construction and laying of the rails had reached to the main crossing or Kitty's Brook when the season's operations closed, but the right of way had been cut out and cleared of timber down to the crossing of Goose Pond Brook on the Humber Valley. The energy with which the Messrs. Reid are pushing on the work, and the substantial character of the line, is worthy of all praise. There can scarcely be a doubt that the coming season will witness the completion of the line to the West Coast thus uniting the two sides of the island so long isolated from each other. What effect this great undertaking may have upon the future development of the country can only be conjectured as yet. Already it has opened up to commerce a large area of timber which would otherwise scarcely ever have been utilized.

Geological Features of the Country Along the Line Of Route.

The geology of the Peninsula of Avalon has been pretty well worked out and details given in former reports, especially in those for 1868—72 and —81. The greater portion of the peninsula has been shown to be chiefly occupied by Cambrian and pre-Cambrian rocks. The Intermediate or Huronian of Mr. Murray is by far the most extensive series, being spread out over at least three-fourths of the peninsula. It surrounds a central nucleus of Laurentian age which occupies a position betwen the east coast and the heads of Conception and St. Mary's Bays. Resting upon these, in the above-mentioned bays, patches of Lower, Middle and Upper Cambrian are met with, unconformably super-imposed, in one case upon both the preceding systems. Still more extensive patches of the Cambrian occur in Trinity and Placentia Bays, where the Lower and Middle portions are well represented. Numerous fossil organisms characterise certain sections of this series in each locality, which have yielded some of the best and most interesting collections of the faunæ of this period in America. The thorough working out of this series in detail would, in a scientific point of view, be looked upon with the greatest possible interest. Nowhere, perhaps, on the American Continent are better or more complete sections exposed than on the shores and islands of our Great Southern and Eastern Bays. Although detached and isolated from each other, the several exposures could, by careful study of their lithological characteristics and fossil contents, afford evidence sufficiently clear to so correlate the different members as to enable the scientist to construct a complete section of the whole, from its lowest to its highest stratum. This has been accomplished to a considerable extent, yet there are some points of extreme interest not yet worked out, especially in relation to the lower portion of the series and their downward extension. To thoroughly complete this work exclusive attention would have to be given to this particular problem for at least a season or two.

Two or three patches only of the Cambrian came within the scope of last season's exploration. A narrow trough of the red and green slates and impure, red limestone, near the base of the series, occupies the valley extending southward from Chapel Arm, Trinity Bay. But small exposures of these were seen and no fossils detected in them. A second narrow trough extends up the valley of Come-By-Chance River. This consists of red-brown and greenish-gray slates not well seen. By far the best and most interesting sections were found exposed on the shores of Smith's Sound and on Random Island. Our time would only permit of a very limited examination of these exposures. A careful measurement was, however, made of one interesting section near Smith's Point, and several fossils were collected from this and other parts of the Sound. The section included a large portion of the red and green shales and limestones, which Mr. Matthew believes to be the equivalent of the Etcheminian group of New Brunswick. The grayish shales towards the middle of the section are referred by him to the lower and upper paradoxides zone, or Acadian division, of the St. John Group, while the black shales and thin sandstones at top are referred to the Johannian and Bretonian divisions of the same. The latter, he says, is merely indicated in the section; but as there is a vast accumulation of black shale further along the shore of the Sound, it is highly probable the other members of the group will be fully represented when these come to be closely studied.

The section measured at Smith's Point consists of the following strata in ascending order—the average angle of inclination being about twenty-one degrees, though it varies from nine degrees to forty-six degrees:—

	FT.	IN.
a. Red and greenish slates chiefly dark-red with numerous thin irregular calcareous layers	182	0
b. Band of greenish-gray slate	25	0
c. Red Slate	17	0
d. Bed of nodular-red and flesh-coloured limestone with shaley divisions, obscure fossils	4	0
e. Red slate	13	0
f. Thick bed light-red limestone	5	0
g. Red and green slates, chiefly red, a few thin layers limestone	38	0
h. Band of hard, greenish-gray sandstone	3	0
i. Wide band greenish shale	46	6
j. Red and green shale more red than green	53	6
k. Dark-red calcareous band weathering blackish very heavy, apparently containing a good deal of iron	2	0
l. Green-red and green shale in about equal proportions	57	0
m. Thick bed of hard, gray sandstone; may be a repetition of band *h*.	8	0
n. Red and green, shaley slate alternating	66	0
o. Greenish-gray slates or shales containing fossils ..	145	0
p. Band of flesh-red limestone	1	0
q. Greenish-grey shale, darker towards top	30	0
r. Blackish, calcareous band, with peculiar, disk-like markings	10	0
s. Grenish-gray shales with thin, arenaceous layers; numerous fossils	120	0
t. Black, finely laminated shales, with irregular, arenaceous layers much broken and contorted. Numerous fossils	425	0?
	1,251	0

The fossil organisms from this section and from the shales on Random Island having been sent to Mr. G. F. Matthew, of New Brunswick, for identification, have all been named and returned to the Museum. I have elsewhere referred to Mr. Matthew's uniform kindness in performing this valuable service to our survey not only on this, but on several previous occasions. The list of specimens names are as follows:—

Olenus Cataractus;
Parabolina c. f. spinulosa;
Conocephalites or Agraulos;
Angelina sp?;
Leperditia?;
Acrotreta sp. ventral valve;
Agraulos c. f. Holocephalus;
Liostracus? c. f. Ouangondianus.
From Kelly's Island—
Lingula Billingsi
From Topsail Head—
Scenella reticulata.
From Manuel's Brook—
Conocoryphe Bufo;
" trilineata;
Agraulos holocephalus;
Paradoxides abenacus;
" Tessini;
Erinnys venulosa;
Lingulella c. f. Dawsoni;
Liostracus Ouangondianus;
Agraulos socialis;
Eocystites?.
From Chapel Arm—
Anopolinus venustus;
Liostracus sp. small;
Solenopleura sp. small;
Microdiscus sp.;
Agnostus Lissus?.

Nowhere in Trinity Bay has the Potsdam division as yet been recognized though it is well pronounced at the top of the section of Great Bell Isle in Conception Bay. Mr. Matthew is even inclined to refer some of the Brachiopods from the uppermost strata of that island to the Ordovician (Lower Silurian series).

At the head of Random and Smith's Sounds the Cambrian series are suddenly disrupted and partly overturned, where they come in contact with a belt of brick-red feldspar porphyry which separates them from an older and more highly metamorphosed series occupying the country inland. In the immediate vicinity of this disturbing element the lower red and green shales and red sandstones are seen, in a low outcrop, striking along the shore. One band of impure, reddish limestone occurs, evidently lower down than any in the section at Smith's Point. At the immediate contact with the porphyry the sandstones become altered to dull-white quartzites and lose much of their original character. One other small, narrow trough of reddish and greenish shales, with a thin bed of limestone was seen in the valley of Shoal Harbor River a short distance inland, apparently of Cambrian age. No other rocks which could be identified either lithologically or otherwise, as referable to the same period were met with anywhere further north or west during the season. The great metamorphosed series occupying the country in the rear of Smith's Sound appear to be spread out over an enormous extent of country. Their contact with the belt of porphyry which separates them from the Cambrian, is not well seen, as the land is low and no rock is exposed for some distance. The first outcrops seen at the heal of the Sound and in the railway cuttings present an amorphous mass of more or less dull, greenish colour and fine, close texture. No lines of stratification are visible, but some purplish, irregular bands seem to indicate a sedimentary origin. By far the greater bulk of these rocks have a more or less slaty structure. They vary in color from dark bottle-green to gray and purplish. Sometimes they partake of a brecciated character. The dark-green portion of the mass is more or less chloritic. Pale, yellowish epidote in strings and patches, often resembling lines of stratification, occur at frequent intervals, while some of the purplish bands approach jaspers in hardness. Intermixed with these more slaty rocks in a most confused manner are numerous belts or masses of graywacke, trap, greenstones, felsites, quartz porphyries, volcanic ash-beds or tuffs, &c. A short distance up the valley of Shoal Harbor River a massive, coarsely crystalline gabbro, forming a belt about 100 feet wide, strikes across the railroad track, running in a N. E. and S. W. direction. It appears to be chiefly constituted of dark, bottle-green hornblende with a considerable admixture of feldspar, usually white, which on the weather surface has become much kaolinized. Some of this decomposed feldspar yields an opaque white or grayish substance, probably saussurite. Accompanying the hornblende, and apparently merged into it, magnetic iron occurs, distinct crystals of which stand out from the mass on the weathered surface. Iron pyrites is also sparsely disseminated in minute crystals. The rock possesses considerable specific gravity, no doubt owing to the large amount of metallic substances contained in it.

The high, precipitous ridge which runs along the western side of the narrow valley of Shoal Harbor River is made up of a set of highly metamorphosed rocks, consisting of peculiar light-colored nacreous flagstones with a rough, slaty cleavage, intersected by belts of dark-colored quartz porphyry. Other portions of this ridge exhibit masses of a flesh-colored brecciated white, weathering rock, apparently a volcanic ash. Towards Thorburn Lake the rock outcrops are chiefly of a chloritic character again, more or less slaty in structure. Hard, dull-colored graywacke with some purplish-colored breccia, apparently interstratified, crop out near the foot of the lake. Strings and patches of epidote characterise all these rocks, and quartz veins, accompanied by pure chlorite, are of frequent occurrence. One of these, cutting a purple breccia near Thorburn Lake, was considerably stained with green carbonate of copper, and contained small strings or nests of a very rich, gray sulphuret of copper (Tetrahedrite).

Just at the outlet from Thorburn Lake a dull, brownish jaspilite forming a wide belt comes in and strikes down the valley of the S. W. River of Clode Sound on its southern side, forming a high, bare ridge. It was traced on the strike out to the south shore of the Sound, where it occupies a considerable stretch of the shore. This jaspilite weathers a rusty brown, has a high specific gravity, and in all respects resembles an impure jaspery iron ore. In many places where water trickles over its surface and lodges in small pools much oxide of iron has accumulated, and the surfaces of the rocks are coated with it. Frequently, also, the overlying gravel deposits are cemented together with the same mineral substances. Whether it contains sufficient metallic iron to render it of commercial value or not has not as yet been ascertained. Specimens have been sent abroad for analysis, but no return has come to hand. This whole series of strata are in such a highly metamorphosed condition, and their original character so completely changed, that it becomes a matter of exceeding difficulty to place them in their proper geological sequence. Lithologically, they bear no resemblance to the typical Laurentian, nor yet do they possess much in common with the Huronian or intermediate system of Mr. Murray. Moreover, as will presently appear, they are overlaid unconformably by strata, having many characteristics of the latter.

Resting upon these in the valley stretching inland from the head of Clode Sound, a much less altered set of sedimentary strata are found. These consist of red and gray silicious sandstones and grits or fine conglomerates, with several arenaceous slaty divisions, bearing a most striking lithological resemblance to the Signal Hill sandstones near St. John's. The greenish-gray sandstones at the base are not so well represented as the redder strata, division f and g. of Mr. Murray's section. Some portions towards the top are more slaty and somewhat micaceous, and would seem to mark an upward extension of the same series not brought in on Signal Hill. The whole stretch across the head of the Sound from the valley of the S. W. River to Salmon River on the northern side, and form a set of wave-like undulations. One or two small greenstone dykes are seen to cut these strata at right angles, but apparently do not cause much extra disturbance. On the northern side of this trough the red sandstones suddenly become more disturbed, are highly tilted and at length distinctly overturned; while at the same time their character has greatly changed, and they become altered to a pale, pinkish quartzite, possessing a remarkably pretty, roseate hue.

A deep depression within a couple of hundred yards of Salmon River Ridge marks the line of contact of this set of rocks with an entirely distinct and much more metamorphosed series. Evidently a fault occurs at this juncton, which appears to follow the course of the depression just alluded to. In the bottom of this depression low out-crops of a fine-grained, compact quartzite occur, dipping N. 20, W. angle 66 degrees. These are succeeded by chlorite schists of a dark-green color merging into grayish-purplish and pale-yellowish nacreous or talcose slates. The pale-colored bands in particular are highly talcose, exhibiting scales of pure, yellowish-green talc between the layers of stratification, as well as on the surfaces of the cleavage plains. Some of these slates are very fissile, having a fine, wavy structure. All are greatly disturbed, and several small quartz, epidote and feldspar veins intersect them, especially near the base. Beyond the N. W. River crossing the rock outcrops are not so frequent, yet the same series continue to shew themselves occasionally nearly up to Pitts' Pond, being no doubt frequently repeated by undulations. Nothing similar to the jaspilites south of Clode Sound was observed on this side.

Approaching the Terra Nova River, the country is low and covered with a deep, sandy soil, which effectually conceals the rock formation for a long distance. A belt of coarsely-crystalline pegmatyte granite, about half a mile in width, strikes up and down the river valley, and is well exposed just at the point where the railway bridge spans the river. It consists of several varieties, including some very handsome ornamental rocks. One is a black and white hornblendic syenite, which affords a pretty appearance. Another, composed of large, yellowish-colored crystals of feldspar, white quartz, and a small proportion of black mica, presents a peculiar and most attractive-looking stone when polished, unlike any granite I have previously come across. It might be called a cinnamon granite, from the prevailing yellow color. Flanking this belt of granite on the north, though not seen in actual contact, a bluish graywacke is found dipping S. 16 degrees E., angle 67 degrees. This is in turn overlaid by a dark, bottle-green chlorite schist which, towards the top, becomes very fissile, breaking into fine, flakey particles, and has a very decidedly serpentinous aspect and soapy feel. It might be termed an impure, slaty serpentine. These rocks seem to hold the surface over a considerable area of country, being no doubt frequently repeated by undulations and disturbances, which latter are indicated by the presence of several small, intrusive greenstones and porphyritic dykes, which are seen to intersect them. In some instances these intrusive layers are apparently interstratified with the graywackes. One or two small outcrops of a dull-grayish or yellowish, nacreous slate similar to that seen near N. W. River of Clode Sound, were seen to underlie the graywacke in such manner as to lead to the conclusion that the latter, with the accompanying dark-green chlorite slate, forms the uppermost portion of the series.

About midway between Terra Nova River and Maccles Pond they are again seen to rest upon a belt of dark grayish and greenish, coarsely-crystalline pegmatyte. It contains large crystals of flesh-red and pink feldspar in a ground mass of grayish and greenish hornblendic material, with little or no quartz or mica. Some portions of this rock would prove a very handsome ornamental material.

Slates, &c., of the same general character now occupy a large extent of country northward, and at Maccles Pond the light-colored nacreous varieties are well displayed. Several minor intrusive masses intersect them at intervals along the railway track. On the shores of Maccles Pond, for the first time, their downward extension is met with. The nacreous slates and graywackes appear to merge gradually into a regular mica schist and gray, micaceous gneiss, with interstratified chloritic bands, all in turn resting upon coarsely-crystalline gray granite, which is partly interbedded with the gneiss. So far as could be ascertained, there appeared to be no break or want of conformity between the gneiss, mica schist, nacreous and chloritic slates and graywackes.

In the vicinity of the Gambo River mica schists and gray gneiss, forming the base of the formation, prevail. One belt of coarse granite, similar to those above described, comes to the surface about five miles south of Gambo. It is flanked on either side by the gneiss and mica slates, which strike up the valley of the Gambo, resting again upon a wide belt of granite near the head of the upper lake. Another tongue-shaped belt of granite rises near Mint Brook on the north side of the Lower Gambo Lake, and strikes thence eastward along the north side of the river out to the salt water near Middle Brook, occupies the whole north side of Freshwater Bay, including Hare Island. It is probably the same belt which spreads out eastward and extends over the country on the north side of Bonavista Bay, forming the point of land between it and Sir Charles Hamilton Sound, of which Cape Freels is the extreme eastern point. It varies much in character throughout its strike from comparatively fine-grained vitrious granite to coarsely-crystalline pegmatite maintaining generally a flesh-red colour. Numerous veins or dykes of fine felsite and dark-grayish hornblendic syenite traverse the mass running in all directions. Many portions of these granitoid rocks would yield handsome and durable building material.

Steel-gray micaceous schists merging into bulish chloritic slate and graywacke, come in again to the north of this belt on the line of the railway towards Butt's Pond. Pale, pinkish veins of felsite occasionally cut these slates or run parallel with the bedding, while quartz veins are numerous. About a mile beyond Butt's Pond a few irregular, lenticular masses of bottle-green serpentine weathering yellowish brown, and reticulated by thin, thread-like strings of asbestos, protrude through these slates and appear to conform with the strike of the strata generally. This was the only true serpentine met with during the season, though many of the chloritic slates have a decidedly serpentinous aspect.

On approaching the eastern end of Gander Lake the mica slates are finally separated from another quite different set of strata by a wide belt of granite which, from its position and strike, would appear to be a continuation of that which crosses the head of the Upper Gambo Lake.

There appears little room for doubt that the rocks described above as occupying such an extent of country from the head of Trnity Bay to Gander Lake belong to one geological system, whatever that may be. It has already been shown that they hold an inferior position to the Huronian sandstones at Clode Sound, while they certainly possess little in common with the typical Laurentian, except it be in the micaceous and gneissoid strata near the base of the series.

Hitherto, from mere cursory observation at remotely-separated pionts, they had been considered as partly Laurentian and partly Huronian, and were classed as such in the absence of more decided evidence to the contrary. The more close and extended investigation of the past season, however, will scarcely now admit of such a classification. All the evidence gathered would seem to point to a different conclusion. The prevailing chloritic and sericitic character of a large portion of the rocks, the presence of jaspilites, breccias, volcanic tuffs, and the decidedly basic character of most of the intrusive masses, all bear a strongly-marked lithological resemblance to the Keewatin series of the Canadian and United States geologists. Then, again, their intermediate position between the Huronian and Laurentian systems is so clearly defined that we must, for the present at least, regard them as the equivalent of that great series. Mr. Andrew C. Lawson, of the Dominion Geological Survey, was, I believe, the first to describe and give this distinctive appellation to a great belt of schistose rocks occupying the Lake of the Woods region, examined by him in 1883.

Mr. Lawson then pointed out the very marked difference between the almost exclusively sedimentary character of the Huronian strata and the very decided volcanic origin of at least a large percentage of his Keewatin series. These differences are well marked in the rocks we have been considering above. The term Keewatin has taken hold, and is now generally applied by the United States geologists, especially in Minnesota, to designate a large section of the celebrated iron-bearing rocks of Lake Superior and Northern Michigan. The Tower and Ely mines in this formation are two of the largest producers of iron in the United States, the Hematite ores therefrom being classed as some of the very best iron ores in the world. Gold has been discovered in this same series near the Lake of the Woods, and the Sultana mine is at present a profitable investment, while several others give fair promise of like results. These are facts worthy of the consideration of mining prospectors in this country, as there is no reason why similar results may not follow upon intelligent and systematic investigation and the judicious investment of capital here also.

The granitic belt near Gander Lake, already referred to, is about two miles wide. It is chiefly composed of rather large crystals of pale, flesh-colored and white feldspar, vitreous quartz and a fair sprinkling of black mica. The feldspar greatly predominates, giving a very handsome appearance. The Messrs. Reid have established a quarry here, from which they have raised a considerable quantity of excellent building material, which they have used extensively in the construction of piers and bridge abutments, for which purpose it has proved admirably adapted. They have also a considerable bulk of the same material ready dressed now on the ground, which, I understand, was contracted for by the Government to be used in the reconstruction of some of our public buildings in St. John's. It will present a very beautiful appearance, and afford a pretty contrast either to brick or freestone. The rock has a natural jointage in its bed, which greatly facilitates the work of quarrying and raising to the surface, and is not extra hard to dress.

Immediately to the north of this granitic belt a set of bluish-gray sandstones and quartzites, overlaid by a bluish, silky slate, the latter often peculiarly mottled, passing into a very black pyritiferous slate towards the top, are met with. All these rocks are intersected by numerous small quartz veins, some of which hold considerable quantities of iron pyrites, both ordinary and magnetic (pyrrhotite), thickly disseminated in minute crystals. The black, pyritiferous slates are particularly much impregnated with these metallic ores, and are usually coated on the exposed surfaces with oxide of iron, resulting from the decomposition of the pyrites, which gives them a highly mineralized appearance.

They bear little resemblance to the rocks previously described. They are in a much less altered condition, and their general lithological and mineral characteristics would seem to point to a higher horizon in the geological scale. Their relation to the lower series by actual contact was nowhere observed.

On the shores of Gander Lake and near the crossing of the outflowing river bluish and grayish silky slates, merging into black, pyritiferous shales, with occasional thin, arenaceous layers interstratified, are the prevailing rocks. Some of the slates are peculiarly mottled, and often display a rough, warty surface. Numerous quartz veins intersect them in all directions, and some of the shaley bands are very pyritiferous, containing lumps and small masses of radiated pyrites. The mineral also occurs in thin, stratified layers. A little to the west of Glenwood, at the Gander River, and in the vicinity of Salmon River Bridge, low outcrops of finely micaceous, red sandstone, underlaid further on by red, flaggy or slaty bands, are seen, apparently occupying an inferior position to the silky, blue slates. These would seem to be conformably related to the latter and to constitute the lowest portion of the series. Similar sandstones, with a very coarse conglomerate at the base, occupy the lower valley of the Exploits River, where they are again found to underlie bluish and black, furruginous slates, sandstones and fine conglomerates, which strike up the valley towards Red Indian Lake, and from thence reach nearly across to the south side of the island. A few fossils were found in these near the mouth of the river, while amongst the black, plumbaginous slates at Little Red Indian Fall, fifty miles up stream, some Graptolites of the genus Namosus occur. The late Mr. Billings, Palæontologist of the Dominion Survey, pronounced these organisms Middle and Upper Silurian. Numerous fossils of the same occur on the Indian and New World Islands in Notre Dame Bay in almost similar strata.

These facts give ground for the supposition that all the slates, &c., of these two great river valleys are in all probability of Silurian age, and apparently not at the very base of that great system. Nothing bearing a resemblance to the sericitic slates, graywackes. traps, &c., of the Keewatin series was met with on either of the river valleys of the Gander or Exploits or further west.

From the junction of the Badger with the Exploits where the line begins to turn westward till reaching the valley of Rowsell's Brook for a distance of about eleven miles the rock exposures are chiefly pyritiferous black slate and hard, bluish sandstone or quartzite. They become considerably disturbed and altered towards Lake Bond, and dioritic intrusions are of frequent occurrence. Heavy, bluish quartzites, blue, slate, and occasional dull, red jaspery bands, all much disturbed, crop out along the south side of Lake Bond. At the crossing of the first branch of Rowsell's Brook they come in contact with a great belt of greenstone which strikes up the valley in the direction of Skull Hill, which is evidently a boss of the same material. Some of the trappean intrusions are of a dioritic character and are often impregnated with minute crystals of iron pyrites and magnetic iron ore. A few quartz veins cutting the black slates contain specks of brilliant copper prites. Epidote intermixed wit hthe jaspery bands, is not uncommon near the base of the series.

Though much altered and disturbed, especially towards their western limits, these slates and quartzites are all apparently part of the same great series which occupies the whole exploits Valley, and must therefore, at least for the present, be classed as Silurian.

From Rowsell's Valley to the height of land, a distance in a straight line of fifteen miles, the whole aspect of the country changes. As has been shown, timber becomes scarce and stunted, and extensive marshes and barrens supervene.

The underlying rock formation, which usually plays such an important part in the character of the superficial deposits and the vegetation supported thereon, is in this case no exception to the rule. All the outcrops over this extensive area are of a granitoid nature and present a variety of rocks, from fine, felsitic dykes to massive, coarse-grained granite, ranging in colour through all shades of red and gray. One small outcrop only, at the crossing of Mary March's River, which exhibits distinct lines of stratification and consists of a reddish quartzite with thin, ribbon-like layers of pale-blue cherty slate standing vertically, is an exception. It probably represents some portion of the preceding sedimentary series in a highly altered condition.

Numerous boulders of the country rock are strewn all over this section, indicating a vast amount of denudation. They are chiefly granitoid, but some partake of a porphyritic structure, and trap greenstones form a considerable percentage of the whole, though this rock was not seen in place in the immediate vicinity of the railway line. Amongst the many varieties of granite met with several beautiful, ornamental stones occur, while ordinary building material is abundant. Mr. Reid had established a quarry on the eastern slope of the Three Topsails ridge, from which much of the material used in the construction of his bridge piers west of the Exploits River crossing was obtained. The rock is a peculiar greenish-gray syenite in massive beds, which was found to cleave readily in any desired direction, affording an easily-wrought material which dressed with little difficulty into any shaped block required. Though a handsome stone when freshly quarried, I am of opinion it will not hold its colour; the presence of a great deal of magnetic iron disseminated through the rock in minute crystals is apt to decompose when exposed to the weather and cause discolouration. A very handsome, red granite, in thick, horizontal beds, occurs on Rowsell's Brook, a few miles north of the line. It greatly resembles the Peter Head granite of Scotland. A beautiful rose-pink variety crops out on the track near the Gaff Topsail, and a very peculiar, yellowish variety is seen also near the same point. The Topsails themselves are composed of rather coarse, grayish syenite.

Westward of the Gaff Topsail no rock is exposed near the line till reaching the forks of Kitty's Brook. Here a fine closed-grained reddish syenite crosses the Brook. A similar rock is exposed in one or two places on the Brook further down and at the Fall forms precipitous cliffs of fifty or sixty feet in height. Immediately below the Falls they are overlaid by rocks of the Carboniferous Series which have been fully treated of in the reports for 1891-92.

It was a marked feature of this great granitic belt that while the central area was usually occupied by the coarsely-crystalline true granites they appeared to merge into finer-grained more felsitic, micrograntes or syenites towards the borders on either side. The green-stone trap intrusions were evidently chiefly confined also to the eastern slope of the range—no rock of this character having been observed at all west of the Gaff Topsail. No distinct evidence of stratification could be detected in this great granitoid region, unless certain alternations of reddish and grayish syenite near the borders of the mass could be considered as such. Again, the alternations of the different varieties of granite may point to a sedimentary origin. Hitherto this belt of archean rocks which forms the Long Range Mountains, extending through the entire length of the island from Cape Ray to the northern extremity, and which is here crossed by the western branch of the railway, has been regarded as the equivalent of the Lower Laurentian system. No evidence which would warrant a contrary opinion has been obtained during the past season's investigation.

Glaciation.

A few notes on the glaciation of the country traversed will afford some idea of the enormous erosion which has taken place in this island during a period of its history when the entire surface must have been covered by a moving mass of ice, the action of which mighty force has tended in no small degree to mould it into its present contour. I shall not here attempt any elaborate theorizing upon this interesting phenomena, but shall merely confine myself to a statement of actual facts observed during the season and the deductions to be gathered therefrom. That the entire face of the country has been subjected to profound and long-continued ice-action which has resulted in wholesale denudation of the fundamental rock material forming its solid crust, is everywhere most apparent. The immense profusion of boulders of all shapes and sizes, the rounded outline of the hill-ranges, the deeply grooved striated and frequently polished surfaces of the rock exposures, all bear most unmistakable testimony to the passage of a detritus-laden ice mass apparently of gigantic dimensions and weight.

The direction of the grooves and striæ though occasionally effected by local circumstances is, on the whole, pretty uniform, and points clearly to a main movement from the westward toward the eastward, varying only a few points throughout. South of the Gander River Valley the main direction is about twenty degrees south of east, but after passing it, especially on the Exploits River and all over the height of land, the prevailing direction is a little north of east, or N. 80 degres E. magnetic.

In confirmation of the above, it was noticed that much of the worn boulder debris scattered along the route of the railway was not characteristic of the formations lying to the eastward near the sea coast, but in many instances resembled those known to occur inland, westward from the line. The frequent occurrence of roche moutonnees, sometimes as low island rocks in the lakelets, but more frequently as isolated knolls or peaks—the latter, when more than usually conspicuous, being known locally as "tolts"—give ample evidence on this point. Invariably all these present a gradually inclined surface towards the south-west, west and north-west, while the opposite sides are usually abrupt. On Maccles Lake, Terra Nova Lake and the Exploits River several such low island rocks occur all well worn and grooved. Such prominent peaks as Mount Peyton near Gander Lake, Hodge's Hill near Badger River, Skull Hill in Rowsell's Valley, the Three Topsails at the height of land, and the Gaff Topsail near Kitty's Brook—all bear out the same supposition. In the case of the Topsails, which crown the highest summit of the Long Range Mountains where the line crosses them, it would appear as though they protruded partly through the ice-cap or were surrounded by it, as the sides of these tolts are equally well worn and grooved with the top. The Mizzen Topsail, the most westerly of the three and occupying the highest point of the ridge, exhibits in a marked manner the mighty force which had been exerted in uplighting and removing from its bed the massive granite of which it is composed. Huge fissures intersect the rock in several directions, crevices extending down out of sight, indicate where cleavage joints had been acted upon by water penetrating the cracks and then subjected to intense frost causing the blocks to be forced asunder. Many large masses of granite thus wedged out, as it were, lay piled at the base of the tolt—their very angular character proving that they had not been far removed. One or two huge, oblong, angular fragments lay on the summit directly across the open fissures, as if they had been merely lifted from their position and lodged on the top of the hill. Many such immense fragments of granite are scattered over the lower levels near by, exhibiting various degree of abrasion, according to the distance they had been transported and the amount of friction they had been subjected to. All the smaller and medium-sized boulders are usually well worn, often striated, when the material was such as to retain these markings distinctly. These same remarks apply to all the parts of the country examined and would seem to indicate that the higher elevations were the seat of the glacier movement which in that case would be purely of local origin.

The lower levels of the country have in all cases received the bulk of the worn disintegrated detritus from the highlands, which is met with in all directions. Immense accumulations of boulders, often piled rampart-like upon each other, may be seen on the shores of some of the lakes, such as Terra Nova and Maccles Pond, always on the north and east sides; again on the river banks, particularly on the Exploits, walls of piled boulders frequently extend many hundred yards along the eastern bank of the river. Similar ramparts of boulders were observed in the Peninsula of Avalon in 1872 on the shores of several lakes and the islands therein. They might almost be mistaken for fortifications erected by the hands of man. A few good instances of perched boulders were observed, one especially on the shores of Maccles Pond, where four large blocks of granite of different character rested on the summit of a well-rounded boss or dome of solid rock. Two of them occupied the very apex of the dome, while the other two, owing to the small space, were resting partly on the inclined sides in such manner that one could imagine a slight push would be sufficient to dislodge them.

The fine material, consisting of coarse gravel, sand and clay, which has been pushed furthest forward by the ice foot or lodged along the sides of each separate stream of moving ice in the form of lateral moraines, as may reasonably be expected, occupies the numerous rivers and valleys, or is found piled up near the heads of the arms or indentations of the sea coast. Evidently on approaching the sea, the ice mass gradually melted or became separated by cracks and fissures into several smaller streams, each of which was given direction by the prevailing features of the country. The numerous, deeply-cut ravines forming the valleys of the lesser streams which flow into the various arms or fiords of the eastern coast-line, all bear evidence of having been ploughed out by such branches or deviations from the main flow. The grooves and stiræ are found to coincide with the trend of the valleys in each instance, following their various meanderings till they reach the sea. When more than usually deep and narrow and bounded by hard, crystalline rocks, the stiræ and polishing extends up the side slopes to and over their summits. Numerous small, lateral currents seem to have joined the larger ones wherever a depression exists in the hills, all exhibiting grooves and striæ, indicating the direetion from whence they came.

The accumulation of mixed sand, gravel and till along the sides and in the bottoms of these ravines is sometimes enormous, especially near their exit into the sea. Occasionally they exhibit a rude arrangement resembling stratification. One heavy gravel cut near the mouth of the Gambo River, at the head of Freshwater Bay, is a good example of this. Near Terra Nova River, just where the railroad line crosses, a series of low, rounded mounds of fine sand were the best sample of kames met with. The following record of the grooves and scratches observed during the season at various points along the route of the N. and W. Railway, will tend to bear out the suppositions set forth above as regards the general direction of the ice movement:—

Locality and Direction of Ice Grooves and Striæ.

Near Tickle Harbor crossing, Peninsula of Avalon, N. 80 degrees E., magnetic;

In valley Lower Shoal Harbor River, Trinity Bay, S. 50 degrees E., magnetic;

Near crossing Shoal Harbor River, S. 44 degrees E., magneac;

Near Camp Pond, three miles beyond, S. 63 degrees E., magnetic;

At outlet from Thorburn Lake, S. 65 degrees E., magnetic;

A little beyond, S. 88 degrees E., magnetic;

On outflowing brook, S. 65 degrees E., magnetic;

Head of Thorburn Lake S. 70 degrees E., magnetic;

S. S. valley of S. W. River, Clode Sound, S. 70 degrees E., magnetic;

About $\frac{1}{4}$-mile beyond N. W. River bridge, Clode Sound, S. 70 degrees E., magnetic;

On Island Rock, Terra Nova Lake, S. 67 degrees E., magnetic;

On Island Rock, Maccles Pond, S. 80 degrees E., magnetic;

Near Lit. Pond, foot Maccles Pond, S. 80 degrees E., magnetic;

On curve seven miles south of Gambo, S. 65 degrees E., magnetic;

Near 170th mile, or nine miles beyond Gander River, N. 80 degrees E., magnetic;

Three and a half miles west of Badger River, N. 80 degrees E., magnetic;

At the 231st mile, head of Lake Bond, N. 80 degrees E., magnetic.

The coarser granites, &c., occupying the height of land or Long Range, though all worn and grooved, are not such as to retain the striæ sufficiently distinct to enable one to ascertain their exact direction, but the other evidence advanced leaves little doubt that they coincide generally with the above.

Economics.

Gold.

Though no actual finds of visible gold were made during the exploration many circumstances seem to favour the great probability of gold being found as an economic product of this section of country at no distant period. It has long been known to occur in small quantities in quartz veins cutting the older Huronian slates near Brigus in Conception Bay. Distinct traces of this precious metal were ascertained in a quartz vein cutting the silky, bluish slates on the S. W. branch of the Gander River in 1876.

The innumerable quartz veins observed all along the route of the railway, but especially near Clode Sound, Thorburn Lake, N. W. River, Terra Nova River, Maccles Pond, Gambo, Butt's Pond, Suley's Brook and Gander Lake, frequently look very promising for gold, particularly those cutting the Keewatin schists. This same series in Canada has been proved to be auriferous, and in the Lake of the Woods district, where much prospecting has been carried on of late years, paying gold mines are now established. Two at least of the numerous finds in that district, the Sultana and

Gold Hill mines, are now giving profitable results. Should intelligent prospecting, followed up by the judicious expenditure of capital and directed by a thorough knowledge of gold-mining, be ever brought to bear in this direction, I have little doubt the result will some day bear out the supposition that gold-mining will become one of the industrial resources of the island.

Nickel.

The frequent mention of the occurrence of magnetic pyrites (Pyrrhotite), though in small quantities only, is significant. This mineral does not afford much iron of value, nor can it ever take the place of the ordinary pyrites as a sulphur-producing ore, but the frequent presence of nickel in greater or less quantity associated with it is a matter of very great import. The now celebrated nickel mines of the Sudbury district, north of Georgian Bay, Lake Huron, yielded, according to the Canadian mining statistics for 1890, nickel to the value of $933,232. The ore producing this metal is a nickeliferous pyrrhotite, which yields on an average about 3.52 per cent. nickel, while it ranges from 2 to 5 per cent. Though no large reposits of this mineral were met with last season, its presence in small quantities, chiefly disseminated through quartz veins at several points along the line, should prove an incentive to search for the ore. Large deposits occur in several places around Notre Dame Bay especially in association with some of the copper ores. A suspicion of their nickeliferous character induced me last winter to send a few specimens of these ores to Canada to have them tested. Through the kindness of Dr. A. R. C. Selwyn, the then Director of the Dominion Survey, they were submitted to the Assayist of the Survey and returned. The result showed the presence of nickel in small quantity in each specimen, and though not sufficient to make the mining of the ore remunerative, should at least be an inducement to mining prospectors to look more closely after this class of ore, hitherto totally neglected.

The following are the assays referred to, the percentage of nickel given being in proportion to the whole mass of the specimen both rock and ore:—

No. 1 Nickel: 0.33 per cent. cobalt trace;
No. 2 Nickel: 0.14 per cent. cobalt trace;
No. 3 Nickel: 0.08 per cent. cobalt trace.

In the first of these the gangue constituted 1.03 per cent. of the whole specimen; in the second 15.00 per cent., while the metalliferous portion of the ore contained 0.16 per cent. nickel. In No. 3 the gangue reached 40.15 per cent. by weight of the whole specimen, the metalliferous portion containing 0.13 per cent. nickel.

Copper.

Copper pyrites in small quantities was met with at several points along the line, usually in quartz veins. At Lower Shoal Harbor, Trinity Bay, beautiful peacock ore, erubescite, was seen to impregnate a quartz vein, but not in sufficient quantity to be of economic importance. Gray copper, tetrahedrite, was also met with in a cutting near Thorburn Lake; also in quartz sparsely distributed. These and other instances are merely mentioned to show the presence of this mineral in the rocks. Possibly it may occur in some part of the region in a more concentrated form and in sufficiently large deposits to be available for mining. Several years since, a very fine, rich specimen of copper was picked up loose on the Gander River below the Lake, but the locality from whence derived has never been ascertained. The occurrence of serpentines near the Gander Lake, and again in large volume on the upper reaches of the Gander River above the Lake, might be looked upon as a favourable augury for the presence of copper and other valuable metallic substances as likely to occur in association therewith. Nothing short of a systematic prospecting of the country by experienced miners will ever reveal the presence of valuable deposits of such ores.

Iron Ores.

Magnetic iron in crystals, pretty thickly dispersed throughout the rock, occurs in a coarse diorite near Shoal Harbor, Trinity Bay. The same ore was seen in minute crystals in other finer-grained diorites west of Badger Brook, and also as one of the accessory minerals in several of the granitic rocks met with. No well-defined vein or lode of this ore was discovered anywhere. A wide belt of dull, earthy, reddish jasper containing much ferric oxide, occurs near Clode Sound, as already mentioned. Though not in iteself sufficiently rich in metallic substance to prove of much value, nevertheless it is accompanying just such jaspilites, and in about the same horizon, that the Minnesota iron ores, famed for producing some of the best iron in the world, are wrought. The abundant indications of the presence of iron in this rock are sufficient to warrant a close search here for Hematite ore, which, I imagine it is exceedingly probable, will some day be found to accompany the jaspers. On the north side of Smith's Sound a very black-weathering calcareous band occurs, which, from its great specific gravity, appeared to contain much oxide of iron also. Iron ores of good quality are becoming much sought after of late years. The possession of numerous deposits of such ores in a country like this, which affords such facilities for mining and shipping the same, especially when situated near the sea-coast, should prove of immense importance to the mining development of the future. The recent discovery of a valuable deposit of Hematite iron on the Great Bell Island in Conception Bay has attracted the attention of outside capitalists, with the result that a company has been formed to work the ore, having first thoroughly tested the extent and quality of the deposit. I have not had the opportunity of visiting the location as yet, but from all I can learn the mineral forms a regularly stratified layer of the formation, which is Upper Cambrian, or possibly at the very base of the Lower Silurian Series. It averages about twelve feet in thickness, and spreads over a considerable area of the island—being situated quite close to the surface and cropping out in the sea cliff on the north-east end of the island. It affords every facility for mining and shipping to advantage. Already the company have constructed a tramway across to the south side of the island, and have erected a pier and loading apparatus at a convenient point on the shore. I understand active operations will be commenced almost immediately.

The following analysis of the ore has been kindly furnished me by the owners of the property, Messrs. Shirran & Pippy, of St. John's. Analysis of Hematite Ore from Great Bell Island, Conception Bay, by G. T. Holloway, F. C. Sa.:—

Iron, 62.7 per cent., corresponding to sesquioxide of iron (Fe. 2; O. 3)	89.57
Silica (Si. O. 2)	8.30
Prosphoric Acid (P. 2; O. 5)	0.398
Sulphuric Acid (S. O. 3)	0.062
Alumina (Al. 2; O. 3)	0.13
Lime (Ca. O.)	trace.

Magnesia (Mg. O.)	trace.
Carbonic Acid (C. O. 2)	nil.
Manganese Oxide	0.55
Moisture and combined water	1.21
	100.22

Bog-iron ore was met with in considerable quantity on the high land near Patrick's Brook. It forms a thin layer underneath the peaty coating of the marshy grounds, and is well seen in some of the side-drains along the line where the peat has been removed. This class of ore, when pretty rich in iron and free from earthy impurities, is a most valuable one. In Canada the pig-iron produced therefrom is largely used in the manufacture of locomotive car wheels, for which purpose it is admirably adapted.

Iron Pyrites.

The well known chemical uses of this ore and its adaptability to the manufacture of sulphuric acid need not be entered upon here. It is one of the most common and abundant mineral substances in this country. Though no actual deposits of an extensive character were met with the past season, this mineral was found pretty generally disseminated in all classes of rock, usually in the form of fine crystals impregnating the quartz veins, diorites, &c. Several very ferruginous slate bands containing lumps and strings of radiated pyrites were observed along the line, as at Shoal Harbor, Trinity Bay, on Random Island, near Suley's Brook, at Gander Lake, and on the Exploits River. Some of the slates on Gander Lake were so filled with this mineral that it seemed almost sufficiently abundant to make it available for mining purposes. Possibly a close search in this neighborhood would reveal even more extensive deposits of the mineral in a concentrated form, comparatively free from rock material, such as that occurring in the well known Pilley's Island pyrites mine. The same remarks may be applied to the Exploits Valley, where the black slates are frequently well charged with the ore.

Manganese.

A very impure, earthy, brown-colored manganese was seen, associated with limestone, in the valley of Shoal Harbor River. It occurs in a band of Lower Cambrian rocks similar to those holding manganese on the south shore of Conception Bay. Wad or bog manganese occurs sparingly, associated with the bog-iron ore, on the highlands west of the Exploits Valley. No ore of a valuable description was, however, met with.

Alum.

Alum one of the products derived from the decomposition of iron pyrites or rather from the action of the sulphuric acid set free thereby upon the alumina contained in the clay slates or shales, is of common occurrence amongst the more highly pyritiferous shales. On the western end of Random Island a very papyraceous black shale occurs, much impregnated with finely-disseminated pyrites. A white crust of alum in considerable quantity, frequently tinged yellow from oxide of iron, is seen coating the exposed edges. Much alum is produced from similar shales in Germany, France, England and the United States by a process of lixiviation.

Building and Ornamental Material.

Frequent reference has been made in the foregoing pages to the granites and granitoid rocks met with in such abundance at various points along the line, more especially over the high land of the Long Range Mountains. There is an infinite variety of these rocks, suitable for building, monumental and ornamental purposes. Some of the red sandstones and grits near Clode Sound would answer well for rough work. The rose-pink quartzite at this locality is a handsome rock, and might be readily dressed with the hammer into regular blocks, though it is too hard to be faced with tools. Some of the graywackes diorites, traps, &c., would afford good material for block pavements, macadamizing roads, streets, &c. The limestones of Smith's Sound, though unfit for building purposes and usually impure, would in some instances afford a good, strong lime, when burnt, for all ordinary purposes. The slates of this same locality have long been known and quarried but only in a small way. The material is of extra good quality, fully equal to the best Carnarvon slate, and should certainly be turned to better account were a little capital and judicious management brought to bear in the development of the quarries.

Slates of a similar character, to all appearances, were met with in the valley of Chapel Arm, at the head of Trinity Bay, not far from the railroad line in the vicinity of Placentia Junction.

Good honestones might be readily obtained from the schistose rocks along the line, especially amongst the mica schists and talcose slates referred to. Brick-clay occurs on several parts of Random Island and Smith's Sound. There is an immense deposit extending along the north side of the Sound. Here a brick-yard has been established for many years by a man named Pitman. He and his sons manage to make a fair living out of the brick manufactured, but it is only on a small scale. A much more elaborate attempt at brick-making has been started at Elliott's Cove on the south side of the island, where adequate machinery and skilled labor are brought to bear. The result is, I understand, proving fairly successful of late, though rather a failure at the outset from some unascertained cause. The material here is not so good or so abundant as at the former locality. Some of this clay is made up in the form of bricks unbaked and is shipped to St. John's to be used for moulding purposes at the founderies.

The Museum.

Many important additions have been made to the Museum since writing last report. They are as follows:—

Specimens of iron pyrites from Pilley's Island: Presented by A. Beatty;

Asbestos and Serpentine from Port-au-Port Asbestos Mine: A. M. White;

Block-dressed Granite from quarry near Gander Lake: R. G. Reid;

Native Sulphur, New Zealand: A. G. Williams;

Fossil Gum, New Zealand: A. G. Williams;

Manganese, Nova Scotia: W. E. Jennison, M.E.;

Amber-colored Calcite from Cape LaHune: W. J. Clouston;

Hematite, Bell Isle: A. F. Shirran;

Lithographic Stone, Parsons' Pond: G. A. Pippy;

Amethystine Quartz, Bonavista Bay: B. Kean;

Serpentine, Port-au-Port: H. H. Haliburton;

Manufactured products from Pilley's $sland—Pyrites, mine consisting of: 1st, Sulphuric Acid; 2nd, Alum; 3rd, Iron (two qualities): 4th, Slag: The Pyrites Company;

Labradorite, Labrador: R. G. Tabor;

Asbestos, Port-au-Port: Capt. Cleary;

Asbestos, Port-au-Port: A. White;

Asbestos, Ming's Bight: A. O'Meara;

Fossils, Port-au-Port: W. A. B. Sclater;

Magnetic Iron Ore, Ming's Bight: A. O'Meara;

A number of Rock and Mineral Specimens, principally Granite Blocks, Fossils, Brick-Clay, &c., have been added by The Survey.

Natural History Specimens.

Small collection of birds' eggs and birds, Conn River: Gower Leslie;

Small collection of birds' eggs, Beaver Cove: E. S. Hennebury;

Sole and Flounder, Harbor Grace: Mat Martin;

Two saws of Sawfish: Bernard Dahl;

Newt: W. A. Ellis;

Bat, Broad Cove: John Squires;

Land-locked Salmon, Gambo: R. G. Rendell;

Two Catfish: William Loughlin;

Pollock, Thoroughfare, Trinity Bay: Stephen Leonard;

Young Lobsters: Aadolph Nielsen;

Two Lumpfish, Labrador: Capt. Blandford;

Flying Squirrel, Labrador: Rev. A. C. Waghorne.

Miscellaneous.

Analysis of Fish Fertilizer: John Munn & Co.;

Bomb from site Central Fire Hall: Inspector Sullivan;

Copy of London *Sun* (Coronation Number): M. Meyers;

Eskimo (toy) Skin Boots: Miss Ethel Addy;

Old French Axe attached to root of tree, Placentia: W. A. B. Sclater;

Rotary Spear Head, Africa: Jas. H. Cousins;

Eskimo Spear Head, Greenland: Jas. H. Cousins;

Old Coins of England, France, Spain, Sweden and United States: Robert Chauncey, Boston;

United States Coin (50 cents): E. J. Bell, Philadelphia;

Weather Charts, Little Bay, '94-5: Capt. G. Foote, M.H.A.;

Weather Records from 1884-90, taken at Cape Norman Lighthouse: Henry Lock.

A splendid collection of the Flora of Newfoundland has been presented to the Museum, through Rev. Dr. Harvey, by Prof. Robinson, of the Harvard University Herbarium. New cases have been set up to receive this beautifully arranged collection, which is a most valuable acquisition to the Museum.

Several specimens have been added by purchase during the past year, and a lot of new cases and fittings required from time to time to receive the same. A number of new and interesting photographs of the scenery of the country, chiefly along the route of the Northern and Western Railway, taken during the past season, are now on exhibition. The interest taken in the Museum by all classes continues unabated.

During the past year the Government were pleased to adopt the suggestion of insuring the collection, so that now, in case of destruction by fire, the Colony will, to some extent at least, be recuperated for its outlay.

It is much to be regretted that, owing to the political and other changes of the past twelve months, the intention of forwarding an exhibit of all the natural resources of the island to the Imperial Institute of London was not carried out.

The intention of the Imperial Government as you are aware, is to bring together under one roof an economic exhibit of all the wealth of the Colonial Empire. Each colony is provided with a section giving to it a distinctive character while forming part of the whole scheme. Such an exhibition of Newfoundland's great natural resources could scarcely fail to attract the attention of the capitalist or investor to the undeveloped wealth of the Colony—the oldest, nearest and most easily-accessible of the vast Emprie. I feel confident, were a sufficient sum placed at the disposal of the Survey to send a thoroughly representative collection in good shape, we should have much to feel proud of, and the good effect likely to be produced would amply repay for the outlay in course of time. If it only had the effect of dispelling the doubts existing outside the Colony regarding these resources, and upsetting the prejudicial character of the many damaging reports sent abroad from time to time that in itself would be sufficient to warrant the comparatively small outlay requisite.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XV.

Report for 1895.—Coal Exploration near Goose Brook.

Geological Survey Office,
July 28th, 1896.

The Hon. Surveyor General,—

SIR,—The investigations of the Geological Survey for the season of 1895 were as you are aware, confined to the further exploration of the carboniferous area near Grand Lake.

According to instructions received from you before leaving for the interior, it was intimated that the desire of the Government was that every effort should be directed to the ascertaining, if possible, whether any coal deposits existed in this region at points nearer the railway line than those already discovered on Aldery, Coal and Kelvin Brooks during the three preceding seasons.

On arriving in the vicinity of Grand Lake in order to carry out this intention a point was selected as a base of operations near Goose Brook, a tributary of Sandy Lake River, where the railway track crossed it. This point was about equally distant from Grand Lake and Kitty's Brook, in the heart of the flat plain which extends up the valley of the latter brook. From this point a close inspection of the cuttings along the line was first made. Little or no rock was visible anywhere except at points far distant from the supposed strike of the coal measures proper, and consequently no clue could be obtained to the general structure.

The whole surface of the country is covered by a vast accumulation of sand, gravel and boulders. Here and there in the cuttings minute fragments of loose coal were observed and these afforded the only evidence of the presence of that commodity. A close study of the drift material and the direction from which it must have come led to the conclusion that the actual position of the seams whence the coal was derived should be confined to a certain section of the country crossed by the railway track. Having arrived at such conclusion one of the gravel cuts near the track where the surface accumulation did not appear to be as heavy as usual was selected for trial and the men were set at work with pick and shovel to costean the place. A few hours' work resulted in striking the bed-rock and exposing a coal seam at the very edge of the graded track.

Work was continued on this seam for a considerable time until the gravel, etc., was removed from a large extent of surface, and the outcrop of the seam fully exposed to view. We then commenced to sink upon it, in order to ascertain the true character of the seam at some depth from the surface. Owing to the continual influx of water from the surrounding low swampy land, and the absence of any adequate means of getting rid of it, we could not get much beyond ten or twelve feet down. This was sufficient, however, to afford a good section of the seam, which was found to dip about N. 40 degs. W. angle 40 degs. and gave the following section:—

	FT.	IN.
Underclay	4	0
Coal with clay streaks	0	10
Layer of clay	0	1
Coal pretty solid and good	1	1
Clay layer	0	2
Coal soft and shaly	1	5
	7	7
Coal	3	4

Many attempts were now made to reach the bed-rock on either side of the line for long distances east and west of the first points. In a few instances only were we successful such was the density and toughness of the overlying deposits and the great influx of water at every place.

A second seam was struck at a point 105 feet to the north of the first. It was only partially seen, owing to the great depth down, and the impossibility of pumping the water free with such appliances as we possessed. One measurement near the top gave one foot six inches pretty good coal. Several extensive beds of fireclay and indications of the near presence of other seams were come across before the season closed, all proving conclusively that the extension of the true coal measures had been correctly located.

The result of this work has now established beyond question the continuation of the coal trough previously reported on the south side of Grand Lake and its extension under the surface of the low lying valley of the southern branch of the Humber. It has been traced for eleven miles east and west, and no doubt extends several miles further eastward. Moreover, the direction of dip and low angle of inclination as it leaves the hill range to the southward gives rise to the supposition that the trough has a wider spread in this portion of its strike. Its southern side only was seen this season, and until the boring rod is again brought into requisition, it will scarcely be possible to determine what the full extent and importance of this central coal area may be.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XVI.

Report for 1896 on the Geological Structure and Economic Resources of the North West Coast, together with a Historical Sketch of the Discovery and Development of the Coal Areas of Newfoundland up-to-date.

Geological Survey Office,
March 10th, 1897.

The Hon. Surveyor General,—

SIR,—In the early part of June I addressed the following letter to the Government as requested, relative to the best mode of employing the services of the Geological staff during the season:--

The Hon. Colonial Secretary,—

SIR,—The season having arrived for the prosecution of the field-work of the Geological Survey, I would respectfully suggest that in the first place it would be well to continue the exploration of the carboniferous areas of the Grand Lake and Bay St. George districts, as there is yet much to be learned in either with regard to the extent of the deposits. It might, perhaps, be also advisable to have a look at certain other sections of the island where there is a possibility of coal still existing. To discontinue this investigation at the present time without ascertaining all that it is possible to learn with reference to the true value of our coal areas would, I submit, be a mistake.

In the second place, what may prove a matter of still more importance to the whole future of this island would be, I conceive, to determine definitely whether or not the country gives promise of containing gold in available quantity. The presence of this precious metal at several points is now placed beyond all question; but the conditions under which it occurs, whether favourable or otherwise, the exact formations or parts of formations in which the gold exists, are points yet to be ascertained. One of the first steps towards a satisfactory solution of this matter would be a comparison on the spot with the rocks and conditions or characteristics thereof in some of the known and established gold regions of the other

North American Provinces, especially with those of Nova Scotia, Ontario, and British Columbia.

Could we once fully establish the fact that here in Newfoundland we possessed exactly similar formations to those of Nova Scotia and the other provinces mentioned where gold was present under similar conditions, I believe it would do more towards attracting attention from outside capitalists than the possession of any other mineral resource. English capital is now flowing into Canada to develop her gold resources on a large scale. As a result, prospecting for the precious metal is vigorously carried on, attended with most favourable results, in regions which a few years since were considered all but useless wastes. One of the features of the occurrence of gold is that it is rarely found in rich agricultural or timbered countries, except as alluvial deposits. The sources of the metal are almost exclusively situated in the most barren and unfruitful regions of the globe, which, but for the presence of their precious treasures, would remain unoccupied and useless for all time. Once establish the fact beyond dispute that a region holds paying quantities of gold, and there will be no lack of capital found to develop it. Believing, as I do, that this island is undoubtedly auriferous in at least certain sections, I look upon it as a matter of the greatest moment to have a thorough investigation entered upon as soon as possible.

In the third place, while hitherto every district in the island has received a fair share of attention in the way of exploration and survey, that of St. Barbe remains almost unknown, at least geologically. White Bay is a very important and interesting locality, and a season might well be devoted to a thorough exploration of it. A good map of this bay is badly needed, the existing old coast charts being extremely erroneous. It would be well to have a careful trigonometrical survey made taking in all the salient features of the bay and surroundings. A small schooner would be required to carry out such a work satisfactorily. A good collection of specimens for the museum might be made at the same time. In this connection I would beg to again call attention to the fact that the idea of sending a thoroughly representative exhibit of our mineral resources to the Imperial Institute has never been carried out, owing to the absence of the necessary appropriation of money to do so. It does appear to me a most desirable object to accomplish, as I do not doubt that such an exhibit would be conducive of a vast amount of benefit to the country. All the other colonies are well represented, and the increased interest taken in them, and the great advancement of their mining industries of late years, is largely attributed to this and other means adopted to place their resources prominently before the world at large.

I have the honour to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

Later on, in conversation with yourself, it was further suggested that a general inspection and report upon such properties as the asbestos and chromic iron deposits of the West Coast, and also the oil region of Parsons' Pond, would be very advisable. It was then stated that the Government should be placed in a position to have accurate information upon all such new discoveries from official sources, if only to act as a guide in the leasing of the same, as well as for the information of outside capitalists who may be inclined to invest in such properties. This was made apparent last fall, when the Imperial Government expressed a desire for reports upon the coal and iron deposits of the island, especially on the Bell Island ores. Were it not that the latter locality was so accessible, the investigation could not have been carried out satisfactorily so late in the season. These reports, when submitted to the Right Honourable the Secretary of State for the Colonies, were considered worthy of presentation to both Houses of the Imperial Parliament, by command of Her Majesty, in August last, and were ordered to be printed amongst the Colonial Parliamentary papers. They also formed the subject of several despatches between the Colonial Office and His Excellency the Governor.

As you are aware, the last suggestion made was the one approved of, viz.: an inspection of the asbestos and chromic iron deposits of Port-au-Port Bay and the petroleum region on the West Coast in the district of St. Barbe.

Various circumstances, but chiefly the late date of the closing of the Legislature, delayed our departure from St. John's till the latter end of July.

Our party proceeded overland by rail to Bay of Islands, where a few days delay were entailed in preparations for actual field-work. A boat and crew were hired to proceed by water to the Lewis Hills in Port-au-Port Bay, where the best known asbestos and chromite deposits are situated. Just as we started, a heavy head wind and sea sprung up, which necessitated three days hard rowing to reach our destination.

A fortnight was spent in exploring the region about Bluff Head and Lewis Hills which proved to be a most interesting district in a mineralogical sense. Unfortunately while engaged in this work I had the ill-luck to meet with a most painful accident by being thrown heavily down a steep incline owing to my right foot catching in a projecting rootlet. This caused me to fall headlong in such a manner as to give a serious twist to the left knee-joint. It proved exceedingly painful for a long time and so maimed me as to thoroughly incapacitate me from such rough and dangerous mountain climbing as the nature of the country called for. Under the circumstances I was unable to visit several of the locations where the minerals exhibited themselves, though previous to the accident I had examined the principal workings, and made the chromite deposit near Bluff Head a special subject of study.

Being anxious, also, before the season had too far advanced to visit the more northerly portions of the coast, and make a close investigation into the nature and prospects of the petroleum deposits at Parsons' Pond, we returned to Bay of Islands in order to catch the S. S. Harlaw, due there on the 22nd of August and bound north.

We arrived at Cow Head on the 23rd, and Capt. Scott kindly dropped into Sandy Bay, off the entrance to Parsons' Pond, to land us. We proceeded up the lagoon by boat to within a mile of the boring place, where we camped.

Having hired a dory for use on the pond, we set about making a very careful trigonometrical survey of this interesting locality, and at the same time a close study of the stratigraphical features of the rock exposures wherever an opportunity offered for such. Several sections were carefully measured and compared with each other, so as to arrive at proper conclusions as to the true nature of the structure and the particular strata or set of strata from whence the petroleum is derived. The results of this study will be given later on. The bore-hole itself then being put down, was frequently visited and the progress of the work noted. The late Mr. Spottswood, who was in charge of this work, kindly furnished such information as was asked for on each occasion.

The coast for several miles north and south of Sandy Bay was examined, and on returning to Cow Head after completing the work at Parsons' Pond, the coast westward to Broom Point was also examined and a visit paid to the boring operations being prosecuted for oil at St. Paul's Inlet.

On the 21st of September I took passage by the Harlaw northward, and visited several points along the West Coast as far as Current Island in St. Genevieve Bay. At Port Saunders, Point Riche, Ferolle, Brig Bay, Bartlett's Harbour, &c., an opportunity was afforded to note the prevailing characteristics of the rock formations and general features of the country in this section of the island. Time did not however permit of any extended exploration, even did my maimed limb render it practicable.

We returned to Bay of Islands on the 25th of September. The remainder of the season was spent at the Grand Lake in exploring the country towards the extreme western end of the Lake. An attempt was made to reach another considerable-sized lake to the southward, known to the Indians as Lewawseechjeesh (Little Grand Pond). But the river flowing therefrom was found impracticable for canoes, and after several days spent in trying to cut our way through the dense tangled forest, while beset all the time with exceedingly bad weather, we had to abandon the attempt.

Learning that the railway operations for the season were about to close down and the trains cease running across the country about the last week of October, we returned to the eastern end of the Lake to take passage home.

Before leaving the district a visit was paid to the settlement on the Humber River, above Deer Lake, where we were hospitably entertained by Mr. A. Bayly, late assistant on the survey. Mr. Bayly has gone into the cultivation of the soil in real downright earnest, and has done an extraordinary amount of labour during the short time he has been here. He has a beautiful place by the side of the river, and is determined to make a success of his farming enterprise. If pluck and perseverance will do it, he is sure to win.

Mr. Bayly's example is one well worthy of imitation and such pioneers as he are entitled to every encouragement and consideration.

GEOGRAPHICAL FEATURES.

In point of scenic beauty and variety, the West Coast certainly surpasses any other portion of the Island. The low-lying shores and long stretches of sand-beach characteristic of some parts of Bay St. George and Port-au-Port give way to the towering, precipitous cliffs and rugged mountain ranges of Bay of Islands and Bonne Bay, to be succeeded further north by the low, flat limestone ledges of the Newfoundland shore of the Strait of Belle Isle.

Port-au-Port Bay has already been pretty fully described in my report for 1874 and as our present exploration was confined to the Lewis Hill Range on the eastern or mainland side of that bay, it will be only necessary now to refer to this latter locality.

This conspicuous Mountain Range commences to rise near Broad Cove, on the eastern side of Port-au-Port Bay, about fourteen miles north from the Gravels, or isthmus of Port-au-Port. Bluff Head, a very high promontory presenting a bold escarpment to the sea, may be considered the western end of the Range. From thence to Lewis Brook, some four miles, the steep, precipitous and jagged sides of the Range front on the waters of the Bay but in their trend northward from the latter Brook they gradually begin to leave the coast and turn inland. On approaching Serpentine River they sweep away easterly leaving a wide flat valley near the coast, and run in the direction of Serpentine Lake, where they terimnate, being just sixteen miles in length.

The Blomidon Mountains, which rise immediately to the north of Serpentine River, though now separated from the Lewis Hills by the intervening low valley of that river, were clearly at one time part of the same range, which must have formed a continuous mountain chain from Bluff Head to the shores of Bay of Islands.

Many deep gorges have been cut through these mountains by the numerous small brooks flowing from the interior, some of which, as in the case of Lewis Brook, about four miles north of Bluff Head are perfect canons for several miles of their courses, Bluff Head Brook, just north of the headland of that name, is a mere mountain torrent. It has sprung into prominence of late owing to the discovery of valuable deposits of asbestos and chromic iron ore along its course. About a mile from the sea-shore the Brook forks, one branch running up north-east while the other takes a south-easterly course. Here the land rises rapidly, and the space between the two branches forms a semi-circular lip or ledge, running around the head of the small valley, giving it an amphitheatre-like appearance. It is in this interval, between the two forks at the head of the valley, that the deposit of chromic iron destined to develop into a valuable mining property is situated.

From the vicinity of the mine a low depression in the hills reaches across to Lewis Brook in an easterly direction behind the first or coast Range. To the south-east another still higher ridge runs parallel with the first. The deep gorge of Lewis Brook sweeps around this second ridge and trends away in a southerly direction till it almost meets a small tributary of the Benoit's Brook. A still higher ridge lies to the south and east of this valley, forming the summit level of the country, which then begins to slope away inland towards the main valley of Benoit's Brook, lying at the back of the Lewis Hill Range. I have been thus particular in describing this section of the country from the fact that recent discoveries of various important mineral substances point to the great probability of its developing into an important mining centre ere long. Already the Halifax Chrome Company have commenced operations at Bluff Head Brook, and during the past season have mined about 1,000 tons of ore, 200 tons of which have been shipped to market.

The coast scenery of Bay of Islands and Bonne Bay is some of the most magnificent to be met with perhaps in North America. All tourists visiting this section of which the number is increasing every year speak in the most glowing terms of it. The towering mountains, which rear their bare, brown-topped or snow-clad peaks to the skies, are scored by many deep gorges, the dense, dark foliage of whose wooded slopes present a fine contrast. The fantastically-sculptured cliffs facing the sea-board, indented by numerous deep coves and arms dotted with islands, all lend most striking and picturesque features of unsurpassed beauty and variety. But it has so frequently been made the subject of reports and newspaper articles that it need not be dealt with at any length here.

Beyond Bonne Bay the character of the coast entirely changes. The precipitous cliffs give way to a comparatively low shore-line, which becomes lower and more level as we proceed northerly. Long stretches of sand and shingle beach are met with, extending almost uninterruptedly from Martin Point to Ingornachois Bay. Cow Head a peculiar peninsula joined to the mainland by a strip of shingle beach about a mile long, and Portland Head, near Portland Creek, are the only prominences of any note on this section of the coast. The former was clearly an island at no distant period, with a channel inside where the present beach now connects it to the shore. It forms the only harbour, worthy of the name, from Bonne Bay to Port Saunders. But it is only suitable for small vessels of light draught inside the Head, and at best it is a rough place when the wind is in on the shore. The low fringe of coastline maintains its comparatively flat character for an average of between eight and ten miles inland. It is bounded to the south and east by the Long Range Mountains, which extend in an almost unbroken chain from Cape Ray to the head of Hare Bay. Many streams find their way to the coast through deep clefts in the Mountain side, and a few deep indentations of the coast, forming estuaries to some of the large streams, extend back to their base. The most notable of these are St Paul's Inlet (south of Cow Head), Parson's Pond in Sandy Bay, Portland Creek (near Portland Head), River of Ponds, Kepple, and Hawke in Ingornachois Bay.

The entrances or guts leading into all these lagoons, are narrow channels through which the tide rushes with considerable force. They are only navigable for small boats, and cannot be approached at all in bad weather.

Point Riche celebrated in the Treaties between England and France, the most prominent projection on this part of the coast. separates Ingornachois from St. John Bay. The latter cuts deeply into the land, almost to the base of the Long Range Mountains, which are here known as the Doctor's Hills. There are several outlying islands, of which St. John Island is the largest, stretching across the mouth of this Bay. Ferolle Point, a low flat piece of land, forms the northern side of the Bay and divides it from St. Margaret's and Genevieve Bays. Current Island lies on the north side of the latter Bay, and between it and Anchor Point, some ten miles further north, lies St. Barbe Bay, from which the Electoral District of St. Barbe takes its name.

The lumbering and agricultural capabilities of this Western Coast fringe, from Bay of Islands northward, are certainly not great. Though generally fairly well wooded as far as the mountain slopes the lumber is for the most part small and stunted, especially along the immediate sea-coast. The exposed position, which lays the entire coast open to the full force of the northerly and northwesterly gales sweeping across the Gulf from the bleak shores of Labrador, has no doubt greatly tended to retard the forest growth. After leaving the shore-line, however, at a mile or so inland, there is a good deal of fairly large timber, consisting chiefly of fir, spruce and birch. No pine was observable anywhere. A very large area of the surface of the low country is covered with peat. Extensive marshes in many cases commencing at the shore, reach back to the foot of the mountain range; nevertheless, some considerable areas of good land occur, especially in the vicinity of Cow Head and Parsons' Pond. Around the shores of the latter there are frequent patches of interval, of many acres in extent, which produce most luxuriant crops of wild hay. The inhabitants of the place entirely depend upon this bountiful natural supply of food for their cattle of which they possess very fine stocks. Hundreds of tons of this wild hay, which is not availed of at present, goes to waste every year. A large stock of cattle and sheep might be raised here were markets available; but the absence of good harbours and non-existence of roads of any kind are a great drawback. Until the latter especially are provided, no great progress can be expected. The facilities for road or telegraph construction from Bonne Bay north are admirable.

Geological Observations.

A reference to my Report for 1874, which contains the fullest details of the structure of the country surrounding Port-au-Port Bay, will afford sufficient information on its interesting geological features. It may be necessary, however, in a general way to observe that the Lower Silurian series occupy nearly the entire peninsula of Port-au-Port and the mainland on the eastern side thereof. Typical Calciferous and Levis fossils are abundant in many places. It was shown that the lower Silurian series of rock formations were here arranged in a set of sharp synclinal and anticlinal folds, trending generally about N. N. E. and S. S. W. true, with many bends and twists of more or less extent. The whole series are much affected by dislocations, which cause several repetitions of the same strata. Intrusive trap dykes are of frequent ocurrence also, and the strata in their vicinity exhibit a considerable amount of contortion and metamorphism. The shales, limestones and sandstones, &c., of the Levis and Sillery formations constitute a large portion of the series and occupy a very considerable extent of the country, especially on the eastern side of the Bay. In the valleys of the Benoit and Serpentine Rivers they are met with, striking obliquely across the courses of these streams for many miles inland. Here they are arranged in a succession of folds dipping alternately a little N. of W. and S. of E. Apparently overlying the sedimentary strata in the Lewis Hill Range, and again in the Blomidon Mountains, a great tangled mass of igneous and metamorphosed rocks, consisting of diorites, dolomites, serpentines and chloritic slates, rise into elevated ridges of from one to two thousand feet and upwards. Whether they were originally of sedimentary origin or are an overflow of igneous and intrusive material, it is extremely difficult to determine. It is certain, however, that in this locality they are of more recent age than the underlying Levis shales and sandstones. There is ample evidence of this fact in the numerous instances where the stratified deposits are seen in conjunction with them. In every case the latter pass beneath the serpentine group, and in the deeply-cut ravines, which intersect the mountain ranges where the hills are worn through to their bases, the sandstones and shales are seen in the beds of the brooks striking across in their regular course and surmounted by the metamorphic rocks.

The country between Bay of Islands and Bonne Bay is occupied by a similar series of igneous and metamorphic rocks which form a very high broken range of hills and are deeply scored by extensive ravines.

At Buck Head on the north shore of Bay of Islands, the bare brown, weathering hills forming so conspicuous a feature of the country indicate the presence of the magnesian group, which appears to extend uninterruptedly to the bottom of the Southern Arm of Bonne Bay, where they are again a prominent feature; but beyond Bonne Bay, to the northward, this group was not recognized, nor does it, so far as I am aware, come in again till reaching the northern extremity of the peninsula. Near the head of Hare Bay and lying between it and Pistolet Bay, Mr. Murray mentions the occurrence of the serpentines in his Report for 1864, and states that they occupy a considerable breadth on the eastern side of the northern peninsula, "extending a distance of fully seventy miles."

In the neighborhood of Bay of Islands and Bonne Bay the serpentine group is still underlaid by the shales, limestones and sand stones, as in Port-au-Port Bay. Apart from the serpentine range, which may be said to stretch along the West Coast from Bluff Head, Port-au-Port Bay, to South Arm, Bonne Bay, a distance of sixty miles, broken only by the intervention of the waters of Bay of Islands, there is another, or coast range, commencing at Bear Head, north of Serpentine River, and occupying the shore to South Head, Bay of Islands. This latter consists of a confused mass of diorite and trappean material often exhibiting a distinctly lava-like appearance, and is undoubtedly in great part of purely volcanic origin. Numerous patches of the stratified graptolitic shales, sandstones, &c., are confusedly caught up in this mass, and at times twisted into most fantastic forms. One patch, of the bituminous shales and limestones, occurs at Bear Cove, of about a mile in extent. The trap dykes in the vicinity of these shales not infrequently contain anthraxolite in small nests and strings. The red shales of the Levis have been changed to jaspers, and at some places are so charged with ferrous oxide as to almost constitute a low grade hematite iron ore. This igneous range rises in sheer vertical, sometimes over-hanging, cliffs to a very considerable height, between Bear Cove and South Head, especially in the vicinity of Little Harbour and Bottle Cove. Frenchman's Head, the most conspicuous point, attains an elevation of some 1500 feet. This rugged coast range is entirely distinct from, and independent of the Blomidon Serpentine Range further east. A wide, low valley separates them, extending from York Harbour, locally known as Broom's Bottom, to Serpentine River, which is underlaid by the Levis shales and sandstones in a comparatively unaltered condition. This coast igneous range is in turn interrupted by the break caused in its continuity by the indentation of Bay of Islands; but the islands which stretch across its mouth in a nearly straight line are chiefly made up of similar materials and on the north shore they come in again in full force stretching to Bonne Bay, and forming another lofty range, of which Cape Gregory, given on the Admiralty charts at 2,226 feet, is one of the highest elevations in Newfoundland.

The area of disruption which must have taken place subsequently to the deposition of the lower Silurian strata, seems to have terminated in the vicinity of Bonne Bay or a little north thereof. The lofty shore range gives way to a comparatively low-lying stretch of country immediately beyond Rocky Harbour entrance to the Bay, on the north side. Here the shales, &c., of the Levis formation are seen in considerable force, but still caught up and twisted and contorted by intrusive dykes, apparently offshoots, from the main centre of disturbance.

As we proceed northerly towards Cow Head, the igneous element disappears and is not met with again on the shore. Still its effects, together with those of contraction or subsidence, are no doubt to a great extent the cause of the numerous sharp foldings and flexures of the Lower Silurian series which hold the entire western fringe of the northern peninsula to Cape Norman, its extreme point. It was observed, however, that the folding and crumpling of the strata assumed less and less intensity proceeding northward, or as the disturbing element was left further and further behind, till finally towards Point Riche and Ferrolle the strata are comparatively undisturbed and lie in gentle undulating folds, and at times almost quite flat. The late Mr. James Richardson, of the Canadian Geological Survey, made a cursory examination of this section of the Newfoundland coast in 1862, and recognized the existence of the Potsdam and Calciferous formations towards the northern extremity of the peninsula, and again near Bonne Bay, while that portion of the coast between the latter and Ingornachois Bays was, for the most part, found to be occupied with the Levis and Sillery formations, all pertaining to the Lower Silurian Series.

The examination of the past season, while confirming in a general way the observations of Mr. Richardson, has tended to extend our knowledge, and the more minute examination, especially in the vicinity of Cow Head and Parsons' Pond, furnishes us with details of the structure, which will cause some important modifications in laying it down on a geological map.

Beginning with the lowest or potsdam group, Mr. Richardson then found it to occupy both sides of the Belle Isle Strait. Similar rocks, holding typical potsdam fossils, were observed to fringe the coastline, dipping at low angles towards each other, thus proving the existence of a low synclinal trough beneath the waters of the Strait. These strata were recognized at Port Saunders, Hawke's Bay, where greyish, calcareous sandstones and quartzites, often covered on the surfaces with fucoidal markings and lying pretty flat, were seen to dip north-westerly. Their strike here would carry them out in the bottom of St. John's Bay to the northward, and thence along inside of the projection of Ferrole Point to St. Margaret's and Genevieve Bays. It is highly probable, judging from the aspect of the country northward, that they hold the coast all along that straight shore, between Anchor Point and Cape Norman; but I had no opportunity of examining this portion of the coast. Just outside the entrance to Port Saunders, on the north side of Ingornachois Bay, some thick beds of dark, gray limestone, filled with fossils, are seen to overlie the former and dip in the same direction towards Point Riche. Here, again, the same limestones dip at a low angle inclined towards the former, exhibiting a gentle, flat, synclinal fold. The fossils from these limestones consist chiefly of orthoceratites and large whorled shells (macluria, &c.), which are described in the Volume of Canadian Reports, 1863, page 290. They are typical of the Calciferous age, which occupies the outlying portions of the coast, including the islands in St. John's Bay. No higher measures were seen on this portion of the coast, nor was their relation with the sandstones and shales of the Levis formation met with in this direction, though clearly shown in Port-au-Port Bay (see Report of Geological Survey for 1874).

Southward from Hawke's Bay the shores are very low for long distances and no rock is exposed. This portion of the coast was not examined, but it appears from Mr. Richardson's report that the structure is interrupted by several transverse dislocations, bringing the potsdam and calciferous quartzites and limestones forward two or three times to the shore with a general S. W. inclination. One of these breaks occurs near Table Point, where the Point Riche limestones were seen repeated, and at a distance of about a mile across the measures a mass of coarse, conglomerate limestone occurs near Daniel's Harbour, and again at Portland Creek, three miles further west. At the latter place there is another fault, bringing up the potsdam sandstones. About four miles further, at a place called the "Arches," a great mass of the coarse brecciated, or conglomerate limestone, occupies the shore for a considerable distance. It runs out into the water here, forming a breast-work to the force of the sea, which has worn several large cavities through the wall of rock, giving it a very picturesque appearance. These have also given rise to the name of the Arches. At this place the mass of breccia which is about 25 feet high and some 50 or more wide, stands upright, forming a perfect wall, and separated from the main outline of the coast by a shingle beach. No rock is seen in contact with this limestone here, and no distinct lines of stratification could be discerned, neither does it appear to contain any fossils. Its relation to the other members of the Levis formation, of which it is clearly a part, is, however, well seen at Cow Head. Not only is the latter headland almost entirely composed of this rock, but the islands in the cove lying in the strike, as well as Stearing Island outside. Near the base and top of the mass at Cow Head thin-bedded limestones, with shaley partings, are seen to underlie and overlie it on the outer and inner sides of the Head. The shaley portions contain a few graptolites and fragments of lingulæ, and some of the thin limestones are quite bituminous, giving off a strong odour of petroleum. Several thin bands of black chert characterize this portion also.

Cow Head, which is a peninsula standing off from the shore, to which it is connected by a shingle beach of a mile or more in extent, accordingly gives no clue to the next succeeding measures, which are hidden from view by the beach on the inner side and the waters of the Gulf outside. In their strike eastward these Cow Head rocks run into the land on the point north of Stanford River, about four miles from Cow Head. They form a high, broken wall along shore for a mile or more, and attain a thickness of 326 feet. On the outer side, midway between Cow Head and Sandy Bay, they are underlaid by a wide belt of greenish-gray, coarse-grained sandstone, dipping inland to the S. E. and passing beneath the limestone. This sandstone forms low ledges, dry at low tide, which strike very regularly in a direction parallel with the shore, and are seen to form two or three sharp indulations showing contrary dips. According to Mr. Richardson, these sandstones form the apex of an anticlinal fold, passing between Cow Head and Stearing Island, which latter is a repetition of the Cow Head limestone conglomerate, dipping seaward. Immediately in front of the limestone mass again, and approaching the mouth of Stanford River, at a distance of 117 feet, a nearly similar greenish, coarse-grained sandstone, also forming low ledges and only seen when the tide is out, holds the shore for 1,020 feet, where an almost continuous section is seen dipping S. 46 degrees E., at an average angle of 41 degrees, exhibiting a total thickness here of 674 feet. Towards the top of this section the sandstones become more and more fissile, and even partake of the character of an arenaceous shale, while at one place there occurs a band of some four feet of interstratified, thin-bedded limestone and shale. An interval of half a mile of low land succeeds, across the measures, where no rock is exposed. Just inside the bar, at the mouth of Stanford River, a few low outcrops occur, consisting of three bands of a peculiar brecciated limestone or conglomerate, in which the enclosed fragments are limestone, mostly angular, and arranged rudely in parallel layers, cemented together by a lime or dolomitic paste often weathering a dull, yellowish colour. This peculiar rock is a very marked feature of the formation, and is very persistent throughout their distribution from Port-au-Port northward. It is entirely different and distinct from the coarser, massive conglomerate breccia at the base of the formation at Cow Head and the Arches, &c. Here at Stanford Brook there are three or four bands of the breccia interstratified with greenish-gray shales and thin beds of limestone, which also overlie it, all dipping S. 38 degrees E., angle 64 degrees. What is believed to be the same section is again exposed on their strike eastward at the first narrows in Parsons' Pond some 7¼ miles distant The yellow-weathering dolomitic, brecciated conglomerate and shale are well displayed here There are several bands of the breccia altogether, associated with a good deal of thin-bedded limestone and shale. These limestones frequently exhibit most extraordinary contortions; some bands in particular are twisted like coils of a serpent and doubled into each other in a most fantastic manner, while, strange to say, the accompanying shales seem comparatively undisturbed.

As we ascend on the section the shales begin to preponderate, and the limestone layers become less numerous and thin out considerably. Interstratified with the shales and limestones are some heavy beds of greenish-gray, coarse-grained sandstones, which merge into thin, flaggy layers towards the top, and finally into green and red shale. These are again overlaid by the thin limestones and shales holding numerous graptolites and a few, imperfect lingula. Some of these bands are quite bituminous, the limestones when broken freshly give off a strong odour. They frequently contain little, drusy cavities, filled with crude petroleum of about the consistency of tar. Several of the shale bands are dark-coloured, nearly black at times, and appear to be saturated with the same material. A thick mass of greenish, coarse-grained sandstone overlies these again, and would appear to occupy the highest part of the section here, forming the centre of the several synclinal folds. To all appearances this rock is the equivalent of the sillery sandstone of Canada. The whole are repeated two or three times between the sea-coast and the base of the mountain range in a series of sharp folds. A heavy-bedded gray limestone forms the foot-hills of the mountain range, tilted up at a high angle, with an overturn dip, pointing towards the hills. On the shores of Lake Spottswood, a small sheet of water half a mile back from the head of Parsons' Pond, and occupying a deep gorge in the mountains, beds of yellow-weathering, calcareous sandstone, underlaid by dull, whitish quartzites, were seen in a vertical position, which were presumed to be the potsdam sandstones, again brought up from beneath by a fault.

The limestone in front is probably the Cow Head conglomerate at the base of the Levis but the typical Calciferous limestone, with its abundance of fossils, seems to be absent here, as nothing resembling it was seen anywhere inside the coastline.

At St. Paul's Inlet, in the line of strike westward, the same strata were met with in a similar attitude, the actual folding being much mo.e distinctly seen here, where the apex of more than one sharp anticlinal comes to the surface. Here the sandstones exhibit themselves more frequently and seem to spread over a large area, while the shaley portions are not so well seen, being for the greater part hidden beneath the low, marshy ground.

No higher series was met with on the northern portion of the West Coast, and from all appearances the rocks described above occupy the entire margin of low-lying country between the sea-coast and the Long Range Mountains. In Port-au-Port Bay only, as was shown in 1874, are they succeeded by higher measures, including small patches of the middle Silurian and the lower Carboniferous series.

The superficial deposits along this fringe of coast were noted for their comparative freedom from large boulders. Though not entirely absent, no such accumulations were met with as characterize most parts of the southern, eastern and northeastern seaboards. The debris is almost entirely local; a few loose rocks were seen, which might have been transported from a distance.

Economic Substances.

The western portion of Newfoundland has been frequently referred to as rich in valuable mineral and other economic substances. Every year is adding new discoveries of importance to the list of those already known. At the chromic iron deposit at Bluff Head Brook, Lewis Hills, already mentioned, the work of mining the ore was fairly commenced last season, and gives promise of splendid results. The deposit is situated between the forks of the brook, about a mile from the shore, the ore showing in the face of a steep incline in several distinct and rudely parallel bands. Ten in all were uncovered in removing the superficial drift from the surface of the slope. One of these showed eight feet of solid ore at the outcrop, while the whole average about two feet in thickness each. Like all chromite deposits, the veins are pockety and very irregular in thickness; nevertheless, the amount of ore exposed on the surface was very considerable, and it was traced for over half a mile eastward by the loose fragments of ore scattered along the surface. The deposits are confined chiefly to the serpentine and chloric slate rocks, but are almost invariably accompanied by huge masses or wedges of a dull gray, very tough, porphyritic diorite, generally characterized by small, rounded quartz grains of a chalcedonic texture. Sometimes the ore rests right upon or is overlaid by this diorite, but in no case was it seen to penetrate it. A good deal of the ore is thickly disseminated, in the form of fine black crystals, through a matrix of steatitic material, which, when exposed on the surface of the ground, gives it a characteristic speckled appearance, by which its outcrop can be easily traced. This class of ore would require to be crushed and washed before shipping to market, as it would scarcely pay in its present condition, owing to the large percentage of rock material present. Some of the better and larger bands are very free from rock, and present a uniform black colour and granular structure, being composed of innumerable fine crystals of chromite, closely cemented together. Specks of pale-green serpentine are disseminated through the mass, the colour, no doubt, being due to the partial oxidation of the chromite. It is a beautiful ore to look at, and should yield a high percentage of chromic acid. About 1,000 tons were mined last summer, and hauled out to the shore with horses. Two hundred tons were shipped to markets in Nova Scotia and the United States, principally to Baltimore. I have been unable to ascertain what prices were received for the ore or any particulars as to how it suited the requirements of these markets, &c. The Halifax Chrome Co., Limited, which have the development of this valuable property in hand, have constructed a good car-road from the water-side to the mine, and erected dwelling-houses, forge, stables, &c., on the ground, preparatory to entering more fully into the work of mining next season. The facilities for shipping, owing to the exposed nature of the coast, are not very good. I understand, however, it is the intention of the Company to construct a hoisting plant, so as to raise the ore to the summit of the Bluff Head Ridge and run it down by tramway on the opposite side to Broad Cove, a distance of about two miles. Broad Cove is tolerably well-sheltered from all northerly winds, and by the construction of a small breakwater at the outer Northern Point, could be converted into a fairly good harbour. The debris strewn along the valley of Bluff Head Brook, between the mine and the sea, contains so many loose boulders and fragments of ore, derived from the wearing down of the mine escarpment, that it appears to offer sufficient inducement to capitalists to undertake surface mining. There is very little brush or soil to remove and the facilities the brook would afford for washing out the clay and sand are excellent. In sinking a shaft for asbestos, within a quarter of a mile of the shore, Capt. Cleary struck chromite at a depth of 24 feet; but as the shaft was filled up with water and fallen rock, nothing definite as to the character of this deposit could be obtained. Specimens of the ore, however, from the dump show a closer-grained, almost homogenous mass, more resembling magnetite in appearance. Others, again, exhibited a good deal of rock (serpentine) mixed with the ore. A similar close-grained ore was found on the surface in the line of strike towards Lewis Brook, and judging from the large fragments of solid ore picked up here, there is evidently a considerable deposit in the vicinity. Other iron ores, such as hematite, pyrrhotite and pyrites, were seen at various points on the same hill-range; but in no instance were these ores of sufficient extent or quality to be of much importance. Pyrites in the form of small nodules are pretty profusely scattered through some portion of the Levis shales.

A valuable deposit of this mineral was reported as occurring in the Middle Arm, Bay of Islands. A beautiful quality of fibrous, brown hematite was brought from Portland Creek last year, which, if in sufficient quantity, should prove a valuable deposit.

Unfortunately the accident to my leg rendered it impossible for me to visit either of these localities during the season. Another deposit of pyrites occurs further north towards St. Barbe, but the precise locality or nature of the deposit could not be ascertained. Some small specimens shown me were of fairly good quality.

Asbestos.

Asbestos, or chrysotile, the well-known fibrous mineral so common in serpentine deposits, occurs in many parts of the Lewis Hill range. In fact, wherever the purer serpentines show themselves, asbestos in more or less quantity is almost sure to accompany it. Several attempts to open up mines for this substance have been made at various parts of the range, but little success has so far attended these efforts. In nearly every case the fibre was found rather short and but sparsely distributed through the rock. Some of the best and most promising looking deposits, when opened up or sunk upon, soon began to show signs of thinning out. Although the quality of the fibre was good, and some of it reached from 1 to 1½ inches long, yet the large amount of barren rock, which had to be removed to obtain even a single ton of the material, precluded the possibility of its paying the expense of mining.

There is, however, one property which appears to give more promise than any of the others so far explored. It is that of Capt. P. Cleary, fronting immediately upon the sea-coast and extending from Bluff Head a mile along shore northeasterly. By far the largest exhibition of asbestos yet discovered in this range occurs here. There are two places, about half a mile apart, in the same line of strike, and lying at a distance of about one-quarter of a mile back from the sea-shore, where the mineral exhibits itself. The first is on the western side of Bluff Head Brook, in the face of the steep slope forming that side of the valley. Two veins of asbestos were uncovered here by costeaning the surface, one of which showed 27 inches, and the other 13 inches, of short, broken fibre, the longest about one inch. It is jointed or split into innumerable, irregular, small veins by thin strings and wedges of serpentine. These were uncovered on the surface for about twenty feet. On the opposite or eastern side of the valley a steep, broken ridge runs along parallel with the shore-line, from which it is separated by a deep ravine and a second lower ridge rising just over the water. On the slope of the former facing the sea, and about 400 yards eastward from the Brook, a vast amount of loose, angular rock, derived from the wearing down of the hills, has accumulated. Much of this loose material was seen to be well charged with asbestos, and on removing sufficient to get at the bed-rock, eight veins or bands of asbestos were uncovered, all running rudely parallel to each other and at short intervals apart. From a sketch of the exposure and notes made by Mr. P. Holden, who had the work of uncovering this deposit in hand, I get the following particulars: "Distance of lode from seaside, 21 chains. Several veins are to be seen on the surface between this and the seaside."

No. 1	vein is	8	feet from top of hill;			width of vein,	3	inches
" 2	"	3	" below	No.	1.	" "	$3\frac{1}{2}$	inches
" 3	"	14	"	"	" 2.	" "	4	inches
" 4	"	20	"	"	" 3.	" "	$4\frac{1}{2}$	inches
" 5	"	9	"	"	" 4.	" "	10	inches
" 6	"	11	"	"	" 5.	" "	4	inches
" 7	"	3	"	"	" 6.	" "	4	inches
" 8	"	14	"	"	" 7.	" "	2	inches

The longest fibre in these veins is only about three-quarters of an inch. The veins were uncovered for distances of 620 and 982 feet. Two of these, 6 and 7, run together at one point, which was selected for sinking upon. The asbestos held out pretty much the same for a depth of twenty-four feet when the deposit of chromic iron, mentioned previously, was struck and the work discontinued. Although the fibre in each case is so short and so much broken by jointage, &c., the quality is good and the percentage in the rock considerable. In the bed of Bluff Head Brook, about midway between these two openings amongst the broken and crushed debris, a large amount of loose asbestos has accumulated, forming a bed of about a foot thick. It is comparatively free from rock, having undergone a natural process of crushing, which has separated the fibre and left it behind. If this deposit has any extent, it should prove a valuable one, as it is very easily raised. In fact, it may be said to be in a form ready for market, with little or no further preparation required. The presence of asbestos in so many places should prove an incentive for prospectors to search this range diligently for the mineral. It is highly probable that in some parts of their distribution the serpentine masses will be found to hold longer and better fibre than any yet met with in the above cuttings.

Magnesite.

Loose pieces of pure white magnesite, or carbonate of magnesia, were picked up on the surface of the hills in several places, and a deposit of a fine white magnesian powder occurs in some places. Beautiful snow-white botryoidal incrustations of the mineral were obtained by Capt. Cleary on one of his lots. It is not improbable that the material will yet be met with in available quantity when this important mineral region becomes thoroughly explored.

Petroleum.

The presence of petroleum in certain parts of Port-au-Port Bay was mentioned in the Reports of 1873 and 1874. The bituminous shales and thin-bedded limestones of the Levis formation in that district were shown to give evidence of their containing petroleum, at least in some parts of their distribution.

The limestone, when freshly broken, frequently exhibited small, drusy cavities filled with the crude material, of about the consistency of tar.

On the middle point, separating the eastern and western bays, petroleum was seen oozing through the sand at low tide and collecting in little pools on the surface. Attention was drawn to these facts at the time, and it was thought that possibly some attempt might be made to prove the ground by drilling. No further attention was, however, paid to the matter until the recent operations further north have brought the question of oil deposits prominently before the public. Similar shales and limestones, of a more or less bituminous character, have now been traced almost continuously from Port-au-Port Bay to Portland Creek; but the disturbed and broken character of the deposits on the east side of Port-au-Port, and between there and Bonne Bay, render it doubtful whether any appreciable quantity of petroleum is likely to be contained therein. Its presence throughout their entire distribution is amply shown wherever any considerable patches of the shales, &c., exhibit themselves, while the igneous and intrusive masses of trap which disrupt the strata at so many points frequently contain nests and strings of anthraxolite, a crystallized form of the same material.

After passing the region of greatest disturbance, and entering upon the more regular and less altered deposits north of Bonne Bay, the bituminous character of some of the limestones and shales is well marked, especially at St. Paul's, Cow Head and Parsons' Pond. At the latter place pools of oil, floating on the surface of the lake and collecting in hollows on its low sandy margin, long since attracted attention. Some twenty years ago a Halifax Company made an attempt at boring for oil at a point where it seemed to collect most on the surface. They succeeded in getting down one hole, some 600 feet, but from all I can learn did not strike oil in paying quantity. It would appear from the location of this hole as though they really sank behind or away from the actual oil-bearing strata and were boring through lower measures. Some three years since, a new Company, called the Newfoundland Oil Company, Limited, was formed, with a capital of $30,000, to test the place more thoroughly. A good drilling apparatus was procured and a couple of expert drill-men from Ontario were employed, with a crew of eight or ten men. The difficulty of reaching the place, and the absence of a good harbour or proper facilities for landing such heavy material and transporting it some seven miles inland by the shallow waters of the pond, caused unavoidable delays in the first year's operations. The late Mr. Spottswood, who was requested to visit the place and locate the most favorable point for boring later in the same season had occasion to remove the entire plant several chains from where it was first erected; subsequently a gale of wind blew down the derrick just as it neared completion, and put an end to the first season's work. In 1895 the drilling was fairly commenced and the hole sunk to a depth of some 1,300 feet. Gas and oil were struck at three different points, viz.: at 700, 1,040 and 1,230 feet, respectively, the latter giving the best yield. Many circumstances, however, but chiefly, I imagine, the absence of experienced persons to control the operations, rendered that season's work also far from satisfactory. Last year, 1896, the Company wisely concluding to avail of Mr. Spottswood's services again, engaged that gentleman to superintend the operations for the season, with a much more favourable result.

Having first withdrawn all the casing pipe, which was found to be bent and ripped open, the hole had to be re-drilled to straighten it. He replaced the piping and continued the drilling down to a total depth of 1,440 feet. Not finding any increase in oil or striking any new bands, he then had the hole cleared out and began to pump it.

Apparently the seepage from the petroliferous strata was slow, and the pumping only averaged about half a barrel per diem. The hole was next plugged at a depth of 1,300 feet, or below the third and deepest oil-band, when it was torpedoed and allowed to settle for several days. It then yielded 6 barrels of oil in forty-eight minutes' pumping.

Work was now stopped for a time, owing to the absence of barrels or other receptacles to hold the oil. At this juncture poor Spottswood's health, which had been failing all summer, completely gave out. He was obliged to leave and come on to St. John's, where he subsequently died. His illness and death was a great drawback to the Company, he having proved himself a most reliable, painstaking and experienced person. By the last account from the locality some eighteen barrels of oil were obtained in about six hours' pumping, when the pumps got out of order and the work had to be stopped again. In the meantime a second hole was drilled some five chains from the first in the direction in which the strata approached nearer the surface, I presume with the object of tapping the oil-bearing bands at a lesser depth and thus avoiding deep sinking. It has been learnt that gas and oil were struck also in this boring, but at what depths or in what quantity I am unable to state.

The result of these borings has clearly demonstrated that petroleum exists beyond question in the Levis shales of our West Coast, but until much more extensive drilling has been accomplished over the most promising locations, it cannot be determined whether the material exists in paying quantities or otherwise.

Hitherto, though petroleum has been known to occur in almost every geological series in more or less quantity, no prolific yield has been struck at a lower horizon than the Trenton Limestone formation. This is the chief repository of the celebrated Ohio deposits. In Canada, Pennsylvania and New York the oil is chiefly derived from the Devonian and Carboniferous series, while in California it is in the Cretaceous and Tertiary formations, all of much more recent geological ages than our rocks. Nevertheless, there is no good reason why it should not exist in quantity, provided the character of the enclosing material affords a favourable receptacle and the rocks themselves are in a suitable condition to retain the oil. On this head I have the opinion of Dr. G. M. Dawson, C.M.G., Director of the Geological Survey of Canada, who sees no reason why oil should not exist in quantity at so low an horizon, "provided the rocks themselves are not so much altered as to render it improbable." He further says, "assuming the Levis shales are about equivalent to the calciferous formation and knowing that oil occurs abundantly in some parts of the Trenton formation there can really be nothing against its occurrence at a couple of stages lower down in the same conformable series if the physical conditions are suitable."

The question of the origin of these hydrocarbons has been a matter of much scientific discussion—some concluding that they were purely a chemical product formed by the action of water on heated metals in the interior of the earth, but the more generally accepted theory is that they are the result of the decomposition of animal and vegetable remains enclosed in the earth's crust. Assuming this latter to be the one carrying most weight with it, we certainly have here in the Levis formation an abundance of such organic remains as would be eminently calculated, under a process of fermentation and great pressure, to yield just such a material. I refer to the extraordinary profusion of graptolises and lingulæ now preserved in the limestones and shales. Some of the latter stratum are fully half composed of the carbonized remains of these delicate and beautiful fossils, and in every case their bituminous character was found to vary accordingly. The sandstone bands in the formation, on the contrary, which did not appear to contain any organic remains at all, were equally non-bituminous. I have little hesitation, therefore, in concluding that, in this instance at least, the petroleum was derived from this source. Should the further development of the oil claims at Parsons' Pond result in successfully exploiting a new oil region at a lower horizon than any hitherto discovered, it will no doubt give an impetus to searching amongst the Levis shales, not only in other parts of Newfoundland, but in Canada and the United States, where they are largely distributed.

Other Useful Materials.

Amongst the many other useful materials of this section of the West Coast may be mentioned an abundance of building stone, limestone, serpentine, marble, slate, hone stones, &c. Some of the fine, close-grained limestones would seem to be adapted for lithographic purposes, but it is so much broken by short jointage that it is difficult to obtain slabs of any large dimensions.

The Museum.

Owing to the curtailment of the grant for the Museum, consequent upon the retrenchment policy, the funds now at our disposal are entirely inadequate for maintaining it in anything like its former condition. No money is available for the purchase of specimens or the proper care of those already possessed. This is especially the case with the natural history collection, particularly the fishes. These require frequent renewal of the preserving liquor (alcohol), owing to evaporation and loss of strength, &c. A number of glass jars are also required for the proper distribution of the specimens. It would be a great pity to allow this interesting section of the Museum to be spoiled for want of a little means to keep it from destruction.

With the exception of the mineral and other specimens collected by the survey the past season, very little has been added to the collection. A few interested persons continue to contribute various articles from time to time, and the names of the donors are always attached to the specimens when exhibited.

Interest in the Museum continues unabated, and the young folks especially find it a great source of attraction. It is in fact to them an educational institution of great value.

Now that it has been decided to send a collection of exhibits to the Imperial Institute and Bureau, Philadelphia, the coming summer, the Museum will be called upon to supply most of the materials. Had it not been for its existence, it would be a difficult and expensive matter to get together a suitable and representative exhibit, while many specimens could not otherwise be procured at all. During the winter letters have been addressed to parties all over the country who may be in a position to forward specimens for this purpose, and I hope when the spring opens to have a good display of the mineral and timber products of the country sent on by the first steamers north and west. In the meantime I have promises of many others from parties interested in mines residing in the city.

I have the honour to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

Historical Sketch of the Discovery and Development of the Coal Areas of Newfoundland, up to date.

The admirable history of the Cape Breton coal fields, their development, trade, &c., by Richard Brown, F.G.S., published in 1871, is a standard work upon all that relates to the important industry which has given to that fortunate little island a world-wide fame. Mr. Brown goes back to the earliest occupation of the island, relates the many vicissitudes connected with its French and English ownership, its frequent change of hands, and its final conquest by the latter nation in 1758.

With regard to the development of its coal mines, a few desultory attempts were made by both nations during the earlier periods of occupation, but only so far as to raise supplies of fuel for the troops garrisoning the fortifications of Louisburg and Halifax. After the conquest, the English Government, strange to relate, pursued the same blind policy which has done so much to retard the development of our own island. They would neither work the mines themselves nor allow others to do so, notwithstanding the frequent and urgent representations made by the Colonial Governors and others in authority, with regard to their extent and value to the kingdom. For a number of years they merely continued to raise sufficient for the requirements of the garrisons. Small bodies of troops were kept constantly on the site of the principal workings to prevent any attempt at regular mining, and the soldiers themselves were employed in the very uncongenial work of mining. Notwithstanding all their vigilance, however, vessels from the New England Colonies carried on a lucrative trade in stealing coal from the cliffs and conveying it to their homes. It was somewhat akin to our smuggling traffic with St. Pierre, and rendered them liable to the seizure and confiscation of their vessels, if not worse punishment. In the meantime, numerous applications were being made to the Government, chiefly by army officers of distinction, who had served in the various wars of the period, for grants to work the coal mines. Offers to pay a handsome Royalty, establish settlements, build towns, &c., and every inducement that could be brought forward to strengthen their applications were made, but all to no purpose. His Britannic Majesty, with the advice of the English Board of Trade, invariably refused his assent, and even went so far as to positively forbid any attempt to work the mines on an extensive scale. All this time the illicit traffic by the colonists continued to grow in proportions, till at length the Government awakened to the futility of keeping the coal locked up any longer, seeing their inability to cope with the smugglers. In 1788, the first lease for mining was granted to one Thomas Moxley. Other leases followed from time to time, all being of short duration, from seven to ten years only, and subject to a heavy royalty per ton. At intervals between the expiration of one lease and the commencement of another, the Government took over the mines and worked them; but, like most enterprises of the kind worked on Government account, they did not pay, the profits being eaten up in salaries to numerous and unnecessary officials. It does not appear that the private speculators derived much profit either in their attempts to mine the coal, for nearly all of them failed to carry out the terms of their leases. This is not a matter to cause much astonishment, however, when it is considered they were obliged to pay from three to four shillings sterling per ton royalty, and were at the same time compelled to sell for about ten or eleven shillings per ton. All this has long past now, and the coal industry of the tight little island of Cape Breton is established on a permanent footing. It has grown to large proportions and has still greater possibilities before it. The industry is the mainstay of its thrifty and industrious inhabitants, and without it Cape Breton would, indeed, be a very insignificant colony. No one who has visited the island of late years can fail to be struck with the importance of its coal trade and what it means to the prosperity of the country. We must all hope that the day may come when a similar prosperity awaits our Island home by the development of her so much neglected mineral resources not the least of which, I am convinced, will be her coal mining industry. With regard to this latter, we have only as yet reached that stage of beginning to believe that we really do possess this valuable commodity in available quantity. The enterprise of the Messrs. Reid, railway contractors, is mining and bringing into St. John's, on the 1st day of November last, a car load of native coal, over the N. & W. Railway, from the Grand Lake region, has marked an era from whence to date the history of coal mining in Newfoundland. Owing to the lapse of time, and changed circumstances under which we now live in these North American colonies, we are not likely to create any such interesting historical record as that surrounding the industry in our sister colony. The time will come, however, when a true history of all that is worth recording in this connection will have to be written. It is with a view, then, to leave correct data for the future historian, while all that relates to its discovery is still fresh in memory's receptacles, as much as for general information, I now publish the following statement of the actual known facts.

To begin at the beginning, the earliest mention of the existence of coal in this Island was, I believe, made by the celebrated circumnavigator, Captain Cook. In reference to the country on the western side of the Island, he is quoted as saying: "There are in Newfoundland as well as in Cape Breton, such rich coal mines that, if the Crown would but grant leave to work them, their produce would be sufficient to supply all Europe and America abundantly with this commodity, and some are even so commodiously situated that coals might be thrown directly from the coal works themselves into the ships as they lie close to the shore." "I had," says the author, (Dr. John Rienhold Foster, 1786), "this intelligence from my late friend the great circumnavigator, Capt. Cook, who for several years successively explored the shores of this island." Mr. Wm. E. Cormack, that intrepid traveller who, in 1822, crossed the island in his philanthropic endeavor to open up communication with the aboriginal Red Indians, with a view to bringing them to civilization, is the next authority I can find who refers to our coal deposits. Cormack was a man of superior education for his time, and possessed a good knowledge of the natural science, more especially of Geology and Mineralogy. He was a close observer also, and in his itinerary made many valuable references to the various natural features, etc., of the country; most of which have since been fully verified. Although Cormack did not actually see the coal deposits of Bay St. George himself, he must have seen specimens, for he says, "Coal of excellent quality is exposed in strata in the bed and banks of a rivulet between the first and second Baraswav River, about seven and nine miles from its mouth." Again, he says, "the land between Codroy and where the coal occurs is low and flat, so that in the event of the coal being raised, it could be conveyed by means of a railroad from the mines to the shipping." All this is perfectly true and now, after a lapse of nearly three-quarters of a century, Cormack's prognostication is about to become a *fait accompli.* Yet this intelligent man, long since laid to rest in a quiet churchyard at New Westminster, British Columbia, was looked upon as a mad enthusiast by his much wiser neighbors, and the generations who have succeeded him. In 1840, Mr. J. B. Jukes, M.A., F.G.S., F.C.P.S., who was employed by the local government in making a geological exploration of the Island, visited the West Coast, and ascended the Middle Barachois River of Bay St. George to inspect this coal deposit. He it was who gave the first authentic account of the coal seam there, since named after him, the "Jukes' Seam." He entered pretty fully into the geological features of this western country, and describes the seam there measured by him, as being "three feet thick." He adds that, "the quality of the coal exposed was good, being a bright caking coal." Mr. Jukes on this same occasion also paid a flying visit to the Grand Lake, and saw one small seam of coal six inches in thickness on Coal Brook, which flows into the south-east corner of the lake. Many references were subsequently made to these coal finds by Bonnycastle, Pedley and other writers, all founded upon Jukes' Report. Bonnycastle, writing in 1842, when speaking of the western side of the Islands, says: "Here, midst profound solitudes, and vast prairies, forests and innumerable large lakes, we find the grand mystery almost brought to light of the continuation of the coal formation of Nova Scotia and Cape Breton, the great coal basin of the St. Lawrence, probably the largest in the world, reaching from the Gaspe territory on the one hand, and covering a vast portion of Newfoundland on the other." Again he says, "former visitors on this part of the coast, beginning with the French navigators and with Cook, asserted, as Mr. Jukes has proved, that coal, gypsum, iron, limestone, marble, the freestone for building, are abundant." And yet again, he adds: "To show that the coal is similarly abundant, to that on the opposite side of the gulf, in Cape Breton and Nova Scotia, we find the rocks associated with it, and on which it reposes exactly the same, whilst the quality of the coal in the specimens 'I have seen of it' appears to be perfectly alike in all." These references, however, with the exception of those of Mr. Jukes, as is usually the case with unscientific observers, are not strictly in accordance with facts. A new era in geological discovery was inaugurated by the establishment of the present Geological Survey, under the able direction of the late Alexander Murray, C.M.G., F.G.S., in 1864. Soon our knowledge, not only of the geological structure of our Island, but of its varied resources, and its hitherto unmapped topographical features, began to dawn upon us as a veritable revelation. Only the very crudest and most hazy ideas of its magnificent lakes and waterways, its unrivalled scenery, and the vastness of its unexplored interior were prevalent. It was as much a "terra incognita" as the regions surrounding the poles of the earth are to-day Mr. Murray being not only a close observer and painstaking geologist, but likewise a surveyor of superior attainments, soon began to map in the principal features of the country from actual survey, and shape out something like a presentable map of England's oldest colony, so long a great blank on the physical delineation of the globe In 1865 he made his first journey across the Island, by way of the Indian Brook of Hall's Bay and the Sandy Lake and Grand Lake waters of the southern branch of the Humber, to St. George's Bay, surveying the entire route as he journeyed along. His map of the Great Lake, this magnificent sheet of water nearly fifty-six miles long, with its huge enclosed island, afforded us the first real idea of this great inland sea, and henceforth it took its place on the map of the Island as one of its principal and most interesting features. But Mr. Murray's main object, as he informs us in his report for that year, was to ascertain the correctness or otherwise of the existence of coal in the interior. To use his own words: "I was to a considerable extent influenced by various rumours regarding the presence of coal in certain parts of the interior, and considered it a matter of the first importance to do my utmost to develop the extent and distribution of the formation, should it prove, as it has done, to exist." Mr. Murray did not, however, on this occasion, find any actual out-crop of coal on the Grand Lake, but met with numerous fragments of that material washed up on its shores. The six-inch seam described by Mr. Jukes was not visible, having, as Mr. Murray says, "probably in the interval since his (Jukes') visit been covered over by debris from above." Judging from the abundance of loose pieces of coal near the inflowing Sandy Lake River, he adds: "There is clearly a seam of coal near the outlet of the Main Brook."

Later on in the same season he examined a portion of the St. George's Bay carboniferous area, and mentions a small seam of coal as occurring on Romains Brook, on the north side of the Bay, but he had not time to examine the Jukes' seam on the Middle Barachois River. Other work, especially amongst the copper-bearing rocks of Notre Dame Bay, then occupied the attention of the Survey for several years successively, and it was not till 1873 that the St. George's Bay coal region was again visited. This time the present writer accompanied Mr. Murray in his exploration. While the latter devoted his attention chiefly to working out the structural details of the geological features, the former was occupied in making topographical surveys of the coast line, ascending and dialing the principal river courses, etc. We visited and examined the seam on Riviere Blanche, which proved to be but six inches thick. Another irregular seam on the same brook was just discovered, but it was of little importance. The Jukes' seam, and another lying above it on Middle Barachois River, were closely examined, and their outcrops measured. A section is given in the report for 1873 showing, according to Mr. Murray, the Jukes' seam to contain 3 ft. 6 in. of coal, and that above (the Cleary seam) 1 ft. 5 in. coal. It was the writer's good fortune while measuring the Robinson's Head River, next east of the Middle Barachois, to discover another good seam, containing four feet of excellent coal. Mr. Murray named it the Howley seam at the time. Other work again occupied the attention of the Survey until 1879, and no further coal discoveries were noted. In the latter year the Government had concluded to institute a series of boring tests in the vicinity of the Grand Lake. A boring apparatus was purchased, and an experienced man from Scotland engaged to carry out the experiment. A trial was made near the mouth of Sandy Lake Stream, where the loose coal was seen strewn on the shore. The bore-hole reached a depth of 250 feet, and a few thin coal seams were passed through, the largest of which only attained a thickness of sixteen inches. The boring was continued the following year, but with no better result. This seemed to throw a damper upon the prospects of available coal deposits occurring in the Grand Lake region, and even Mr. Murray himself began to entertain grave doubts that any appreciable portion of the true coal measures would be found here. The Bay St. George area, of whi.. there might be some hope, remained in abeyance also, no further attempt being made to explore it. In fact, a general concensus of opinion seemed to have been arrived at, that our coal areas were of too limited an extent to call for further outlay in that direction. With this opinion I could never concur, more especially after a visit to Cape Breton, and an inspection of the Sydney mines section. When, after the retirement of Mr. Murray, and his decease in 1884, I succeeded him as Director of the Geological Survey, the subject of continuing the exploration of our carboniferous areas was repeatedly urged. Not, however, until several years had elapsed was it entertained again. At length, in 1889, permission was obtained to devote another season to the further exploration of the Bay St. George coal field. Much scepticism was expressed at the time by members of the Executive as to the prospects of there being coal of value in the region, and it was only after repeated assurances that I succeeded in convincing them, upon geological grounds, that the coal should be there, and if it was I would most certainly find it I told the Colonial Secretary and Surveyor General of the time, that I believe there were millions of tons of coal yet undiscovered in the Island. I even asked the former official to take a note of what I had stated, and see how near I could go to proving my assertions. The result of that season's work, as set forth in the report for that year, 1889, I think, speaks for itself, and amply bore out what was then claimed.

The coal seams already known to exist on Robinson's Head and Middle Barachois Rivers were first visited, and thoroughly uncovered, so that accurate measurements, and good average specimens of their quality could be obtained. The Howley Seam was uncovered for 150 feet along its out-crop, and was found to attain a thickness of 4 ft. 2 in. good solid coal. The Jukes' Seam was traced over a quarter of a mile, and various openings made across the strike of the seam. It was found to vary from three to eight feet in thickness, and averaged 4 ft. 6 in. It is a beautiful quality of coal, of a brittle nature, presenting a brilliant, sometimes iridescent lustre, and would seem to be somewhat analogous in appearance to what is known in Scotland as Cherry coal, though it partakes more of the nature of caking coal. The Cleary seam above this gave a thickness of 2 ft. 2 in. It is a good solid coal, breaking out in oblong blocks, and much resembles Glace Bay coal. Twelve other seams, varying in thickness from a few inches to six feet, were discovered on the Middle Barachois River. Two others besides the Howley seam on Robinson's Head River, and four more, including the Shears' seam on the Northern Feeder, a tributary of the latter River. The principal seams in the section, the actual existence and dimensions of which have been so far ascertained beyond question, are:—

	FT.	IN.
The Jukes Seam	4	6
The Cleary Seam	2	2
The 18-inch Seam	1	6
The Slaty Seam	1	4
The Clay Seam	1	8
The Rocky Seam	1	5
The Murray Seam	5	4
The Howley Seam	4	2
The Shears Seam	1	2

The Murray Seam, which shows the greatest average thickness of coal, is made up of alternate layers of coal and shale. It is a tough, rather slaty coal, much inferior, at least, at its out-crop to the others. It was named after the late Director of the Survey, Alex. Murray, C.M.G., F.G.S. The Shears seam, though so small, is a very superior quality of coal, approaching a semi-anthracite in hardness and brilliancy of lustre. It is a very clean coal, remarkably free from impurities. Altogether, the coal seams contained in the St. George's Bay trough, that have been so far discovered, aggregate about 27 feet in thickness. They are all repeated by being again brought to the surface on the opposite side of the trough, where several of them were seen and uncovered. The area occupied by these coal seams has not as yet been definitely ascertained, nor is it my intention now to make any haphazard assertions as to what it may probably amount to. As set forth in the commencement of this paper, I shall not go beyond an actual statement of the facts observed. Were I permitted to continue the exploration of this region, I have little doubt that long ere this I should have been in a position to furnish reliable information on this head. To illustrate the importance of what such information would mean, it may be stated that an aggregate of 27 feet of coal, provided the seams maintained their ascertained thickness throughout, should, for every square mile of superficial area they may be found to underlie, contain about 25,920,000 tons of coal. All that is known with certainty at the present time is, that on the Middle Barachois River, the trough has a width of at least two miles, while in its longitudinal extent coal has been found to outcrop at points five miles apart in a straight line, from the most easterly to the most westerly known limits. Turning now to the Grand Lake, or central carboniferous region, which lies just one hundred miles to the northeastward from the Bay St. George trough, it has been seen how far our knowledge of this coal field extended up to the coal boring operations in 1879-80. The results of those two season's work were certainly far from encouraging.

In 1890 the staff of the Geological Survey was employed in making the preliminary survey for the proposed extension of the N. W. Railway, from the Exploit's valley to the West Coast, upon which the contract for its construction with the Messrs. Reid was subsequently based. It is not necessary to enter into details of that survey here, but it may be stated that no time was available for geological research, and consequently, though the Grand Lake region came within its limits, nothing further was ascertained as to its coal deposits. In the report for that year, however, it was strongly urged that a further and more minute examination of the district should be undertaken. To quote the exact words from the report in question, they are as follows: "I can scarcely conceive that in such an extensnve area of over 500 square miles, where the presence of coal is indicated at all, there should not be some more promising deposits; and I think it well worthy of consideration as to whether this great central carboniferous area does not warrant such an extensive exploration as that hinted at above." "While on this subject, it may be as well to remark, that previous to last year's investigation of the St. George's Bay carboniferous area, it was generally thought that the latter also was destitute of workable coal seams. It had been regarded as occupied almost entirely by the lower and unproductive members of the series, viz.: The carboniferous limestone and mill-stone-grit formations, but I now have the satisfaction of informing you, that upon referring the fossil plants then collected, to Sir Wm. Dawson, Principal of McGill University, Montreal, and one of the most eminent authorities upon fossil-botany in North America, he has, in one of his letters to me, made the following reference thereto: "I may say that the specimens now sent, indicate a development of the coal measures not unlike that of Eastern Cape Breton, with which I fancy your beds may be connected under the Gulf." "This is much more evident in the specimens you have sent than in those previously collected by Mr. Murray, which had the aspect of lower coal measures or even of the mill-stone-grit series."

This is a most important announcement, coming as it does from so distinguished a source. In a later letter Sir Wm. adds: "Your Government might make a point as to the West Shore, by informing the English Government of the value of the coals on the West Coast, and their prospective importance to Britain and Newfoundland, as well as to the other colonies. *You have the nearest coal to England on this side of the Atlantic.*" In the following year, 1891, the Government were pleased to adopt the suggestion of giving the Humber River area a more thorough search for coal, especially in view of the contemplated extension of the railway system to the western side of the Island. On leaving for the scene of operations, the Colonial Secretary, Hon. R. Bond, said to me: "If you can find a workable coal seam at Grand Lake it will be the means of insuring the construction of the railway to the West Coast." I replied that I would do my utmost, and if it were there I believed I could find it. The result of this and the succeeding season's work is contained in the published report of the Geological Survey for 1891-92, under one cover. As many of those interested in this subject may not have seen these reports or cared to wade through the geological details, I shall only give a summary of the actual facts ascertained from an economic point of view. The existence of a long, narrow trough of true coal measures on the south side of Grand Lake was established, commencing at a point about four miles from its head, which was traced easterly as far as Kelvin Brook, a distance of over six miles. Here it was lost to view, being covered over by an immense accumulation of superficial drift, which spread over a large area of the flat country, lying between

Grand and Sandy Lakes on the Southern branch of the Humber River. Several small streams flowing into Grand Lake afforded the only sections of the strata which were at all accessible, and these only after an immense amount of labor in removing the dense forest growth, and then costeaning the banks wherever any prospect of reaching the bedrock presented itself. The principal brooks thus explored were Aldery Brook, Coal Brook, and Kelvin Brook, which occur at intervals of about two miles and a half, succeeding each other from west to east as named above. Two other smaller rivulets, unnamed, were also explored. Very perfect sections of the coal measures were obtained on Aldery and Coal Brooks. On the former, in a horizontal distance of about one-quarter of a mile, thirty separate outcrops of coal were observed, crowded together, with but a comparatively small amount of intervening rock strata. Owing to the doubling up of the strata composing this section, there is, of course, a repetition of the different layers, and in reality the thirty outcrops only represent fifteen actual distinct coal seams. Most of these are quite small, varying from a few inches to a foot in thickness. Those over a foot are as follows:

	FT.	IN.
No. 6 Outcrop contains coal................	2	0
No. 7 " " "	1	6
No. 8 " " "	1	8
No. 12 " " "	1	3
No. 15 " " "	3	0
No. 16 " " "	2	5

Another section of the same measures, on the opposite side of the brook, gave a better showing in some respects, No. 6 seam was about the same, but Nos. 10, 11, 12 and 13 seemed to have come together, forming one large seam, containing fourteen feet of coal. No. 14 outcrop showed 2 ft. 10 in. coal; No. 15, 2 ft. 2 in., No. 16, 2 ft. 6 in., and No. 25, 1 ft. 7 in. The coal contained in Nos. 6, 7, 16 and 25, is of excellent quality, as is also that of some of the smaller seams; but the fourteen foot seam, and also No. 15th outcrop is soft, and rather impure on surface exposure. On Coal Brook the same section is exposed in part, and here the trough has a wider spread, measuring about thirty chains across in a horizontal line. Eighteen outcrops of coal were uncovered here representing nine separate seams. The remainder of those seen on Aldery

Brook, if they exist, could not be reached, owing to the great depth and toughness of the superficial deposits. Only four of these seams showed over one foot of coal, viz.:

	FT.	IN.
No. 2 Outcrop contains coal................	1	4
No. 4 " " "	3	5
No. 11 " " "	1	6
No. 12 " " "	2	4

No. 4 is a good seam, and the coal is of excellent quality. It was from this outcrop the Messrs. Reid obtained the car load of coal mentioned at the commencement of this paper. On Kelvin Brook but a very small section of the measures is exposed. It contains, however, six outcrops of coal. No. 1 consists of soft coaly and shaly layers alternating, three feet eight inches of which is coal. No. 5, contains 2 feet 6 inches of rather impure coal, but No. 6, is made up of two layers of excellent bright black coal, divided by a layer of carbonaceous shale. The lower coal is 3 ft. 6 in. thick, and the upper 2 ft. 8 in., making in all 6 ft. 2 in. of good coal. The shaly layer in the middle is about one foot in thickness, but appeared to become somewhat thinner as the seam was sunk upon. As it was impossible to go beyond a few feet down at the time, owing to the influx of water from the river, it could not be clearly ascertained whether it maintained this same character to any extent. In all probability, the shale in the middle may thin out entirely, or merge more and more into real coal, as the seam is developed. In either case it will be seen that this is one of the most promising coal seams so far discovered in the Grand Lake district, though, perhaps, not the best coal as regards quality. The results of these two seasons operations were considered of sufficient importance and promise to warrant the application of the boring rod again In the following year, 1893, the Government purchased a Sullivan diamond boring drill, and after much delay and heavy labour, consequent upon the transporting of so cumbersome an apparatus to the Grand Lake, in the then condition of the country, boring was commenced near the head of the Lake. Seven different attempts were-made to reach the bed rock, all of which, except one, failed. Such was the enormous depth of the superficial deposits, amounting to over 140 or 150 feet, and made up as they were of tough sand, gravel, and innumerable boulders, of all sizes, that could not be moved out of the way, hole after hole had to be abandoned. Only at a bend of Kelvin Brook, near the shore of the Lake, and about a mile north from the lowest part of the section already uncovered on Coal Brook, were we successful in penetrating to the underlying rock formation. Even here, 105 feet of the surface deposit had to be passed through. The boring was continued down to a depth of 335 feet without finding any true seam of coal. A few thin impure carbonaceous shaly layers, just showing a sign of coal, were met with. It became quite evident that we had struck a portion of the formation below the actual coal bearing measures. Though this result was of a negative character, it was not without value in a scientific point of view. It clearly demonstrated the fact that an anticlinal fold in the strata occurred, whereby the coal seams proved to exist near the mouth of Sandy Lake River in 1879, must occupy a separate and distinct trough from those discovered on the South side of the Lake in 1891-2. What the value or extent of this more northerly trough may be can never be determined without the continued and extensive use of the boring rod. During the past season of 1895, our knowledge of the more southern trough has been greatly increased, by the discovery of two seams of coal, and indications of others at a point on the line of railway, four and a half miles to the eastward of the Kelvin Brook section, and on the same line of strike. This discovery places beyond all reasonable doubt the fact, that the coal measures form a continuous trough, from about one mile to the west of Aldery Brook, to the point on the railway line above indicated, a total distance in a straight line of eleven miles. Certain observations made during this past season also, seem to point towards a widening of the trough in its easterly extension, but much yet remains to be accomplished before any definite conclusion can be arrived at as to what may be the full extent and importance of this promising coal field. In conclusion, I may add, that the foregoing is a plain statement of the actual facts regarding our knowledge of the coal fields of Newfoundland up to the present time. I have confined myself strictly to what I know and can prove to be correct. I have taken considerable pains to gather all possible information of a reliable character outside of what was already in my possession, and have refrained from putting forward anything of a speculative nature whatever. In the interests of the country generally, it is to be hoped that authoritative statements which can be amply borne out, will be the means of attracting the attention of those whom it would be desirable to interest in our coal deposits, which I am convinced, no overcolored, grossly exaggerated and unsupported assertions are likely to effect.

I have the honour to be Sir,

Your obedient servant,

JAMES P. HOWLEY

CHAPTER XVII.

Report for 1897.—Coal Deposits in the Codroy River Valley.

Geological Survey Office,
St. John's, Newfoundland,
February 15th, 1898.

T. C. DUDER, Esq., M.H.A.,
Surveyor General.

SIR,—Herewith I beg to submit my annual report upon the operations of the Geological Survey during the season of 1897.

Early in the year just past I was instructed to prepare two sets of exhibits of the Mineral, Forestry and Agricultural products of the country, to be forwarded to the Imperial Institute, London, and the Bureau-Philadelphia Museum, Philadelphia, U. S. A. After some preliminary arrangements in reference to expenses attending the exhibits, hiring a suitable room wherein to place them preparatory to arranging, labelling and boxing up for shipment, &c., the work of getting together specimens was at once proceeded with. A room having been secured in the basement of the T. A. Hall, and rough board counters provided therein, the Museum was first examined to see what could be spared therefrom, without materially affecting the collection. A printed circular, requesting contributions of mineral and other substances illustrative of the above resources was prepared and despatched all over the country. A copy was sent to every person known to be in any way connected with, or interested in mines, minerals, lumbering operations, &c., outside the city of St. John's while many persons equally interested within the city were approached on the subject. In this manner a number of specimens were obtained, and a great many more promised as soon as the spring opened and communication North and West was again fully established.

Early last spring, however, before navigation had fully open-
ernment deemed it of more immediate importance to have a thorough examination of the Codroy Valley made, and the staff of the
ed, or anything could be sent on from the extern districts, the Gov-

TABLE III.

Table of comparative values of the Mineral Products for the past five years, based upon the metallic contents and average ruling prices of the metal, this being the final value of the reduced ores. The value of the non-metallic minerals is their selling price in the local and foreign markets, less the cost of production.

PRODUCT.	1897		1898		1899		1900		1901		Total Value
	Quantity	Value.	Quantity	Value.	Quantity	Value.	Quantity	Value.	Quantity	Value.	
Brick	870,000 M	$ 7,570	870,000 M	$ 7,570	772,000 M	$ 8,464	800,000 M	$ 11,200	1,305,000 M	$ 13,050	$ 47,854
Building Stone	500 t	500	600 t	900	500 t	500	500 t	500	5,000	5,000	7,400
Chromite	3,035 t	42,462	724 t	15,457	706 t	10,399	....	....	....	....	68,318
Coal	....	....	2,900 t	11,600	5,000 t	20,000	....	....	....	....	31,600
Cobble Stone	....	500 ?	....	500 ?	....	500 ?	....	500 ?	....	500 ?	2,500 ?
Copper	2,518⅝ t	690,384	2,407½ t	656.741	2,955½	1,165,757	2,882½	1,045,387	2,755½	1,018,207	4,576,476
Gold	3,000 oz	62,010	2,783 oz	57,525	2,600 oz	53,742	2,400 oz	49,608	*2,180½	43,609	260,494
Granite	120 t	1,008	4,000 t	20,000	100 t	500	....	2,500	3,240 t	19,710	43,718
Iron	30,786½ t	347,409	55,000 t	712,200	165,633 t	2,650,128	177,584½	2,841,348	410,127 t	6,562,032	13,133,117
Lime	....	....	....	....	....	....	....	....	7,800 bls.	975	975
Manganese	1,500 t	18,000	....	....	....	....	....	....	....	....	18,000
Mica	....	....	....	....	23 t	660	....	....	....	....	660
Paving Stone	....	....	1,700 t	13,600	3,512 t	28,100	....	....	140,000 b	14,000	55,700
Pyrite	32,790 t	229,530	32,335 t	226,345	26,154 t	183,078	....	....	7,353 t	37,128	676,081
Silver	4,000 oz	2,684	2,616 oz	1,543	no ret	urns.	no ret	urns	no ret	urns	4,227
Slate	300 sq	1,350	300 sq.	1,350	....	....	600 t	10,800	6,000 sq.	22,500	36,000
		$1,103,407	....	$1,725,331	....	$4,121,828	....	$3,961,843	....	$7,736,711	$18,949,120

M: thousands; t: tons, 2,240 lbs.; b: blocks; bl: barrels: sq: squares; oz: ounces, fine.

*Estimated on average yield of former years, per ton of ore, viz.: 1.5 dwts.

Geological Survey was ordered West to enter upon the exploration, with as little delay as possible.

In the meantime the collection of exhibits for the above named institutions had to remain in abeyance. All that could be done, during our absence, was to provide for the reception of such specimens as were sent, until some future time, when the arranging, &c., could be attended to.

Up to date the following specimens have been obtained from all sources:—

LIST OF MINERAL AND OTHER PRODUCTS, IN COURSE OF PREPARATION FOR THE IMPERIAL INSTITUTE, LONDON, AND BUREAU-PHILADELPHIA, U. S. A.

I. Metals and Metallic Ores,—

IRON.

SPECIMEN.	LOCALITY.
Magnetic Iron Ore	Union Mine, Tilt C., N. D. Bay.
ditto	Mings Bight.
ditto	Bay St. George.
ditto	Labrador.
Hematite	Bell Island Mine, Great Bell Is., Conception Bay.
ditto	North Shore, Conception Bay.
Limonite	Portland Creek, West Coast.
Hematite	Union Mine, Tilt C., N. D Bay.
Manganiferous Iron Ore	Fortune Harbor, N. D. Bay.
Specular Iron Ore	White Bay.
Clay Iron Stone	Grand Lake.
Spathic Iron Ore	Sandy Lake.
Bog Iron Ore	

COPPER.

Copper Pyrites	Union Mine Tilt C., N. D. Bay.
Ditto	Betts Head Mine, Betts C., do.
Ditto	Rogues Harbor, N. D. Bay.
Ditto	Colchester Mine, S. W. Arm, do.
Ditto	Little Bay Mine, Little B., do.
Ditto	Sunday Cove Is., Halls B., do.
Ditto	Blomidon Mountains, B. of Is.
Ditto	Rabbitts Arm Mine, N. D. Bay.
Erubescite	Lady Pond, N. D. Bay.
Regulus, in various stages from Smelter	Union Mine, Tilt C., N. D. Bay.
Ingot of Metallic Copper	ditto ditto

NICKEL.

Nickel Pyrites ... ...Tilt Cove, N. D. Bay.
Copper Nickel ... ...Union Mine, Tilt C., N. D. Bay.

ZINC.

Zincite .. ..Oil Island, Notre Dame Bay.
Zinc Blende ... ...Placentia.

LEAD AND SILVER.

Galena ... ...La Manche Mine, Placentia Bay.
ditto ....Port-au-Port, West Coast.
ditto ....Little Lawn, Placentia Bay.
Galena Argentiferous ... .Little Placentia, Placentia Bay.
ditto ... .Oil Island, Notre Dame Bay.

GOLD.

Gold ... ...Brigus, Conception Bay.
do. ... ...Mings Bight, N. E. Coast.
Auriferous Mispickel ... .Moreton's Harbor, N. D. Bay.
Auriferous Quartz ... ...Cape Broyle Mine.

ANTIMONY.

Stibnite .. ..Moreton's Hr. Mine, N. D. Bay.

II. Materials used in the production of Heat and Light.

COAL.

Bituminous Coal ... ...Jukes Seam, Bay St. George.
ditto ... ...Cleary seam, ditto
ditto ... ...Howley Seam ditto
ditto ... ...Shears Seam, ditto
ditto ... ...No. 4 Seam, Coal Brook, Grand Lake.
ditto ... ...No. 6 Seam, Coal Brook, Grand Lake.
ditto ... ...No. 12 Seam, Coal Brook, Grand Lake.
ditto ... ...No. 6 Seam, Aldery Brook, do.
ditto ... ...No. 7 Seam, ditto
ditto ... ...No. 12 Seam, ditto
ditto ... ...No. 16 Seam, ditto
ditto ... ...No. 25 Seam, ditto
ditto ... .Jubilee Seam, Codroy Valley.
ditto ... ...8 Feet Seam, ditto
Bituminous Shale ... ...Humber River.
ditto ... ...Grand Lake.
Petroleum ... ...Nfld. Oil Wells, Parson's Pond, West Coast.

III. Minerals applicable to certain Chemical Manufactories, &c.

PYRITES.

Iron Pyrites ... ...Pyrites Mines, Pilley's Is., N.D.B.
ditto ... ...Tilt Cove, N. D. Bay.
ditto ... ...Port-au-Port Bay.
ditto ... ...Codroy Valley.
ditto ... ...Hall's Bay.
Pyrrhotite ... ...Rogues Harbor, N. D. Bay.
ditto ... ...
Mispickel ... ...Moreton's Harbor.
Magnesite ... ...Lewis Hills, Port-au-Port Bay.
Manganite ... ...Topsail Head, Conception Bay.
Chromic Iron Ore ... ...Bluff Head Mine, Port-au-Port Bay.
ditto ... ...Lot No. 1, Port-au-Port Bay.
ditto ... ...Rocky Harbor, N. D. Bay.
Molybdenite ... ...Fortune Bay.
Rutile ... ...White Bay.

IV. Mineral Manures.

GYPSUM.

Gypsum ... ...Romains Brook, Bay St. George
ditto ... ...Flat Bay, ditto
ditto ... ...Codroy River, Codroy.
Selenite ... ... ditto ditto
Shell Marl ....Bay St. George.
ditto ... ...Codroy.

V. Mineral Pigments.

IRON OCHRES.

Red Ochre ... ...River Brook, Bay, St. George
Red Ochreous Earth ... . ditto
Yellow Ochreous Earth ... . ditto
ditto ditto ... . ditto
Barite ... ...Cross Point, Placentia Bay.
ditto ... ...
Whiting Shell Marl ... ...Romains Brook, Bay St. George.

VI. Refractory Materials.

Plumbaginous Clay ... ...Garia.
ditto ....Bay D'Espoir.
Steatite ... .Tilt Cove.
Soapstone (slabs) ... ...Fleur-de-Lys.
ditto ... ...Tilt Cove.
Mica ... ...Labrador.
do. ... ... ditto.
Asbestos ... ...Bond's Mine, West Coast.
do. ... ...Bluff Head, Port-au-Port.

Fireclay ... ...Grand Lake.
Kaolin ... ...Bonavista Bay.

VII. Materials for Grinding, Polishing, &c.

Whetstones ... ...St. John's Slates, Carbonear.
ditto .... ditto Hodge Water.
ditto ....Sound Island, Placentia Bay.
Grindstones .. ..Codroy, West Coast.
Scythestones ... ... ditto

VIII. Materials suitable for Building and Decorative or Ornamental purposes

MARBLES, &c.

White Marble ... ...Humber River.
Variegated Marble ... ... ditto
White ditto ....Canada Bay.
ditto ditto ....White Bay.
Limestone .. ..Topsail Head.
ditto .... ditto
ditto .... ditto
Serpentine ... ...Tilt Cove, N. D. Bay.
ditto (polished block) ditto
ditto ditto .....Lewis Hills, West Coast.
Granite ditto .....Rose Blanche.
ditto ditto .....Gaultois.
Granulite ditto .....Petites.
ditto ... ...Reid's Quarry, The Topsails.
Syenite ... ...Reid's Quarry, Shoal Harbor.
Granite ... ... ditto Benton.
ditto ... ... ditto near Terra Nova River.
ditto .. .. ditto Gambo.
ditto (Pillars Polished.) ..Petites.
Sandstone Block ... ...Fortune Bay.
ditto ... ...Bay of Exploits.
ditto ... ...
Freestone Block ... ...Codroy.
ditto ... ... ditto
Slate (Quarry) ... ...Smith Sound, Trinity Bay.
Slate (Dressed) ... ... ditto ditto
Flags of Syenite ... ...Petites.
Labradorite ... ...Labrador.
Agalmatolite .. .. .Foxtrap.
Brick Clay ... ...Smith Sound, Trinity Bay.

IX. Materials applicable to the Fine Arts and to Jewellery &c.

Lithographic Stone .. ..Grand Lake.
A specimen of Porphyry,polished Petites.

Labradorite, polished	Labrador.
Red Jasper	Port-au-Port.
ditto polished	ditto
ditto (block)	Notre Dame Bay.
Agalmatolite, (polished)	Foxtrap, C. B.
Opalescent Quartz	Humber River.
Amethystine Quartz	Bonavista Bay.
Rock Crystals	Bay of slands.
Garnets	
Iceland Spar, Amber colored ..	Cape La Hune.
Fluor Spar, shaded Green	Little Lawn.
Calcareous Spar, variegated ...	Grand Lake.

MISCELLANEOUS.

Pyramid of Copper Ores	Notre Dame Bay.
Collection of Country Rocks ...	Tilt Cove.
Vein or Lode Rock	ditto
Small cabinet of Rocks and Minerals	ditto
Soil, upland	Bay St. George.
Soil, intervale	ditto

TIMBER.

White Pine		Glenwood.
Yellow Pine		ditto
Spruce		Gander Lake.
do.		ditto
do.		ditto
Yellow Birch		Whitbourne.
ditto		ditto
ditto		ditto
White Birch		Gander Lake.
dittor		ditto
Tamarack		ditto
Aspen		ditto
Dressed Pine Plank,	(section of)	Reid's Mill, Benton.
ditto	ditto	ditto
Dressed Pine Board	ditto	ditto
ditto	ditto	ditto
Dressed California Siding		ditto

THE SEASON'S SURVEY OPERATIONS

The object, aimed at by the exploration of the Codroy Valley, was to ascertain, what were the prospects of available coal deposits, existing in that section of country, and what was the nature and extent of the coal seam located in the upper part of the Codroy Valley last season, by one of the staff of the Messrs. Reid.

We left St. John's in the S. S. Grand Lake, on the 19th of May last, and arrived at Channel on the 24th, where we were obliged to hire a schooner, to get up to the Codroys with all our outfit. The Grand River, Codroy, was reached next day, the 25th, and immediate preparations for the field-work entered upon.

The Little Codroy River was first visited, and some three weeks spent in exploring and costeaning along its lower reaches. We then ascended the Great Codroy to the Forks, and followed the Southern Branch up to the mouth of a small tributary flowing in from the South, upon which the coal seam mentioned above had been seen. The greater part of the season was spent here, in a thorough and close investigation of the surrounding country, and in extensive costeaning operations along the principal tributary brooks, wherever the coal measures proper exhibited themselves.

Towards the close of the season, a short time was spent at the Grand Lake, where a further examination of the coal seams already located there, was made.

CARBONIFEROUS SERIES IN THE CODROY VALLEY

As may be seen by reference to former reports, particularly those of Mr. Murray for the year 1866 and my own report for 1883, the entire valley of the Codroys, lying between the Anguille Range on the North and the Long Range Mountains on the South was shown to be occupied by the members of the Great Carboniferous Series. The lower members, including the limestones and gypsiferous deposits, are well displayed in the sea-cliffs near Codroy village and along the coast towards the long projection known as Stormy or Enragee Point. The strata in this section are considerably disturbed, being tilted up, corrugated, and several times repeated by dislocations. Stormy Point forms the Northern side of the bay or sweep in the coast line into which the Great Codroy River finds its exit to the waters of the Gulf of St. Lawrence. For several miles around this bay the coast is low and flat, occupied only by sand banks, and there is no rock exposure 'till reaching a point about one quarter of a mile South of the Gut or Channel forming the entrance to the river. The first exposure here consists of reddish and greenish gray shales and sandstones overlaid by coarse gray grits or fine conglomerates. The general aspect of these latter and the presence of numerous carbonized fragments of plants on the surfaces of some of the beds indicate pretty clearly a portion of the Millstone Grit Formation. A good section of this member of the series is exposed between the two rivers, though several repetitions of the same strata, caused by small dislocations, occur. Towards North-West Cove and Larkins Point, near the entrance to Little Codroy River, some of the uppermost strata assume an aspect not unlike portions of the true coal measures. Mr. Murray's estimated thickness of this section was but 2306 feet of vertical thickness. Messrs. Robb and Fletcher, after many careful measurements in Cape Breton Island, estimated the total thickness of the Millstone Grit formation there as 4591 feet. It, however, varies greatly in different localities. I am inclined to think, that while here at Codroy the accumulations may not reach such a volume as in Cape Breton, it is also more than probable that a considerable portion of the lower part of the formation is concealed under the flat country referred to, so that the great difference in thickness may not be as real as it appears to be.

From Larkins Point Southward, towards the base of the Long

Range Mountains, an interval of about one and a half miles occurs, of low flat country, chiefly occupied by the estuary of the Little Codroy River, where the underlying rocks are entirely concealed from view.

Referring back to the Carboniferous Limestone formation to the north of the Main River, it was found to strike eastward up the valley flanking the southern slope of the Anguille Range. At several points on the Main River and the tributaries flowing into it on the north side, portions of the limestone or gypsum exhibited themselves, always inclined southerly, at various angles.

The coarser grits, &c., of the succeeding formation, are also met with on many points along the Main River, and near the falls, about three miles above the tidewater, they strike obliquely across in very massive beds, forming low ledges. Here they are also characterized by some carbonized plant remains; and a little above the falls, on the north side, occurs an impure bed of carbonaceous shale. Near the forks of the river and along the northern branch, the Millstone Grits are displayed in considerable volume. The general inclination of these rocks, being always towards the south, this fact, together with other circumstances, left little room for doubt, that it was in the latter direction, and towards the base or northern slope of the Long Range that we might reasonably look for higher accumulations of strata with any prospect of finding even a portion of the true coal measures.

Acting upon this belief in the previous year, when the construction of the railway was approaching the Codroy valley, I intimated to the Messrs. Reid that it would be well to keep a lookout for coal near the line of route. It was no surprise, therefore, to learn, late in the autumn, that one of their staff had succeeded in locating a coal seam on a small tributary of the south branch of the Great Codroy River, close to the base of the mountains, at about two miles distant from the railway. Beyond the mere fact of its existence, nothing further was ascertained that season.

There had long been a tradition among the Indians at Codroy, that coal had been seen away up the country somewhere. Jukes mentions this in his report in 1842, but he states that he could not find anyone to show him the precise spot.

In 1866 the late Alexander Murray, C.M.G., made an accurate topographical survey of the Main Codroy River up to its exit from the mountains, and, though he had also heard of the existence of coal and came within a mile of the place where it was, it would appear he did not see it. Indeed it was no easy matter to locate the place, so confined was the area, and so hidden away under the mountain mass, and a much more minute and prolonged investigation was required to get at all the facts, than any of these cursory explorations and surveys aimed at. Nevertheless, the value of such a survey as Mr. Murray's in narrowing down the possible limits where coal might be expected to occur cannot be overestimated. In 1883, while the staff were engaged in blocking off the agricultural lands of the Codroy, some additional Geological facts were learned, but it remained till the season just past, to enter upon a regular systematical exploration for coal only.

When last May, I was called upon to make such a thorough examination of the district, I immediately set about preparing for operations, though the season was rather early for the successful prosecuting of field work.

It had been a very backward spring, and when we reached the Codroys on May 25th, the weather was still unsettled, much snow lay on the higher levels, and in the mountain gorges, and as a consequence the rivers were swollen by freshets, caused by the melting snows, and the ground saturated with cold snow water. It was deemed inadvisable to attempt proceeding up the country immediately, so a short time was given, while waiting for the water to subside and the weather to improve, to the examination of the lower reaches, especially of the Little Codroy River.

A close examination of the coast between the two rivers was first made, with the hope that possibly some portion of the true coal measures might still be found to exist near the top of the section there, with perhaps one or more coal seams included, but though several bands of carbonaceous shale, at times approaching impure coal, and little nests and strings of real coal were met with, it was clearly apparent that no genuine workable seam of real coal existed here. As there seemed a reasonable prospect of finding coal on the south side of Little River Estuary, close to the base of the Long Range, some three weeks were spent in a thorough exploration of this section. Not only the course of the Main River, but that of every little tributary flowing into it, was minutely examined, with the result, that on one of the latter, Campbell's

Brook, a small outcrop of true coal measures was met with. This was uncovered, and the sides of the Brook costeaned up and down for several hundred yards, or as far as it was possible to get at the bed-rock. But a very small section was found to exist, consisting of finely micaceous, greenish gray sandstones, shales and clays, with a few dirt streaks, and some thin coaly layers. Towards the top a wide bed of drab fire-clay, supporting a seam of coal of about one foot in thickness, was uncovered. The coal was irregular, and in a distance of some ten yards along the strike had thinned down to a few inches.

A short distance beyond this outcrop the coal measures terinmated very abruptly, coming in contact with the metamorphosed rocks forming the foothills of the Long Range, and being apparently cut off by a great fault. No other outcrop of these measures was anywhere else visible. Several attempts were made to penetrate the superficial deposits at points along the course of the Main River, but the immense depth and toughness of the accumulations and the influx of water in every case prevented our reaching the bed rock.

Seeing the futility of any further attempts, and as the weather by this time had vastly improved, while the waters in the rivers had greatly subsided, it was deemed better to abandon this locality, and push on up the country without further delay, to the point where the coal had been seen last year.

It was quite a heavy undertaking to get up so far with all our season's outfit, considering the means at our disposal. Having returned to Grand River, boats were employed to convey ourselves and baggage to the head of the tide-water, a distance of some seven miles. From thence a portage of two miles had to be made along the river side to the end of the railway track, where construction ceased last year. Here we found two heavy cars, such as are used for running out rails upon, when track-laying. These were brought into requisition, placed upon the rails, loaded up with all our belongings, and started along the line. By pulling and shoving the heavy cars with us, fairly good progress was made. Frequent stoppages to clear obstructions, or raise and fill up parts of the track where washouts had occurred, caused considerable delay. When we reached Mollychigneck Brook, the largest tributary on the south side of the Main River, the trestle was gone, leaving the sleepers and rails only, suspended in a loop across the stream. The greatest part of a day was spent here, constructing temporary blocks under the track, to render it sufficiently strong to enable us to get the heavily laden cars across. This accomplished, we got on well for some distance further, till we came to a deep gravel cut, when our progress was stopped, owing to the caving in of the banks on both sides by which the track was buried several feet. The following morning, June 19th, we succeeded after much labour in clearing out the cut, and having then a clear track and down grade we soon arrived at the crossing of the South branch of the Main Codroy.

The trestle which had spanned this branch, had been completely demolished last fall, and nothing remained of it, except a few bent and twisted rails half buried in the bed of the river on the south side. We could proceed no further by the railroad, but we were now within two miles or so of the small tributary upon which the coal had been seen. Although the water in the main river was still pretty high, necessitating much wading, we commenced portaging at once, and on the 22nd inst., had all our things removed, and camps erected at the mouth of the above tributary. That same afternoon, we ascended the brook to where the coal outcrop was situated, and began to clear away the loose boulders and gravel, which encumbered the surface to a depth of some eight or ten feet. It was very tough work owing to the material being cemented together so firmly as to almost constitute a solid conglomerate rock. The outcrop was low down, nearly level with the water of the brook, and the coal-seam, when fully uncovered, was found to stand almost vertically, or inclined southward, at a very high angle of between 70 and 80 degrees. This seam was named the Jubilee Seam, this being the day set apart for the celebration of Her Majesty's 60th or Diamond Jubilee Regnal Year.

The work of uncovering this seam, and stripping the section above it on the left side of the brook was continued till the 24th, when the junction with the metamorphosed series, at the base of the mountains, was reached. Beside the coal seam just mentioned, but one or two dirt streaks shewing a little coal were met with in this cutting. The principal seam, however, appeared to be a fine one, and where first exposed gave the following measurement:—

	FT.	IN.
Fireclay	0	4
Coal, soft but bright	4	8
Clay and shale	0	5
Clay and Coal mixed	1	10
Coal and clay mixed	1	10
Arenaceous shale	1	1
Coal, Clay and Shale	0	7
Total	10	9
Coal	6	10

While engaged in uncovering this section, a new discovery was made further up the stream on the right side, where a considerable bend takes place, just before it enters the mountain gorge. The bank here is very steep and rises to a height of about 150 feet. It was covered, for the most part, with gravel, sand and clay, and supported a heavy growth of timber. A landslide at one part had laid bare a portion of the cliff, consisting of gray sandstones, tilted up at a very high angle, but slightly inclined Southward. The exposure gave a clew to the structure, and a few small fragments of coal and dirty clay found amongst the gravel led to the discovery of a coal seam. Upon removing the timber and then the gravel, &c., near the base of the cliff the coal seam exposed showed a thickness of about six feet. It was dull coloured and rather slack on the surface. The outcrop was followed up the slope and the whole surface of the cliff uncovered up to the junction with the older rocks. After cutting down all the timber and throwing it into the river below, the stumps had to be extracted, and then the gravel and clay cleared off down to the rock surface. The immense accumulation of material which had to be removed, and the labor involved, took our whole crew until the 8th day of July, to accomplish this work. When fully uncovered, this section exhibited four distinct seams of coal, in close proximity to each other. Only the first one however assumed any dimension worth considering. The other three were small and very irregular, the largest showing at one part, about two feet of coal, but this rapidly thinned away again. The main seam was uncovered for over ninety feet up and down the slope, and was found to vary somewhat in thickness. At one part it showed six feet two inches of coal and lower down about four feet. It was much broken towards the top, and apparently a slip had occurred repeating a portion of the seam. The angle of inclination was still to the Southward and stood as high as 72 degrees. It was further very clearly apparent from the work done here, that the whole of the coal measures were cut off by a great fault, and that they occupied but a very limited space on the river. What the exact nature of the fault was, had yet to be ascertained, and the ocurrence or otherwise of workable seams of coal still further removed therefrom and lower in the section, became a matter of much importance to determine. The costeaning was consequently continued along the right side of the river, down stream from the above junction to the lowest outcrop of the true coal measures, or to the point where the change from the gray sandstones to the reddish grits and standstones of the Millstone Grit Formation took place. In this manner a complete section was obtained of the entire volume of the coal measures here, which was found to amount only to about 250 feet of vertical thickness, and owing to the high angle of inclination the horizontal measurement across the section was only four chains.

In carrying out this costeaning, a large seam of coal was struck nearly opposite to the one first seen. It was low down, and difficult to get at, owing to the heavy deposit of boulders and gravel under which the outcrop was concealed. On removing this an influx of water from the higher ground, greatly impeded our work, nevertheless we succeeded in uncovering it sufficiently to get a good view of the seam, make measurements, and obtain a general idea of its character. Its dimensions were as follows:—

	FT.	IN.
Fireclay	8	0
Coal, bright and good	12	10
Clay and shale	1	0
Coal and shale	0	10
Clay, shale and coal, mixed	4	0
Coal with thin shale	1	7
Clay, shale and coal, streaks	0	8
Total	23	11
Coal	15	0

Two small seams occur above this large one, quite close together, and about four chains further down the stream another was uncovered, showing a thickness of about five feet, thus:—

	FT	IN.
Fireclay	0	1
Good clean coal	1	9
Shale	0	4
Coal	0	1
Shale, clay, with coal streaks	0	7
Good coal	0	10
Clay, shale and coal streaks, mixed	1	6
Total	5	2
Coal	3	0

Still lower down near the base of the section, some thin, irregular seams occur, making in all six separate coal seams.

Whilst engaged in stripping the above section, the river up and down was most carefully and minutely examined, and the result was the finding of another large seam on the left side at a sharp turn of the brook below. This upon being uncovered proved to be by far the finest seam yet seen. It measured at the base eight feet across, all clean coal and maintained this thickness for forty feet up the steep slope, or as far as it could be followed on the surface. The coal was hard and clean, and apparently very free from pyrites. The slope here, extending several chains up and down stream was quite steep and densely wooded. It was necessary to cut away the timber and then make a continuous trench either way from the eight foot seam, to the full extent of the coal measures, or to the junction with the other rocks, up and down stream.

At 34 feet above the eight feet seam, another one averaging two feet was met with, which, on being exposed, seemed to run into the former towards the top. Near the upper end of the cut, three small seams, close together, were found, divided by a few feet of shale, or arenaceous clay, and still further up near the fault, a couple of dirt streaks showing a little coal only were exposed.

In the lower part of the cutting two seams, a foot or so in thickness, were met with.

It was now become clearly apparent that the section here exposed corresponded, very nearly, in most respects, with that on the right side of the river, and still further investigation proved, beyond question, that they were one and the same. The eight feet seam of the last cutting, could be no other than the five feet seam on the oposite side, while the three smaller seams were ascertained to be the continuation westward of the first seam uncovered, the Jubilee seam, which had here become split up and divided by clay and shale partings. This latter in its eastern extension proved to be one with the twenty-four feet seam, and also with the seven feet seam furthest up stream. The fact that the brook here runs obliquely with the strike of the measures, and makes several sharp turns in its course, afforded opportunity of getting at the several outcrops.

During the prosecution of these costeaning operations on the above brook, a continuous exploration of the surrounding country was kept up. The course of the Main River was examined, to its exit from the mountain range, as well as that of every tributary flowing into it on the south side. Expeditions were also made over the mountains, to ascertain the possible occurrence of any outliers of the Carboniferous series, in that direction.

Outcrops of the coal measures were come across on the west branch of the brook we were camped upon, and here a good section was exposed, which gave promise of containing one or more coal seams. Other outcrops were observed on two tributaries further up the country, to the eastward, one a little over a mile, the other one mile and three quarters distant, on the line of strike of the coal measures. Still further on the Main River, near the junction with the older series, another small outcrop was visible.

Our attention was first turned to the Western branch of the first brook, but in the meantime part of the crew under Mr. Thorburn's charge was dispatched up the country to the tributary furthest east to costean there. They spent eleven days there, and accomplished an immense amount of work, for the time, clearing the section on both sides of the brook, very thoroughly. On the left, or west side, they struck one coal seam, two feet three inches wide, containing about two feet of shaley coal, and a little further up a band of fireclay three feet wide, containing a good deal of broken coal, but owing to the huge masses of loose rock covering this latter outcrop, it could not be properly examined. On the right side four small seams were laid bare. One of these consisted of about three feet of fireclay, with two inches of impure coal on top. Another further up was a foot and a half thick, with about one foot of good coal, while a third showed six inches of coal A few dirt streaks also containing a little coal occur in the section.

On the western branch of the first river, only three or four outcrops of coal were met with, all, with the exception of one, being but a few inches only in thickness. On the left side a seam containing one foot seven inches of good coal was struck. It was the only true seam found on this branch, and there was every indication, that the larger ones of the eastern branch, either thinned out, or were cut off by the great fault before reaching so far west.

A short time previously, I had received a communication from the Government, to take out some sixty or seventy tons of coal, which was to be afterwards brought out to the sea-coast, for the purpose of being tested by H. M. ships on the station, with a view to ascertain its qualities for steam purposes.

On the 16th of August we received a visit from the Hon. H. J. B. Woods, Surveyor General. He was accompanied by Mr. W. D. Reid, Mr. Long and Mr. Park. The latter was an experienced coal miner, originally from Scotland, but at present employed at the Londonderry Iron Mine, Nova Scotia.

The surface display of coal at this time laid bare was most promising, and caused them no little surprise. It was now arranged that my party was to continue its costeaning operations, to ascertain, if possible, by surface digging, how far the seams might extend. Mr. Park, with a few men from the railroad, should be employed opening up some of the seams, with a view to test their permanency underground, and prepare for the work of actual mining, should the result prove satisfactory.

A few days afterwards Mr. Park commenced to drive a tunnel on the course of the eight feet seam, near the base of the bank, or just above the level of the brook. The coal was found to be very hard and tightly nipped between the walls, but of excellent quality, being very free from pyrites, or other impurities. Only six feet of the actual thickness of the coal, was removed, the remaining two feet being left to support the rather loose shaley roof. Good progress was made, as day and night shifts were kept going, but on the fourth day, August 21st, they came, quite unexpectedly, upon a wall of dead rock apparently stretching across the seam, and cutting it off. Mr. Park was inclined to think, it was a transverse fault, lifting the coal right out, but such was not the case. It proved to be a jog, or protection of the foot wall, into the body of the seam, whereby it was turned somewhat from its course, and compressed into the space of four feet. On passing this "trouble" it resumed its regular course and in a short time, increased again to six feet in thickness. It continued to maintain this thickness, but showed signs of deterioration, in the shape of shaley or earthy strings, and patches here and there called by Mr. Park "batte." At about sixty feet the coal began to rise in the seam, the bottom of the drift showing more and more dead rock, or batte. From this point to end of drift, thirty-four feet further, the coal rose rapidly, and began to thin out very perceptibly. Although the breadth between the walls of the seam remained nearly the same, the coal began to give place more and more, to this dead arenaceous rock, or batte 'till very little real coal was left in the end of the drift, 91 feet from the outcrop. An opening near the top of the seam, confirmed the supposition previously entertained, that the two seams here came together, showing in this opening 9½ feet of coal, across the top, from side to side. In the meantime trial pits were sunk, at several other points, to test the other outcrops. The five feet seam on opposite side of river, supposed to be the continuation of the eight feet seam, was driven upon some ten or twelve feet. At first it improved considerably, and about three feet of good coal was visible at one time, but it soon began to exhibit clay and shale streaks, and finally but very little coal. It was, however, a difficult place to get at and dangerous to work under, owing to the constant falling of the ground from above, and being lower than the level of the brook, it became impossible to keep it free from water.

Trial pits were also sunk on the Jubilee seam, at four different points and a drift of about thirty feet made on the strike of its farthest eastern outcrop. The result of these trials, was as follows: At the most westerly outcrop, where the seam is split into three parts, it appeared to improve at first, and at one time, showed three feet of good coal, but this thinned out again, and gave place to clay and shale. At the next opening it showed a couple of feet of rather slack coal. In the third opening, where the seam was first uncovered, it was sunk upon for about ten feet, the principal band of coal only, in the seam, being tested. This was found to maintain pretty much the same character throughout, being rather slack, or shelly coal, but the band, which at the surface measured nearly five feet across, had contracted to three feet two inches, at bottom of pit. At the fourth opening, where the seam exhibits the great width of twenty-four feet, the principal layer of coal was again sunk upon to a depth of about eight feet, and then cut across from wall to wall. Here it was found to maintain its thickness of something over thirteen feet of good, solid, bright coal. A few layers of shale or batte, began to appear towards the bottom of the shaft. The outcrop here was situated at such a low level, and the soakage of water from above was so great, that a fair trial could not be given the seam. In the tunnel or drift on the last outcrop, the coal remained dead slack and of a dull colour throughout, and at twenty-eight feet on the strike, it had dwindled down to three feet in thickness.

While these testing operations were being carried out, several attempts to reach the bed-rock on either side of the brook, and on the supposed line of strike of the principal coal seams were made. In no case could we succeed, owing to the enormous amount of drift material covering the surface, most of which was so tough and firmly cemented together, that in our efforts to penetrate it, all our tools were completely used up. In some instances, the influx of water compelled us to abandon the work, as almost invariably when a certain depth was reached, water made its appearance in greater or less quantity. Small fragments of loose coal were scattered through the gravel in several pits, but as these may have been derived from the outcrops already mentioned, they afforded but little clue, as to whether the seams were continuous or not.

A close examination of the contact of the coal measures with the older (Silurian)! schists, at all the places examined, left little room for doubt, of the existence of a great break, being an upthrow of the older series on the South side. The effect of this break was the complete cutting off of the coal measures which at one time must have occupied an extensive area, and leaving behind a few small segments only, of the northern edge of the trough. But one of these appeared to be sufficiently extensive to afford much prospect of bringing in any of the workable coal seams, at least so far as has been ascertained. It was that which we had been uncovering during the greater part of the season.

It will be seen from the foregoing remarks, that although the surface indications when first exposed were most promising, yet the seams did not maintain this character throughout, and in almost every instance showed indications of failing, after very little testing. The close proximity of the measures to the line of great disturbance indicated as having, at one period, taken place, and the consequent broken, disturbed, and highly tilted condition of the strata, had undoubtedly much to do with the absence of permanency of the coal seams. In view of these unfavorable developments, and the now short remaining season which would not afford sufficient time to more thoroughly decide the value or otherwise of these deposits, the Messrs. Reid abandoned the idea of constructing a branch line of railway to the coal, at least for the present.

It was decided, before finally giving up the field work for the season, to devote a short time to the further testing of the coal seams near the Grand Lake. Accordingly, on the 18th of September, we began to move down again to the railway crossing, where we remained till the 25th, examining some of the smaller brooks below the trestle, where coal had been reported. An excursion was also made to Highland, or River Brook, of Bay St. George, and the portion above the railway crossing examined. Nothing of any consequence resulted. No portion of the true coal measures being visible on any of these brooks.

We arrived at the Grand Lake on the 27th of September, and camped near the track, about two miles beyond the crossing of Sandy Lake River. This position was selected, as being the nearest point to the coal outcrops on Kelvin Brook, which it was first intended to examine. The water in this brook was found rather high from the late rainfalls, and it soon became evident that we could not accomplish much work here.

The principal coal seam discovered in 1892 was so near the river, and so low down, that all attempts to uncover it properly or sink upon it, were frustrated by the influx of water from the river under which it dipped. A considerable amount of costeaning was performed on the west side, some distance back from the brook, where the ground rose a little, but here again the depth of clay and gravel was enormous. Much loose coal in small lumps, was scattered through the gravel, but only two small seams were met with in placse. Having next accompanied Mr. Park to Aldery Brook and Coal Brook, where all the outcrops known to exist on these, were pointed out to him, and the best places to test the principal seams decided upon, I then left him and returned home to pay off my crew.

Nearly six months had been spent in the field, during which time a vast amount of work had been accomplished. Irrespective of the extensive costeaning operations, several of the chief tributaries were dialled, and lines run through the woods, on the strike of the principal coal seams. My assistant, Mr. Thos. Thorburn, was entrusted with the latter work, as also with the costeaning operations, on the most easterly tributary, all of which he performed most satisfactorily.

Not having heard from Mr. Park, up till the 20th of October, and being anxious to learn the result of his work at Aldery Brook, I decided to pay him a flying visit before he abandoned his work for the season. On reaching his camp at Aldery Brook I was greatly pleased to learn that things were looking very promising. The first opening was made on the right side of the brook on the exposed outcrop of seams No. 10, 11, and 12, of my section (vide Report of 1892,) where these had been shown to come together. The principal layer of coal in this outcrop, had been driven upon, for some ten or twelve feet, and had shown a decided improvement, both in size and quality. It had increased from four and a half, to nearly seven feet in thickness, and from being rather soft and dull at outcrop, now began to exhibit a fine face of clean, bright and tolerably hard coal.

Another opening had been made on the seam, near the top of the bank, which is here fully one hundred feet high, and again the coal looked well. At seven chains along the line of strike eastward, a pit had been sunk, some twelve feet through the gravel, and the coal seam was struck again, but owing to the usual impediments, it could not be well seen at this place. Still another pit was sunk, at a point thirteen chains eastward, and some loose coal found in the gravel, but the bed-rock was not reached on account of the influx of water. On the West side of Aldery Brook, where this same seam is split up considerably, it was also drifted upon for a short distance, and began to improve much, one band containing about four feet of coal. No. 16 seam of my section, in Report of 1891, on West side of brook, was opened up for some ten or twelve feet. It maintained the same character as at the outcrop, and was seen to contain two and a half feet of very excellent coal.

Mr. Park next moved to Coal Brook, where he spent a short time testing the seams there, with favorable results, but the season had now so far advanced, and the weather become so cold and stormy, that it was considered useless to further prosecute the work, more especially without proper appliances for so doing.

Although the exploration of the Codroy Valley might be looked upon rather in the light of negative, than positive value, still there appears to me to be enough to justify further attempt at least to more thoroughly test the seams that have been discovered. The large size of some of these, and the superior quality of the coal contained therein, are in themselves sufficient to warrant a small extra expenditure. Possibly, the apparent cutting out of the coal at the end of the drift on the eight feet seam, is somewhat akin to certain interruptions, or irregularities found in some of the Cape Breton coal seams, notably the Victoria seam, at Sydney Harbor, and the Blockhouse seam at Cow Bay. Mr. Robb, of the Dominion Geological Survey, in his Report for 1875, refers to these interruptions, and quotes the opinion of Mr. Rutherford, M.E., late Inspector of Mines, Nova Scotia, upon their probable origin, and their effect upon the continuity of the coal seams. It would appear, from these reports, that such interruptions or rather thinning out of the coal, where it is replaced by shale or rock, are of frequent occurrence, and that they come in quite unexpectedly, without exhibiting any change in the thickness of the seam, &c. In some cases, but a few feet of dead rock occurs, but in other instances, between thirty and forty feet were found. On cutting through these walls, or barren ground, however, the seams resumed their usual character, and the coal its quality &c. Possibly then, this is the case here, and there may yet be a sufficient quantity of available coal in this locality to make it worth mining, even on a small scale.

With regard to the Grand Lake Area, it appears to me, an effort should be made to further test it by means of the diamond drill, with a view to ascertain, if possible, the full extent of this important coal-field, which appears likely to be the first availed of. The Bay St. George District should certainly receive more attention also, as this is, in all probability, the most important Carboniferous Area in the Island.

Most of the other Economic Substances, observed during the season, have been treated of, in former reports. The Codroys contain an abundant supply of admirable freestone and material suitable for the manufacture of scythe, or grindstones.

Gypsum occurs along the southern slope of the Anguille Range at several points, and on the coast near Codroy Village, white, and variegated marble in considerable volume was met with on several of the smaller tributaries on the South side of the valley amongst the adtered schists, which form the foothills of the Long Range.

In most cases it is tilted up on end and much shattered. There may, however, be portions of these outcrops, where by the removal of the weathered surface, and quarrying into the main body of the rock, it may be found less broken and of better quality generally. Some small loose fragments, picked up in the bed of the brooks, seemed to indicate a fairly good marble.

Iron pyrites, Galena, and Molybdenite were observed sparsely disseminated in quartz veins amongst this same set of rocks. At one point, near the junction of the Carboniferous, with the Silurian Series, a rather large quartz vein was seen, pretty well charged with pyrites.

Near the railway siding at River Brook, a brine spring occurs, and surrounding it for many yards there is a thick deposit of red and yellow ochre, which attains a depth of six feet or more, and spreads over, at least, a couple of acres of surface. The material seems free from grit, and should be of considerable commercial value, for use as a pigment. The brine spring, no doubt, indicates a deposit of salt beneath the surface, but of what extent, can only be determined by boring. The frequency of the occurrence of similar springs, among the lower members of the Carboniferous series, would seem to point to a possible industry, in the manufacture of salt from these brines by means of evaporation. Much would of course depend upon the percentage of saline matter, freedom from earthy impurities, and lasting character of the wells, all of which can only be determined by actual tests.

There is an abundance of excellent fireclay in the vicinity of, and associated with the coal deposits, which would make good fire-brick. Some specimens of mica were shown me as coming from the Long Range, several miles back. It appeared to be of large size and fairly good quality, nothing however was learned of the extent of the deposit.

I have the honour to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XVIII.

Report for 1898.—Blocking off Land along the Railway Line—Mineral Statistics for Current Year.

St. John's, N. F.,
March 15th, 1899.

T. C. DUDER, Esq.,
Minister of Agriculture and Mines.

SIR,—I beg to submit the following report of the past year's operations for the information of the Government.

In the early part of the summer and prior to entering upon the field work of the season the collection of specimens referred to in the previous year's report was, at the earnest request of the Imperial Institute authorities, finally boxed up and despatched to London. These exhibits comprised in all forty-one (41) packages, of which thirty-one (31) contained various specimens of the mineral products, the remainder being illustrative of the forest wealth of the island, as follows:—

LIST OF SPECIMENS

Forwarded to the Imperial and Colonial Institute, London.

No. P'k'ge.	Name of Specimen.	Locality or Mine.
1	Block of Magnetite	Tilt Cove, Notre Dame Bay.
2	" "	Bishop's Mine, Long Range.
3	Manganiferous Iron Ore	Fortune Harbor, N. D. Bay.
4	Chrome Iron Ore	Bluff Head, Port-au-Port Bay.
5	Red Hematite	Bell Island, Conception Bay.
6	Red Hematite and Clay Iron Stone	Bay-de-Verde and Grand Lake.
7	Mispickel	Moreton's Hr., N. D. Bay.
8	Pyrites	Pilley's Island, N. D. Bay.
9	Pyrrhotite and Pyrites	Rouge Hr. and Three Arm, N. D. B.
10	Copper Pyrites	Union Mine, Tilt Cove.
11	Copper Pyrites and associated rocks	Union Mine, Tilt Cove.

LIST OF SPECIMENS.—(Continued)

Forwarded to the Imperial and Colonial Institute, London.

No. Pkg.	Name of Specimen.	Locality of Mine
12	Copper Pyrites	East Mine, Tilt Cove, Burton's Pond and Rouge Harbor.
13	"	Blo-mi-don Mine, Bay of Islands.
14	Copper Pyrites, Green Ore and Copper Ingot	Tilt Cove and Little Bay.
15	Galena	Silver Cliff Mine, Little Placentia.
16	"	La Manche Mine.
17	"	E. and W. Bays, Port-au-Port.
18	Antimonite	Moreton's Hr., N. D. Bay.
19	Steatite Slab, Mica .... Asbestos, Agalmatolite ..... Fireclay, Shell Marl	Tilt Cove, Labrador. Bluff Head and Fox Trap. Grand Lake & Bay St. George.
20	Three (3) blocks of rough dressed granite	Petites, Shoal Hr. and Terra Nova.
21	Three (3) blocks of rough dressed granite	Gaultois, Petites and Terra Nova.
22	Four (4) blocks of rough dressed granite	Rose Blanche, Gambo, Hare Is. and Petites.
23	One (1) block Var. Polished Marble	Humber River.
24	One block Gray and three blocks White Marble	Humber River and Canada Bay.
25	Coal from 3 ft., 8 ft. and 13 ft. seams	Codroy River.
26	Coal from Jukes', Murray, Howley and Shears' seams .	Bay St. George.
27	Coal from Aldery and Coal Br'ks	Grand Lake.
28	" " "	"
29	Barytes, Syenite, Gypsum	Bay St. George, Codroy.
30	Copper Ore, Nicholite, Magnetite, Hematite, Zincite, Molybdenite, Errubescite and Specular Iron Ore	Tilt Cove, Oil Island, Fortune Bay, Lady Pond, Fogo Island.
31	Petroleum, Red and Yellow Ochre, Red Granite and Syenite blocks	Parson's Pond, Bay St. George, Petites and Terra Nova.
32	Slates and Dressed Timber ...	Trinity Bay and Benton.
33	One (1) block Red Spruce	Gander Valley.
34	One (1) block White Pine	"
35	One (1) block Red Pine	"
36	White Birch	"
37	Yellow Birch	Whitbourne.
38	Poplar	Gander Valley.
39	Yellow Birch	Whitbourne.
40	Tamarack	Gander Valley.
41	Red Spruce	"

The receipt of these exhibits was duly acknowledged by Sir Frederick Abel, Secretary and Director of the Imperial Institute, in a letter of which the following is a copy:—

Imperial Institute Road,
London, S. W., July 30th, 1897.

My Dear Sir,—

The first instalment of exhibits from Newfoundland, to which your letter of the 18th inst. refers, were received here a few days ago and unpacked in time for Sir James Winter, who paid a visit to the Institute yesterday, to inspect them. I am very glad, indeed, that Newfoundland will now be represented by specimens of some of its products at the Imperial Institute.

I have selected a very suitable position in one of our Galleries for their display. Sir James Winter approved of the locality where they were to be placed, and has given me authority to have cases constructed, and stands for the timber specimens, at a cost of about £50.

I am strongly in hopes that through the action of the Premier and your good offices, Newfoundland will ere long be well represented here by its products—a result which cannot fail to be of material benefit to the Colony.

I am, yours faithfully,

(Sgd.) F. A. ABEL,
Hon. Secretary and Director.

James P. Howley, F.G.S.,
Director of the Geological Survey, Nfld.

These exhibits were, for the most part, fairly good specimens of the crude materials which the country is capable of affording; but should not by any means, be looked upon as a complete and comprehensive suite of the varied mineral and other resources of the Colony. Much more time and means than were placed at my disposal would be required to collect and properly arrange a thoroughly representative one.

There can scarcely be room for doubt that such a means of bringing before the eyes of mining capitalists and others, the valuable natural resources of the country, is calculated, as Sir Frederick Abel remarks, to result in material benefit to it.

This fact is thoroughly recognized by the Governments of the Dominion of Canada, the Australian and other provinces of the Empire, all of which spare neither effort nor expense to make the best possible display of their material wealth; with the result that capital is flowing into these provinces from all directions.

The effect here is already quite perceptable, judging from the interest now displayed by outsiders in the mineral development of the country. The enquiries with regard to the nature and quality of our various ore deposits are numerous and all the time on the increase.

In view of the above facts, I would strongly urge the advisability of adding to these exhibits from time to time, and that a small annual sum of money be set apart for the purpose. Now that the nucleus of a permanent exhibit of the Colony's resources is established at this world-famed Institute, it would, I submit, be detrimental to our interests if we fail in keeping it up to date. The concluding paragraph of Sir Frederick Abel's letter of acknowledgment clearly shows that he assumes it to be the intention of our Government to add to the present collection, which he looks upon as a first instalment only

Acknowledgments are due to the following persons who, in response to the printed circular sent them, or to a personal application, assisted in procuring or presenting specimens for the above purpose:—

Francis Williams, Esq., Manager for the Cape Copper Company and Captain W. R. Toms, Tilt Cove, Mr. Beatty, Manager of Pilley's Island Pyrites Mine, Mr. Bishop, Bay St. George, Mr. Chambers, Manager of Bell Island Iron Mine, Mr. A. John Harvey, Mr. John Browning, Mr. R. Rendell, Messrs. Shirran and Pippy, Mr. Sclater, Mr. Cook, Captain Cleary, Mr. W. Ellis—for mineral and rock specimens; the Messrs. Reid and W. T. Sterrit for the timber.

During the past year several communications were received relative to the mineral statistics of the island. One of these was from the Under Secretary of State for the Home Department of the Imperial Government, and was accompanied by a blank form to be filled in and returned. The object, as set forth in this document, is to obtain a general idea of the mineral wealth of the Empire, and for the purposes of instituting comparisons with that of other nations, etc. In acknowledging the letter, such figures of a reliable character as it was possible to obtain were made use of, but these, I regret to say, were of a meagre description. I would here beg to draw attention to the fact that there is no act of the Legislature making it compulsory upon those engaged in mining pursuits to furnish details of their operations or output, such as exists in all other mining regions, nor is there any authority resting with any person to collect such statistics. For some years past I have been endeavoring to get at the actual facts with regard to our mining industry, aided by the voluntary assistance of the mine managers and some of our principal mine owners, to whom my thanks are now tendered. Fortunately, only last spring I had the results published in an article on "Mining in Newfoundland" in the May number of the Canadian *Mining Review.*

In preparing this paper every effort was made to obtain the most accurate information, extending back to the very inception of mining in the country. To Mr. Beatty, of Pilley's Island, and Mr. Williams of Tilt Cove, I am much indebted for the full and accurate figures so kindly furnished. The latter gentleman even took the trouble to search back amongst the books of the former company and supply me with data of the earlier years' operations.

These statistics, though valuable for reference, were not by any means perfect, yet they certainly were the nearest approach to accuracy yet published.

A comparison of some of the figures, as given below, with those of the Customs Blue Book for the corresponding years, will convey some idea of the inutility of the latter for arriving at correct conclusions with regard to our mineral wealth.

Comparative Returns of Minerals.

As per Customs Blue Book.			From Mine Managers.	
Year.	Copper Ore.	Pyrites.	Copper Ore.	Pyrites.
	Tons.	Tons.	Tons.	Tons.
1864	....	....	15	
1865	236	....	459½	
1866	283½	....	1,774½	
1867	79	....	3,377	
1868	....	....	7,831½	
1869	3,422	....	5,661	
1870	5,226	....	3,908	
1871	1,407	....	1,817	
1891	....	19,150	....	29,009
1892	....	35,176	....	35,216
1893	....	37,889	....	39,953
1894	64,672	40,582	45,951	42,095
1895		36,496	5,467	34,330
1896	66,852	15,720	68,323	27,274
1897				32,790

FIELD WORK,

In July last, as you are aware, when it was decided to commence the blocking off of the lands along the line of Railway, in accordance with the new Contract, and for the purpose of facilitating the selection of the said lands, I was appointed to superintend the work. A plan was prepared and submitted to the Government for approval, showing what was deemed the best method of carrying out the provisions of the Contract. It was proposed that all lands bordering on the line of Railway be blocked off as nearly as possible in conformity with its general trend, but at the same time, and in order to avoid subsequent confusion, every block was to be bounded by true North, South, East and West lines. As different portions of the Railway assume entirely different courses, it was found best to separate it into three main divisions of nearly equal lengths, which, for convenience, were called the Eastern, Central and Western Sections. The first, beginning at Hall's Bay junction, extends to Gambo River. The second from thence to the mouth of the Humber, and the third from Bay of Islands to Port-aux-Basques. The general trend of the first and last sections approaches more nearly a Northerly and Southerly direction than any other, consequently the lands along each were to be bounded by true East and West lines, while the trend of the Central section being more nearly Easterly and Westerly, true North and South lines were found best adapted to this section.

At first it was contemplated running out all the lines to the full extent of ten miles on either side of the track, where the land area would permit of doing so, but this idea was subsequently modified, and it was decided for the present to traverse the railway track and distinctly mark the intersections of every mile block with posts driven into the ground on either side of the right of way, which posts were also to indicate the direction of the boundary lines. At every fifth mile intersection a more permanent mark or hub was to be inserted in the centre of the road-bed, and marked with a cross-headed iron spike on the top. These were to serve as fixed points, from which a departure could at any time be taken if required to run out any of the lines, or to establish the position of any point of interest or importance in the vicinity.

The system having been approved of by the Government, Messrs. White and Noel were given charge of the field work, and instructed to proceed with the survey forthwith. Written instructions and tracings showing the proposed system were furnished each for their guidance.

Mr. A. White was directed to commence at Port-aux-Basques, the western terminus, and from thence work northerly along the Railway towards Bay St. George. Mr. Noel's instructions were to take his starting point at the intersection of the Little Barachois River, near the head of Bay St. George, and thence work towards Bay of Islands. Each in turn, having finished his section, would move on ahead, and make a new departure from some well defined point on the line.

Both parties proceeded by rail to their respective destinations, but owing to the absence of regular freight arrangements in the early part of the season, it was decided to send their provisions and outfit by the Coastal boat, Grand Lake, westward. Mr. Thorburn and myself also took passage by her. We met White's party at Port-aux-Basques, where all their stores were landed, and at Sandy Point we found Noel and party awaiting us. With as little delay as possible, the remainder of the outfit was landed and transported by boat across to the Main Gut, at the head of the Bay, where our first camp was pitched.

Before starting work here, Mr. Noel and myself took separate sets of observations to ascertain the correct variation of the magnetic needle, and establish a true meridian to work from. The result of these observations was very satisfactory, giving a mean variation of 30° 37′, which was subsequently confirmed by a third set of observations taken by myself, giving an exactly similar result. Having next decided upon the starting point for Mr. Noel near the bridge, at the intersection of the Little Barachois River, and further fixed it by permanent marks and bearings on surrounding objects, I left him to prosecute his traverse along the railway track northward.

In the meantime, two men of the neighborhood were hired to accompany Mr. Thorburn and myself in an exploration of those parts of the adjacent country not fully examined previously. The lands in the immediate vicinity of the track being first inspected, we then made an excursion up country from the head of the estuary of the Main River, by means of a stream known as Bottom Brook. This fine stream enabled us to penetrate, with canoe, a considerable distance inland, from whence we traversed over much of the country lying between its waters and those flowing into the western end of the Grand Lake.

On our return to the coast we moved to Seal Rocks and examined the country on the south side of Flat Bay. We next proceeded by train to Middle Barachois River, and made a similar examination along the track in each direction. Here we met White's party again, coming up from Port-aux-Basques. They had completed their traverse to Crabb's Brook, making rapid progress, and were now pushing on towards the end of their first section.

While in this vicinity the opportunity was availed of to take a further look at the coal seams uncovered in 1889, some ten miles up country, and also to explore and survey some of the tributary streams of the Middle Barachois. On arrival at the coal outcrops we found them completely obliterated by landslides and debris fallen from the cliffs above, so much so, indeed, that without a previous knowledge of their whereabouts one might pass along entirely unsuspicious of their existence. Not a vestige of them could be seen, except at one point, where, after some considerable labor, we were able to uncover a part of the Jukes' seam.

On again reaching the railway track we moved to Fishel's River, and examined the country in this vicinity. An excursion was made inland over the Long Range Mountains, taking in a wide range of country between Fishel's and Flat Bay Waters, bringing us out again near Cairn Mountain, and thence back to Seal Rocks.

In the meantime White's party, having completed their traverse up to where Noel commenced, had moved on to Grand Lake and taken up a new section, commencing at Junction Brook.

Our provisions now running low we had to send for a further supply, and go on to Bay of Islands to await their arrival from St. John's.

During the delay here I proceeded on foot to Deer Lake, where Noel's party were then encamped. I found them progressing most favorably with their work, which was faithfully performed throughout.

Having obtained our fresh supplies we went back by train to St. George's Pond, where a considerable time was spent in an examination of the surrounding country. Those portions towards the north and west not having hitherto received much attention were now traversed in several directions. Portions of the Lewis and Blo-mi-don ranges were also included, and a visit paid to the York Harbor Copper Mines.

The remainder of the season was devoted to a further examination of the coal areas of the Grand Lake region, and an inspection of the coal mining operations now being conducted by the Messrs. Reid at Coal and Goose Brooks.

Mr. White, having completed his second section to Joe Gload's Pond, (now Millertown Junction), was employed surveying a line of road to connect White Bay with the railway near Sandy Lake River. Noel, having also completed his second section, had commenced a third between Gload's Pond and Norris' Arm, and was now working down the Exploits Valley. Subsequently both parties took up another section each, Noel working from Gambo to Clode Sound and White from the latter plae to Come-by-Chance.

That portion of the country lying between Norris' Arm and

Gambo having been previously surveyed, the blocking off of the land along the entire line of railway from Port-aux-Basques to Come-by-Chance is now completed. The total number of mile blocks laid off amounts to three hundred and eighteen (318), but the actual traverse of the line is considerably more, the measurements of the past season alone being three hundred and ninety-four (394) miles.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

Report on the Mineral Development and Statistics of Newfoundland for the Year ending December 31st, 1898.

THOMAS C. DUDER, Esq.,

Minister of Agriculture and Mines.

SIR,—In view of the rapidly growing importance of the mineral development of the country, the time seems to have arrived when it would be a matter of great public interest to have a regular and reliable annual record of the mining statistics kept for general information.

The placing of an intelligent and satisfactory review of this important industry before the world at large each year could scarcely fail to have a beneficial result, and to draw attention, such as actual figures are best calculated to do, to the mineral possibilities of the country.

I had previously made several attempts to get at the facts with regard to this branch of industry in the past, and had met with a fair amount of success, but not being fortified with the necessary authority to demand information from those engaged in mining pursuits, I had to depend entirely upon the courtesy of those parties which, in most cases, was freely extended to me. Still a certain amount of reluctance or indifference on the part of a few made it all but impossible to obtain full and accurate figures in every case.

Upon presenting to the Government the importance of such statistics, and the difficulties under existing circumstances of collecting the necessary data, etc., I am now happy to inform you that by a communication received from the Hon. Colonial Secretary, of date February 3rd, 1899, my request to be authorized by the Government to collect and arrange such information has received their sanction. Since then I have used every effort to get at the most correct and reliable figures possible.

There are many difficulties, however, still to be overcome before an absolutely satisfactory statement can be produced. Nothing short of a personal visit and inspection of each mining locality and the obtaining of direct information on the spot, during the working season, would, it appears to me, accomplish the desired result.

In previous publications on this subject recourse was had to such returns as were published in the Customs Blue Book or the Year Book of Newfoundland, etc., but these were subsequently found to be unreliable.

In 1892, in a pamphlet entitled "The Mineral Resources of Newfoundland," I made the first attempt at presenting to the public statistical figures of this important industry, depending almost entirely upon the above mentioned sources of information. Subsequently an appeal was made to the mine managers and those interested in the mineral development for more direct information with good results. A much more satisfactory statement was produced and published in the May number of the *Canadian Mining Review* for 1898. This, with the information obtained latterly, enables me now to present the fullest and most complete returns ever yet placed before the public on this head, as the accompanying tables will attest.

It may be necessary to state, that in the following tables the long ton of 2240 pounds is used throughout, except where otherwise stated. The value of the ores are chiefly only approximate, but wherever possible the correct figures are given. The calendar year ending on December 31st, 1898, is used instead of the fiscal year, because the information obtained referred thereto, and it was not feasible to arrive at the proper proportions of the shipments for the year ending June 30th.

The mining people, as a rule, make up their returns extending over the whole shipping year, so that I could not expect them to take all the trouble to divide up their yearly output and furnish returns including the last half of one year and the first half of anothei

With regard to the discoveries and development of the past year, the information given is derived chiefly from those parties engaged in mining whose statements may be considered reliable; my thanks are especially due to the following gentlemen:—Mr. Wiliams, manager of the Tilt Cove copper mine; Mr. Beatty, manager of Pilley's Island pyrites mine; Captain Toms, of Little Bay mine; R. E. Chambers, M.E., manager of the Bell Island mine; Hon. P. Cleary, proprietor of Sunday Cove Island mine; Mr. John Currie, of Wilton Grove slate quarry; the Messrs. Reid, John Browning, R. Rendell, Thomas Cook, R. Sleater, P. Holden; and to Mr. J. C. Leaver, Secretary of the Cape Copper Co.; and Mr. Rothwell, Editor of the *Mining Industry*, New York. From these and other sources an amount of valuable information has been gathered which, when properly formulated, cannot fail to be of interest.

In this connection, if I might offer a suggestion, I think it would be advisable in the future, should the publication of annual Mining Statistics be approved of, to have a set of printed blank forms prepared to be furnished to parties engaged in mining pursuits, with a request to have them filled in and returned to the Department.

These blank forms might be arranged somewhat as follows:—

NO. I.

Mines and Minerals Statistics.

Name of Mine and Char. of Product	Quantity of Ore Raised	Manuf'd or used in country	Exported To What Market	Value of Crude Material at Mine

NO. II.

Number of Persons Employed in and About Mine.

Above Ground	Below Ground	Totals

NO. III.

Number and Kind of Accidents.

Name of Individual	Occupation	Nature of Accident	Remarks

Discovery and Development, 1898.

Under this head I propose to givę a brief account of what has been accomplished in the furtherance of our knowledge of the mineral resources of the island by such exploration and development as has taken place during the year, and of which no regular mining statistics are yet available.

It is well known that renewed interest was taken in the exploration for, and exploitation of mineral deposits last year, not only in Newfoundland but on Labrador. According to the reports circulated from time to time some of the various prospecting parties met with considerable success. Of course it is difficult to obtain any reliable information from such sources, and all the reports in question must be received with a considerable amount of caution. Where, however, actual mining development has taken place, even though no shipments of ore have yet resulted, it is possible to get at some interesting facts. These will appear under the headings to which they refer in the following detailed account of the year's mining operations.

Brick.

I am indebted to Messrs. W. C. Job, James Pittman and Charles Pelley for such information of this industry as could be acquired Mr. Pittman informs me that some forty years ago a Mr. Cameron, builder, of St. John's, made the first attempt to manufacture brick in Smith's Sound, Trinity Bay, at the place now known as the Brick Yard. After some five years experience Cameron sold out to Pittman, who, with his family, has been prosecuting the business on a small scale ever since, depending on the local markets for the disposal of the product of their industry. Their output averages about 60,000 brick per annum, which they sell at their yard for seven dollars ($7) per M. Mr. Pelley, of

George's Brook, also in Smith Sound, has been making brick since 1888, and turns out about the same average quantity, which he disposes of in St. John's at the same rate of $7 per thousand.

Eight or ten years ago a company was formed to work on a more extensive scale at a place called Elliot's Cove, on Random Island, in Random Sound, and a considerable outlay in procuring the necessary plant was undertaken. For the first few years their operations were not very successful as regards quality, though a large quantity of brick was made. According to the census returns for 1891 the figures for that year are given as 100,000, valued at $7,000. Of late years much improvement has taken place in the character of the product turned out, and a consequent better demand for the article has resulted. Mr. W. C. Job, who is largely interested in this venture, informs me that their annual output to date has averaged about 750,000, and that the selling price in St. John's is about nine dollars ($9) per M. They are introducing some new and expensive plant this season and expect, if circumstances prove favorable, to produce at least one million brick.

The manufacture of brick is the only industry as yet established, dependent upon the clay deposits of the country for the raw material. As, however, it has been pointed out in the reports of the Geological Survey, there is a vast natural supply of clays, suitable for a variety of purposes, in the island, there is consequently room here for an immense development of kindred employments

Few people realize the important part clay plays in the economic enterprises of the globe. There is in reality scarcely any product of the mine whose value to the world at large outweighs that of this commonplace material. The value of the clay and clay products of the United States in 1897 reached the immense amount of $56,121,101, being only exceeded by that of the coal and iron products. In Canada, also it was over $2,000,000, ranking next in importance and value to that of gold, silver and coal.

Building Stone, etc.

The only returns I could obtain under this head were from Mr. H. D. Reid, who kindly furnished me with the figures of building stone and paving stone quarried by them on Southside Hill last year. As both products were obtained from the same quarry and are of the same material (Signal Hill sandstone) I shall, for convenience, class them together. Some 400 tons of building stone, valued at $400, and 1,700 tons of paving stone, worth $13,600, were extracted and rough-dressed during the season.

A considerable industry in quarrying rock of a similar character from the hills or ridges in the vicinity of St. John's has been prosecuted for a great number of years, and an enormous amount of the material has been utilized in the past in the construction of several of our churches and other public buildings. It is used extensively also, in such works as retaining walls, house foundations, etc., and the debris in macadamizing the streets of the city. The industry is, however, of a desultory nature, and is only active when some large structure is in course of erection, or at such times as during the building boom consequent upon the great fire of 1892. A few farmers and others devote a portion of their leisure time each fall and spring to quarrying in the vicinity of their homes, and usually find ready sale for the small amounts they take out.

Altogether, if the figures could be even approximately estimated, it would be found that this source of employment has been productive of a considerable amount of wealth in the past.

Under the head of paving stone, also, might be included the beach stones used in laying down the side drains. The Municipal Council purchase each season an average of $500 worth for this purpose.

Sand and gravel for mortar and roof covering are items of considerable value, but no figures can be quoted with any degree of accuracy.

Chome Ore.

The Bluff Head Chromic Iron Mine does not appear to have been actively worked during the year 1898, but the crushing and concentrating of the lower grade ore previously mined resulted in the shipment, as per table, of 724 short tons of 55 per cent. chromic oxide. The only other mining operations for this class of minerals was a small attempt to open up a deposit on the N E. coast, near Rocky Bay. I have no particulars of the result of this latter work.

The figures in Table 2 are the actual quantities of ore mined, but 863 tons were shipped to market up to the end of last year.

Coal.

Last year witnessed the first actual *bona fide* attempt at coal mining in Newfoundland Early in the season the Messrs. Reid constructed a branch railway line from the trunk line near Scott's Pond to Coal Brook, head of Grand Lake, a distance of about 2½ miles, and established at the junction the new station of "Howley," where a fine house and other structures have since been erected. They commenced mining on the No. 4 seam, Coal Brook, in July, with some twenty-five (25) men, afterwards increased to fifty. Most of the work was of a preliminary nature, preparatory to mining on a large scale. I was informed by Mr. H. D. Reid that up to the end of the year some 2,900 tons of coal were taken out, all of which was consumed on their locomotives and is said to have given satisfaction as a steam coal.

Copper Ore.

The greatly increased value of metallic copper of late years, owng chiefly to the demand for this substance for electrical purposes, has given an impetus to the search for copper-bearing ores all over the world. Mining properties not hitherto considered worth developing are now eagerly sought after, and several abandoned mines are being re-opened under new auspices. Amongst those latter the Little Bay Copper Mine, in Notre Dame Bay, was operated last year by the Newfoundland Copper Company, Limited, a new Company recently formed, which holds options on several other properties in the same neighborhood. I learn from their manager at Little Bay, Captain Toms, that during the season they sent to market from Little Bay and Lady Pond Mines 443 tons of ore and twenty tons of regulus, while they had in stock at end of the season 150 tons of ore at Lady Pond and 130 tons at Little Bay. Previous to this Company's taking over the properties in June last Messrs. Stewart and Foote, of Little Bay, had shipped 220 tons of ore and 30 tons of regulus of 24 per cent.

During the same season, also, the Tharsis Company took options on several properties in the same Bay and did considerable developing work on one or two, especially on Sunday Cove Island Mine and on a claim in S. W. Arm. No particulars of their work could be obtained direct from the management, but by parties interested in both properties I was informed that from the former they raised 200 tons of ore, and from the latter 100 tons. None of this has yet been marketed. The Hon. P. Cleary, owner of Sunday Cove Island Mine, had previously raised 130 tons of ore, which is, also, still on the ground.

The Messrs. Reid worked on a very rich copper vein in the Lewis Hills Range, West Coast, for a time, raising about one ton of ore. The Messrs. Harvey & Co. did considerable mining at York Harbor, Bay of Islands, on the foot-hills of the Blomidon Range, and though not much ore was actually taken out, the indications presented especially during the work of last winter, give promise of its developing into a good mine. Several smaller attempts to open up copper deposits took place in various sections of the island and on Labrador, but I have not been able to procure any particulars of the results. Operations at Tilt Cove were active during the year, and no less than 66,085 tons of ore were sent to market up to the end of December.

Granite.

During the construction of the cross-country railroad, the Messrs. Reid have opened up three granite quarries. One near Shoal Harbor, Trinity Bay; another near Benton, east end of Gander Lake; and the third on the Three Topsail Range, near the height of land in the western interior. The material derived from these quarries was almost exclusively used in the construction of their bridge abutments, and was found admirably adapted for the purpose. In fact, the rock is not only durable but pretty, and when polished presents a very handsome material for structural or monumental purposes, for which latter a small portion has been used. This refers more particularly to the Three Topsail granite. What the value per annum of the material so quarried and utilized may have been I do not know. Mr. Reid estimated last year's output at 4,000 tons, valued at $20,000, and this would probably be a fair average of the amount and value for each year since the quarries were opened. Many beautiful granites occur along the course of, or in proximity to, the railway. Varieties of a pretty black and white, and white and yellow rock are seen near Gambo; and a red granite, fully equal to, if not superior to the St. George rock of New Brunswick, lies not far from the Topsails.

Granites and granitoid rocks of infinite variety of color and texture occur in many parts of the Island. At Petites, on the Southern Coast, Mr. William Ellis, builder, has opened up a quarry of close grained reddish syenite of a unique character. This rock presents a set of remarkable cleavage planes, which admits of its being quarried out in slabs of almost any dimensions, from a few inches up to several feet in thickness, and of various lengths up to twenty-five (25) or more feet. Its natural cleavage and the perfect parallelism of the bedding planes render it suitable just as it comes from the quarry, and with scarcely any dressing for many useful purposes, such as door and window sills, stair treads, hearth stones, paving and curb stones, etc. During the past few years Mr. Ellis has brought to St. John's, in schooners, about three hundred tons of this rock, which he has succeeded in disposing of to advantage in the local market at the rate of about eight dollars ($8) per ton, but the demand for such material in the country is too limited. I fully believe if this rock could be properly introduced into foreign markets it would create a demand for itself in a short time.

Iron Ore.

The only iron mine which can be said to have been systematically worked as such, so far, is that of the Nova Scotia Steel Company, situated on the eastern end of Bell Island, in Conception Bay. Their output last year reached the respectable figure of 102,000 tons, which shows a rapid development. Only four years ago the first shipment of 750 tons took place from this property. Preparations were made last autumn for a very extensive scale of operations during the coming season. The tramway was extended east and west from the present workings about one mile each way, and a new mine established at either extremity with independent power houses, hoising gear, etc. The surface has been stripped and the ore band exposed over several acres of ground. I understand orders were then booked in advance for at least 200,000 tons of ore. It was rumored that negotiations were pending with the Whitney Syndicate for a transfer of a portion of this property to the latter for the handsome sum of one million dollars ($1,000,000). Should this deal be consummated, it would mean the opening of a separate mine under different auspices on this favored islet.

Quite recently information reached us that the famous German gun manufacturers Krupp & Company—have purchased out the rights of those individuals holding leases over the western half of Bell Island. It is to be hoped this information, also, is correct, and that the coming summer may witness still another iron mine opened, which should afford quite a lot of employment for our people.

In the District of Bay-de-Verde last year, prospecting for iron was prosecuted with vigor, and resulted in the application for licenses of search covering almost the entire area of the peninsula between Conception and Trinity Bays.

The "Newfoundland Iron Ore Company, Limited," having acquired the leasehold of some fourteen square miles of this territory in consecutive order, through the entire length of which the continuity of the main hematite lode of the district is said to have been proven by means of shafts and trial pits, and commenced last year to prepare for active mining operations. A main shaft was sunk vertically at Workington, near Lower Island Cove, to a depth of one hundred and twenty (120) feet, which is expected to intersect the lode at about 200 feet below the surface. In all, seven holes have been sunk at intervals along the lode, ranging from forty (40) to one hundred and twenty (120) feet in depth, and it is reported that some four hundred (400) tons of ore have been raised to the surface, and about half a million (500,000) tons are said to be in sight (?). The ore is a red hematite, of a higher grade than that of Bell Island, and freer from injurious ingredients, such as sulphur and phosphorus. The Company have built a railroad from Workington to Old Perlican in Trinity Bay, seven (7) miles in extent, and at the latter place constructed a substantial loading wharf, so that everything will be in readiness to ship ore the coming season.

Another Company, known as the "Coltness Company," has just leased a second area of nineteen (19) square miles in the same district, near the Ochre Pits, said to cover the continuation westward of the same deposit of ore.

Several other discoveries of iron ore and a few attempts to open them up were made during 1898. The Messrs. Reid commenced work upon a deposit of hematite near the Grand Falls of the Exploits River, and took out about one hundred (100) tons of ore. I am not in possession of the facts as regards the extent or thickness of this deposit. Mr. William Cook struck some pockets of a rich hematite at his manganese mine, Fortune Harbor, Notre Dame Bay. Mr. Robert Rendell had some men at work on another somewhat similar deposit of hematite in White Bay. The value or otherwise of these latter finds has yet to be established by actual experiment. So far as the ores are concerned, all the specimens seen by me were of a suprior quality, averaging ovr sixty (60) per cent. in metallic iron.

Quite an excitement has been created during the past autumn and winter by the discovery of iron ores at several points on the south side of Bonavista Bay, and a consequent rush for licenses of search to cover the ground has resulted.

Other finds of iron ores both in this Island and on the Labrador were rumored last year, but nothing reliable could be obtained regarding these latter. They all serve, however, to emphasize the oft repeated opinion that iron ores abound and are likely to become a great source of wealth and employment for the people in the future. The advantage of our proximity to the principal markets of the world should weigh greatly in our favor in this respect.

Manganese.

Some work was done during the summer at Fortune Harbor by Mr. William Cook on the manganiferous iron deposit in that locality, but no shipment of ore was made. So far as I can learn only one cargo of 1,500 tons, in 1897, has as yet been sent to market, and I am unable to find what disposal was made of it.

Petroleum.

There was no work done either at Parsons' Pond or St. Paul's, on the N. W. Coast, last year in the way of further developing the oil region there.

Negotiations were pending as regards the former property with an English syndicate, which were finalized during the past winter, and it is understood the work of testing the property will soon be resumed, with a more thorough equipment, when it is confidently hoped by the Newfoundland Oil Company that the results will fully come up to their expectations. Mr. Andrews, of St. Stevens, N. B., did a considerable amount of prospecting and boring for petroleum at the Middle or Shoal Point of Port-au-Port Bay during the summer months. Four bore holes were put down to varying depths, each of which gave indications of oil. It has been stated that quantities pumped from these wells indicated a probable yield of 20 barrels per diem (?). I cannot vouch for these reports, as I had no opportunity of either visiting the spot or of acquiring definite information of the work performed, etc. As the formation is identical with that of Parsons' Pond, and the quality of the petroleum quite similar, there seems reason for the opinion that the other conditions are likely to prove pretty similar also. I am informed extensive boring operations will be conducted in this field the coming season.

Pyrites.

Pilley's Island Mine has, as usual, shipped a large quantity of ore, amounting to 32,355 tons, all of which went to the United States market.

A new pyrites mine was opened at Middle Arm, Bay of Islands by the Messrs. Reid last year, which gives promise of becoming a large producer ere long. About 200 tons of ore high in sulphur were mined, but none has been shipped away as yet. Another deposit which looks favorable for development was discovered near York Harbor, Bay of Islands, on the foot hills of the Blomidon Mountain Range.

Slate.

The slate industry of Trinity Bay is not, I regret to say, in as flourishing a condition as the undoubted excellent quality of the raw material and the facilities for operating the quarries in Smith's Sound should warrant. Mr. John Currie, who is now the only person engaged in the manufacture of slate, informs me that there is an unlimited supply of first class material available, but it would require a large capital and access to foreign markets to make a good paying business of it. Mr. Currie can only find a local demand for some 300 squares per annum, valued at about four dollars and fifty cents ($4.50) per square at the quarry.

In view of the large and increasing demand for a good quality of slate for roofing and other purposes and the fact that in the United States this trade is growing rapidly in importance owing to an increased export, it does seem a pity that our slate cannot be turned to better account. So far as I can learn none of the material used in the United States is of better quality than that of Trinity Bay, which in point of excellence ranks fully up to the standard of the far-famed Carnarven slate. It is very probable, also, that it is situated in exactly the same geological horizon as the latter.

MISCELLANEOUS.

Under this heading a few notes referring more particularly to ores mentioned in Table II., but not operated last year, may be of interest.

Antimony.

A visit to the antimony mine at Moreton's Harbor last spring, and a close examination of the property convinced me that it was a valuable deposit. The census returns for 1891 give 80 tons of ore valued at $6,400, whereas the Customs returns only show a value of $1,000 for the same year and $1,200 for the year previous (1890), or a total of $2,200. These are the only figures I could procure, and they are evidently not much to be relied upon. While at the mine last year I was informed that about 150 tons of ore had been shipped therefrom altogether, and some eight or ten tons were then on the ground in a dump near the entrance to the main drift and at the inner end of the same drift.

Arsenical Pyrites.

Only one small lot of 125 tons was shipped in a schooner from Stewart's mine, Moreton's Harbor, in 1897, to some part of Nova Scotia, but I am told no return was ever made, as the purchaser of the ore declared incolvent about that time .

Asbestos.

In 1895 the Customs returns put a value of $2,000 upon some sample bags of asbestos sent to England, but the owner of the material, Captain Cleary, has not, so far, realized anything from this shipment

Gypsum.

Considering the immense deposits of this material in the country, surrounding St. George's Bay and the Codroys, it is rather strange it has not been utilized to better advantage. Large quantites of gypsum are mined and shipped every year from Nova Scotia, Cape Breton and the Magdalen Islands to the United

States markets. An attempt was made a few years ago by a Mr. Scoles to work gypsum at Codroy and Bay St. George, and I find the following figures of the result in the census and Customs returns:—in 1891, 250 tons, $1,250; 1892, 170 tons, $850; and in 1893-94, $1,000 and $1,200 worth. There are no returns since the latter date, so that the work must have been abandoned about that time.

Labradorite.

About 1894-95 some Americans took out claims for this mineral on St. Paul's Island, Labrador, and made an attempt to mine or quarry it and introduce it into the American market. Evidently the experiment did not prove remunerative, as they have not continued to prosecute the enterprise. The Customs returns for 1895 are responsible for crediting them with a shipment of $400 worth.

Lead.

Nothing has been done of late in the development of our gelena deposits, and I can only find the small sum of $200, in 1893, credited to this mineral. From whence the shipment was made or what amount of ore it represents does not appear. In the early part of last spring a Mr. Treloar, representing the Tharsis Company, had the old workings of the Silver Cliff mine, at Little Placentia, cleared out, and did a little prospecting work there, but nothing has so far come of it. Mr. R. Rendell has some men at work on a galena deposit at Sopp's Arm, White Bay. The ore is contained in a ferruginous quartz vein, in combination with copper and iron pyrites, assays of which have shown it to contain an appreciable percentage of gold.

Lime.

There are no returns either of lime-stone quarried or lime burnt that I can get hold of, except from the last census of 1891. That year, it appears, some 13,500 bushels of lime, valued at $3,610, were manufactured in or near St. John's. It is well known that for a great number of years lime has been regularly burnt at three or four kilns in St. John's and Topsail. Much of the stone used was of local product, quarried near Topsail Head, Conception Bay, or at Cobb's Arm, New World Island, Notre Dame Bay. A large amount of lime-stone also was used in fluxing the copper ores at the smelting works in the latter Bay during their operation No account of this source of industry is obtainable.

Precious Metals.

Though both gold and silver are known to exist not only in the free state but in combination with other metals in the island, we cannot so far point to any output of either amongst our mineral products. It is worthy of note, however, that the assays of many of our ores, especially copper and iron pyrites, have shown the presence of both gold and silver in many instances, and often in appreciable quantities In 1892, in the pamphlet published on the Mineral Resources of Newfoundland, it was stated that gold to the value of £10,000 sterling had been extracted from the Tilt Cove ore, in the process of smelting it, during the previous twelve months. Since then I have ascertained that this information was quite correct. Colonel Young, one of the owners of the Tilt Cove property, informs me that the Cape Copper Company, at their smelting works at Briton Ferry, are obtaining a yield of gold of about two ounces to one ton of metal. As the ore averages 3½ per cent., or say 33 1-3 tons of ore produce one ton of metal, we thus have an average yield of about 1 1-5 dwts. of gold per ton of ore. A further confirmation of the profitable extraction of gold from this ore is to be found in the *Mineral Industry* for 1897, published in New York, which credits Newfoundland, for that and the preceding year, with a production of 3,000 ounces of gold, valued at $62,010, and 4,000 ounces of silver each year, all of which was derived from the same source.

TABLE I.

MINERAL PRODUCTION OF NEWFOUNDLAND FOR THE YEAR 1898.

Name of Product.	Quantity.	Value.
Brick	930,000	$8,010
Building Stone	100 Tons	400
Chrome Ore	724 Short Tons (*a*)	15,000
Coal	2,900 Long Tons (*b*)	11,600
Copper Ore	66,798 Long Tons (*c*)	274,452
Granite	4,000 Long Tons	20,000
Iron Ore	102,000 Long Tons	102,000
Paving Stone	1,700 Long Tons	13,600
Pyrites	32,335 Long Tons	161,675
Slate	300 Squares	1,350
		$608,087

(*a*)—This is the amount of ore dressed, *i.e.*, concentrated at the mines and shipped to market last year. It assayed 55 per cent. As every unit over 50 per cent. increases the value from 75 cents to $1 per unit, I have assumed $15,000 as the probable value of this shipment.

(*b*)—These were the figures given me by Mr. Reid. He, apparently, did not deduct the cost of mining, etc.

(*c*)—For the Tilt Cove portion of this output, Mr. Williams, manager of the mine, estimates the value of the ore at about $3 per ton. Mr. Rendell, agent for the Company, thinks it should be about $4.50 per ton. From other grounds I have assumed $3.50 as the probable average value of the ore after deducting all charges for working expenses, etc. The regulus which, from the Cape Copper Company's reports, averages about 16 per cent. metallic copper, should, after deducting all costs for mining, smelting, etc., stand about $36.60 per ton, allowing thirteen cents per pound of metal as the market price for the year.

The figures given in Table II. are based chiefly upon the metallic contents of the ores and the average price per ton of the manufactured material during the years specified, without deducting the cost of mining, shipping, etc. The values of the non-metallic substances are chiefly the selling prices in the local market, which was the only source from whence to form any conclusions.

I have the honor to be, Sir,

Your obedient servant,

(Sgd.) JAMES P. HOWLEY.

TABLE II.

COMPARATIVE STATEMENT OF MINERAL PRODUCTION FOR THE PAST TEN YEARS, FROM 1888 TO 1898, BOTH INCLUSIVE.

MINERAL PRODUCT	1888		1889		1890		1891		1892		1893		1894		1895		1896		1897		1898		TOTAL VALUE.
	Quan.	Value	Quan	Value	Quan.	Value	Quan.	Value.	Quan.	Value	Quan.	Value	Quan.	Value	Quan.	Value	Quan.	Value	Quan.	Value	Quan.	Value.	
Antimony						$ 1,200		$ 1,000															$ 2,200
Arsenical Iron																			125				
Asbestos																		$ 2,000					2,000
Brick	120 M	$ 840	120 M	$ 840	120 M	840	820 M	7,140	870 M	$ 7,570	870 M	$ 7,570	870 M	$ 7,570	870 M	$ 7,570	870 M	7,570	870 M	$ 7,570	870 M	$ 7,570	62,650
Building Stone																					100	400	400
Chrome Ore															32	? 640	1,500	22,500	2,300	33,350	sh 1724	? 14,400	70,890 ?
Coal																					2,900	11,600	11,600
Copper Ore Regulus, etc.	5,817¾	*433,059	4,410	404,719	2,245	230,118	11,825	472,665	26,643	789,527	45,431	639,401	44,893	523,001	45,951 ?	?483,698	54,467	584,325	68,323	690,384	66,798	656,741	5,907,638
Granite															50	? 504	120	? 1,008	120	1,008	4,000	20,000	22,520
Gypsum							250	1,250	170	850		1,000		1,200									4,300
Iron Ore															750	750	38,450	38,450	58,940	58,940	102,000	102,000	200,140
Labradorite																400							400
Lead												200											200
Lime							13,500	3,610															3,610
Manganese																			1,500	? 18,000			18,000 ?
Paving Stone																					1,700	13,600	13,600
Petroleum																	110 brls	?					
Pyrites	1,850	† 9,250	7,530	37,650	16,070	80,350	29,009	145,045	36,216	186,080	39,953	199,765	42,095	210,475	34,330	171,650	27,274	136,370	32,790	163,950	32,335	161,675	1,502,260
Slate													300 sq.	1,350	300 sq.	1,350	300 sq.	1,350	300 sq.	1,350	300 sq	1,350	6,750
Totals		$443,149		$443,209		$312,508		$630,710		$984,047		$847,936		$743,596		$666,562		$793,573		$974,552		$989,336	$7,829,158

* Based on the average percentage of metallic copper, and its market value, during each year.

† Average estimated value at mine, after deducting all costs and charges, $5 per ton of ore.

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CHAPTER XIX.

Report for 1899.—A Further Examination of the Coal Trough of Bay St. George—Mineral Statistics for Current Year.

St. John's,
January 21st, 1900

The Minister of Agriculture and Mines.

Sir,—Owing to the unusually protracted Session of the Legistlature, and the late date at which the necessary appropriations for the Public Service were passed, the season for carrying on the investigations of the Geological Survey was now greatly restricted.

It was considered, therefore, that the best way to employ the short time still remaining for field work, was in a further examination of the St. George's Bay Trough, and the porcuring of better specimens of the coal itself by driving in a short distance on the principal seams already exposed.

Having now been deprived of the services of my two assistants by the curtailment of expenses under the new order of things, I was left entirely alone. Mr. Bayley had resigned his position on the Survey consequent upon the retrenchment scheme adopted by the Government a few years ago, and Mr. Thorburn had been transferred to the Crown Lands Department.

From these and other circumstances I proceeded by rail to Bay St. George unaccompanied, there to select a crew of men for carrying out the work. These were provided with picks and shovels, and when all arrangements were completed we started by boat for Robinson's Head, from whence we portaged inland about ten miles to the position of the coal outcrops on Robinson's and Middle Barachois Rivers. This was very laborious work owing to the rough nature of the country to be traversed, the excessive heat and presence of swarms of flies, it being the height of their most troublesome season. In a few days, however, we reached our objective, and commenced operations at the outcrop of the Juke's Seam, Middle Barachois. Here we spent quite a considerable time driving in on the seam upon both sides of the deep ravine, mentioned in report of 1889, where the best exposures were seen. Some ten or twelve feet of the seam were opened up and a few tons of the coal extracted.

It was found to hold its thickness, and improve much in quality after passing the weather-worn surface outcrop. The work of the season was now directed chiefly to the tracing out and identification of the various seams on either side of the trough which was shown to exist here by the previous work performed. Two new seams of small dimensions were added to the number, making fourteen in all, besides a few impure carbonaceous shaly layers, exhibiting traces of coal.

Middle Barachois River.

In the section exposed along the east side of the Middle Barachois River, the strata for quite a long distance dip very regularly towards the east, or about N. 80° E. magnetic at an angle of inclination varying from 30° to 60° and averaging about 45°. In this section of the fourteen seams now known to exist, four only are worthy of special reference, viz.: the Murray, the Two and a Half Foot Seam, the Juke's and the Cleary Seams, which exhibited the following dimensions:

Murray Seam.

	FT.	IN.
Underclay	0	3
Coal	1	1
Shale and Clay	0	10
Coal	0	10
Shale and Clay	1	3
Coal	0	4
Clay and Shale	0	4
Layers of coal and carb. shale and clay	2	0
Tough Shale	0	9
Coal, shale and clay mixed	1	6
Clay and shale	1	0
	10	2
Coal	4	9

Two and a Half Foot Seam.

	FT.	IN.
Underclay	0	4
Good Coal	1	6
Clay shale and coaly matter	0	8
	2	6
Coal	1	6

Juke's Seam

	FT.	IN.
Underclay	0	3
Good bright coal	2	4
Clay layer	0	3
Shaley coal	0	3½
Clay	0	1
Coal and Carb. shale	1	7
Shale and clay	0	7
Carb. shale and coaly matter	0	1½
Shale	0	4
	5	10
Coal	3	8

Cleary Seam.

	FT.	IN.
Underclay	0	1½
Coal, good	2	1
Clay and Shale	0	9
Coal	0	1
Clay and Shale	0	5
Carb. Shale	0	2
Shale	0	4½
	4	0
Coal	2	2

These three last seams are situated pretty close together, near the top of the section, there being but 50 or 60 feet of strata between the first and second, and just 100 feet between the second and third. In each interval also there is a thin coal layer about midway. Judging from the relative position of these seams their uniformity of dip and strike, and the fact that the steep banks forming the river valleys just here, run parallel with them for some distance, it appeared to me quite feasible to work them conjointly. A tunnel or drift at right angles from the base of the bank and extending across the measures would intersect each in turn. The average height of the bank is about 100 feet, and for at least one-quarter of a mile on either side of the principal outcrops, every facility for readily tapping the seams is afforded.

Between the upper set of seams and the Murray seam down the river, there is an accumulation of some 2,000 feet of strata, which so far as our knowledge extends at present, appears to be destitute of any coal seams of workable dimensions. Two or three thin impure layers of Carbonaceous shale and dirty coal occur within this section and possibly others of more promise may yet be found.

Beneath the Murray seam again, there are also a few coaly layers visible, but no true seam. The entire section with all its contained coal seams, is repeated on the eastern side of the trough further up the river, each in turn being brought to the surface with an opposite angle of inclination. Here again they were all uncovered and examined in detail, and were found to exhibit pretty much the same character throughout.

The Juke's seam, though not so large as the Murray, is much superior in quality. The bottom coal in particular is bright and clean, and of a very bituminous character igniting readily and burning with a brisk flame. It leaves a comparatively small percentage of ash, and altogether may be ranked as a very good quality of household coals. It is probable, also, that it will prove a good gas producer as well. This seam has now been traced from its outcrop on the main River along its line of strike, northward for a distance of nearly three-quarters of a mile. Trial pits were sunk at intervals exposing the coal up to a point some 12 chains from the Main River. Here a deep ravine, caused by the action of a small tributary stream, has been cut across the measures to a depth of nearly 100 feet exposing two fine sections, one on either side of the ravine. This is where the coal was best seen, and where the specimens were taken from. Several chains further along the line of strike, a pit was sunk through the sand and gravel, to a depth of 15 feet when the influx of surface water obliged us to abandon sinking. Nevertheless, a bluish drab fireclay filled with angular fragments of coal was struck which left little room for doubt that we were close upon the seam.

At 27 chains further north on the same line of strike, four pits were sunk, and the bed-rock reached in each instance. The first revealed a greenish gray sandstone filled with carbonized plant impressions. The second pit to the westward of the first exhibited reddish sandstone similar to that beneath the coal outcrops on the Main River. A slight change in the direction of the dip also indicated a turn or curve in the strata towards the eastward. On this account, the two last holes were sunk to the eastward, one at three, and the other at eight chains distant. In each case the bedrock exposed was a greenish gray micaceous sandstone, true coal measure rocks, and not far from the position of the seams themselves. The presence again in these two latter pits of numerous fragments of coal clearly indicated that the seams were in the immediate vicinity, but our time having expired, and moreover, having run out of provisions, we were obliged to give up further search. The vast amount of surface debris covering the country in all directions, which is for the most part also heavily timbered, renders any attempt at tracing out the coal seams with the aid of pick and shovel, next to impossible. The use of a small hand or horse power boring drill such as that manufactured by the Davis Calyx Drill Co., of New York, would be of the greatest utility in the investigation of a country of this description, and I believe would give most favourable results. There is every reason to think that other and higher seams than any of those seen, are likely to occur towards the central part of the trough, where an accumulation of several hundred feet of extra measures, not seen at the outcrop, must still exist. The occurrence of numerous angular pieces of float coal amongst the surface deposits above the Cleary seam and in such a position that they could scarcely have been derived therefrom, lends much force to the above supposition.

ROBINSON'S RIVER.

On this River and just two miles distant in a straight line from the Juke's seam, an outcrop of coal occurs, known as the Howley seam. It was discovered in 1873, but not fully examined till 1889, when it was uncovered and followed for 130 feet up and down the slope of the river's bank. This coal seam possesses so many of the characteristics of the Murray seam on the Middle Barachois River, that I am much inclined to regard it as the continuation of the same, on the opposite, or eastern side of the trough, a point, however, not yet fully determined. The exposure of the coal measures on this river, which runs through a low, flat valley, is so limited that but little clue to the correct structure is afforded.

Where best seen, the Howley seam gave the following measurement:

Howley Seam.

	FT.	IN.
Underclay	0	1
Good solid coal	3	0
Coal and Carb. shale in thin layers	1	0
Coaly shale	0	4
Shale and Clay	0	1
	4	6
Coal	4	2

The quality of the coal in the Murray and Howley seams is inferior to that of the Juke's, yielding considerably more ash on combustion, but as the only tests made to date were of specimens derived from the long exposed and much weathered outcrops, it is but reasonable to expect much improvement in quality will take place as these seams become opened up and mined.

A short distance both above and below the outcrop of the Howley seam on the main river some bands of carbonaceous shale and clay exhibiting a few inches of real coal, were seen, and on a small tributary nearby two considerable bands of fireclay were uncovered. One of these contained about 1 foot 4 inches of soft, impure coal with 4 inches hard coal at top and 2½ inches at the bottom; the other showed about 1 foot of impure coal in the middle.

BIG OR NORTHERN FEEDER.

On the Big Northern Feeder, a large tributary of Robinson's River, and at a point two miles and thirty chains to the Northeast from the Howley seam, another outcrop takes place This is known as the Shears seam, and is situated so low down by the river side, and partly under water, that it could not be traced any distance. Where best exposed, it caps the crown of a low undulation of the strata. The coal is of a very superior quality, being a brilliant, black, clean coal, almost approaching Anthracite in hardness, yet it is highly bituminous, burns with a clear brilliant flame, leaves very little white ash, and I believe, would make an excellent gas coal. The section of this seam, where measured was as follows:—

	FT.	IN.
Underclay	0	3
Bright, hard, clean coal	1	2
Clay and shale	0	2
	1	7
Coal	1	2

The coal measures are seen to occupy several miles of country extending up and down the valley of this River, but owing to their being arranged in a series of low, flat undulations, there is not a great thickness of strata brought in. Several small impure seams were met with both above and below the Shear's seam, but none worthy of particular mention. In consequence of the low ground and difficulty of getting at the bed-rock, little work could be accomplished with the means at our disposal. It is quite possible, however, that the application of the boring rod here would reveal the presence of other and more promising seams. It has now been fully established that the coal measures proper extend from the west of the Middle Barachois River to beyond the Northern Feeder uninterruptedly and underlie at least the greater portion of the intervening area. The aggregate thickness of coal in all the known seams in this trough is about 28 feet. Should the supposition of the probable existence of higher seams towards the centre of the trough prove correct, this aggregate is likely to be greatly increased. Although there is not sufficient data at hand to form any reliable estimate of the quantity of coal available, still there can be very little doubt, judging from what is known, that the quantity is no insignificant one, the conditions present, as a whole, being of such a favourable nature.

An analysis of the four principal seams of this section gave the following results:

	Cleary Seam	Juke's Seam	Howley Seam	Shear's Seam
Moisture	3,548	3,036	2,784	4.90
Volatile matter	30,897	30,344	29,784	33.12
Fixed carbon	55,229	60,142	54,468	Not given
Sulphur	3,946	1,963	3,047	0.44
Ash	6,380	4,515	10,430	3.16
	100.000	100,000	100,000	Coke 61.371

Since the above was written, the Messrs. Harvey & Co. made an attempt to open up the last named seam, but owing to the low situation near the river the influx of water was so great that the work had to be abandoned, no adequate pumping apparatus having been provided. So far as the seam was sunk upon, it was found to maintain its good quality and increase in thickness.

As this is in all probability my last visit to this region, I shall append a list of the fossils from the coal measures here. They have all been identified by the late Sir Wm. Dawson, Principal of McGill University, perhaps the most eminent Palaeobotanist in North America. He has on all occasions been most courteous in affording our survey his valuable assistance and services in this respect, for which our thanks are gratefully tendered.

LIST OF FOSSIL PLANTS FROM THE COAL MEASURES OF BAY ST. GEORGE. (Dawson.)

LEPIDODENDRA.

Lepidodendra pictoense.
L. Murrayanum.
L. cliftoense.
L. Terranovicum N. sp.
L. Sternbergii.

CALAMITES, Etc.

Calamites suckovii
C. cistii.
C. cannoeformis.
Stem of Annularia or Asterophyllites.
A. longifolia.
A. sphenophylloides.
Sigillaria ?
Stigmaria ficoides.

FILICES.

Neuropteris rarinervis.
N. auriculata.
N. hirsuta.
Altehopteris lonchitica.
Pecopteris abbreviata.
P. oreopteroides.

P. arborescens.
P. allied to Athyroides.
Sphenopteris (Cheilanthites) hoeinghausi.
Sphenopteris sp.
Dictyopteris sp.
Psaronius sp.

GYMNOSPERMEAE.

Dadoxylon materiarium.
D. acadianum.
Cardaioxylon sp.
Cardaites barassifolia.

ANIMAL REMAINS.

Naiadites carbonarius.
N. elongatus.
Spirorbis carbonarius.

Towards the close of the season, after having returned to Sandy Point and paid off my men, all except two Indians, an excusion into and over a portion of the Long Range Mountains was undertaken. The main object of which was to ascertain, if possible, the source from whence the vast quantity of loose boulders and pebbles of titaniferous magnetite, so plentifully distributed along the courses of the rivers, was derived. It was known that a large deposit of this class of ore had been located inside the head of Bay St. George, some three or four miles from the seashore, but this could scarcely have given origin to all the float ore so abundantly strewn over the lower levels, and at such a distance therefrom. This ore, should it ever become utilized, in conjunction with an abundant supply of coal in close proximity, might prove a most valuable asset in the future development of this favoured district.

Starting from the shore on the South side of Flat Bay we travelled inland towards the base of the mountains, crossing the Flat Bay and Fishels Rivers, till we reached the point where the Northern Feeder of Robinson's River debouches from the mountain range. The valley of this stream was much less precipitous and extended much further inland than any of the others. We traversed up this valley, till we reached a point well into the country, and then climbed out of it to the summit level of the range.

Here the country on all sides presented a very bare, bleak appearance, occupied mainly by extensive marshes, numerous ponds and tarns and low ridges of bare rock, all composed of granitic and gneissoid varieties. A few patches of stunted woods, and other typical mountain vegetation were come across in the hollows between the ridges, but the general aspect was one of desolation. After crossing over to the Hay Place on the main Robinson's River, we then made a great circuit, crossing the various rivers a long distance inland. While here we were beset by very bad weather with dense fog which precluded our getting about for two or three days, as nothing could be observed beyond a hundred yards or so. The country all around bore such a sameness that no land-marks to act as guides were anywhere discernible. The unlooked for delay greatly retarded our progress and brought our small stock of provisions to so low an ebb, that we were obliged to make a hasty retreat to the shore. After crossing Fishels River a long way inside, we then struck out for Flat Bay River which we reached some miles above the Cairn Mountain, traversed it down to the steady water below the mountain and thence out to the shore at Seal Rocks.

Our search for the iron deposits proved fruitless, as we did not observe a single particle anywhere along our extensive circuit till we reached Flat Bay River. Just under the Cairn mountain, we again met with some float ore and saw a few small irregular veins. I afterwards learned from some of the hunters at Sandy Point, who are in the habit, late in the fall, of traversing the country inland in search of game, that they had observed outcrops of this ore a long distance back almost over to the valley of the upper Exploits River, and much beyond where we had been. According to their reports, and the indication observed, there must be a large quantity of the ore distributed through the rock formation constituting this mountain range, as float ore is found more or less from the extreme head of Bay St. George to the head of the Grand River of Codroy. It also occurs on the north side of St. George's Bay on the Indian Head Range.

I have the honor to be Sir,

Your obedient Servant,

J. P. HOWLEY.

Report of the Mineral Statistics for the Year 1899

St. John's, N. F.,
May 1st, 1900.

ELI DAWE, Esq.,
Acting Minister of Agriculture and Mines,—

SIR,—Encouraged by the interest taken in my last year's report on the mineral production of the island as evinced by the constant demand for copies thereof and the favorable newspaper comments upon its value, I have again endeavoured to carry out the idea of furnishing an annual return of this important branch of the country's industries.

As pointed out last year, however, it is all but impossible to procure perfectly accurate information without a personal visit and inspection of each mining locality. While most of those persons interested or engaged in mining development are ready and willing to furnish particulars of their operations, and are most obliging in this respect, there are still some few who, either through indifference or reluctance seem disinclined to do so.

In some cases I am only furnished with the quantities of the raw materials raised or manufactured, and am consequently left to conjecture the probable values Where there is no market price ruling, as in our local markets, for such raw materials, any figures given can only be therefore of a very approximate character. Under the circumstances any attempt at absolute accuracy is, of course, out of the question. As to the value of the figures now furnished, I can only claim that they have been more carefully studied and weighed than any heretofore published, and, imperfect as they undoubtedly are, they will nevertheless serve clearly to demonstrate the growing importance of the mining industry of the country.

Notwithstanding the frequent failures to establish mines where no mines exist, and the occasional closing down of active operations at some of the mining centres, yet the business as a whole is steadily expanding. New enterprises spring up to take the place of those closed down, and, as may be seen in the following tables, a steady increase in value is shown from year to year.

The total value of the minerals produced in 1898, as per report for that year, was $608,087.00, while that of 1899, so far as can be ascertained, reached the respectable sum of $970,297.00.

This shows an increase of $362,210.00 over 1898.

TABLE I.

Mineral Production of Newfoundland, 1899.*

NAME OF PRODUCT.	QUANTITY.	VALUE.
Brick	772,000	$8,464.00
Building Stone	500 tons (?)	500.00 (?)
Chrome Ore	†706 short tons.	10,399.00
Coal	5,000 tons.	20,000.00
Copper Ore	†86,957 tons.	460,524.00
Granite	1,000 tons.	5,000.00
Iron Ore	†306,880 tons.	306,880.00
Mica	23 tons.	660.00
Paving Stone	281,000 blocks.	28,100.00
Pyrites	25,954 tons.	129,770.00
		$970,297.00

The increase is chiefly observable in the large output of iron ore from Bell Island, which more than trebled that of the preceding year, as also in the output of copper ore from the Tilt Cove mine, owing to the high prices ruling for metallic copper during the same period.

Other products of the mine which showed a slight increase are coal, brick, and paving stone, while there has been a falling off in pyrites, granite, building stone and slate. Of the latter, I have been informed, none was manufactured at all last year.

The following table of increase and decrease will show more concisely where the progress has been made, and otherwise, in the several mining industries:—

*The year referred to throughout this report is, in every instance, the calendar year of 1899, ending December 31st last.

†Only takes into account ore actually shipped to market.

TABLE II.

Showing Increase and Decrease in Quantity and Value.

PRODUCT.	QUANTITY.		VALUE.	
	Increase.	Decrease.	Increase.	Decrease.
Brick	...	158 M.	$894.00	...
Building Stone	...	100 tons.	...	$400.00
Chrome Ore	...	18 tons	...	4,601.00
Coal	2,100 tons.	...	8,400.00	...
Copper Ore	20,159 tons.	...	186,072.00	...
Granite	...	3,000 tons.	...	15,000.00
Iron Ore	204,880 tons	...	204,880.00	...
Mica	23 tons.	...	660.00	...
Paving Stone	144,000 blks	...	14,500.00	...
Pyrites	...	6,581 tons	...	32,905.00
Slate	...	300 squares	...	1,350.00

DISCOVERY AND DEVELOPMENT, 1899.

The information obtainable under this heading is of very meagre character. I shall only give such details now as are believed to be fairly reliable, so as to keep in touch with the progress being made and the new developments taking place, or the reverse.

BRICK AND BUILDING STONE.

Mr. W. C. Job has again kindly furnished me with the figures of the brick manufacturing industry at Elliot's Cove, Random Island. There was turned out last year 612,000 brick, of which 466,975 were disposed of in the local market at an average price of $12.00 per M. I have not received replies to my request for information on this head from the other brick manufacturers in Smith's Sound, but I presume their output was about the same general average as in former years, viz.: 120,000—valued at $7.00 per M. at their yards.

I could obtain no reliable information relative to the amount of building-stone quarried or disposed of in the vicinity of St. John's. As stated last year, a considerable industry exists in supplying of Signal Hill rock for the construction of foundation walls, etc. The industry is in the hands of a few farmers, who are said to quarry some 500 tons annually, which they dispose of at the rate of about $1.00 per ton.

CHROMITE.

It is very difficult to obtain any really reliable figures of the chromite output, and those which have been procured from different sources exhibit such a variation, both as to quantity and value, as to render it all but impossible to arrive at a definite conclusion on this head.

The Customs returns for the fiscal year 1898-99, ending June 31st last, give an export of 634 tons chromic iron ore, valued at $16,093.00 or equal to an average value per ton of $25.38, which is altogether too high. In any case this shipment most probably belongs in reality to the calendar year of 1898. As a rule, no shipments take place in the first half of each year; hence there would be none up to June, 1899 It would consequently be the subsequent shipments, not yet published, which really belong to the calendar year 1899.

Mr. Sidney Woods, of this city, part owner of the Bluff Head Chromite Mine, of Port-au-Port Bay, has kindly furnished me with some returns of the quantities of ore actually marketed during the corresponding years, viz.: 1897, 906 tons; 1898 800 tons; 1899, 706 tons; but he was not cognizant of the value or average price per ton.

In the "Mineral Industry" of 1898, the work previously referred to, I find this country credited with the following production: 1895, 44; 1896, 1,031; 1897, 3,084 metric tons, values not stated; while for 1898 the shipment was 724 short tons of 55 per cent. chromic oxide.

The value of this ore is effected to a considerable extent by the percentage of chromic oxide contained therein.

The standard for merchantable ore used in the manufacture of chromic salts is 50 per cent. or over and any ore of a lower grade, or which could not be readily and cheaply concentrated so as to reach this standard, was scarcely worth mining a few years ago. On the other hand, ores above this grade increased rapidly in value, being quoted at from 75 cents to $1.00 for every additional unit.

The use of this mineral in the manufacture of ferro-chromium and as a refractory furnace-lining, etc., in wh[illegible] [illegible]es of a lower grade, even as low as 40 per cent.—can, it is claimed, be economically used, has of late greatly enhanced the value of the material as a whole. Still the price of ore seems to hinge upon the 50 per cent. basis; and as there is no means of ascertaining how much of the material shipped exceeded or fell short of this standard, we can only assume it as the average of the whole output. The next difficulty is to arrive at anything like an average value per ton for the ore. I find the following figures quoted for the year 1898, the last published:—

Canadian Mineral Statistics, average price per ton, $12.31;

Mr. Obolski, Inspector of Mines, Province of Quebec, $13.85;

The Mineral Statistics of the United States, $16.08;

The Mineral Industry, United States, $16.70.

In lieu of any more reliable figures I can only assume the mean of the above, viz.: $14.73 as a basis for calculating the value of the output for last year, which was as stated: 706 tons; equal in value to $10,399.00.

Coal.

It is much to be regretted that the coal mining operations of the Messrs. Reid, commenced at Grand Lake in 1897 under such propitious circumstances, have not resulted in that measure of success which the indications seemed to warrant. I have been informed the work was closed down last fall pending some further examination and boring operations, which I conceive should have been preliminary to the actual mining experiment. According to the returns furnished by the Messrs. Reid, some 5,000 tons of coal were raised last year, all of which was consumed on their own engines. Nothing further in the direction of coal-mining took place except the removal of some eight or ten tons by my own party from the outcrops in Bay St. George district, when procuring fresh specimens for the museum last summer.

Copper Ore.

The high price of metallic copper last year caused increased activity in copper mining the world over, in which Newfoundland also became a participant. I am again indebted to Mr. Williams, the manager for the Cape Copper Co. at Tilt Cove, for the returns from that mine, which gives an output of 62,138 tons of 3½ per cent. ore from the east mine, and 3,699 tons of 11 per cent. ore from the old west mine, or a total of 65,837 tons. The actual shipments, however, exceeded the output by 20,242 tons, making a grand total of 86,079 tons. No doubt this was made up of reserves held over from previous years, awaiting the high price anticipated from the rapid upward tendency of metallic copper for several years past.

With metallic copper averaging 17.61 cents per lb. last year as against an average of 12.03 cents in 1898, or an increase of 5.38 cents, the corresponding increase in the value of the ore is considerable. For instance, the Tilt Cove ore in 1898, after deducting all costs and charges for mining, shipping, freight, insurance, and swelting, etc., showed a net value of just $3.50 per ton as it left the country. Taking the same general average of metallic contents, and assuming all the costs and charges to be about the same also, we have an increase in the value of the crude material as it goes aboard ship of $1.62 per ton, which, on the whole shipment from this mine in 1899, would reach the respectable sum of $440,724.48 clear net profit for Tilt Cove alone.

The returns from the Newfoundland Copper Ore Co. operating Little Bay and Lady Pond mines have not come to hand, and I am consequently unable to give any figures of a reliable character relative to their output for the year.*

The Messrs. Reid mined about 200 tons of ore at New Bay, N. D. B., of which 21 tons, picked, were sent to Swansea, with what result I am not aware. The ore is a rich grey chalcocite, but in the specimens I have seen it looks rather sparsely disseminated; nevertheless, the richness of the ore, which is said to contain a high percentage of metal, might render the process of crushing and vanning on the ground, provided it is in sufficient quantity, a profitable undertaking.

Captain Cleary informs me that the Tharsis Company shipped about 210 tons of 10 per cent. (?) ore from his property on Sunday Cove Island during the summer.

Some considerable development work also took place at Rouge Harbor, Stocking Harbor, and other parts of Notre Dame Bay, where copper ore has been met with in more or less promising deposits.

The preliminary work of opening up the new copper lode near

*since the above was written, the returns were received through the kindness of Mr. Roskilley, manager at mine.

York Harbor, Bay of Islands, has resulted, so I am informed, in disclosing a fine band of ore averaging fully four (4) feet thick, of a 10 to 12 per cent. grade. It is expected that at least one cargo will be ready for shipment the coming spring.

GOLD.

I have frequently, in former reports, referred to the presence of gold in various parts of the island, more especially in connection with the baser metals, and have given expression to the opinion that, sooner or later, gold will become a factor in our mineral production. For that matter, it might almost be considered so now. Although in its free state it does not yet appear amongst the exports from the country, any more than does metallic or refined copper, yet the Tilt Cove ore containing the latter metal, which we assume to be a product of the country, has also yielded an almost constant and but slightly varying quantity of the precious metal each year This gold is recovered at the smelting works of the Cape Copper Company at Breton Ferry, and may fairly be claimed as the production of Newfoundland. I have been unable, so far, to obtain the figures for 1899, but those of 1898 showed 2,783 ounces, valued at $57,521.61. Whether this is included with the copper in summing up the yearly profits, I am not in a position to say. At all events, it is of sufficient significance to entitle this country to the dignity of a gold-producer, which is accorded it in the American work on the Mineral Industry of the World, published by the Scientific Publishing Co. of New York, the best authority on this subject extant. Gold has been detected in about the same proportion as at Tilt Cove in the Rouge Harbor ore. Quite a gold excitement has been recently started in reference to the district of Rose Blanche, where large bodies of quartz are reported to exist, which are said to have yielded on assay an average of some two dwts. of gold per ton. It is maintained that should this low percentage prove constant, such is the enormous quantity of quartz available, the facility for cheaply mining, crushing and treating it by the most modern processes, it can be made to pay a handsome dividend. These matters can, however, only be determined satisfactorily by actual experiment. One company, at least, is preparing to go to some expense to test this point. As far as I can learn, no visible gold has been perceived in the quartz, which contains a small quantity of pyrites, both sulphur and arsenical. Possibly the gold is due to the presence of these latter minerals, and may be confined to them. I understand a large number of mining aplications have been staked off and applied for. It is to be hoped some of them, at least, may develop into paying gold mines.

GRANITE.

There has been a great falling off in the production of granite, there being no local demand for it now that the construction of the railway is completed. The Messrs. Reid give a return of but 1,000 tons for last year; but, on the other hand, the greater portion of the paving blocks manufactured were from the same granite of the quarry at the Topsails, reduced to suitable dimensions. Mr. Ellis, at his quarry near Petites, also produced material for paving purposes only, last year, which were purchased for the laying of Water Street pavement.

IRON ORE.

Great activity in iron mining took place at Bell Island last year, with the result, as stated before, that the output more than trebled that of 1898. The fame which this mine has acquired as a unique deposit in every respect has attracted much attention to it. During the year just passed the Dominion Iron & Steel Company, who are now erecting such costly and enormous smelting works at Sydney, Cape Breton, have acquired by purchase about half the mining area held by the Nova Scotia Steel Co., for the transfer of which they are reported to have paid the sum of $1,000,000.00. The new company are now engaged in constructing a second pier and tramway to their portion of the mine, and it is expected very extensive operations will ensue the coming summer. It is unfortunate that, notwithstanding an immense outlay of capital at the Workington mine, in Bay-de-Verde district, as yet no tangible result has followed.

The hopes entertained by those parties holding mineral claims in the vicinity of King's Cove, Bonavista Bay, were also destined to be disappointed. The investigations of last year failed to discover anything that could be called a mine in that locality.

PAVING STONE.

This was chiefly derived from the Topsail granite quarries worked by the Messrs. Reid. A considerable quantity was derived from the blue sandstone or quartzite of the South Side Hills, near St. John's, and some 31,000 blocks were purchased from Mr. Wm. Ellis. I have included with the paving stone some $500.00 worth of cobble or beach stones, purchased, as usual, by the municipality for the side drains of the city. All the above paving stone was utilized in the paving of Water Street, under the terms of the Reid contract.

Petroleum.

Some attempts at boring for petroleum were conducted in Port-au-Port Bay during the summer season; but I have failed to obtain any information as to the result.

Pyrites.

A considerable falling off in the shipment of pyrites is indicated by the figures for last year, and this was followed by the closing down of work at the Pilley's Island mine in November last. The Messrs. Reid give a return of 400 tons raised, I presume, at their mine in Middle Arm, Bay of Islands. It is not stated whether any was shipped or of what percentage or value the ore is. I have assumed these to be about the same as that of Pilley's Island and calculated it at the same rate of value, viz.: $5.00 per ton.

Silver.

In connection with the extraction of gold from the Tilt Cove copper ore, there is also saved each year an appreciable quantity of silver In 1898 there was 2,616 troy ounces refined metal, valued at $1,543.44, obtained. It would thus appear that the gold and silver contents are very nearly equal in amount, though, of course widely apart in value.

Slate.

The quarries of Smith's Sound, Trinity Bay, were not operated last year, as the property was being transferred to a new company of American capitalists, who have purchased out the Messrs. Curries' interests. This company is at present engaged in erecting suitable buildings, machinery, etc., preparatory to working the quarry on an extensive scale, and there is every reason to expect a greatly increased output shortly.

In the comparative table No. III. annexed, extending over the past five years, I have given the values of the metallic contents of the ores, based upon the average selling prices of the metal in the markets of the world, where these could be obtained. This is done in Canada and elsewhere, although the ores may not be refined in the country itself.

The non-metallic substances, which in our case are nearly all used at home, are estimated at their selling price in the local markets.

Although these figures cannot be fairly taken as the true value of the raw materials, as they leave the mines or quarries, yet they go to prove the intrinsic wealth of our mineral products in their final stage or marketable condition. The figures will, I have no doubt, prove a surprise and will tend to show not only the growth of the industry, but what an amount of wealth might be retained here, were these materials manufactured in the country.

The final value of the Tilt Cove copper ore alone, last year, was in the neighborhood of $1,136,553.00, independent of its gold and silver contents.

The product of the Bell Island iron ore reached somewhere about $2,650,128.00, with metallic iron worth about $16.00 per ton in the principal markets.

TABLE III.

Comparative Table of Mineral Production for the past five Years, from 1895 to 1899, both inclusive.

Products.	1895.		1896.		1897.	
	Quantity.	Value.	Quantity	Value.	Quantity.	Value.
Asbestos	....	....	....	$2,000 00	....	....
Brick	870 M.	$7,570.00	870 M.	7,570.00	870 M.	$7,570.00
Building Stone	500 tons ?	500 00 ?	500 ?	500.00 ?	500 ?	500.00
Chrome	44 tons.	572.00	1,014 tons. ?	15,210.00 ?	3,033 tons. ?	42,462.00
Coal	....	....	....	....	....	....
Cobble Stone	?	500.00	?	500.00	?	500.00 ?
	t. cwt. qr. lbs.		t. cwt. qr. lbs.		t. cwt. qr. lbs.	
Copper	2,008 6 1 7	483,698 00	2,328 6 1 7	584,325.00	2,518 16 1 20	690,384.00
Gold	....	....	3,000 ozs.	62,010.00	3,000 ozs.	62,010.00
Granite	50 tons.	504.00	120 tons.	1,008.00	120 tons.	1,008.00
	t. cwt. qr. lbs.		t. cwt. qr. lbs.		t. cwt. qr. lbs.	
Iron	388 10 6 10	445.00	20,375 1 1 10	230,201.00	30,786 10 0 20	347,409.00
Labradorite	....	400.00	....	....	....	....
Manganese	....	....	....	....	1,500 tons	18,000.00
Mica	....	....	....	....	....	....
Paving Stone	....	....	....	....	....	....
Pyrites	34,330 tons ore	240,310.00	27,274 tons.	190,918.00	32,790 tons	229,530.00
Silver	....	....	4,000 ozs.	2,684 00	4,000 ozs.	2,684 00
Slate	300 squares	1,350 00	300 square.	1,350.00	300 squares	1,350.00
Totals	....	$735,849.00	....	$1,098 276.00	....	$1,403,407.00

TABLE III.

Comparative Table of Mineral Production for the past Five Years, from 1895 to 1899, both inclusive.—(Concluded.)

Products.	1898.		1899.		Total Values.
	Quantity.	Value.	Quantity.	Value.	
Asbestos					$2,000.00
Brick	870 M.	$7,570.00	772 M.	$8,464.00	38,744.00
Building Stone	600 tons.	900.00	500 ?	500.00 ?	2,900.00
Chrome	724 sh. tons	15,457.00	706 sh. tons.	13,649.00	87,350.00
Coal	2,900 tons.	11,600.00	5,000 tons.	20,000.00	31,600.00
Cobble Stone	?	500.00	?	500.00 ?	2,500.00
	t. cwt. qr. lbs		t. cwt. qr. lbs.		
Copper	2,407 5 1 19	656,741.00	2,955 11 2 6	1,165,757.00	3,580,905.00
Gold	2,783 ozs.	57,525.00	No returns.		181,545.00
Granite	4,000 tons.	20,000.00	100 tons.	500.00	23,020.00
	t. cwt. qr. lbs.				
Iron	54,050 17 3 12	712,200.00	165,633 tons	2,650,128.00	3,940,383.00
Labradorite					400.00
Manganese					18,000.00
Mica			23 tons.	660.00	660.00
Paving Stone	1,700 tons.	13,600.00	3,512 tons.	28,100.00	41,700.00
Pyrites	32,335 tons ore	226,345.00	26,154 tons ore.	183,078.00	1,070,181.00
Silver	2,616 ozs.	1,543.00	No returns.		62,911.00
Slate	300 squres.	1,350.00			5,400.00
Totals		$1,725,331.00		$4,071,336.00	$9,034,199.00

The printed forms, recommended in last years' report, were sent out to all those known to be engaged in actual mining, and, in most cases, have been returned with the desired information filled in, either wholly or in part.

I am indebted to the following gentlemen, in particular, for their information:—Messrs. W. C. Job, R. G. Reid, Mr. Williams, of Tilt Cove, Mr. R. E. Chambers, Wabana, Bell Island, Mr. John Noonan, Customs Department, Captain P. Cleary and several others, to all of whom my thanks are tendered.

I have the honor to be, Sir,

Your obedient servant,

JAMES P HOWLEY.

CHAPTER XX.

Report for 1900.—Mineral Statistics and Mines of Newfoundland

St. John's, N. F.,
May 20th, 1901.

ELI DAWE, Esq.,
Minister of Agriculture and Mines,—

SIR,—In reporting upon the mineral development and statistics of the Island for the past couple of years I took occasion to express my obligations to all those individuals who so kindly furnished me with the necessary information to enable me to compile these reports. Had it not been for their co-operation, any attempt to furnish accurate information upon this important and growing industry would be futile. Seeing that as we have no mining inspection in this country, and no special department charged with the collection and arranging of mining data, it would be impossible to place before the world a truthful and reliable statement of what we are doing in that line without the voluntary assistance of those actually engaged, or otherwise interested in the development of the mineral resources of the Colony.

Some few individuals still exhibit a reluctance to make public that which they consider nobody's business but their own, but their numbers are diminishing each year, and the majority seem perfectly disposed to furnish any information asked for.

I have again to thank the following gentlemen to whom I am indebted for much of the material contained in the following report, viz.: Mr. Williams, manager of the Tilt Cove Mine, Mr. C. R. Rendell, Bett's Cove Mine, Mr. Hooper of the York Harbor Mine; the managers of the Dominion and Nova Scotia Steel Co.'s Mines at Bell Island, Messrs. Harvey & Co., Job Bros., R. Rendell, W. Ellis, C. Taylor and several others.

While the year 1900 witnessed considerable activity in the search for minerals, and a good deal of development work was carried out in various directions, no new producer was added to the list. There was consequently a considerable falling off in the amount and value of the total quantity of ore mined and shipped from the Colony, in comparison with that of the previous year.

The chief causes which operated in bringing about this result were the closing down of the Pyrites Mine at Pilley's Island, Notre Dame Bay, and the suspension of work on the Coal seams at Grand Lake, which together represented at least $150,000 decrease. These figures would have been made good by the increased output of Iron ore from the Bell Island mines had not the prolonged strike amongst the miners, which occurred in the height of the shipping season last summer, resulted in the total suspension of work for a period of nearly two months, and caused the cancelling of several large orders for ore. It will be seen by the returns that the total output for the two companies only exceeded that of the Nova Scotia Co., alone for the previous year by a little over 10,000 tons.

On the other hand it is pleasing to learn that the Slate industry in Trinity Bay has been revived, and that a small shipment of 600 tons was made during last summer to the London market with favorable results. It is also a pleasure to be able to record the fact that several abandoned mining properties are now being reopened with a view to further testing them. The Newfoundland Exploration Company have taken over the old Terra Nova Mine at Bay Vert, also the Pilley's Island Pyrites Mine, both of which they are making preparations to reopen the present season. The Cape Copper Co. have secured an option upon the Stocking Harbor Mine, and will probably develop it this summer. Thompson & Co., mined about 120 tons of Copper ore from the Colchester property last summer, and have men at work all winter on the Little Bay Mine. The Newfoundland Copper Concentrating Co., are engaged at the Bett's Cove Mine, and are now driving a tunnel from the water-side in towards the old workings with a view to unwater the mine, and get out the ore still believed to exist in quantity below the original excavations, but which was rendered unreclaimable some years ago owing to the caving in of the entire roof of the mine. The low price of copper at that time, and the great expense which it would entail to drive underneath the old working, necessitated the abandoning of the mine in 1885. The present high price of copper has stimulated the original owners to attempt reopening it.

Mr. William Cook has men employed doing some further development on his Manganese Claim at Fortune Harbor, Notre Dame Bay, and Capt. Stewart is engaged sinking upon the Arsenical Pyrites lode opened up some years ago at Moreton's Harbor, New World Island, N. D. B.

The Batt's Hill Copper Mine in Conception Bay, now being tested, is according to reports promising well.

Several new and no doubt some valuable mineral finds have been made during the past season, and there is reason to believe that the Coal seams of Bay St. George and the vast bodies of Magnetite in the same region are likely at length to receive the attention their importance deserves. Here we have the nucleus of a similar gigantic industry to that which the Whitney Syndicate have established at Sydney, Cape Breton, awaiting the application of capital to set it in motion.

Quite recently the low grade Manganese deposits on the South side of Conception Bay which for many years have been regarded as of no commercial value, are attracting considerable attention, and are now about to be devloped by the Dominion Iron & Steel Co. The adaptability of this class of ore for the production of ferro-manganese and spiegeleisen two substances now largely used in the manufacture of the best qualities of steel, is the desideratum which has brought it into requisition.

Should a portion only of these new ventures, now being exploited, become actual producers in the near future, we may look forward to a greatly increased output, and a consequent increase in the money value of our mineral products.

The promise which the country gives of possessing economic mineral wealth of no ordinary character, has long been recognised, and is now amply borne out by actual experiment. The failure of pioneer effort, so frequently attending the earlier attempts at mining, here as elsewhere, should not be regarded as evidence of a negative character. Such failures are frequently followed by ultimate success, and, taking it altogether, mining enterprise, when conducted upon business and systematic principles, by persons qualified and experienced in such undertakings, presents really no greater risks than any other form of speculation.

It has been proved by statistics, that in proportion to the amount of capital invested, and the number of individuals employed therein, no other industrial enterprise shows anything like as favorable results. In the United States of America, the dividends paid through mining investment exceed those of all other industries combined. There is nothing to compare with the mineral products of a country, fortunate enough to possess such, for the increasing of its solid national wealth. Most other products are consumed, and after a little while their effect upon those enterprises which tend to keep the progress of the world in motion, and prevent stagnation is a thing of the past, not so with the minerals won from mother earth. With very few exceptions those products remain in the shape of colossal structures, or works of utility, art, &c., for generations.

If then we are convinced that we possess an abundance of these undeveloped natural resources, I would respectfully submit that the time has come when we should bring more intelligent effort to bear upon the question of how best to exploit and encourage legitimate mining enterprise.

I am more and more impressed each year that the future prosperity of this country will depend in a great degree upon the manner in which its mineral development is dealt with.

The establishment of a Mining Bureau, such as they possess in Canada and most of the states of the American Union, whose object is to collect data, inspect mining properties, explore and trace out any new and important finds, assay specimens both for the state and individuals, furnish all possible information of a useful character to those requiring it, and above all place the Government in a poition to formulate the necessary legislation to effect the desired end, would I imagine be a subject worthy of consideration.

At the close of the last calendar year printed forms such as those suggested in my report for 1898, were sent out to the managers of the several mines in active operation, with a request to have them filled in and returned to this department. Nearly all these requests were complied with, and the following very full particulars, which will, I doubt not, prove interesting have been furnished me.

The other information contained in the summary of mineral products for the year 1900, as set forth in tabular form, was derived from various sources, chiefly from parties in the city who were connected with some or other of these minor enterprises, or who were in a position to afford reliable data.

MINES AND MINERAL STATISTICS.
No. I.

Name of Mine and Character of Product.	Quantity of Ore raised.	Manuf'ed or used in Country.	Exported to what Market.	Val. of Crude Material at Mine.
UNION MINE, TILT COVE.				$
Copper Ore East Mine............	Tons. 66,250	None.	32,758 to Swansea	331,250
West Mine Copper Ore	3,144	do.	30,301 to New York	151,505
Fines	600	do.	3,900 to Swansea	58,400

NO. OF PERSONS EMPLOYED IN AND ABOUT MINES.
No. II.

Above Ground.		Below Ground.		Totals.
Engineers and Smiths	24	Miners ....,	106	
Laborers on Surface.	161	Trammers.................	53	
Boys do. do.	32			
	217		159	376

NUMBER AND KIND OF ACCIDENTS.
No. III.

Name of Individual	Occupation	Nature of Accident	Remarks.
John Winsor........ William Cooper... Nathanael Mills...	Miner. do. do.	Killed by falling of earth and Rock.	The Company generously donated the families of these men £100 and £150 stg.

MINES AND MINERAL STATISTICS.
No. I.

Name of Mine and Character of Product.	Quantity of Ore raised	Manuf'ed or used in Country.	Exported to what Market.	Value of Crude Material at Mine.
BLO-MI-DON MINE, York Harbor, BAY OF ISLANDS.				
Copper Pyrites.....	500	None.	None.	$ 12,000

NO. OF PERSONS EMPLOYED IN AND ABOUT MINES.
No. II.

Above Ground.	Below Ground.	Totals.
12	14	26

NUMBER AND KIND OF ACCIDENTS.
No. III.

Name of Individual.	Occupation	Nature of Accident	Remarks.
		None.	

Mines and Mineral Statistics.
No. I.

Name of Mine and Character of Product.	Quantity of Ore raised.	Manuf'ed or used in country.	Exported to what Market.	Value. of Crude Material at Mine.
NOVA SCOTIA STEEL COMP'Y. GREAT BELL ISL. Hematite Iron Ore	Tons. 127,791	None.	Philadelphia, U.S. and Pictou, N.S.	$ 127,791

No. of Persons Employed in and about Mines.
No. II.

Above Ground.	Below Ground.	Totals.
300	None.	300

Number and Kind of Accidents.
No. III.

Name of Individual.	Occupation.	Nature of Accident	Remarks.
		Fracture of Fibula do. Tibia do. Lmaxilla do. 2 ribs do. do. do. do. do. 2nd Metacarpal bone Amput. 1 Finger do. do. Scalp wounds Injuries from falling of Ore Injuries to cornea due to particles of Ore	None Fatal.

Mines and Mineral Statistics.

No. I.

Name of Mine and Character of Product.	Quantity of Ore raised.	Manuf'ed or used in Country.	Exported to what Market.	Value of Crude Material at Mine.
WABANA MINE GREAT BELL ISL. Hematite Iron Ore	Tons. 189,425	None.	Sydney, Cape Breton.	$ 189,425

No. of Persons Employed in and about Mines.

No. II.

Above Ground.	Below Ground.	Totals.
565	None.	565

Number and Kind of Accidents.

No. III.

Name of Individual.	Occupation.	Nature of Accident	Remarks
Thomas Shannahan.	Miner.........	Blasting Accident.	Recovered.
Alfred Pike...........	Watchman.....	Fracture both legs	do.
Mark Lee	Labourer.......	Simple " Humerus	do.
Thomas Craig.........	Trackman.. ...	Pott's Fracture.....	do.
Joseph Butler..........	Engine-r. help	Severe Scalp W'ds	do.
John Martin	Labourer	Pott's Fracture.....	do.
Eli Brown	Not Employed	Compou'd Fract're	do.
Michael Burke	Labourer	Severe Lacer. Knee	do.

MINES AND MINERAL STATISTICS.
No. I.

Name of Mine and Character of Product.	Quantity of Ore raised.	Manuf'ed or used in Country.	Exported to what Market.	Value of Crude Material at Mine.
SLATE QUARRY Smith's Sound TRINITY BAY. Slate....................	Tons. 600	Tons. 600	Lon. Gt. Brit'n.	$ 10,800

NO. OF PERSONS EMPLOYED IN AND ABOUT MINES.
No. II.

Above Ground.	Below Ground.	Totals
50	None.	50

NUMBER AND KIND OF ACCIDENTS.
No. III.

Name of Individual	Occupation	Nature of Accident.	Remarks.
		One man had ankle hurt, sent to hospital.	Recovered.

Comparative table of the Mineral production for the past five years, from 1896 to 1900, both inclusive, based upon the average market prices ruling during each year. In the case of the metallic minerals, these are calculated upon the final value of their metallic contents, while for the non-metallic, I have assumed a valuation based upon the selling price of these materials in the local and foreign markets, where it could be ascertained.

TABLE III.

Character of Product.	1896. Quantity.	1896. Value.	1897. Quantity.	1897. Value.	1898. Quantity.	1898. Value.	1899. Quantity	1899. Value.	1900. Quantity	1900. Value.	Total Value
	Tons.	$	Tons.	$	Tons.	$	Tons.	$	Tons.	$	$
Asbestos	....	2,000	....	....	....	....	....	....	....	....	2,000 00
	M		M		M		M		M		
Brick	870,000	7,570	870,000	7,570	870,000	7,570	772,000	8,464	800,000	11,200	41,374 00
Building Stone	500 t	500	500 t	500	600 t	900	500 t	500	500 t	500	2,900 00
Chromite	1,014 t	15,210	3,033 t	42,462	724 t	15,457	706 t	10,399	....	....	83,528 00
Coal	....	....	....	....	2,900 t	11,600	5,000 t	20,000	....	....	31,600 00
Cobble Stone	....	500	....	500	....	500	500 t	500	500 t	500	2,500 00
Copper	2,328½ t	584,325	2,518¾ t	690,384	2,407¼ t	656,741	2,955½ t	1,165,757	2,882½ t	1,045,387	4,142,594 00
Gold	3,000 oz.	62,010	3,000 oz.	62,010	2,783 oz.	57,525	*2,075 oz.	42,890	2,400 oz.	49,608	274,043 00
Granite	120 t	1,008	120 t	1,008	4,000 t	20,000	100 t	500	....	2,500	25,016 00
Iron	20,375 t	230,201	30,786½ t	347,409	55,000 t	712,200	165,633 t	2,650,128	177,584½ t	2,841,348	6,781,286 00
Manganese	....	....	1,500 t	18,000	....	....	....	....	....	....	18,000 00
Mica	....	....	....	....	....	....	23 t	660	....	....	660 00
Paving Stone	....	....	....	....	1,700 t	13,600	3,512 t	28,100	....	....	41,700 00
Pyrites	27,274 t	190,918	32,790 t	229,530	32,335 t	226,345	26,154 t	183,078	....	....	829,871 00
Silver	4,000 oz.	2,684	4,000 oz.	2,684	2,616 oz.	1,543	....	....	....	....	6,911 00
Slate	3,000 sq.	1,350	300 sq.	1,350	300 sq.	1,350	....	....	600 sq	10,800	14,850 00
Grand Total	....	1,098,276	....	1,403,407	....	1,725,331	....	4,110,976	....	3,961,843	12,298,833 00

M. Thousand.

t. Ton of 2,240 lbs.

sq. Squares.

oz. Ounce.

*Estimated from average yield per ton of ore smelted, which is given as 1.5 dwts. fine gold worth $20.67 per ounce.

Name of Mine an
Character of
Product.

NFLD. BRICK
& TILE CO.,
Random Island
TRINITY BAY.

Bricks........... ...

No. OF

Above

Name of Individ

Mines and Mineral Statistics.
No. I.

Name of Mine and Character of Product.	Quantity of Ore raised.	Manuf'ed or used in Country.	Exported to what Market.	Value of Crude Material at Mine.
NFLD. BRICK & TILE CO., Random Island, Trinity Bay.				
Bricks...........		800,000	None.	$ 11,200

No. of Persons Employed in and about Mines.
No. II.

Above Ground.	Below Ground.	Totals.
35	None.	35

Number and Kind of Accidents.
No. III.

Name of Individual.	Occupation.	Nature of Accident	Remarks.
		None.	

It will be seen by the following tables that the total value of the mineral products for the calendar year 1900, fell short of that of the preceding year by $221,306. Had it not been for a slight increase in the items of iron, slate and brick, this decrease would have reached $251,379.

TABLE I.

Mineral Production for the Calendar Year 1900.

NAME OF PRODUCT.	QUANTITY.	VALUE.
*Brick	800,000	$11,200 00
Building Stone........	500 tons	500 00
Cobble Stone............		500 00
Copper Ore	70,614 tons	399,775 00
Gold..........................	2,400 ozs.	49,608 00
Granite		2,500 00
Iron Ore...	317,216 tons	317,216 00
Slate.........................	600 tons	10,800 00
	Total	$792,099 00

TABLE II.

Showing Increase and Decrease in 1900 *as Compared with* 1899.

PRODUCT.	QUANTITY.		VALUE	
	Increase.	Decrease.	Increase.	Decrease.
Brick	28,000	....	2,736	....
Building Stone.. ...	....	....	....	....
Chrome Ore...	....	706 tons	....	$ 10,399 00
Coal....................	....	5,000 tons	....	20,000 00
Copper Ore...	....	16,342 tons	....	60,749 00
Gold...	335 ozs.	....	6,718	....
Granite.........	....	....	....	2,500 00
Iron Ore...............	10,336 tons	....	10,336	....
Mica.....................	....	23 tons	....	660,00
Paving Stone	....	....	....	27,700 00
Pyrites.................	....	25,954 tons	....	129,770 00
Slate.	600 tons	....	10,800	....

*No returns were received from the other Brick yards in Smith's Sound. Their average output used to be about 120,000, worth at yard, $840.00.

NOTES ON THE OCCURRENCE OF VARIOUS MINERAL SUBSTANCES, AND UPON RECENT DISCOVERIES, &c.

ABRASIVE MATERIALS.

Under this head are included such materials as grindstones, whetstones, scythe stones, stones used in the manufacture of wood-pulp, &c. all of which occur in abundance in some parts of the Island, notably amongst the Carboniferous Series along the West coast and at Grand Lake. Coarse Garnets are plentiful in some of the mica schists. When crushed into fine powder, the material is used in cutting and polishing other rocks or as a substitute for emery. Its degree of hardness is however inferior to that of Corundum, or emery proper. This latter mineral has not yet come under my observation as occurring in this country, but there is no good reason why it should not be found some day amongst the Archaen series, of which a great portion of the Island is composed.

AGALMATOLITE.

This peculiar substance or something nearly approaching it, is known to exist in large quantity a few miles inside of Manuels on the Southside of Conception Bay. Owing to the ease with which it can be cut with any ordinary implement, it has been given the name of figure-stone. The Indians of America, the Chinese and other people carve from it, pipes, images, and ornamental articles of various kinds, hence the name. It is composed of silica, alumina, potash, and water. It does not contain magnesia, yet has the unctuous feel of magnesian substances. When ground, the powder produced is beautifully white, and experiments have been made, I understand, with it as a paper filler, but with what result I am not aware. That it will sooner or later be found to serve some useful purpose seems most probable.

ANTHRAXOLITE.

Anthraxolite which is believed to be an altered product of Petroleum or asphalt in a crystalized condition, occurs in trap dykes cutting the petroliferous shales in Port-a-Port Bay. It is a jet black lustrous material not unlike Albertite in appearance, and contains a large amount of fixed carbon. It is not an abundant mineral though some fairly large veins of it are said to exist on Labrador. It has been experimented with as a possible source of fuel, but with what success I have not learned. Ground into an impalpable powder and mixed with oil it has been used as a black paint. Possibly it might be made to take the place of jet in jewelry.

ANTIMONY (*Stibnite.*)

This valuable mineral substance does not seem to have received that attention its importance deserves. It occurs at several places in Notre Dame Bay, and at Moreton's Harbor in New World Island quite a promising deposit was worked for a short time, and during the years 1890 and 1891, ore to the value of $2,200 was sent to market. I visited and inspected this property in 1898, and was very favorably impressed with it, yet nothing has since been done to develop it. The crude ores of Antimony, both in the European and American markets of late years, have not been equal to meet the demand, the price of raw ore in London reached £37 Stg. in July 1898. In view of these facts the present would seem a very favorable time to exploit this promising property.

ASPHALTUM.

A small specimen of mineral tar or asphalt was shown me last autumn as being derived from the hydro-carbonaceous shales of the Northern Peninsula. I merely mention it here as an addition to the number of mineral species occurring in the Island, as coming under my notice for the first time. It is simply another form of Petroleum, but I do not anticipate its existence in economic quantity. Were such the case it should prove a very valuable addition to the mineral resources of the country.

ASBESTOS.

Asbestos is known to be quite a common mineral substance in association with the serpentine deposits of the country. The fibre though usually short, sometimes attains considerable length, and is apparently of very good quality. The property owned by the Hon. R. Bond near George's Pond was at one time operated by the John's Asbestos Co., of New York, but owing to the then difficult and expensive means of transportation, work was abandoned after a short while. Now that all this is changed by the construction of the Railway, which passes within a couple of miles of the locality, it is probable that ere long, this, like many hitherto almost inaccessible mineral properties, will soon receive attention. Asbestos of good quality also occurs at Bluff Head and other parts of Port a Port Bay, and as the serpentine areas of the Island become more thoroughly prospected it is but reasonable to expect that many new finds of this useful substance will be brought to light.

BARITE.

Barite as a vein material associated with other gangues such as fluor and calc-spar is not uncommon. It is usually, however, tinged with per-oxide of iron which effects it injuriously as a marketable commodity. A large vein of this character occurs near St. Bride's in Placentia Bay. I have seen some specimens of pure white Barite both from the Island and Labrador coast, but whether it exists in economic quantity I am unable to say. It is chiefly used, when ground into powder as a pigment also to a limited extent in pyrotechny, and when treated with sulphuric acid and converted into barium sulphate for a few other purposes. The chief manufactories of barites products in the United States are situated at Chicago and St Louis, where the raw material in 1898 cost the grinders $7.25 per ton of 2,000 lbs. Its selling price at the mines in Washington County, Mo., was about $4.50 per ton. These prices considering the ease with which the material can be mined are good, and should serve as an inducement to prospectors to search for the mineral.

CEMENT.

Cement though properly speaking an artificial product never-the less does occur in nature in the form of natural rock cement, and there is every reason to believe we possess an abundance of the material here. The manufacture of Portland cement is a growing industry of immense proportions, both in the United States and Canada, where the supply is not at all equal to the demand of late years. Our own importation of this most necessary and useful material is growing apace, and its home manufacture might be well worthy the consideration of some of our local capitalists. Some of the lime-stones of the country, especially those containing more or less magnesia, iron, manganese &c., would undoubtedly produce good hydraulic cement. Some of the lime-stones of Conception, Placentia, and Trinity Bays are of this character.

COAL.

It is much to be regretted that the attempt to operate the coal deposits at Grand Lake has not been attended with that degree of success which was anticipated The failure to establish a coal mining industry in that locality has unfortunately tended to engender a considerable amount of unbelief in our coal resources generally, not at all warranted by the facts which have been, from time to time, brought to light.

It is nothing new in the history of coal mining, or for that matter in any other species of mining, where unscientific methods of procedure are employed. Many promising properties are thus condemned by the absence of a sufficient knowledge of the geological structure, and mineralogical conditions pertaining to the particular district, and the modes of occurrence of the product sought for.

In this connection, I cannot do better than quote from an admirable paper on "Mining" by A. J. Bensusan, A.R.S.M., F.C.S., read before the New South Wales Chamber of Mines, January last.

Speaking of mine management, the author says:

"I shall be glad to see the day when most of the men managing our mines all over this country retire in favour of trained engineers, when we will then hear of fewer failures, and of people investing in mining knowing that they will have at least a fair run for their money.

"The employment in managerial positions of the so-called 'practical' man, and I use the word practical advisedly, is one of the greatest drawbacks from which the industry suffers. He is generally a miner who has been cute enough to raise his status by first becoming a shift boss, then foreman of a mine, then perhaps manager of some concern, and finally he takes responsibilities far beyond his capacity, with the result that he almost invariably ruins the mine, and not infrequently those who have found the money for the work.

"The management of mines now-a-days should be in the hands of the most highly trained and educated men available.

"Good mines are frequently abandoned, and work continued at the bad ones, from the incompetence of those usually placed in charge.

"Good men command comparatively high salaries, but they are usually able to save the cost to their employers several times over by not spending money in useless ways."

The above quotations go to prove that mining ventures, like all other undertakings, may be easily rendered successes or failures, not always through the lack of mineral, but through incompetency and mismanagement. This country has unfortunately witnessed much of this sort of thing in the past, and its damaging effect in the eyes of capitalists has been of a most injurious character.

The proneness to enter upon elaborate works, purchase expensive and unnecessary machinery, etc., before first ascertaining the extent and character of the deposits, has been a fruitful cause of so many mining failures.

The Coal area of Grand Lake should have been thoroughly tested by means of the boring drill before any attempt at actual mining was entered upon, and this applies equally to the coal area of St. George's Bay. This latter as has been frequently asserted, is so far as the surface indications have been ascertained, of a most promising character. Yet it would be most certainly advisable as a preliminary to mining the coal here, to use the boring rod extensively. Such is the nature of the surface covering the coal beds, and so few are the rock exposures to be met with, that it is only by such means the extent and importance of this coal field can be determined with any degree of accuracy.

CHROMITE.

No shipments of Chromic iron were made from the Bluff Head Mine last year, and operations were suspended during the summer for causes of which I am not cognizant. During the same season some important new finds of this class of ore have been made, one on the inner side of the Louis Hill range of Port a Port, which is reported as being a large deposit. In the vicinity of Pipe Stone Pond on the Bay D'Est River another extensive deposit has been located and staked in. Both these latter localities are situated some considerable distance from the sea-board, and will require roads or tramways for the transportation of the ore to the shore. If the deposits are at all in keeping with the reports, especially as the specimens procured are of a high grade ore, there should be no great difficulty in exploiting these properties. Chromite is in demand, and the low grade ores heretofore of little value are now, by means of concentration, easily brought up to a marketable condition. Formerly this substance was exclusively used in the arts, for the purpose of which only high grades were saleable. Now, however, other uses have been found for the ores, such as furnace linings and for the manufacture of ferro-chromium, chrome steel, &c. tI is said to give to the steel such hardening properties as to afford some of the best material for edged tools, where excessive hardness is required.

Cobble Stone.

Under this head is included the worn beach stones used somewhat extensively by the Municipal authorities for paving purposes and side-drains throughout the city. Some $500 or $600 worth are purchased annually for these purposes.

Copper.

The operations of the Cape Copper Co., at Tilt Cove last year again proved highly successful, as may be seen from the accompanying tables. This valuable property is holding its own notwithstanding its continuous operation, now extending over the past 36 years, and the reserve of ore still in sight according to the Company's report for the fiscal year ending August 31st, 1900, was as follows: East Mine 203,692 tons; West Mine 487½ making a total of 204,179½ tons. The mine produced a gross profit for the year of £66,349 12s 5d equal to $318,478.18.

Although much of the ore now being won from the East Mine is a low grade sulphuret not exceeding 3½ per cent. in metallic copper, still the high prices ruling during the past few years, and the presence of a variable yet economic amount of the precious metals, Gold and Silver contained therein, has resulted in a splendid margin of profit for the Company. The ore of the old West Mine, though small in quantity, is of much higher grade averaging

11 per cent. copper, and this tends to add considerably to the value of the output.

So far as I can learn no copper ore was shipped from any other mine except Tilt Cove last year, but as previously stated there were several small quantities mined at various points, most of which will probably be marketed the coming season.

The York Harbor copper mine under the able management of Mr. James Hooper is being put in good working condition. The 500 tons of ore raised up to last autumn has not yet been shipped, the preliminary work of constructing a tramway from the mine to the shore not being completed before the close of navigation last year, prevented doing so. This, together with the winter's output will probably be marketed the coming summer.

New copper finds have been made recently in Conception and Placentia Bays, amongst the Huronian series hitherto not exploited for copper to any extent. As in the Lake Superior dishtrict of Canada, and the Northern States of the American Union, the ores accompanying these ancient series are generally rich sulphurets, such as Chalcocite, Chalcopyrite, Bornite etc. Cuprite and Native Copper are also present, and though usually sparsely disseminated in the rock mass, their exceeding richness has proved an inducement to attempt mining ores showing less than 1 per cent. of metal.

In the Keweenaw mining region of Northern Michigan, where has taken place the greatest development of native copper in the world's history, the richest mine in operation, the Calumet and Hecla, averages only about 3.05 per cent. cu. None of the other mines of the region exceed 2 per cent. on an average, and several give much lower return, the Atlantic Mine actually treating ore of only 0.61 per cent. with profit.

Mr. R. McGrath, M.H.A., has made a discovery of native copper on Oderin Island in Placentia Bay, which seems to promise well. The metal is contained chiefly in an amygdaloidal trap rock or igneous overflow, though it is found also in quartz and calcarious veins cutting the latter, in some cases in the form of mass copper. Lumps ranging from a few ounces up to 55 lbs. in weight, and which averaged at least 75 per cent. metal, were procured from some of the veins. Some development work is being carried out during the winter under Mr. McGrath's supervision, and new finds are being made from time to time.

The geological conditions, judging from the character of the rocks, would appear to be almost identical with those pertaining to the Lake Superior region, and there is reason to believe that this cupriferous series also is about in the same geological horizon.

Millions have been expended in exploiting the Lake Superior mines, and frequent failures have attended the initial operations in most instances, but the rich corporations which have persistently carried on the work, and have brought the treatment of this class of ore down to a fine science, have usually had their efforts crowned with success in the end To-day the Lake copper region stands first in the world as a producer of the metal, and Lake copper is the standard by which the price of the metal is governed in the principal markets.

Metallic or Native Copper is known to exist in other parts of this country, and has been frequently referred to in former reports. I might here draw attention to the importance which might attach to a close study of the conditions under which this metal occurs with a view to applying the knowledge to other parts. It appears to me that such an investigation might have a very important bearing upon the future mining prosperity of the country. Could it be definitely determined that our rock series were really identical with those of Lake Superior, and that the copper occurred under exactly similar conditions, the tracing out and mapping of the cupriferous belts or zones, could scarcely fail to be of immense advantage to the prospector.

Feldspar.

Feldspar is an abundant and common mineral amongst the Archæn series, frequently in the form of large veins penetrating the gneiss and mica schist. It is used extensively in the manufacture of china and porcelain ware, and as a glaze fo rthe surfaces of ordinary earthenware. There are many varieties of the mineral, but only those free from iron and other impurities are in requisition.

Fluorspar.

Fluorspar which is worth from $6.00 to $7.00 in the raw state is used chiefly in the production of Fluorhydric Acid and as a flux in metalurgical smelting. The acid is especially useful in cleansing iron castings for which purposes it is expected to supercede all other acids. The business of manufacturing it, is growing in importance each year, and there would appear to be quite a future before it. The material occurs as a gangue or veinstuff in several localities, and is that which carried the Native Silver at Lawn in Placentia Bay.

Gold.

No returns of the amount of gold extracted from the Tilt Cove ores have been forthcoming the last two years,* but it is presumable it has averaged much about the same per ton of ore smelted as heretofore, viz., 1.5 dwts. Nothing definite appears to have been accomplished at the Rose Blanche properties during the year. Reports of various lots of quartz having been sent away as test samples have appeared from time to time, but with what results I have been unable to ascertain.† That there is a vast amount of quartz in the locality and that it contains some gold has I believe been satisfactorily determined. In all such cases where assays show encouraging prospects systematic prospecting by persons understanding the business should be entered upon. No one can doubt the existence of gold in this country, but it is not every person, nor yet every prospector, who is sufficiently qualified and experienced to enter upon gold prospecting per se.

Graphite.

Graphite or Plumbago is another mineral substance not uncommon in the Island, but the manufacture of artificial graphite from coke is now superceding the natural product in the markets to a considerable extent. The uses of graphite are too well known to require mention here.

Granite.

I could obtain no returns from the Topsail Granite Quarries for the past year, but was informed indirectly that some 600 tons

*Since the above was written the returns have been received (see tables).

†Quite recently most favourable assays have been received.

had been taken out most of which was used in the constructing of the new R. R. bridge over the Exploits River. Mr. W. Ellis who has entered into a contract for supplying granite to be used in the construction of the new Court House informs me that his output from the quarry at Petites amounted to about $2,500,00 worth last season. The utilization of this durable and handsome rock in the new building will I have no doubt prove a standing advertisement of the superiority of the native material over any imported article of the kind.

Gypsum.

The immense deposits of this material in the District of Bay St. George still remain unproductive. Between the years 1891 and 1894 gypsum to the value of $4,300.00 was exported to the United States from the above mentioned locality, but since then nothing further has been done to develop the industry. That there is practically an inexhaustible quantity of gypsum of excellent quality in the region in question has been frequently set forth in former reports, and there is no adequate reason why these deposits should not be contributing to the mineral production of the country. In Canada in 1898 gypsum to the value of $232,515.00 was quarried and sent to market.

Iron.

The Bell Island Iron Mines scarcely need any reference, their great value and importance being now a matter of world wide fame The enormous quantity of ore so unique in the character of its mode of occurrence, so easily and cheaply mined, and its proved adaptability for the manufacture of first class pig iron and steel has established for the ore a reputation which is likely to hold. Last year the Dominion Iron and Steel Company who had purchased the principal ore band from the Nova Scotia Steel Co., commenced active operations and were preparing to ship large quantities of ore to their new reducing works at Sydney, C. B., while the latter company began to operate the upper band of ore, and had constructed a new tramway and pier for loading purposes further west on the Island. The strike of the miners referred to previously in this report greatly retarded the work on both mines however, with the result shown. Now that all differences have been adjusted there is every prospect of a vast increase in the output from both mines the present season. Already several cargoes of ore have been shipped off at a much earlier date than usual. The gigantic proportions of the new smelting works at Sydney and the vast possibilities outlined for its future is intimately associated with our own iron ore development seeing that these works are dependent to a great extent for their supply of the raw material from this country. Might it not be a very pertinent question to ask in view of these facts why Newfoundland should not have a similar industry established. Iron ores are not confined to Bell Island by any means. They are about the most universally distributed minerals we posses. New finds are constantly being made, and the enormous bodies of Magnetite known to exist on the western side of the Island in close proximity to our best Coal deposits should, if properly exploited, prove an incentive to capitalists to enter upon such an industry here.

A recent writer on the subject of the "Future of the Iron and Steel Industry," in the Canadian Mining Review for April, 1901, speaking of the growing increase in the consumption of pig-iron of late years, and of the outlook for this industry in the near future, predicts an enormous demand, probably reaching not less than 60,000,000 tons within the next decade. "Viewing the situation on the North American continent," the writer affirms that, "the United States must supply the greater part of this increase in the world's output." Concerning Canada he says: "The recent opening of vast deposits of rich steel ores in the Maritime provinces of Canada, close to deep water, may enable Great Britain to keep in line, but as these deposits are adjacent to abundant deposits of coking coal and limestone, perhaps British iron and steel works may have to be in part removed to this continent in order to continue."

Were we in a position to offer a small bounty upon the production of pig-iron in the Colony, manufactured from our own ores, the day might not be far distant when we would see smelting works erected at the most favorable localities, and who can doubt what the effect would be upon the building up of the prosperity of the country. It is by such a fostering policy that the Dominion Government, a few years since gave an impetus to an iron manufacturing industry which is growing rapidly within its borders and is destined to become one of the chief factors in the building up of this vast new world Empire.

Lead.

Ores of lead chiefly Galena, are known to occur at many points and in most of the great bays indenting the coast line. Several attempts have been made from time to time to establish mines of this ore, the most notable being those at La Manche, Lawn and Little Placentia, in Placentia Bay. The first and last named seemed to give every promise of being really good properties. Between the years 1857 and 1868 some 2,375 tons of galena were extracted from the La Manche Mine which was a yield of 2.37 tons per fathom of ground excavated. The ore occurs in a well defined fissure vein of mixed calc and fluorspar, with a little quartz and sulphate of barytes, and it averaged about 3 feet in width. Its attitude was nearly vertical and it runs very straight, and with great persistency for a mile or more. The only time I ever visited this mine was in 1868, in company with the late Alexander Murray, C.M.G., F.G.S. This was shortly before it closed down. I then made a cursory inspection of the underground works and to all appearances it gave me the impression of being a very valuable deposit. The Silver Cliff Mine at Little Placentia, was operated for a few years only and then abandoned. A few desultory attempts were subsequently made to re-open it, but it has now been closed for the past two years. This ore proved to be highly argentiferous, some specimens yielding as much as 336 ozs. of silver per ton. The prospects of this mine, like those of La Manche, certainly at one time looked most favourable, and I am greatly inclined to the opinion that in both cases, it was not so much the absence of paying quantities of ore that occasioned the closing down, as that already adverted to, much to be regretted, absence of skilled scientific management.

Manganese.

The low grade Manganese deposits on the South side of Conception Bay are at length receiving attention. The adaptability of this class of ore to the manufacture of spegeleisen and ferromanganese, two substances now largely used in the production of the better classes of steel, has directed the attention of the Dominion Steel Co., to this convenient source of supply, in connection with their operations at Bell Island. Should the ore on trial, prove suitable for the purpose, a new industry will shortly be established in Conception Bay, bidding fair to equal that of Bell Island. Already several men are at work opening up the deposits, and the latest reports from the locality are of the most favorable nature.

Manganese is a mineral that may be reasonably looked for in several other districts of the country, as its presence is frequently indicated by coatings of oxide covering the rocks at many points. Wad or bog manganese may be seen on the surface of the ground in a great many places, and is often encountered amongst the debris in the beds of shallow streams. The deposit of mixed iron and manganese at Fortune Harbor, Notre Dame Bay, from which a shipment of 1,500 tons was made in 1897, has I understand been leased by the Newfoundland Exploration Company from Mr. W. Cook, and is again about to be operated. It is to be hoped this new venture will prove more successful than the former attempt.

MISPICKEL.

Mispickel or Arsenical pyrites is a mineral substance of very common occurrence and usually contains a small percentage of gold. The extraction of the precious metal is however difficult owing to the refractory nature of the compound. The treatment of such ores requires an expensive process, and unless gold to paying quantity is present, few capitalists are likely to handle it. In this however, as in other metallurgical operations, science is every day discovering new modes of treatment, and it goes without saying that ere long it will succeed in economically extracting from all these baser refractory substances their gold and silver contents.

Some years ago Capt. Stewart opened up a large lode of Arsenical pyrites ore at Moreton's Harbor, New World Island, N. D. B. An assay of this ore by Martin & Pettybridge of London, England, gave the following result:

Silica	3.98 per cent.
Lime	.97
Phosphoric Anhydride	.14

Manganese Dioxide	2.39		
Metallic Iron	47.64		
Sulphur	29.11		
Metallic Arsenic	15.717		
Loss	.053		
	ozs.	dwts.	grs.
Gold per ton	0	7	14
Silver per ton	0	18	9

A small shipment of this ore was made in 1897, but no returns were received. During last winter Capt. Stewart has been again at work sinking a shaft upon the lode, and by last accounts was down about 108 or 110 feet. The lode is reported to have averaged 18 inches solid ore throughout.

Molybdenite.

This mineral which is somewhat rare, at least in large deposits, is found at a few places in this Island. Some enquiries in reference to it were directed to me during the past year. The metal Molybdenum extracted from this ore, is now taking the place of Tungsten in the manufacture of certain special high class steels. Ferromolybdenum or its combination with iron is now an article of regular production in the United States. The steel produced therefrom as well as the Tungsten steel, is chiefly employed in the manufacture of cutting tools where extra hard material is required. Tests made with both the above mentioned substances have given varying results, but it is conceded that molybdenum possesses many qualities which render it fully equal to if not superior to Tungsten. It is therefore likely ere long, to take the place of the latter expensive and comparatively rare material in the market.

Nickel.

Between the years 1860 and 1876 some [illegible] tons of Nickel ore were shipped from the Tilt Cove Mine, valued at $32,740.00. Since that time there have been no returns of any further shipments either from this or any other locality in the Island. The Pyrrhotite or magnetic pyrites ores which occur abundantly in many parts of Notre Dame Bay and elsewhere, have proved by analysis to be with few exceptions nickeliferous. Although the per centage of metallic nickel is usually small, not showing a sufficient amount to render the ores commercially valuable, still its presence at all should prove an incentive to prospectors to look more closely after this class of ore, when better results may be attained.

The great Nickel industry of Sudbury in Canada is founded upon the occurrence of similar nickeliferous pyrrhotite, whose tenor in nickel ranges from 2 to 5 per cent. only, and averages but 3.52 per cent. Whether any of our ores come up to this figure, is a matter which can only be determined by an extensive series of analysis of specimens from many different localities.

PEAT.

Peat, properly speaking is a purely vegetable substance, but as an economic material is usually classed with minerals, as are Coal, Petroleum, etc. The question of substituting peat for fuel in lieu of coal, at all events for domestic purposes, is one that has long occupied the attention of the inhabitants of countries where coal is either absent altogether, or otherwise scarce. Such countries possess an abundance of peat and as its chief constituents are to all intents similar, it only remains for man's ingenuity to perfect and put in operation some apparatus which is able to effect, in a small way, what nature has done on the larger scale in the production of coal. The rapidly increasing consumption of the latter for smelting purposes indicates the approach of a period when as a household fuel it will be of such an expensive character, as to preclude its use, except by the wealthy. This stage has already been reached in many countries, and here in Newfoundland, it is a very serious matter to contemplate, especially in view of the rapid depletion of our forests. Necessity will compel us ere long to turn our attention to some other source of fuel for domestic purposes, and it is clearly to our abundant supply of peat we will have to turn.

The manufacture of peat fuel, it is claimed, is now placed beyond the experimental stage. In Holland, Denmark, Germany and other European countries, many apparatus for this purpose have been patented, each of which has its particular merits. Possibly a combination of them may produce machines having all the requirements sought for. By some of these patents it has been possible to produce peat coal which compared favorably with ordinary bitumenous coal, but this process is said to be too expensive, and moreover the peat was found to lose some of its calorific value.

A peat briquette factory in Pomerania, Prussia, claims to be a complete success. This factory, says "The Mineral Industry," turns out 80 briquettes per minute, or 35 tons per day, with an average output of about 12,775 tons per annum, and the demand is far greater than the supply. The cost of production is about $1.70 a ton, and it is believed with larger plant it can be reduced to about $1.20.

In Canada, the Trent Valley Peat-fuel Co., and several other smaller concerns have been experimenting the past few years, and some claim complete success. New patents, and improvements on old ones have been taken out, of which that machine known as Dickson's patent appears to possess almost all the necessary requirements. It is claimed here again, by some of the fuel manufacturers that they can produce for at least $1.00 per ton if not less. One individual, in reply to queries addressed to him by the Mining Bureau of Ontario, says he has no difficulty in finding a ready market for all he can produce. He gets $3.00 per ton at the works, and adds that his customers think well of the fuel. Some who use this material consider it as good as coal and prefer it because of the absence of smoke and clinker. One thing which has been satisfactorily determined with regard to this peat fuel is, that while it can scarcely be claimed that it comes up to the better qualities of household coals for domestic purposes, yet its calorific value exceeds that of wood, and is fully equal to much of the coal in ordinary use.

The Bureau of Mines of Ontario have now detailed a specialist to enquire into the whole question of the peat fuel industry in that Province, which they consider one of very great importance, especially in view of the fact that they possess no coal resources of their own. This report when completed, will not doubt prove to be one of very great interest, and as I have been promised a copy of it, I am looking forward with much pleasure to its perusal.

In the meantime I would like to draw the special attention of our local capitalists to this matter. It does appear to me that in this direction a very promising opening presents itself for the investment of money, with coal at almost prohibitive prices in our markets, and very little prospect of its being any cheaper in the near future.

Could a fuel, at least equal to the inferior qualities of foreign imported coal, be placed upon our markets at reasonable prices, say from $2.50 to $3.00 per ton, it would prove a great boon to the poor, and could scarcely fail to furnish a nice margin of profit to the investors. The plant required for its manufacture is simple and inexpensive. The same person who furnished the Bureau of Mines with the information quoted above, also states that his plant could be duplicated for $8,000.00.

Peat serves many other useful purposes besides that of fuel, and is extensively utilized in some of the continental countries of Europe, where it is an article of considerable commercial value. The half decomposed fibrous, upper layers of the peat bogs, when thoroughly dried, make the very choicest litter for cattle. Its absorbent quality tends to keep the animals clean and dry, while the same property, when used in stables, renders it a valuable fertilizer. It also possesses disinfecting properties and is utilized with good effect as an antiseptic in hospitals, etc.

To enumerate all the possibilities of this valuable, yet heretofore much despised gift of Nature, would be beyond the limits of this report. It is sufficient to say that its utility is becoming more and more fully recognized, every year, and in Canada it is expected ere long to take an important place in connection with the industrial pursuits of the country.

PETROLEUM.

No direct information could be obtained of the boring operations at Port a Port, for the past year or two, and it is only through reference to the reports of the United States Geological Survey, that I can obtain anything definite. According to this report, "There were four wells drilled in 1898. Three of these struck oil at from 136 to 684 feet in moderate quantities. The shallow well is said to have produced ten barrels per day for a month. The colour of the oil is dark amber, the gravity 33° Baume, and it seems to have good lubricating qualities."

The Parson's Pond Oil Company engaged the services of an expert oil driller last season, and purchased a new outfit of the latest and most approved pattern, with the intention of carrying out extensive boring operations on their claims. Owing to unlooked for delay in the delivery of the machinery, and the consequent lateness of the season when all was safely deposited upon the ground. the expert concluded it would be preferable to await another season before beginning work. He has recently returned to this country and is now I believe on the ground. Great hopes are entertained of a successful issue from this present attempt, with much probability of their being realized The three wells previously bored in this locality all showed oil in greater or less quantity. The first after being shot, is said to have yielded 18 barrels of oil in the space of some forty or fifty minutes pumping.

There can be no doubt now, that the pyro schists at the base of the Silurian series, along the Western coast of this Island are frequently oil bearing, but to what extent has yet to be determined. Judging from the few trial borings that have so far been made, they certainly give fair promise of eventually turning out productive. So far as I can learn no well yet sunk in these schists has failed to show some sign of oil, and when it is considered that in Canada even the best wells do not average a barrel per day of 24 hours (in the case of the Petrolia oil field it is less than onequarter of a barrel daily) there is good reason to look forward with hope to the future of our local oil fields. According to the latest Canadian statistics at hand, I find that there are 7,000 wells in the Petrolia fields, 1,600 in Oil Springs field, their combined production aproximating 57,000 barrels per month or about 6.63 barrels per individual well. The other smaller oil fields in the same neighborhood do not even come up to this yield, but of course the annual production of all combined is in the aggregate a large output.

PYRITE.

As has already been stated the closing down of the Pilley's Island Pyrite Mine caused a very marked deficit in the value of our mineral products last year. An attempt has recently been made to re-open this mine by the Newfoundland Exploration Co., with what results remains to be seen. The same company have leased the old Terra Nova Mine at Bay Verte, where a large body of pyrites carrying about 1½ per cent. of copper is known to exist. It is more than likely this property will be operated the coming season.

Pyrites, fairly high in Sulphur is a common mineral, and may be encountered in almost every district of the Island, and we may fairly assume that other mines of this ore will be established in course of time. It is reported also as an abundant mineral on Labrador, and one property at least is about to be opened up there this summer.

SALT.

Saline springs are of frequent occurrence amongst the Lower Carboniferous series in the district of Bay St. George, more especially in the neighborhood of the gypsiferous deposits, with which they seem to have an intimate connection. Some of those springs are intensely saline, and their overflow causes a coating of fine white salt to be deposited upon the rock surfaces in their vicinity, by the evaporation of the water during the dry summer season. I believe much salt could be obtained from this source by a proper system of treatment of the brine. Possibly deposits of rock salt underlie these springs. Even so now a days, it is found more economical in most cases to dissolve out the salt from such deposits, pump it into tanks, purify it by the addition of calcium chloride, filtre and evaporate it in specially provided pans, and then dry it for market.

There appears no good reason why a small but paying industry might not be established in the preparation of this useful article of consumption in the district referred to.

SLATE.

The revival of the slate industry in Smith's Sound last year, was due chiefly to the visit of Prof. Walcott to this country the previous season. He was so taken with the superior quality of the slate in that section, that upon his return to the United States he brought its merits before some of the slate manufacturers there, with the result that Mr. Willis the present owner of the property came down to inspect it, and shortly afterwards purchased out the quarries from the original owners.

These slates belong to the Lower Cambrian series of rocks, the same in which the celebrated Carnarvan slates occur, and from whence also some of the best material in the United States is derived. The series occupies several extensive areas in Newfoundland, and it is not reasonable to expect the occurrence of good roofing material at other points of their distribution.

Last year, as may be seen by the tabular statement, some 600 tons were shipped to the London market, which I am informed met with a ready sale. Operations are now being prosecuted vigorously at the Quarries in Smith's Sound, and the coming season will no doubt witness a largely increased output. The colour of this slate is chiefly dark purple inclining to red, but there is also in the same locality a smaller proportion of unfading green slate which fetches a higher price, and is looked upon with much favor.

Stone.

Stone fit for building, structural and ornamental purposes is abundant in many parts of the Island. Sandstones of many colours, and various degrees of texture are very common in the Lower Carboniferous series of Codroy and Bay St. George districts. Limestones also abound in the same region, some of which would make handsome marbles, while others are well adapted for burning into lime. Serpentines of many varieties, and often of great beauty are met with amongst the magnesian group or metamorphic series, wherever the latter attain any considerable development. A very beautiful green variety, of an attractive appearance, admirable for ornamenetal purposes, comes from Tilt Cove in the vicinity of the copper mine. The well known Signal Hill stone near St. John's is extensively used for building purposes, and for rough work can scarcely be excelled. An infinite variety of other stones suitable for almost any purpose to which stone can be applied, exists in many parts of the Island, and the time must soon arrive when the importation of stone for structural work of any kind should cease.

Soapstone.

Many varieties of this useful material exist in connection with the serpentine deposits, which occupy such large tracts of the country, and seeing the many useful purposes to which it is applied in other countries there should be a market for at least the better qualities of steatite, etc., both in Europe and America.

Titanite.

A beautiful specimen of this material has recently been presented to the Museum by Mr. Pippy of this city, which came from the Labrador. Although of no present commercial importance, for economic purposes, titanic acid is used to a small extent in the arts, and recent experiments with titanium in combination with aluminum, chromium, and copper produced some very hard and tough alloys. Possibly in this and similar directions, a use will be found ere long for the material. There are other ores of titanium such as Rutile and Ilmenite found in the neighborhood of White Bay, but they are of somewhat rare occurrence. The former has been employed in painting on porcelain, and in giving the requisite colour and enamel appearance to artificial teeth.

Zinc.

Ores of zinc such as blende, sphalerite, calamine are known to exist at several points, but so far but little attention has been paid to them, and whether they occur in economic quantities or not has never been determined. Zinc is a very useful and valuable material and the demand for the raw material is in excess of the supply in all the markets. This fact should stimulate prospectors to search diligently for the ores, which there is reason to believe this country will eventually number amongst its valuable natural products.

Miscellaneous Products.

There are many such which as yet with few exceptions have not been brought into practical utility. Clays suitable for brick and tile manufacture abound. Fire clays, terra-cotta, and kaolin are known to exist, the two former being of frequent occurrence amongst the Carboniferous series on the West side of the Island. Lithographic stone of good quality has also been obtained from the same series. Limestone suitable for burning into lime and fluxing metallic ores is abundant. Some of this stone has been utilized for many years for the above purposes, but I never could obtain any reliable returns as to the amount or value. Sand of all colours and of various degrees of fineness possessing all the requisites for the manufacture into cement mortar, etc., may be encountered in almost every section of the Island. In the immediate vicinity of the Grand Lake there is an enormous depth of fine sand, some of which would evidently serve the purpose of triplite. Mica and phosphate rock or Apatite have only been found in small quantity as yet, but no systematic search has ever been instituted for either of these substances, nor is there any reason why they may not occur in paying quantity.

Materials applicable to the fine arts and for jewellery are not uncommon. Red and yellow ochres, as well as other substances now largely used as pigments, are awaiting the enterprise of some person versed in their preparation to be turned to account.

Many beautiful ornamental stones may be encountered in various parts of the country, such as red, yellow and variegated jaspers, amethystine and opalescent quartz, handsome porphyries, syenites, traps, amygdaloids, and a variety of other rocks too numerous to specify. From time to time I have brought in many specimens of these, some of which have been given to jewellers and others who have had them cut and polished, and set in brooches, pins, pendants, or other forms of ornament. Some of the combinations produced were very beautiful, and it appears to me that quite a lucrative trade might be established in this line, could the materials be worked up in this country. The advent of so many tourists to the country of late years, and the certainty of an increased influx every succeeding year points to a possible large demand for souvenirs of this character. It might be well for some of our jewellers to turn their attention to this matter. A diamond cutting wheel for the preparation of the rough material can be had for a comparatively small figure.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XXI.

Report for 1901.—The Mineral Statistics of Newfoundland.

St. John's,
February 20th, 1902.

ELI DAWE, Esq.,
Minister of Agriculture and Mines.

SIR,—With the commencement of the new century, Newfoundland has made a good beginning in the development of her mineral resources.

For a country possessing so small a population, a mere modicum of whom are engaged in this industry, her showing for the year 1901, as may be seen by the following figures, will bear favorable comparison with many more thoroughly developed and well established mineral regions.

It was predicted in my last report that the value of the coming year's mineral products would probably greatly exceed that of any preceding year, which prediction has been amply fulfilled.

The total value of the output for the year 1901, of the crude materials at the mines and quarries, amounted to the handsome sum of $1,211,163, being in excess of that of 1900 by $419,154.

The chief factor in bringing about the above result has been the large production of iron ore at the Bell Island mines, which reached a total of 738,206 tons, which, estimated at the same number of dollars only fell short of the entire value of the preceding year's mineral output by $53,893.

There has also been an increase in the production of copper ore. Tilt Cove alone shipped 74,808 tons as against 66,959 tons in 1900. From Little Bay and Colchester mines, there were shipped 440 tons, and from Blo-mi-down mine, York Harbor, 100 tons, bringing the total up to 75,348 tons. So far from the copper production decreasing, it will be seen by reference to former reports that at no time in the history of the enterprise has this large output been exceeded, except in 1899, when it reached 86,957 tons. This was, however, due to the holding over of reserves from former years to await the anticipated rise in the price of copper.

The re-opening of the Pilley's Island pyrites mine by the Newfoundland Exploration Syndicate proves conclusively that this latter mine is by no means exhausted. Mr. C. F. Taylor informs me that new ore bodies have been struck, and a diamond drill is now at work proving them. About 150 men are at work during the winter taking out ore, and it is expected that two or three cargoes will be ready for shipment in the spring. One small cargo of pyrites was exported during the season from Little Bay Mine.

The large deposit of pyrites near Ramah, Labrador, mentioned in last year's report, has, I understand, been tested during the summer. The ore is said to be of excellent quality, averaging about 50 per cent. in sulphur, and the mineral band is reported to be of great extent. The principal drawback to successful mining would appear to be the shortness of the shipping season, owing to the presence of floe-ice up to so late a period in summer.

Another pyrites deposit, from which some fine specimens were procured, is situated on an island in St. John's Bay, west coast of Newfoundland, but no development sufficient to determine the prospective value has as yet taken place.

It is pleasing to be in a position to record the fact that other mineral products, not hitherto looked upon as of much importance, are beginning to attract attention, and in some cases the activity and enterprise displayed in exploiting them is reaping a deserved reward. This is particularly noticeable in the manufacture of brick and slate. There are now four brickyards in operation in Smith's and Random Sounds, the combined output from which the last year reached 1,305,000, being an increase of 505,000 over the production of 1900.

The operations at the Wilton Grove slate quarry in Smith's Sound were actively prosecuted during the year, resulting in a large increase in the manufacture and exportation of roofing slate. The output was about 2,000 tons, equal to 6,000 squares, valued at $22,500. The slate is made in two sizes, 29x10 and 24x12. It was all shipped to the English market, the former to Newcastle, the latter to London, where a ready sale at remunerative prices was obtained for it. This quarry is now a well established industry. I paid it a visit last autumn, and was surprised at the work being accomplished.

A fine pier was in course of construction along the water front, being filled in with the waste from the slate. Vessels of almost any size could lie alongside within a stone's throw of the quarry, and in perfect safety. A large space immediately in the rear is used for storage purposes, where a splendid display of slate lay piled in tiers awaiting shipment. About 50 men were busily engaged with Ingersol steam-drills quarrying huge slabs from the cliff. These were swung by derricks on to trollies in waiting, and quickly removed to the sheds, where a number of Welsh slaters were busy cleaving and dressing the material into the required dimensions for roofing purposes.

So far, no attempt has been made to manufacture any of the other articles for which this slate is equally well adapted, but I understand the plant requisite for such purposes is soon to be installed.

The slate is of various shades of colour, dark purple prevailing, but there is also a band of pale sea-green of beautiful texture. The quarry is of immense proportions, and there is sufficient material in sight to last for generations.

Several new deposits have been located within the past season, similar in geological age to that of the Smith's Sound quarry. Some of the large Welsh firms are beginning to take an interest in the possibilities of this country as a slate producer, little, if anything inferior to their own. One of those firms informs me that our slate is much superior to any imported into Great Britain from foreign countries. They add that "there is a great future for slate in Newfoundland."

Few people are aware what a gigantic industry the manufacture of slate is in the United Kingdom. In 1900 the total quantity produced in the British Islands was 585,859 tons, valued at the immense sum of £1,528,336 stg., or equal to about $7,336,613 of our money. Of this large production all but £147,800 worth was used within the kingdom itself besides which there was a large importation.

In the matter of structural material, such as building stone, granite, etc., it is pleasing to note that the superiority of native stone is beginning to assert itself. During the past season a marked increase is manifest in the quantity quarried and utilized in the several public and other structures in course of erection. The new

Court House is being entirely constructed of sandstone from Kelley's Island, Conception Bay, faced with syenite from Mr. Ellis' quarry near Petites, South Coast. These form an excellent contrast, and their durable character is unquestionable.

A more than usually large quantity of the Signal Hill stone was utilized the past season, owing to the construction of the new wing to the Lunatic Asylum creating an extra demand for it.

Reliable statistics of the amount and value of the annual production of this latter stone are difficult to obtain, and the figures given can only be considered as approximate. The industry is conducted by a number of individuals, chiefly farmers, who utilize their slack time in quarrying the stone for sale when in demand. The total sum realized each season must in the aggregate be quite considerable.

The Reid Newfoundland Company vigorously prosecuted work at their granite quarry near the Topsails during the greater part of the summer. Much of the material raised was utilized in bridge construction, and a large amount was dressed for the new station to be erected at Riverhead. They also manufactured 140,000 passing blocks for the laying down of Water Street.

As there is an abundant supply of admirable building material in endless variety, readily obtainable in many parts of the island, we are not likely to witness such importations of foreign stone as formerly in the future.

It is to be regretted that the result of the boring operations at Parsons' Pond for petroleum have not proved as successful as was anticipated. The Company prosecuting these tests have gone to great expense, and are deserving of better success. Their effort to prove the existence of oil in economic quantity in that region might well form the subject of assistance from the public funds. The establishing beyond question of an oil region in that locality would mean much for that industry in the island, whereas a discontinuance of the attempt at this juncture, though by no means to be looked upon as a complete failure, may have the effect of discouraging further operations, and thereby leave it to be inferred that petroleum is not to be reckoned as amongst the possible resources of the country. I do not think this would be a justifiable conclusion to arrive at in view of the results already attained.

I have been unable to obtain any information relative to the drilling operations carried on in Port-a-Port Bay, but presume these also have not come up to expectation.

That petroleum exists in both localities has been amply demonstrated, and I feel warranted in expressing the belief that persistent effort will yet be attended with success.

When it is remembered that in Canada many holes annually drilled prove unproductive, and while there are now some 10,000 wells yielding oil, they are all pumping wells, only averaging about one-quarter of a barrel each, daily, I do not see any reason to lose hope.

I am again indebted to the managers of the various mines in operation for their courtesy in supplying the necessary information to enable me to compile these statistics. I have also to thank the following gentlemen for information relative to the minor industries coming under the same head, viz.: Messrs. Job Brothers and Davey Brothers, George Pilley, Smith Brothers, and James Pittman, relative to brick manufacture; Harvey & Co. and Mr. Willis, *re* slate; the Reid Newfoundland Company, Wm. Ellis, Kennedy Brothers and J. Ledrew, *re* building stone; J. Score, *re* lime; to Mr. H. LeMessurier, Assistant Collector of Customs, for returns from his Department, and other parties from whom various items of information were obtained.

The following tables, which present the chief features of the mineral industry during the year, will, I trust, afford some useful and interesting facts in regard to this growing and important industry, showing its rapid growth and present condition.

TABLE I.

Mineral Production of Newfoundland for the Calendar Year, 1901.

Product	Quantity Raised	Manu'factrd or used in country	Exported to what Market.	Value at Mine, $
Brick...........	1,305,000	1,305,000	....	13,050
Building Stone.	5,000 ts.	5,000 ts	....	5,000
Cobble "	500 "	500 "	....	500
Copper ore.......	75,348 "	....	36,641 to Gt. Britain 35,167 to New York 540 to Pictou, N.S.	360,094
Granite...........	3,240 ts.	3,240 "	....	19,710
Iron ore..........	738,206 "	....	35,830 to Gt. Britain 213,335 to Germany .. 408,617 to Canada...... 76,860 to U. States...	738,206
Limestone........	1,300 "	7,800 "	....	975
Paving Stone...	... ...	140,000 bl.	....	14,128
Pyrite	7,532 ts.	....	7,532 to New York...	37,128
Slate.......	2,000 "	6,000 sq.	6,000 to Gt. Britain...	22,500

Total Value, $1,211,163

TABLE II.

Showing Increase and Decrease in 1901 *as Compared with* 1900.

PRODUCT	QUANTITY		VALUE	
	Increase	Decrease	Increase	Decrease
Brick	305,000	....	1,850	
Building Stone.	4,500 ts.	....	4,500	
Copper ore..........	4,734 "	....	....	39,681
Granite	2,615 "	....	17,210	
Iron ore..............	417,743 "	....	417,743	
Lime...	7,800 bls.	....	975	
Paving Stone........	140,000 bks	....	14,000	
Pyrite..................	7,532 ts.	....	37,128	
Slate...................	1,400 "	....	11,700	

The above tables are based upon the very most reliable information that is obtainable as to the quantities and value of the raw materials exported from, or made use of in, the country. It will be seen that they indicate an increased output all around. In the case of copper ore only, although the amount shipped was in excess of that of the previous year, there was a slight falling off in the value. This was owing to a depreciation in the price of metallic copper during the year; nevertheless, the output exceeded that of any season since the initiation of copper mining in the country, with the single exception of that of 1899, when it reached the large figure of 86,957 tons. In the latter year copper had attained to an abnormally high price; and to obtain the benefit of this, all reserves of ore held over were sent to market.

An analysis of the figures now presented indicates a condition of this important industry with which all interested in the country's welfare must feel pleased. It shows an increase in value over the preceding year of 52.9 per cent., a result unequalled by any other of the country's industrial pursuits.

If we assume the present population of the island to be about 200,000, the per capita value would be $6.05. In 1891, when the last decennial census was taken, it only amounted to $3.19 per head of the population, showing that it has more than doubled in the interim. Assuming again, that the actual number of persons engaged in mining last year was about 2,000, the figures represent an earning power of $605.10 per head, which is far in excess of any other source of employment the country affords, not excepting the great fisheries. The annual outcome of this, the country's staple resource, is, in round numbers, about $8,000,000. There are about 40,000 persons engaged in prosecuting the industry, consequently, their earning power represents about $200 per head, and apparently the fisheries are at a standstill.

It will be thus seen that mining, though as yet only in its initial stage, as it were, is destined to outstrip all the other industrial pursuits of the island in course of time. What might it not have been to-day, had it been in existence since the earliest settlement, or had it received a similar measure of attention and encouragement to that bestowed upon the fisheries no person can form the least idea, nor yet what it may arrie vat a half a century hence.

In the comparative table, No. III., the estimates are based, as formerly, upon the metallic contents of the ores, where these could be ascertained, and the selling price of the same in the principle markets of the world. This is the final value of the country's mineral products when reduced to the metallic state, but does not take into account the cost of mining, freight, smelting charges, etc., none of which are within my reach.

This table is intended to show in the first place: the rapid growth of the industry within recent years; and in the second: what might be the result could the manufacture of these ores be carried out in the country itself. There was a time when our copper ores were smelted here, producing a high-grade regulus, and afterwards ingot copper; but, for some unknown reason, the attempt was subsequently abandoned. It is to be regretted that some steps were not taken to ensure a continuance of this enterprise in our midst.

It appears to me there is an opening here for a great smelting industry at some central point in Notre Dame Bay; more especially if the coal seams near Grand Lake were utilized for the purpose. Many small copper deposits, not sufficiently extensive in themselves to warrant mining on a large scale, could be made to pay handsomely were a ready market for the raw ore available in their immediate vicinity.

I have frequently adverted to this subject before, and as I am a firm believer in its practicability, perhaps a repetition may lead in the end to attracting the attention of capitalists to what I conceive to be an enterprise holding out much promise of profitable investment.

Our Iron Ore Industry.

The enormous growth in the iron and steel industry of late years, both in Europe and America, has given an impetus to iron mining the world over, in which Newfoundland has participated to such an extent that iron ore now ranks foremost among her mineral productions.

Heretofore copper ore claimed this place, and though it has not diminished in quantity, but, on the contrary, is on the increase, yet it has been completely outstripped by the production of iron ore at the Bell Island Mines. The figures of the foregoing tables reveal the fact that, not only has the output of the latter for the year just passed more than doubled in value that of the copper, but that it only falls short of the total value of all the mineral products in 1900 by $54,893. It is probable the coming year will witness a still further increase, and that nothing short of 1,000,000 tons will be the outcome.

In view of the enormous demand for iron products and the almost absolute certainty of its continuance, any country so favorably situated as Newfoundland, possessing an abundant supply of cheap iron ores, cannot fail to reap the benefit therefrom in the near future. The fact that pig iron and steel produced from Bell Island ore can be placed upon the market at $5 or $6 a ton less than any other, as has been demonstrated, must inevitably draw attention to this country's superior advantages in this respect.

Britain's home production is on the decline; her foreign sources of ore supply are diminishing. American manufacturers ever ready to take advantage of such conditions, are rapidly forcing their iron products upon her markets. Their phenomenai ore deposits, use of labor-saving machinery, both in mining and converting the ores into marketable condition enables them to do this, and compete successfully with the foremost manufacturing nations in the world.

If Britain hopes to hold her own, or retain her position as a great iron producer, it is pretty evident that it is only by turning attention to her colonies and utilizing their rich ore deposits she can hope to do so. When this fact becomes fully realized by the mother country, then must Newfoundland's opportunity come. Most certainly, no colony under the British flag holds a superior position in this respect.

It is not to be supposed for a moment that the Bell Island deposits constitute the only iron resources of the country; though it is not probable that others of an exactly similar character do exist. It is at least known that magnetite and clay ironstone are found in available quantities on the western side of the island, and the abundant indications of the mineral in several other localities will assuredly lead to important discoveries when systematic prospecting for this class of ore takes place.

Any country posessing iron and coal has within itself two of the most potential factors upon which to base an industrial prosperity. Mr. Moxham of the Dominion Iron and Steel Company has shown, that by a combination of most favorable circumstances his company is enabled to assemble at Sydney, Cape Breton, the three principal elements required in the production of pig iron, at the lowest possible cost for raw materials. Owing to the situation of their plant at tide-water, and their exemption from expensive railway carriage, they are thus placed in a position to produce the cheapest iron in the world. Bell Island is, however, their chief source of supply of ore.

Since, then, Newfoundland possesses the iron, coal and limestone all within her own borders, it does seem very apparent that she presents a still more favorable field than even Cape Breton for the establishment of such an industry.

Nature has certainly done its part in providing all the necessary ingredients, with magnificent harbors, open water-ways and proximity to the principal European markets. These considerations should place her first before all the colonies as a field for the development of a great iron trade. The establishment of such an industry here would place the country upon a pinnacle of advancement and prosperity, not hitherto dreamed of.

Our Copper Ore Industry.

Although the copper markets have been in a disorganized condition of late, and prices have fallen considerably, this is believed to be only temporary.

The chief causes of these fluctuations are not due so much to a depreciation in the value of the metal as to the action of certain stock-jobbers; especially, a syndicate known as the Amalgamated Copper Company. This syndicate made a bold attempt to corner the market by buying up all the metal they could lay hands upon; and holding it so as to enable them to dictate prices. Not content with this, they made a bid for the chief sources of supply of the raw ore; but when they approached such concerns as the Calumet and Hecla and Rio Tinto companies, they met with a rebuff which caused a collapse. A slump in the price of copper was the immediate result. They were obliged to dispose of their accumulated stocks at reduced prices, and the inflated condition of the market ceased for the time being.

It is also understood that the demand for copper in such industries as it is chiefly made use of, especially in Europe, was not so brisk as it was the preceding year. The probable truth is, that the sudden collapse of the great copper combine threw upon the market an enormous amount of accumulated metal held by them.

Whatever may be the true cause, copper has certainly taken a downward tendency for the present; but, it is believed, when it has reached its normal value of a few years ago, it is likely the present deranged condition of the market will re-right itself.

The immense demand for the metal in electrical appliances, will most certainly continue to increase proportionately with the utlization of this great modern motive power; nor is it at all likely that prices will ever again touch so low a figure as they did some fifteen or twenty years ago.

The marked improvements in copper metallurgy of late, have rendered the economic treatment of low grade ores possible; so that deposits which could not be handled a decade ago, are now attracting capital to their development.

In the matter of ore concentration, great improvements have been achieved, and new methods are constantly being patented. One of the simplest and most effective of these adapted to the treatment of most metallic ores, but especially to sulphides, is the concentration by means of oil. If all that is claimed for it be true, it seems to point to a great revolution in the treatment of such ores as contain rich metallic substances, but sparcely disseminated in the matrix. Where they contain an appreciable amount of the precious metals, as is not infrequently the case, their utilization becomes all the more profitable.

This patent, which is known as the Elmore process, consists in the treatment of the slimes with oil in a series of revolving cylinders, whereby the fine metallic particles are taken up by the oil, which floats off into a receiver, carrying the metal with it. From 80 to 85 per cent. of the metallic contents of the ore are said to be saved, where hitherto, under the method of concentration by water, a large percentage was lost owing to the lighter particles floating away.

The patent has been installed at the Glasdir mine, North Wales, where it has given every satisfaction. Here an ore containing only 1.12 per cent. of copper, with a small amount of gold and silver per ton, was treated with such marked success that, when 14 tons were concentrated into one ton, it contained 70 per cent. of the copper, 69 per cent. of the gold, and 65 per cent. of the silver. The company believe that by this process their property will be converted from a non-dividend paying concern into a profitable mine.

The process is also being experimented with in Norway and elsewhere on a similar class of ores. Here in Newfoundland we have several such deposits, chiefly amongst the rocks of the older Huronian series, which were hitherto considered unworkable. Should the claims of its originators for this new system of treatment prove well founded, it may open up for those rich but sparsely-disseminated ores a profitable future.

Notre Dame district still continues to be the chief copper producer, the only mine outside of its confines as yet developed to any extent being the Blo-mi-don mine at York Harbor, Bay of Islands. Recent reports from this locality tend to confirm the good opinion always held of the property, and seem to give promise of results little if anything inferior to the best of those in Notre Dame Bay.

A few years hence may witness a second copper mining centre established on our West Coast, whose proximity to the coal areas would no doubt prove a great incentive to the smelting of the ores on the spot.

General Remarks on the Mining Industry.

The time appears to me to have arrived when local capital might be invested to advantage in the exploitation and manufacture of some, at least, of our mineral products. If there is money to be made out of them, as has been amply demonstrated by those outside who have made a success of mining enterprise in the country, there appears no good reason why local capital, under careful and judicious management, should not participate in them with profit.

There are many valuable deposits of various mineral substances locked up and lying unproductive because outside capital is difficult to entice and the advantages possessed by this country are not sufficiently recognized. Its insular position, magnificent harbors, nearness to both European and American markets, abundance of the raw materials, splendid water powers, cheapness of labor, &c., place it in a foremost position in these respects. Why, therefore, cannot some of our local capital be employed in operating these resources? We have seen what can be done by enterprising Canadians and Americans in our midst, and this should prove an object-lesson worthy of imitation.

It seems useless to expect outsiders to pay exorbitant prices for undeveloped mining properties, and every year is demonstrating this fact more clearly.

If the holders of mineral claims of any promise expect to dispose of them they will require to do at least a certain amount of development work, sufficient to establish the character of their properties as paying investments. This can scarcely be accomplished by single individuals, nor would it be advisable for any such to attempt it.

Why then not form companies,—put a sufficient number of shares upon the local market to ensure the raising of capital to perform the work required to place their properties on a saleable basis, if indeed they do not feel disposed to continue operating themselves? It will have to be done sooner or later if we hope to see our rich mineral deposits worked. Then again, it would afford an opportunity to the smaller capitalists of investing in local industries not more risky than many of those they are at present willing to embark in.

I am a strong advocate for this means of exploiting our mineral wealth. If we do not show faith ourselves in this way, how can we expect others to do so.

In this connection I might suggest that, could our Government see its way clear to encourage legitimate mining enterprise by the offering of a bounty upon the production and manufacture of certain classes of metallic products in our island, such as pig iron, steel, spiegeleisen, ingot copper, lead, spelter, gold, etc., I believe a great impetus to mining would be brought about, which in the course of a short time would recoup the treasury for any such outlay.

There are many properties now lying unproductive, which under such a system could be rendered paying investments. Amongst the more valuable mineral substances known to exist on the island and on the Labrador, which might easily be wrought by local capitalists, may be mentioned asbestos and mica, two products requiring no process of manufacture beyond a little sorting and concentration to render them marketable commodities. Both are of high value and both are in demand. Few minerals of ordinary character realised higher prices. The best, or 1st grade Canadian asbestos sold last year, 1900, for $200 a ton in the American markets, while No. 2 fetched from $80 to $100 per ton. The refuse fibre left after milling is all utilized for plastering purposes under the name of asbetic, and this material is gaining rapidly in favour. Its manufacture now forms a special industry in itself, and there appears to be a great future before it. Much of the short fibre in this country would be admirably adapted for this particular purpose.

The value of the asbestos output of the province of Quebec in 1901 reached $735,364, or nearly equal to that of our Bell Island iron ore last year. About 1,000 persons were employed in the industry whose wages amounted to $266,000, or $266 per head.

Valuable as asbestos appears to be, mica far exceeds it, ranging all the way from 7 cents up to $1 per lb., or at the rate of $2,000 per short ton. Of course this latter price is only realised for the very largest and clearest material. Scrap mica is now used extensively in making lagging for packing steam boilers, pipes, &c. One firm in Toronto manufactures large quantities into suitable sheets or mat, as it is termed. Its non-conductive qualities, durability, facility with which it can be applied, and absence of injurious substances are strongly in its favour. Canada and India are the two greatest producers of mica in the world to-day, though more or less quantities are obtained in several other countries.

The use of mica as an insulating material in electrical apparatus, for which it is especially valuable, would alone ensure a considerable demand for it. England's importation for 1899 exceeded one million dollars' worth. It came chiefly from India.

From what we know of our Labrador territory, there would appear to be in that region room for a vast mica industry in the near future. It is certain that the country possesses an abundance of the material of large size and superior quality, nor is the island of Newfoundland itself destitute of some good mica.

Chromite is another substance which might well engage the attention of our mining people. Some large depoits of this valuable mineral have recently been discovered, and the probabilities are that, as the serpentine areas of the island become more thoroughly explored, many other finds will come to light. The deposit mentioned last year as occurring near the head of the Bay D'Est River has been further examined and found to be even more extensive than at first supposed.

In view of the almost prohibitory price of coal in our markets, and the certainty of the existence of this most necessary article of fuel in available quantities within our borders, it is strange nothing has as yet been done towards utilizing it. Here we certainly have a merchantable commodity, with a home market capable of absorbing all that could be raised for years to come, and yet we must look to outsiders to put it in our possession. A local company could most certainly operate a coal mine, and it would not require a very large capital to do so. I look upon such an undertaking, especially in the Bay St. George coal area, as affording equally as good a risk as any other of the country's resources.

Gold mining will eventually be numbered amongst the industrial pursuits of the country. It is one that, under careful handling and skilful scientific treatment, can become a remunerative investment, even where the precious metal is only present in comparatively small quantity.

There can no longer be any room for doubt that the country is auriferous. True, the gold is either hidden in the baser metals or otherwise distributed rather sparsely through quartz leads, as in the case of the Rose Blanche deposits; but as every year witnesses improved methods of recovering the metal from its ores, a very small percentage, under favorable general conditions, can now be economically extracted. As yet no systematic search has been made for gold, and some of the most likely localities have never been looked to at all.

At Deloro, Ontario, Canada, a company called the Canadian

Gold Fields, Limited, are operating an auriferous mispickel deposit, which they are successfully treating for its gold and arsenic contents. Hitherto all attempts to extract the gold from this highly refractory ore, economically, proved ineffectual. Expensive plant that had been established from time to time resulted only in successive failures. Now, however, the new company who have the business in hand are not only extracting the gold contents successfully, but also the chief by-products, especially the arsenic, which finds a ready market in Canada and the United States. It is said to be of purer quality than any imported, and its production has become an established success. This is the only arsenic plant in North America. The ore is treated by a new process called the bromo-cyanide.

We have in Newfoundland many known deposits of almost an exactly similar mispickel to that at Deloro, and, like it also, containing sufficient gold and silver to be well worth recovering. There would appear to be an opening here for just such another industry, could the capital be found to exploit it.

Pyrrhotite, or magnetic pyrites, is a common ore in this country. It usually contains more or less nickel, and is similar to the ores upon which the great nickel industry of Sudbury, Canada, is founded. The percentage of nickel is generally very small, rarely exceeding 5 per cent., while the average is not more than 3 per cent. Our pyrrhotites may yet prove the basis of a valuable nickel industry when capital and enterprise are brought to bear upon their utilization.

Galena or sulphuret of lead is another mineral which should be receiving some attention. There are several well-known deposits of this valuable material, and years ago it was worked to a considerable extent in the district of Placentia and in Port-a-Port Bay. None of these deposits were exhausted, and it is a great pity that such valuable properties should be now lying unproductive. In the case of the Silver Cliff mine at Little Placentia, the ore was found to be highly argentiferous, which should prove an incentive to capitalists to re-open this promising property.

Manganese, or rather manganiferous iron ore, is an abundant mineral, and is now largely used in the production of spiegeleisen, a substance of growing economic importance. The deposits of this class of ore along the south side of Conception Bay have been proved to be very extensive. They have been visited and examined by several mining experts, all of whom are unanimous in the opinion that the deposits are, so far as quantity is concerned, practically inexhaustible. As yet, however, the hopes of those holding mineral claims in that locality have not been realised. It is understood that the Dominion Iron and Steel Company are at present experimenting with this ore, with a view to its utilization at their smelting works in Sydney, C. B. Should it come up to their requirements, a considerable boom may be looked for.

By a decree of the United States treasury, it was decided that a mineral to be classed as a manganese ore must contain 50 per cent. or upward of manganese oxide, and not over 10 per cent. of iron. This decision was afterward modified, so that ores containing less than 50 per cent. manganese, when the iron contents did not exceed 3 per cent. were so classed. Ores containing 44 per cent. manganese, with 3 per cent. or less of iron, are now generally recognised as coming within the standard; all those with a lower percentage of the one and a higher percentage of the other are classed as manganiferous iron ores.

With its iron and manganese deposits fully developed, Conception Bay will take first place as the greatest mining district in the island, a position heretofore held by the great Bay of Notre Dame. In all probability, however, both will eventually be far outstripped by the district of Bay St. George, whose more varied natural resources must in time force it to the front rank. Possessing, as it does, the only coal deposits of value in the island, it holds the key, as it were, to the greatest mining possibilities of the entire country, which, sooner or later, must make themselves felt.

Gypsum has frequently been referred to as an abundant mineral substance among the lower arboniferous series in the last-named district. Little has been done in the way of exploiting this useful material as yet. Immense quantities are annually exported from the lower provinces of the Dominion of Canada to the United States, to be used as plaster and for paper-filling. We are in just as favorable a position for shipping this material as they are, and as we possess unlimited supplies of a first-class quality, it only requires a little enterprise to enable us to share in this trade. Canada's production in 1899 reached the value of $257,329. It is nearly all sent to market in its crude state, just as it comes from the quarry, only requiring a little sorting before being shipped.

The manufacture of cement, which is a gigantic industry in the United States and Canada, might well engage the attention of some of our people. There is an abundance of raw materials suitable for the purpose in many parts of the country, and there is a considerable local demand for cement, amounting annually to many thousands of dollars.

A considerable portion of the cement of commerce is made of natural rock, usually an argillaceous limestone, but by far the greater portion, and that of the better quality, is produced artificially by a combination of lime, marl, and sand, etc., which, when ground together and calcined in suitable kilns, forms what is called Portland cement—Portland, England, being the original seat of its manufacture.

The initiation of a cement industry here might not for a time prove very remunerative, owing to the limited demand, but there is room for great expansion, and a cheapening of the article in the market would so bring it into more general use.

The manufacture of peat-fuel is now placed beyond the experimental stage. In a country like this, possessing so much peat of excellent quality, with coal at almost prohibitive prices, and firewood becoming more and more difficult to procure each year, there should certainly be an opening for such an industry. The advantage, especially to the poor, to be able to procure a cheap fuel at least equal to the inferior varieties of the imported coal, would indeed be a great desideratum. There can scarcely be a doubt that the demand for such an article would be in excess of what could be manufactured for some years to come.

One of the results of publishing an annual statement of the mineral development of the island is a constantly-increasing demand for information from outside sources concerning the minerals of the country generally. So great has this demand become of late that it takes a large portion of my time to reply to the numerous letters of enquiry received.

It is scarcely necessary nowadays to state what the value of correct statistics of any industrial pursuit means. They are the index, as it were, of the state or condition of the particular industry to which they refer. They point out its various fluctuations, and are, in fact, a measure of its value. When such figures show a falling off or a tendency to depression, it would seem to point to the necessity of some steps being taken to arrest this downward tendency. Where, again, they show a fair prospect of a development into a permanent and far-reaching benefit to the country at large, it would indicate the wisdom of applying thereto a fostering and progressive policy. This latter is the stage at which our mineral industry has now arrived, and there can be little question that under such a policy it is destined some day to become one of the foremost pursuits of our people; if not, indeed, the very mainstay of the country itself.

I have the honour to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XXII.

Report for 1902.—Geological Exploration in the District of White Bay.

Geological Survey of Newfoundland,
St. John's, February 20th, 1903.

HON. ELI DAWE,

Minister of Agriculture and Mines.

SIR,—I beg to submit the following report of my past season's geological investigation in the district of White Bay.

The discovery of gold in the vicinity of Sop's Arm, White Bay, having been placed beyond all question by the persevering labors of Mr. Stewart, M.E., it became a matter of importance to have the country examined geologically. The object of such investigation was, in the first place, to ascertain to what particular series the auriferous deposits belonged; secondly, were they confined to any particular member thereof; and thirdly, under what conditions did the gold occur, and how far were these conditions applicable to other parts of the region. Having ascertained these facts as far as possible, it was essential, in order to render the work of value to the mining prospector, to have the results recorded upon a geologically colored map of a sufficiently large scale to allow of the insertion of fairly minute details. Only in this way could an intelligible guide to the most promising localities be conveyed, and what is equally important could it be shown what areas may be avoided, as offering but poor prospects to reward his labors. Finally, the knowledge obtained here might be applied with advantage to other districts of the Island where a similar series of rocks were known to exist, and where possibly similar conditions may prevail.

The district of White Bay being virgin soil to me, it was necessary to fully understand the complicated structure of the region, that as many points as possible should be visited. Owing to the absence of roads, and utter impossibility of locomotion by land in most parts of the surrounding country, it was found necessary to hire a small fishing smack of about ten tons burthen, and two extra hands, with which to prosecute our investigation along shore. A suitable craft was obtained at Conche from which point we proceeded up White Bay. Canada Bay was first visited, and a week spent in studying out the structure here. Its deep indentations and the numerous rock sections exposed on its shores afforded a good opportunity for obtaining an insight into the general characteristics of the Cambrian and Lower Silurian deposits, which, according to the late Alex. Murray, were well displayed in this vicinity.

After leaving Canada Bay we proceeded on our way, touching in at Hooping Harbor, Little Cat Arm, and Frenchman's Cove, then on to Sop's Arm. At the latter place a fortnight was spent in thoroughly exploring this arm and its immediate neighborhood; the Main Brook was ascended and surveyed for four or five miles, and the Corner Brook as far as Stewart's mine.

From Sop's Arm we crossed the bay to Purbeck Cove, thence down the south shore, exploring Western Arm, Middle Arm and Southern Arm. We then ran up the south side of the bay, touching in at Granby Island on the way, and finally anchored at Gold Cove near its extreme head. From Gold Cove the shores all around the head of the bay were examined, and excursions made inland towards Sop's Arm, Corner Brook and Sandy Lake.

Returning down the bay we visited Salt Water Pond, and again ran into Sop's Arm where I met Mr. Stewart for the first time during the season. From him much information was obtained of a valuable character relative to his operations.

At Jackson's Arm, Great and Little Coney Arms, considerable time was given to examining the coast-line and the country inland from the latter place. Two days were spent at Great Harbor Deep, after which we revisited Canada Bay before returning to Conche.

The weather had now set in exceedingly stormy so that we were obliged to abandon any attempt to proceed further north. Considerable delay was experienced at Conche awaiting the arrival of the *Virginia Lake,* which vessel was detained on the Labrador coast long over time, picking up the crews from the various fishing vessels that had been wrecked during the recent gales.

GEOLOGICAL FEATURES OF THE DISTRICT.

Since the visit of the late Alexander Murray to the Northern Peninsula, now nearly forty years ago, no attempt to study out the details of its complicated geological structure had been made.

Mr. Murray at that time made a cursory examination along the eastern coast line to the head of White Bay, and passing around Cape John explored the north shore of Notre Dame Bay as far as Hall's Bay. His main object was to gain a general idea of the geology of this northern section of the country so as to form a clue to the further study of the main body of the Island. It was also desirable to connect his work with that previously performed by Mr. Richardson, of the Canadian Geological Survey, on the West Coast. Mr. Richardson had been sent by Sir Wm. Logan to examine the shores on both sides of the Belle Isle Straits, and his work on the Newfoundland side formed the key, as it were, to the study of the Island's structure.

Mr. Murray commenced his work where Richardson left off, at the northern extremity of the Island, traced out the succession of the various geological horizons southward, so as to form a ground work for future and more detailed examination. His work, I need scarcely say, was performed with his usual well known ability, and though so many years have elapsed, and geological science, like all others, has undergone so many modifications, yet in the main it leaves little to alter.

From Hare Bay, southward, along the coast of the great Northern Peninsula, he studied out the structure in an admirable manner, unravelling many of its most formidable complications. He found the Northern Peninsula of the Island spread over by a series of formations representative of the great Laurentian and Silurian ages, intermixed with areas of metamorphic and eruptive rocks, referable at that time, to the middle division of the so called Quebec Group. The other members of this same group, viz.: the Calciferous, Levis, and Sillery divisions were largely exhibited around Hare Bay. The first, characterised by a great preponderance of calcarious strata, forms a prominent feature of the western side of the peninsula, with the succeeding slates and shales of the Levis resting in narrow troughs generally conforming with the lower levels and indentations of the coast.

At Canada Bay, the same series are met with, and good exposures of the different members are displayed along the shores of the various arms and creeks. The coast between Hare Bay and Canada Bay is occupied almost exclusively by the metamorphic group, consisting of chloritic, schists, diorites, serpentines, and various other altered or eruptive materials. An exception to the general structure, however, occurs upon the two small projecting peninsulas of Cape Rouge and Cape Fox. Here a higher and less altered series rests unconformably upon the former. This forms a striking contrast, lithologically and otherwise, to the underlying Silurian, sufficient in itself to class it in a separate horizon. The presence of a few carbonized plant impressions, though very obscure, when examined by the late Sir Wm. Dawson, a noted authority on fossil botany, enabled him to pronounce them as unmistakably of Devonian types.

At Englee, near the entrance to Canada Bay, the limestone and shales of the Calciferous and Levis formations of the Lower Silurian seem to pass beneath a set of altered silicious deposits, most probably representing the Sillery sandstone. On the Island of Englee and along the shores of Bide Arm the Calciferous formation is well exposed. It strikes obliquely across the arm, coming out on the shore of the main bay near the head of the N. E. Arm, from whence it strikes inland northerly. Its characteristic fossils, *Macluria, Ophileta* and *Murchisonia*, &c., were recognized in profusion on the surfaces of some of the beds in Bide Arm, and again up the N. E. Brook. Most of these limestones have undergone a considerable amount of change, and are frequently converted into white or variegated marbles, but they are usually too thin-bedded and broken by cleavage joints to afford good material for ornamental or structural purposes. A large body of similarly altered limestone occupies the extremity of the point of land separating Bide Arm from the N. E. Arm and striking across the bay forms also the point between the Gouffre and Canada Harbor. Here they appear to be let down by a fault which brings them in contact with the Archaean Laurentian. This fault comes out on the coast at a place called Degrat de Cheval, about half way between Canada Head and Hooping Harbor. Canada Head itself is composed of the upper metamorphosed rocks similar to those outside of Englee.

On the West side of the N. E. Arm of the bay, at a place called Devil's Cove, a set of strata resting upon highly altered rocks was seen to consist at the base of coarse and fine grained dark-red sandstone and conglomerate dipping towards the arm. They include one or two beds of red limestone in which obscure fossils resembling *Hyolithes* and *Archaeocyathus* occur, forms typical of the lower Cambrian limestone of Smith's Sound, Trinity Bay. Mr. Murray recognised in a similar reddish limestone near Salt Water Pond, in the inner Arm of Canada Bay, fragments of a trilobite, *Olenellus Vermontanus,* and a few Lingula, referable at that time to the Potsdam group, but the latter is now generally regarded as Cambrian. The limestones are overlaid in turn by greenish-grey slates with irregular nodular layers marking the planes of stratification. This is another very characteristic feature of the lower Cambrian slates of Trinity Bay. Some corrugated bands of black slate further along shore seem to form the highest strata of the section.

The long straight stretch of water which extends from the Gouffre to the head of the N. E. Arm would appear to occupy the position of the line of fault, already alluded to, and to separate the Cambrian by a considerable interval from the lower Silurian of Bide Arm point.

The rocks underlying the Cambrian at Devil's Cove are highly altered, consisting of feldsitic and quartzose strata, with intercalations of dark-green trap. They form huge beds, rising layer above layer, like steps of a gigantic stairway. Whether of igneous or igneo-aqueous origin, this latter series was clearly laid down prior to the deposition of the overlying Cambrian, as there is no evidence of intrusive dykes penetrating the latter in the vicinity. The Clouds Mountains which rise in peaked summits high over the surrounding country to the north of Devil's Cove, and near the base of the long point which separates the outer from the inner arm, called Weymouth Point on the chart, are entirely composed of effusive trappean materials. One thick layer about the middle of the escarpment of the highest peak exhibits a most perfect columnar structure, the columns being slightly bent in the middle as if resulting from the weight of the superincumbent mass of close-grained phonolitic trap which caps the summit.

Whether these latter belong to the Laurentian or Huronian period or should be classed as an independent formation, will require further investigation to determine. In the meantime they are colored as Laurentian, provisionally.

Rocks of Archæan age next hold the coast on the west side of White Bay, nearly up to little Coney Arm, and spreading out inland form the central plateau of the Northern peninsula, being the prolongation of the Long Range Mountains. This range, which commences at Cape Ray, extends in an almost unbroken line to within a short distance of Hare Bay. Where the series comes out to the shore on the east side of the peninsula it presents a bold precipitous coast-line, with lofty rugged cliffs of a most forbidding aspect. The bold outline is, however, indented here and there by numerous coves and deep arms or fiords which cut into the land for several miles. The shores of these arms are usually very precipitous and the waters correspondingly deep, giving this section of our coast a decidedly Labradorian aspect.

At Hooping Harbor, Great Harbor Deep, and Cat Arm, as well as along the outer coast, the prevailing rocks seen consist of dark gray hornblendic gneiss, pinkish and white feldspathic gneiss, with micaceous schists interstratified with heavy bedded granitic and syenitic masses, the whole intersected with huge dykes of dark-colored close-grained greenstone. These latter are frequently seen to overflow the gneiss, portions of which are sometimes caught up in it. The entire series have undergone a vast amount of disturbance and exhibit extraordinary folds and corrugations throughout.

Near Cobbler's Head, about a mile from Little Coney Arm, they leave the coast, and striking inland are seen just inside Coney Arm, and again on the Main Brook of Sop's Arm, about a mile from its mouth. Thence they trend away westward towards the head waters of the Humber River.

The whole interior plateau of the Northern Peninsula is clearly occupied by this Archaean series, judging from the aspect of the country, as seen from the summit of the Clouds Mountains, and from the high land inside of Little Coney Arm. Away to the North, East and West, as far as the eye could reach, the surface presented one unbroken, rugged barren, interspersed here and there with ponds and marshes. A few isolated patches of stunted timber represented the only vegetation worth mentioning over this great waste.

These Archæan rocks are frequently cha acterised by the presence of specular and magnetic iron ores, and in a few instances copper pyrites. Mr. Murray mentions indications of the former ore at Grand Vache, and the latter at Hooping Harbor, but only in small quantity. Specular iron is said to occur in a regular deposit at Cat Arm. Iron sand was observed in some quantity in the N. E. cove of Hooping Harbor, and copper pyrites in a loose boulder on the shore of Soufflet's Arm, Great Harbor Deep.

Flanking the Archæan nucleus on either side of the Northern Peninsula are the more recent deposits of the Cambrian, Silurian, and Carboniferous periods. The two former extend almost continuously along the west side, from Port-a-Port to St. John's Bay, thence sweeping around the northern extremity of the peninsula, they have a wide spread between Pistolet and Hare Bays, and as already shown, hold the eastern side to Canada Bay. They come in again further up White Bay, at a place called Cobbler's Head, resting uncomformably upon the Archæan gneiss, and dipping away from it towards the waters of the bay. The base of the series here, consists of micaceous schists overlaid by a great thickness of limestone, slate, and quartzite. Good sections of these latter rocks are exposed on both sides of Little Coney Arm, details of which are given in Mr. Murray's report for 1864 (page 16). They form bold cliffs along the western side of Great Coney Arm, and strike inland up the valley of Coney Arm River, where they constitute the high bare-topped ridge which runs out near the mouth of the Main River of Sop's Arm. They are met with about a mile up this river, where they repose upon a pinkish porphyritic syenite. At this point the thickness has greatly diminished, and the limestones have become altered to marble of variegated and handsome character. Their strike South-Westward would carry them inside the head of Sop's Arm, in the direction of the head waters of a branch of the Humber River, where cliffs of white marble were met with in 1891.

The entire absence of fossils in this highly altered series, which if they ever did exist, have been totally obliterated, leaves their true geological position altogether conjectural. Yet from certain lithological evidence, and their relation to a higher series holding distinct Silurian forms, there is little room for doubt that they are referable to the Cambrian system. They are overlaid at Coney Arm Head, Frenchman's Cove, Jackson's Arm, and Sop's Arm, by coarse and fine grained sandstones and conglomerates merging into slates with occasional thin irregular layers of impure limestone, all highly metamorphosed. The conglomerates at the base in particular, are confusedly intermixed with trappean and porphyritic intrusions so intimately associated with each other that it is not easy to distinguish them. Dykes or elvans of pale yellowish and flesh-colored feldsite intersect all these rocks, occasionally running with the strike, but in some instances they cut the strata obliquely. Some of these dykes at Jackson's Arm bear a striking lithological resemblance to the agalmatolite near Manuels in Conception Bay, and like it also the rock possesses a somewhat unctuous feel, but it is much more silicious.

These intrusive masses were undoubtedly the product of igneous outbursts forced through the weaker portions of the crust in the form of molten matter, which in some instances overflowed the surface, and surrounded or enclosed masses of the strata. It must have been a period of active volcanic disturbance and the effect of this agency upon the overlying slates is very manifest. A ridge composed of the highly altered conglomerates strikes across the head of Sop's Arm, and up the west side of the valley of Corner Brook in a south-west direction. The slates reposing upon these conglomerates present many peculiarities both in color and texture, no doubt attributable to the chemical and mechanical changes brought about through the medium of the dynamic forces alluded to.

In the ascending section to the east of Corner Brook the slates present a less and less altered appearance, and are more chloritic in character, while arenaceous and calcarious strata are more frequent towards the top, where thick-bedded quartzites are the prevailing material. Near the entrance to Sop's Arm and on Sop's Island much disturbance is again manifest; huge trap dykes are seen to uplift the strata and throw them into a state of confusion. One immense belt of pinkish feldsite strikes lengthwise through Sop's Island, and continuing its course from a point on the mainland south of the Island, widens out inland, forming a bare ridge of high mountains, called the Salt Pond Barrens. Accompanying the feldsite are huge dykes of dark colored greenstone sometimes presenting a rudely columnar structure, which is well seen on the S. W. end of Sop's Island. The strata in the immediate vicinity of these intrusive masses are much disturbed, and there is apparently some repetition. Similar characteristics prevail on the north side of the Arm to a greater or less degree, and throughout the projecting point of land northward, which terminates in Coney Arm Head.

The true geological horizon of all this series of rocks is not easily determined owing to the absence of fossils in the lower portions, and the obscure nature of those observed in the higher members of the section. On George's and Sop's Islands, and again on some points of the main shore of the Arm, Mr. Murray observed a few indistinct forms in some of the less altered calcarious strata. Such as could be identified by the palæontologist of the Canadian Geological Survey, Mr. Billings, were *encrinite stems,* a *Murchisonia, Orthoceras,* and *Graptolites,* with a few corals *Syringopora* and *Favorsites,* which he considered to have a general aspect of Upper Silurian types.

From where these fossils occur to the head of the arm a horizontal distance of one mile intervenes, occupied by slates, sandstones, and thin calcarious layers aggregating a total thickness of 2,600 feet. They are all greatly changed from their original character, and are apparently quite destitute of organic remains. Their position between the recognised Upper Silurian and Cambrian leaves scarcely a doubt that they are referable to the base of the former, and are therefore of Lower Silurian age. These being the more pronounced auriferous rocks of the region, though the gold is not altogether confined to them, a more detailed description of their chief characteristics seems called for.

By far the greater portion of the slates in the immediate vicinity of the gold deposits are finely laminated, of a bluish silky texture, and much impregnated with fine crystals of iron pyrites. The presence of so much pyrites causes the weathered surfaces to present a very ferruginous appearance, which frequently penetrates the slates to considerable depths. Some of the surfaces assume a peculiarly pitted aspect, resulting from the conversion of the pyrites cubes into peroxide of iron, and this characteristic might act as a guide to the prospector in other parts of the country. The slates themselves are of a brownish drab color, while the markings are of a deeper reddish-brown. Other bands of the slate are of a distinctly talcose nature, of a pale yellowish color, having the usual soapy feel. There appears to be a regular gradation, from the less altered dark bluish slate through various shades of blue, green and grey, to the yellowish pearly looking talcose bands. A few dark green chloritic serpentinous strata occur here and there, and several interbedded thin layers of pale bluish limestone. Towards the top of the section the slates become more and more arenaceous, and finally pass into thick bedded altered sandstones or quartzites.

Throughout this whole series quartz veins are numerous, running generally in the strike of the slates and apparently conforming with them in dip. The veins vary much in thickness, ranging from mere threads to a foot or more, but appear to increase in strength downwards. In sinking a shaft on the east side of Corner Brook, Mr. Stewart informs me that several such veins were intersected, and one belt was passed through of mixed quartz and slate 32 feet in thickness which he considers the main lead. It was composed of irregular alternating layers of quartz and decomposed ferruginous slate, all of which was found to carry gold, from a mere sight up to several ounces to the ton. The origin of these quartz veins may have been the result of metasomatic change, or the replacing of one material by another whereby silicious matter held in solution, and probably carrying the metallic salts, took the place of some other constituent of the rock formation such as the lime, which had been leached out by the action of the heated waters. Such leaching out of the lime and replacing it by silica, especially during periods of active volcanic disturbance, is a natural and common result of metamorphic action. Again they may have resulted from the opening up or separation of the strata along the planes of stratification, by the disrupting agency of the igneous outbusts through which the circulating thermal waters charged with the silicious and metallic substances found access. The porphyritic intrusions being composed chiefly of alkaline substances would have the effect, first of heating the aqueous solutions and then precipitating, or causing to be precipitated their metallic contents.

Assuming that the gold may have been originally contained in the country rock, or more probably in the pyrites disseminated through it, the chemical action which would appear to have taken place, resulted in the dissolving out the gold therefrom, and its redeposition by the precipitative action of the injected alkaline substances.

Whether either of the above be the correct solution of the *modus operandi* by which Nature in her grand laboratory brought about the deposition of the precious metals or not, it is a noted fact that in the vicinity of the most prolific gold bearing leads, porphyritic intrusions seem to have exerted a marked influence upon the character of the auriferous deposits.

That a period of active disturbance resulting in considerable metamorphism took place subsequent to the deposition of the Lower Silurian, and even the Devonian sediments is quite manifest. It would appear then that the recognised conditions rarely absent in gold quartz regions are all here present, and these are points which the gold prospector would do well to familiarise himself with. The same geological series may, and as a matter of fact do, spread over a large area of White Bay as has aleady been shown, but not having undergone a similar amount of meamorphism, and being destitute of any of those favorable conditions referred to, they do not seem to carry gold in any appreciable quantity. It would thus appear that it is not so much a particular formation or series, but rather "a combination of favorable circumstances that can produce a rich mining district, these are principally heat and metamorphism." That these favorable conditions seem to have prevailed in the vicinity of Sop's Arm, and more especially along the valley of Corner Brook is abundantly evident.

The quartz veins of this particular section present a most favorable aspect for prolific gold impregnation. They are of a dull white color, not vitreous, and are considerably intermixed with calc and brown spar, which renders them comparatively soft and easily crushed. They are exceedingly ferruginous, more especially on the exposed surfaces where cavities filled with iron peroxide are abundant. The most common metallic substances other than gold, found in the quartz, are iron and copper pyrites, zinc blende, galena, with a little specular iron and pyrrhotite. The gold seems to run more with the zinc and galena than with the other metals, but it is mostly free-milling and is frequently seen in the quartz entirely independent of the other metallic constituents. The galena, which is fairly abundant in some parts, carries good values in silver.

Although the gold is for the most part concealed, and in the greater bulk of the ore body there is none visible, yet some rich specimens were seen in which small nuggets and strings of the precious metal arranged along the weathered edges of the quartz were quite perceptible.

During my visit Mr. Stewart made several washings in my presence from crushed quartz in which no gold was previously observable not even with the aid of lens. Nearly all these wastings exhibited signs or color of gold, and some were quite rich. One in particular, made from about three ounces of crushed vein rock, yielded, according to his estimate, an average of about ten ounces to the ton. He has since informed me that he has made washings from material taken from the shaft he has sunk on the lode, and from a depth of thirty feet below the surface, which panned out fully fifteen ounces to the ton. He had also washed gold from the enclosing rocks, and from the surface soil covering them. The indications altogether are of so favorable a character as to give ample promise that here at least a good gold proposition exists.

In following out the geological structure of the district it was found that the Cambrian and Silurian series decreased in volume from Sop's Arm, southward, and that a nucleus of Laurentian gneiss occupied the country inland, between it and the head of the bay. It spreads out westward forming an elevated barren ridge reaching towards the Humber valley. In travelling over the country inside of Gold Cove, near the head of White Bay, these Archæan rocks are met with about three miles from the shore, and were found to occupy a wide belt of country, stretching nearly across to Corner Brook of Sop's Arm. But a narrow fringe of the superior series flanks this nucleus on either side, seemingly terminating at no great distance from the shore. Possibly the Corner Brook trough may extend to the head waters of the Humber, where the white marbles and bluish silky slates of the Lower Silurian were met with in 1891.

On the south side of White Bay, what appeared to be an entirely different series extends uninterruptedly from the head of the bay all along shore to Middle Arm Point. Lithologically it bears little resemblance to any of the rocks already described, and consists chriefly of brilliant mica schists, sometimes characterised by the presence of innumerable coarse garnets. These are interstratified with micaceous quartzites little distinguishable at times from ordinary gneiss. Throughout their extension many calcarious layers sometimes of considerable thickness, but more frequently in the form of thin irregular schistose lenses crop out. Such has been the degree of metamorphism to which all these rocks have been subjected, that the limestones generally assume the character of impure marbles, more or less dull white or pinkish in color, and often coarsely crystalline in texture. The presence of magnesia in some beds is indicated by their yellowish tinge and dull brownish weathered surfaces. In a few instances only, some of the more massive deposits exhibit marbles of apparently economic value. This is notably the case at Purbeck Cove, where an immense body of almost pure white marble rises in a cliff on the north side of the cove, attaining an elevation of fully 500 feet a short distance back from the shore. At the time of my visit Mr. Wm. Lacey was engaged in uncovering this deposit, but the amount of work performed upon it was not sufficient to warrant any positive assertion as to the prospective value of the deposit as a whole. Much of the surface exposure appeared to be rather coarsely crystalline, and stained from percolating waters through the cleavage joints, furthermore, fire had at one time overrun the country and blackened or discolored the rock. A few specimens were procured, however, which were of the purest white, fine grained and nearly translucent, presenting a superior quality of statuary marble. How much of the mass partook of this character could not be ascertained in its present condition, nor until more development work is accomplished. The deposit is an immense one, and certainly warrants the expenditure of a few thousand dollars to fully test it.

Hitherto the geology of this section of White Bay has been mapped as undetermined. Although not a vestige of any organic remains was come across in these metamorphosed rocks, yet their position in relation to those of other parts of the district, and the general arrangement of the strata, together with certain lithological features seems to point pretty conclusively to their correlation with the rocks of Canada Bay, and that they are therefore referable to the Cambrian and Lower Silurian periods. Towards the head of the bay and on Granby Island, the higher members of the section show a less degree of alteration, the slates partaking more of the character of those of Sop's Arm and Island.

The inclination of the entire series is towards the waters of the bay at a high angle. This clearly indicates that the whole arrangement of the structure is in the form of a great trough, resting upon the older Archæan on either side of the bay. At Western Arm and Middle Arm where the supposed junction takes place it is exceedingly difficult to determine what really belongs to the one or the other, so much do the strata resemble one another near the point of contact. The older system is, however, indicated by a preponderance of heavy bedded micaceous and hornblendic gneiss, grayish and flesh-colored feldsites, and huge dykes of dark-colored greenstone.

At Spear Cove, just inside the point of that name on the south side of Sop's Arm, a great fault is unmistakably evident, whereby another and more recent series is let down against the Silurian. The actual junction at the head of the cove is concealed in a low valley stretching inland, but on the eastern side of the cove huge vertical walls of red and grey sandstone with slaty divisions, tower upward 100 feet or more, presenting their basset edges to the sea. Where the more slaty portions have yielded to the action of the waves the harder sandstones stand out from the mass, frequently producing picturesque outlying pillars. Outside Spear Point and stretching into the cove of Salt Pond, lofty cliffs of similar strata are again met with, which exhibit frequent dislocations and considerable distortion. What appear to be the highest measures consist of red slate with layers of brown-weathering nodular dolomite interstratified. The same rocks are repeated on the east side of the cove, and form the headland outside called Upper Head. The thickness here is considerable and some extra strata are brought in, with a few bands of black slightly bituminous slate, in which some obscure fossil plants were observed.

These rocks hold the coast from Upper Head continuously to the point of Gold Cove, showing a nearly vertical wall of rock all the way, except at Brown's Cove, Hannah's Cove, and a few other places. They have a slight inclination inland, but are for the most part nearly vertical. Lower and lower measures acumulate along shore towards the upper part of the bay, consisting of grey sandstones, altered almost to quartzites, gray grits, and coarse grey and red conglomerates, which latter pass into brick-red sandstones.

From Gold Cove their strike carries them across the head of the bay, where they form Miller Island and the point opposite near the River Head. In Gold Cove, on the west side, the bituminus black slates again appear striking along shore, and one thin layer of bituminous fossiliferous limestone was also observed here. Northward from the cove the same series were found to constitute a succession of ridges rising one beyond the other for a couple of miles inland, when they fall away again into a deep valley, which seems to occupy the line of dislocation.

Much alteration is again visible throughout this series, and several intrusive feldsite dykes, or elvans, similar to those of Jackson's Arm, occur along the shore.

Although in so much more disturbed and changed a condition than the rocks of Cape Rouge and Fox Peninsulas, certain peculiarities in the structure and lithological characteristics of the less altered portions, induced Mr. Murray to class them in the same horizon. The discovery of fossil plant remains in Salt Pond Cove and again on the outer coast during the past season confirms this impression, and that they belong to the Davonian period. So far as is known, these two small areas in White Bay comprise the only deposits of that particular age in the Island.

It would appear that a second trough within the greater one existed heretofore where the waters of White Bay are found to-day, all that remains of the more recent Devonian trough being the two small isolated areas above referred to, and a mere patch on the northern extremity of the offer Gray Island, indicating the opposite side of the trough.

At the extreme head of White Bay this trough is very limited in width, and where it strikes inland in the valley of the River-Head Brook, it evidently soon terminates in a sharp point at no great distance. The strike would carry it in the direction of the Sandy Lake on the southern branch of the Humber, but no evidence of its occurrence is anywhere visible in that locality.

The presence of small nests of coaly matter and black bituminous shale beds amongst the rocks of the Cape Rouge Peninsula, has led to the supposition that coal seams might exist somewhere in the vicinity, but this is not at all probable. The Devonian system is not known anywhere to contain coal in workable quantity; on the other hand, it is one of the most prolific gas and oil producers, especially in Canada and the eastern United States. There is a strong probability that at least one of those substances, petroleum, may exist in available quantity. Asphaltum occurs sparingly at Piliar on the north side of Cape Rouge Peninsula, and a somewhat similar substance was seen amongst the shales near Conche. Mr. Murray noted this in his report in 1864, and remarks, "the fact is one not to be lost sight of."

It would require the use of the boring drill to fully determine whether petroleum really exists here or not, in economic quantity, and it is a matter some of our local capitalists might deem worth testing.

The Devonian area in the upper part of the bay does not offer so much prospect for petroleum development owing to the highly tilted, altered, and faulted condition of the strata. It is worthy of note, however, that Mr. Stewart has washed out gold from quartz veins penetrating these rocks near Gold Cove.

Numerous specimens of quartz were gathered during the season from almost every place visited in the bay, and from the various rock formations met with. Since returning home these have been submitted to Prof. Holloway for assay. The result of his tests goes to show that the quartz from the Archæan areas, and from the less altered Silurian gave traces only of the precious metal. It was, however, chiefly the meamorphosed sericitic slates of the latter which were found to be most auriferous, while the highly altered mica schists of the south side of the bay, appeared to be barren.

All the above facts tend to prove that although the Lower Silurian series of formations are apparently the chief auriferous rocks of the region, the peculiar conditions which seem to favor the existence of gold in them, does not extend to the entire series, but it is limited to such portions as have undergone an intermediate degree of metamorphism, brought about by the action of the porphyritic and other eruptives upon the pyritiferous slates. This is especially the case where the element magnesia was present or introduced from solutions containing magnesian salts.

Agricultural and Lumbering Capabilities.

In an agricultural point of view, White Bay is not so well favored as many other parts of the country, yet it is by no means destitute of good, though limited, areas of land. In the immediate vicinity of Conche the soil is of superior quality, and produces very fine root and hay crops. The potatoes grown here last summer were the finest I have seen this season. Some of the land, so I was informed, has been continuously cropped for over forty years without being ploughed or receiving any kind of fertiliser. Late springs and early frosts are, however, a great detriment to agricultural operations in this exposed locality.

In Canada Bay many small tracts of good land occur, especially around the inner arms and coves. Being more sheltered than the outer coast, agriculture might be carried on here with advantage, but the few inhabitants of the bay do not seem to take kindly to the cultivation of the soil.

Little land of any account was found to exist on either the north or south side of the bay until the extreme head is reached. About Gold Cove and vicinity, but more especially in the valley of the River-Head Brook, the soil is of excellent quality. The latter valley, through which the new line of road to Sandy Lake has been laid down, widens considerably inside, and presents a most favorable site for an agricultural settlement. It is very level for a long distance, and judging from the forest growth, and rank vegetation along the roadside the soil seems well adapted for cultivation.

The country around the inner part of Canada Bay is densely timbered with spruce, fir, and birch, and so far has escaped devastation from forest fires, but from here almost up to Coney Arm, the little timber that did exist has been for the most part denuded. From Jackson's Arm to Sop's Arm fire has again overrun the country, leaving it bare, bleak and desolate. Some good timber still exists in the valley of the Corner Brook of Sop's Arm, and along the shore of the bay towards Gold Cove, but by far the finest timbered tract in the district is that of the River-Head Valley. There is a good deal of timber of fair size and quality along the south side of the bay, particularly in the Western and Middle Arms, but there are many extensive burnt patches, and in Southern Arm the forest has been totally destroyed.

Apart from its timber, its mineral, and its land resources, the district of White Bay possesses other advantages which should render it thriving and prosperous, were the facilities for fully utilizing them provided. It has a splendid herring fishery, and its average annual catch of salmon exceeds that of any district in the Island. This latter reaches about 4,000 qtls., all of which is salted down and sold to traders during the fishing season. Could this splendid catch of "the king of fishes" be marketed fresh it would mean many extra thousands of dollars in the people's pockets. Should the cold storage scheme be successfully initiated in this country, White Bay would furnish a splendid opening for a fresh fish industry, during the summer months.

But the greatest need of the district is better steam service on the bay, and railway connection with the main line near Sandy Lake crossing. The distance from the head of the bay to Howley station is about thirty (30) miles, and the route followed by the new road could with little alteration be rendered an admirable one for its construction.

Were such facilities afforded the district, White Bay products would be brought many hours nearer the Canadian and American markets than those of any part of the coast to the east or south. The distance by rail from the head of the bay to Port-aux-Basques is about 200 miles less than half that from any of our principal eastern bays About 20 hours should suffice to place these fish products at some distributing centre on the mainland

I have the honor to be, Sir,

Your obedient Servant,

JAMES P. HOWLEY.

CHAPTER XXIII.

Report for 1902.—The Mineral Statistics of Newfoundland,

HON. ELI DAWE,

Minister of Agriculture and **Mines.**

SIR,—In presenting the annual report upon the mineral statistics of Newfoundland for the year just ended, I am happy to inform you that, though the increase in the value of the year's output was not large, yet it indicates that the mining industry is in a most hopeful and healthy condition.

The total value of the mineral products for the calendar year 1902, according to the figures now in my possession, amounted to the sum of $1,217,686, which, in comparison with that of the preceding year, shows an increase of $6,395. In reality, however, the increase is somewhat more, as I find I was misinformed as to the value of pyrites shipped in 1901, which was less by $8,891 than the figures given in that year's report, so that the actual increase was $15,286. This result is very satisfactory, considering the poor market conditions that prevailed, principally owing to the great depreciation in the price of metallic copper, which fell from 16 to 12 cents per lb., making a difference in the value of the copper output alone of $94,284.

It is true that there was a falling off in the actual amounts of both copper and iron ore shipped during the year. In the former case it was less by 740 tons, and in the latter by 9,485 tons, representing a money value of $11,335. This would have been amply compensated for by the increase in other directions, the value of the slate alone having nearly doubled, while that of pyrites more than quadrupled the preceding year's output.

The decrease in shipments of iron ore from Bell Island was unexpected, and may be accounted for from the fact that the Dominion Steel Co. did not ship any of their ore to foreign markets last year. All they mined was sent to their own reducing works at

Sydney, C. B.; consequently their shipments fell off by 92,995 tons. On the other hand, the Nova Scotia Co. increased their output by 87,074 tons.

So far from the mining industry as a whole showing any decadence, at no time in its history was it in a more flourishing condition, several new features having been imported into it during the past year. A lively interest was displayed in the prospecting for minerals, and new and important discoveries were the outcome. Some properties have been taken up by capitalists who are preparing the way for active development, while one or two abandoned mines have been re-opened, which promise to become considerable producers in the near future. Pilley's Island pyrites mine, upon which work was suspended a few years ago, is now under its new management, coming again to the front, its output last year nearly equalling some of its best production. The same company have taken over the old Terra Nova mine at Bay Verte, lying dormant for over forty years, and during the season raised some 3,500 tons of cupriferous pyrites, 350 tons of which was shipped to the United States market.

The pyrites property at Rowsell's Harbor, Labrador, was visited and examined by an expert last autumn, and it is thought the Dominion Steel Co. will commence work upon it during the coming summer.

The York Harbor copper mine, Bay of Islands, has passed into the hands of a strong syndicate, who purchased it not long since. Mr. C. E. Willis, the new manager, is pushing development work during the winter, and this mine bids fair to add considerably to the copper production of the future.

There has not been much done to exploit our valuable chromite deposits as yet, but Mr. Willis, of York Harbor, has had a route surveyed for a tramway to connect the chromite mine near Benoit's Brook, with the railway at George's Pond. His company intend constructing this branch during the coming summer, to enable them to bring out the ore to a convenient shipping point at Bay of Islands.

Last year witnessed the first shipment of barytes from the country It was sent to the U. S. market, where, I understand, it sold at a fair margin of profit, and was considered a good quality of ore.

Our brick and slate industries made a decided advance and showed a marked increase in value over the figures of the preceding year. Both are likely to figure prominently in the future. No returns are forthcoming from the slate quarry at Summerside, Bay of Islands. It is not probable any shipments were made, as there is usually a great deal of preliminary work in clearing away the surface debris in such undertaking before the actual manufacturing of slate can be entered upon. Messrs. Mitchell and Campbell have optioned their slate property at St. Jones, Trinity Bay, to an English company who will probably begin operations upon it as soon as spring opens.

Perhaps the most noteworthy feature of the mining industry for the year was the actual commencement of gold quartz mining. The prognostications of several years past are apparently at length about to be realised. There are now two gold mines in operation in the Island: one at Rose Blanche, on the southern seaboard, and another at Sop's Arm, in White Bay. As yet mining for the precious metal in either locality is in its first stages. No stamp mills have been so far erected to treat the ores, though they have been purchased and will be placed on the ground early the coming season. I have no particulars of what has been done in the way of development in the former locality, but in the latter some thirty men are engaged sinking on the lead and clearing away the surface. Having visited and examined this property during the past summer I am in a position to state that the prospects here are of a most encouraging nature, particulars of which will be found in my geological report of the district. The discovery of free gold at this place by Mr. A. Stewart, M.E., gave a stimulus to the search for the precious metal, with the result that several rich specimens have been brought to light. It looks as though a gold mining development of no mean order will become an established industry ere long. That the country would eventually prove auriferous, no person who understood its geological features could doubt.

A use has been found for the peculiar substance agalmatolite, as a paper filler, and for enamelling purposes, and a company has recently purchased the property near Manuels, on the south side of Conception Bay, which they are opening up.

The quarrying of granite and other stone to be used in the construction of the new Court House and Railway Station, as well as for foundation walls and street paving was actively pursued, but it is not easy to get at the full particulars of this industry.

The boring operations for petroleum at Parsons' Pond resulted somewhat more favorably than in previous years. One hole was put down to a depth of 2,160 feet when oil was struck in fairly good quantity and of very superior quality. This oil appears to come from a lower set of petroliferous strata not hitherto pierced by the boring drill. It possesses the property of burning freely in its crude state without undergoing any process of refining, giving off but little smoke or offensive smell and is apparently free from explosive gas. The well has not yet been torpedoed, but I learn that eighteen barrels were pumped therefrom without greatly diminishing the quantity present. So far the company has put down five holes all of which have yielded oil, and although the quantity has not been great, still the fact that no dry holes have been encountered is very encouraging. The company are now contemplating the erection of a refinery upon the ground to treat the crude product themselves, and they certainly deserve every encouragemnt in their enterprise.

The great interest of late manifested in mining, and the search for minerals, can scarcely fail to bring many properties into the productive stage ere long. It is safe to predict, should the market remain firm, that the coming year will witness a largely increased output all around, more especially should the Bond-Hay Treaty become a *fait accompli*.

An attempt has been made to ascertain the number of persons employed in the mining industry during the year; number of accidents and deaths caused by same, with the following result:

	No. Employed.	Accidents.	Fatalities.
Iron mining	791	19	4
Copper mining	448	3	1
Pyrites mining	225	2	1
Quarrying granite, etc.	108	..	..
do slate	90	..	..
Brick making	44?	..	..
Gold mining	30?	..	..
Miscellaneous	64?	..	..
	1,800?	24	6

It will be seen from the above figures that the occupation of the miner is not at all so hazardous as is generally supposed, and will bear a favorable comparison in this respect with any other of the country's industries. The percentages of accidents and fatalities represented above indicate for the former 1.3 per cent., and for the latter .3 per cent. In the preceding year, 1901, it was much less, there being only two fatalities in seventeen accidents or .1 per cent. of the number employed.

I am again indebted to the managers of the various mines for the greater part of the information contained in this report, as well as to several individuals more or less interested in mining enterprises, all of whom, with very few exceptions, have willingly filled in and returned the forms sent them.

I may here state that the publication of these annual mining statistics is drawing considerable attention from outside to our valuable mineral resources, and constant applications are being received for copies. The statistical Department of the Home Office, London, and the publishers of the "Mineral Industry," New York, regularly quote my figures of late years. The latter publication has perhaps the widest circulation amongst mining people, all over the world, of any work devoted to this industry.

The subjoined tables represent the chief features of the mining industry for the year.

TABLE I.

Mineral Production of Newfoundland for the Calendar Year 1902.

Product.	Quantity raised.	Manufactured or used in the country.	Exported to what market.	Value of ores at mine.
Barytes	315 tons		United States	$630
Brick	1,625,000 M.	1,625,000 M.		18,950
Building Stone	5,000 tons	5,000 tons		6,000
Cobble Stone	500 tons	500 tons		500
Copper Ore	74,608 tons		35,947 Eng.	265,810
			35,538 U.S.	
Granite	2.955 tons	2,955 tons		17,730
Iron Ore			107,189 Eng.	
			204,720 Ger.	728,721
	728,721 tons		328,033 N.S.	
			81,920 U.S.	
Lime Stone	1,150 tons	3,100 bus.		345
Paving Stone	2,250 tons	180,000 blks.		18,000
Pyrites	26,000 tons		26,000 U.S.	117,000
Slate	3,500 tons	11,000 sqrs.	3,500 G. Br.	44,000
Total				$1,217,686

TABLE II.

Showing Increase and Decrease in Comparison with Preceding Year's Output.

Product.	Quantity.		Value.	
	Increase.	Decrease.	Increase.	Decrease.
			$	$
Barytes	315 tons		630 00	
Brick	320,000 M.		5,900	
Building Stone			1,000	
Copper Ore		740 tons		94,284 00
Granite		285 tons		1,980
Iron Ore		9,485 tons		9,485
Limestone		150 tons		630
Paving Stone	40,000 blk.		3,872	
Pyrites	19,725		88,763	
Slate	1,500		21,500	
Total			$121,665 00	$106,379 00

These tables point conclusively to a steady upward tendency of this impotant industry. This year's output indicates a *per capita* value of $5.61, while it represents an average earning power of $676.49 for the number actually engaged, being far in excess of either the fishery or lumbering industries.

The proportionate value of the several mineral products to the whole amount will show the relative standing of each individual product during the year:

Iron Ore	59.844	per cent.
Copper	21.829	"
Pyrites	9.608	"
Slate	3.613	"
Brick	1.556	"
Paving Stone	1.478	"
Granite	1.456	"
Building Stone	.492	"

Gold is not included in any of the above calculations for the reason that the figures are not available. Basing the estimate on former results, and upon such other information as was ascertained some few years ago, *i.e.*, about two ounces per ton of metallic copper, last year's output should yield about 4,760 ounces fine gold. To be well within the mark it may be assumed at 4,000 ounces, worth $82,680.00. These figures, even if approximately correct, would materially increase the total value and add much to the *per capita* and other percentages given above.

In the next table of the comparative values for the past five years, based upon the metallic contents of the ores where such could be ascertained, and the ruling market prices for the year, an idea may be gained of the final value of these products when reduced to the metallic state. It would be of great importance to the country could some of the companies producing these ores be induced to erect reducing works in the Island, or as hinted last year, could a company be formed to build a smelter in some central locality for the purchase and treatment of ores generally.

In referring to this subject again, and in connection therewith, it of course pre-supposes the existence of an available coal supply within our Island. Capitalists could scarcely be expected to embark in an enterprise of this kind if they had to depend upon outside sources for their fuel supply which might at any time fail.

TABLE III.

TABLE SHOWING COMPARATIVE QUANTITIES AND VALUES OF MINERAL PRODUCTS FOR THE PAST FIVE YEARS, BASED UPON THE METALLIC CONTENTS AND AVERAGE RULING PRICES.

PRODUCT	1898		1899		1900		1901		1902		TOTAL VALUE
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
Barytes	....	....	....	....	....	....	....	....	315 tons	$ 630	$ 630
Brick	870,000 M	$ 7,570	772,000 M	$ 8,464	800,000 M	$11,200	1,305,000 M	$13,050	1,625,000 M	18,950	59,234
Building Stone	600 tons	900	500 tons	500	500 tons	500	5,000 tons	5,000	5,000 tons	6,000	12,900
Chromite	724 "	15,457	706 "	10,399	....	....	....	....	....	....	25,856
Coal	2,900 tons	11,600	5,000 "	20,000	....	....	....	....	....	....	31,600
Cobble Stone	....	500 ?	....	500 ?	....	500 ?	....	500 ?	....	500 ?	2,500 ?
Copper	2,407½ "	656,741	2,955½ "	1,165,757	2,882½ tons	1,045,387	2,755½ tons	1,018,207	2,660 tons	715,008	4,601,100
Gold	2,783 ozs.	57,525	2,600 ozs	53,742	2,400 ozs.	49,008	*2,180½ ozs	43,609 ?	*4,000 ozs.	82,680 ?	287,164 ?
Granite	4,000 tons	20,000	100 tons	500	....	2,500	3,240 tons	19,710	2,955 tons	17,730	60,440
Iron	35,000 "	712,200	165,633 "	2,650,128	117,584½ tons	2,841,348	410,127 "	6,562,032	364,360 "	5,465,400	18,231,108
Lime	....	....	....	....	....	....	7,800 bls.	975	3,100 bls.	345	1,320
Mica	....	....	23 tons	660	....	....	....	....	....	....	660
Paving Stone	1,700 tons	13,600	3,512 blks	28,100	....	....	140,000 blks	14,000	180,000 blks.	18,000	73,700
Pyrites	32,335 "	226,345	26,154 tons	183,078	....	....	6,275 tons	28,237	26,000 tons	117,000	563,551
Silver	2,616 ozs.	1,543	No	returns	No	returns	No	returns	No	returns	1,543
Slate	300 sqs.	1,350	....	....	1,800 sqs.	10,800	6,000 sqs.	22,500	11,000 sqs	44,000	78,550
TOTALS	....	$1,725,331	....	$4,121,828	....	$3,961,843	....	$7,727,820	....	$6,486,243	$24,031,956

M, thousands: ozs. ounces; bls., barrels; blks, blocks; sqs., squares; * estimated.

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Again there would be the danger of tariff wars or private interests interfering, which might be used to crush out the industry. In view of the above possibilities something should be done to exploit our coal deposits with as little delay as can be avoided. This is a matter of national importance, the far reaching effect of which upon the future of the mining industry of the country should not be lost sight of.

With available coal of our own, properly handled, we would be independent of outside sources of supply and thus assured of the principal factor in a great smelting industry. If we have not the coal then we must ever remain the producers of the raw material only, which must be shipped abroad to swell the millions of the already wealthy corporations and syndicates of other lands. Our people may earn the mere miners' wage, nothing more, or in other words "become the hewers of wood and drawers of water."

Coal is essential to a complete and prosperous mining development such as the country gives ample promise of, and unless we can find a means of utilizing those deposits which are known to exist, stagnation of the mining industry must result. It can never advance beyond the stage of producing the raw material, and there are many of these which may not bear profitable exportation in that state.

In this connection there is another matter which might well engage the serious attention of all interested in mining in the country. It is one which the present condition of our mineral industry imperatively calls for. I refer to the establishment of a thoroughly equipped Government assay office where specimens could be treated satisfactorily without the necessity or expense of sending them out of the country. In view of the rapidly increasing importance of our mineral development, such an institution becomes an absolute necessity. No country, state or province in America with half the promise of mineral wealth Newfoundland possesses is to-day without such an establishment, and no geological survey can be conducted with any prospect of beneficial results unless aided and assisted by such an adjunct as a laboratory. Its absence has been the greatest possible drawback to the furtherance of the aims and objects of the geological and mineralogical exploration of this country.

COPPER ORE.

This industry was greatly affected during the year by the low price of metallic copper as compared with the last few years. Copper fell from 18 cents in 1899 to 11 cents, and as a consequence the value of our copper ore output declined considerably. This falling off has had a greatly reducing effect upon the total value of our mineral production. In all probability the York Harbor Copper Mine, Bay of Islands, will begin to ship ore the coming year.

The development of the old Terra Nova Mine, Bay Verte, is being vigorously prosecuted by the Newfoundland Exploration Syndicate, durin gthe winter. The ore is low in copper like that of the Tilt Cove Mine, and, like it also, contains a small percentage of gold. Some of the other copper properties will likely be operated this year also and notwithstanding the low price of copper we may look forward to an increased output the coming season.

CHROMITE.

To those interested in chromite deposits perhaps some recent developments of the uses to which this valuable material may be applied will prove interesting. The higher grade ores, as is well known, are chiefly used in the arts for the production of pigments, dyes, &c. Quite a large amount is applied to the manufacture of ferro-chromium for certain grades of steel, but it is as a refactory material for furnace lining that its future use seems to hold out most promise. Its power of withstanding the intense heat of the blast furnace better than any other known material so far tested, has been amply demonstrated by recent trials. What is important in this connection is the fact that comparatively low grade ores answer the purpose equally as well as those of a higher grade. The ore can be used in its raw state just as it comes from the mine. The rough lumps are packed in and covered with a cement made of ground ore mixed with fire clay, or it may be manufactured into suitable brick for the purpose. The life of such furnace lining has been found to greatly exceed that of any substance hitherto in use. Up to a recent date it was only applied to furnaces used in the reduction of iron ores, but it is now being experimented with in copper converters with equally good results. Should this material become generally adopted for those purposes, there will likely be a large demand for chromite or chromic iron ore ere long.

Another point in connection with chromite worth noting is its intimate association with the rare metal platinum. This very valuable substance is in great demand, and the supply obtainable is not at all equal thereto. The metal is worth per ounce $21.00, which is about 33 cents above the price of gold. It is suggested that chrome deposits be carefully examined to ascertain whether this rare and noble metal is present or not. The same class of peridotite rock which usually accompanies the one is also frequently the repository of the other.

GARNET.

Garnets of good quality and color, when free from flaws, are well known as gems under the names of cinnamon stone, carbuncle, and oriental ruby, &c. It is highly probable that it occurs in the gem form both in Newfoundland and on the Labrador. The coarse dull garnets are abundant in many parts of the Island, and during the past summer were met with profusely disseminated through some of the mica-schists on the south side of White Bay. They appeared to be in sufficient quantity to be of economic importance in one or two localities. Such material is used extensively for abrasive purposes, more especially in the manufacture of sand-paper, cutting wheels, &c., or as a substitute for emery. The crystals are easily removed from the enclosing rock by crushing so as to release them, when they can be readily picked and sorted by hand for market. The last report of the United States Mineral Resources gives the value of this crude garnet at $35.57 per ton of 2,000 lbs. The industry is quite a large one, and there is a good demand for the raw material.

GOLD.

The possibility of a gold development in the country has been frequently prognosticated in former reports, and seems at length about to become realised. Up to last year nothing that could be termed an actual gold mine had any existence here, but the discovery by Mr. Stewart of free gold at Sop's Arm, White Bay, which gives such good promise of favorable results, may be looked upon as the initiation of this industry. Work is being vigorously prosecuted on this property during the winter, and a stamp mill is in readiness to be erected in the spring. So far as can be learned, up to the last accounts, everything was progressing satisfactorily. Particulars of this deposit, and the geological and mineralogical features of its environments will be found in my geological report for last year. Not having personally inspected the Rose Blanche deposit, I am not in a position to give particulars of it. The quartz lead is represented as an enormous one, but the yield of gold is very low, from mere traces up to a few dwts. per ton. Such a proposition would not be entertained a few years ago, but with the advance in chemical and metallurgical science now-a-days, it becomes possible to treat very low grade ores with profit where other conditions are of a favorable nature. In fact it is such low grade propositions which seem to attract most attention just now. Even the tailings of several abandoned mines have been sucessfully treated of late, and in some cases more gold extracted therefrom than from the original workings. The gold contents of Tilt Cove supriferous pyrites has already been referred to, and it is known that the ore of the Terra Nova Mine, Bay Verte, is also auriferous. Several rich specimens of gold bearing quartz were shown me last autumn, said to have been derived from the south side of the latter named bay. All this will give a stimulus to the search for the precious metal, which I do not doubt will result in many new finds being made in the near future.

Iron Ore.

It has been shown in the beginning of this report that there was a slight falling off in the shipments of iron ore from Bell Island last year, and the causes which tended to produce the decline were given. Probably also the fact that the great body of surface ore so easily removed is diminishing every year, may have had something to do with this decline. Henceforth much of the ore will have to be won from underground workings, causing a slower delivery, and no doubt a decreased output; nevertheless, there is a large amount of ore still in sight, enough to last for many years to come.

In the meantime other bodies of ore are being exploited, which, when rendered available for shipment, will tend to keep up the growth of the industry. One of these near Ming's Bight on the N. E. coast, is said to be extensive and of good quality. Several miners are engaged during the winter opening up this deposit.

While in Canada Bay, the past summer, I was informed that quite a promising find of hematite ore was made upon one of the Messrs. Reid's locations inside the Cloud Mountains. Several good specimens of ore have been submitted to me from various localities of late, and it is probable that some of them may lead to new and valuable mines.

The growth of the iron industry has been on such a scale of late years, and the increased demand for iron products so enormous, that any good deposit of iron ore, especially of hematite, favorably situated for mining and shipping, is sure to command attention. As a consequence the search for such goes on apace.

The United States producers are most active in pushing their iron products and are fast gaining a foothold in all the principal markets of the world. In order, however, to compete with the European producers it is found that the reduction works would be best situated on their eastern seaboard, but this removes them far from the principal ore supplies, and necessitates a long and expensive haulage by rail. They are therefore turning their attention to foreign sources for the raw material. Cuba, Spain, Canada and Newfoundland are at present the leading exporters to their markets. Newfoundland came fourth on the list in 1901, as may be seen by the U. S. mining statistics. Should the Bond-Hay treaty be ratified it will afford an opening for our ores, which in a short while would enable us to take a foremost place in this respect. Thus the possibilities before our iron ores in particular are most favorable. The abundant supply of good ore which the country possesses, situated so near the American Atlantic seaboard, and which can be so cheaply marketed by water, are facts which cannot fail to be readily recognised by our astute neighbours.

Brick and Slate.

The increase in these two industries is of a very hopeful nature, and as has already been shown, last year's output was much in excess of the preceding year's. The brick now manufactured is claimed to be fully equal to most of the ordinary imported article. There is an abundance of material suitable for the manufacture of first class brick in many parts of the Island. Fire-clay also exists in quantity amongst the coal measures on the West Coast.

The manufacture of roofing slate is destined to form a prominent feature of our mining industry in course of time. The superior quality of the raw material, and the many known deposits, which are only beginning to attract attention, coupled with their favorable situation, should in time enable us to run all foreign competitiors out of the English market. Our slate is pronounced fully equal in quality to the Welsh article, and far superior to any imported into the British Isles. Most of our slate deposits are situated at the water's edge, all are high above the sea-level, and the facilities for operating them are of such an exceptional character, together with their nearness to the English market, that they should at all events sucessfully compete with any from the United States or Canada.

Petroleum.

The use of petroleum as a fuel is fast gaining favor, and in view of the increased expense of coal, and diminution in the sources of supply of this necessary commodity, the time may not be far distant when it will entirely substitute the latter, at least for steam purposes. In the IX. vol. of the "Mineral Industry," published in 1901, there is an admirable paper on this subject by Mr. P. Dvorkovitz, which contains much useful and interesting information. The author says: "The most noteworthy example of the use of fluid fuel during the year was the trip of the oil tank steamer *Cowrie*, from Borneo to London, a distance of 10,000 miles entirely on liquid fuel. Compared with coal the consumption was stated to have been about 26 tons a day, equivalent to 30 or 32 tons of Welsh coal. During the year several ships were launched adapted to the burning of liquid fuel, and both in America and Russia it was being largely adopted for industrial purposes."

Various inventions and improvements in burners for this class of fuel have been made, but one by which the fuel is pre-heated, as well as the air necessary for combustion, seems to act best. This invention, by which the oil vapors are completely consumed, has been introduced into several steam vessels, and found to work well.

Numerous papers have been published by mining and mechanical engineers on this same subject. One by a Mr. Orde sums up the advantages of oil as a fuel, over all other combustibles, as follows: (1) "Liquid fuel, of good quality, used in boiler furnaces, if efficiently treated, should show a reduction in consumption of about 40 per cent. compared with coal. (2) A reduction in bunker space of about 15 per cent. for the same weight of fuel, a reduction of about 50 per cent. for the same radius of action. (3) A reduction in the stoke-hold staff of at least 50 per cent. In addition to these advantages, are others, such as ease of manipulation, cleanliness, absence of smoke, reduced temperature of stoke-hold, as compared with coal, increased life of boilers, owing to the constant temperature and improved performance of engines, owing to constant steam pressure."

It will thus appear that the possibilities before the oil products of the earth as a substitute for coal and other classes of fuel, are being more and more recognised every day, and it will not come as a surprise to those who have followed those experiments if, ere many decades, petroleum will entirely supercede coal, both in naval and mercantile steam vessels, and perhaps, also, in locomotive engines.

All this should prove encouraging to those interested in our oil deposits, and act as an incentive to the vigorous prosecution of the boring tests at Parsons's Pond and elsewhere.

LIME.

The small quantity of lime manufactured in the Island and the fact that there is but one lime kiln in operation, that of Mr. J. Score, calls for some comment. The demand for this material is at present confined to its use in making mortar, or for building purposes, which is necessarily limited. With an abundance of excellent lime-stone in many parts of the Island, there should be a large amount of lime used for agricultural purposes. It may not be generally recognised that lime is a most important ingredient in all good soils, and where it is not naturally present, or otherwise not in sufficient quantity, it should be supplied artificially. Such I believe to be the case with most of our thin gravelly soils, more especially such as we have here in the vicinity of the city. Lime being an absolutely essential plant food, its addition to the poor soils would undoubtedly enhance the value of the crops raised from them. It is a very cheap commodity and should certainly be used more extensively for agricultural purposes than it is. If this were fully recognised there would soon be a demand for many times as much lime as the present figures indicate, and quite a considerable industry in lime burning might soon spring up.

GENERAL REMARKS UPON THE MINERAL INDUSTRY.

It is unnecessary to repeat here all that has been set forth in previous reports relative to the various undeveloped mineral properties, or to the number and kind of minerals known to occur in the Island.

Amongst the industrial pursuits of the country, this one is every year assuming more and more importance, and each year shows a steady upward growth as indicated by the figures published. It is true the increase is not a large one yet, but it is growing in proportions, and may at any time make such a forward bound as to place the mining industry in the foremost place. It is not to be wondered at that its progress has been so slow up to the present time, when the many drawbacks it labored under are considered. The vast amount of ignorance and prejudice that had to be overcome before people could be brought to believe that there was anything of value in the country, would scarcely be believed were not the facts patent to everyone.

It will be remembered that until a few years since the same influences which tended to retard the mineral development were equally active in regard to our timber resources. Ten years ago the timber of the Island was decried on all sides as nothing but scrub, or otherwise "Rotten, shaky and unfit for any useful purpose." We are now told that no better lumber can be produced anywhere than our timber affords, and as to pulp-wood the supply is all but inexhaustible, and of the very finest quality. Vast enterprises, founded upon this belief, are now being projected, and large sums of money have recently been expended in the purchase of timber rights by outside capitalists who presumably know what they are doing.

Valuable as the timber resources of the Island undoubtedly are, they pale into insignificance in comparison with its minerals. Were the same amount of capital *judiciously* invested in exploiting of the latter, the result in ten years would astonish even the most optimistic. The country has been recently described as "one of great possibilities," and such it will eventually prove to be.

In last year's report it was hinted that if we expected to attract capital to the development of our minerals, we must be prepared to put some money into the business ourselves, and show to the outside world our faith in their value. It is clearly apparent that capitalists are not going to invest money in the purchase of undeveloped properties, or mere prospects of problematical value. This is a fact which all interested in mineral properties would do well to consider. Prospects, be they ever so promising, are not saleable comodities; they require at least sufficient development to enable a would-be purchaser to form some idea of their prospective value, to place them on a saleable basis. Any person holding a property upon which little or no work has been performed, might as well give up the idea of getting extravagant sums for such. We will have to take a leaf out of the book of our Canadian and American neighbours, and by forming small local companies perform this preliminary work ourselves. By placing stock on the market at a low figure ,and thereby giving everyone a chance to invest, a sufficient amount of capital could easily be raised to carry out this undertaking. The risk would not be very great and should failure ensue, no one need lose much. Such a policy, if generally adopted, would undoubtedly result in great benefit to the mining interests of the country in a short while.

This advice has been acted upon in one or two instances, notably, in the case of Sop's Arm gold mine, which is being exploited entirely on local capital. Many valuable properties are tied up owing to the inability or unwillingness of the owners to do anything with them, and they are likely to remain in that condition of unproductiveness, so long as the same policy is persisted in. There is an old mining adage which has a very significant application just here.

"Mines are made, not found, and money is needed to make them."

I have the honor to be, Sir,

Your obedient Servant,

JAMES P. HOWLEY.

CHAPTER XXIV.

Report for 1903.--The Mineral Statistics of Newfoundland.

St. John's, Nfld.,
February 27th, 1904.

THE HON. ELI DAWE,
Minister of Agriculture and Mines.

SIR,—Considerable delay has been experienced in getting together the necessary information upon which to formulate a report on the mineral industry for the past year. The usual blank forms sent out early in December to the various mine managers and others engaged in this occupation were not all returned till quite recently and then only after frequent personal application in many instances. This reluctance to furnish particulars is quite at variance with the action of those in other countries engaged in similar pursuits, all of whom recognize the value of such statistics, and look upon their publication as a good advertisement.

Applications for copies of these reports both from home and abroad are constantly being received, and great numbers of them have been sent to Canada, the United States, Great Britain and other European Countries as well as to South Africa, the Australian Commonwealth and elsewhere during the last few years. The demand is constantly on the increase and it is a satisfaction to know that authentic information of this kind as to the Colony's mineral wealth is appreciated.

There can be little doubt that its dissemination abroad is creating a more lively interest in the country and its rich mineral resources than was heretofore evinced, as witnessed by the constantly increasing numbers of capitalists and others interested in mining, who visit the country each succeeding year.

Notwithstanding the great falling off in the shipments of iron ore from Bell Island in 1903, the increase in other directions will bring the total output well up to the average of other years. It is a noticeable feature of this branch of the country's industrial pursuits that as one mineral product begins to fail others come to the front to supply the deficiency. Thus during the past year the value of both copper and iron pyrites shows a considerable increase, while the output of barite and slate is much beyond that of the preceding year also. Other less important substances such as granite, limestone, etc., were in excess. Taking it as a whole, the industry indicates a substantial growth from year to year.

The total value of the raw mineral substances used in the country, or exported therefrom, during the year 1903, amounted to $1,269,805.00 as against $1,217,686.00 in 1902, or an increase of $52,119.00. Had the iron output reached anywhere near that of 1901 or 1902 the total result would have far eclipsed that of any previous year in the history of the country.

The depression in the iron markets last year, a natural sequel to the inflation which preceded it, was, no doubt, the chief cause of the shortage, but what affected it most was the unsettled condition of the Dominion Iron and Steel Co.'s affairs. This Company was faced with financial and other difficulties which compelled them to curtail their business. Their output fell short by 59,885 tons. The Nova Scotia Steel Co. also fell off by 80,041 tons, making a total shortage for the year of 133,072 tons representing the same number of dollars.

Tilt Cove copper ore production reached the large amount of 75,676 tons, being only exceeded by that of 1899, which was the greatest since the inception of the mine. Terra Nova Mine shipped 11,000 tons, and York Harbor Mine, 1,114 tons, making in all 87,790 tons, an excess of 13,182 over last year, and also exceeding the total of 1899 by 833 tons. The abnormal high price of metallic copper during the latter year, however, greatly enhanced the value of the ore to the extent of no less than $117,474.00.

Pyrite exhibits a substantial increase, Pilley's Island Mine marketing 42,000 tons against 26,000 the year previous, or an excess of 16,000 tons. The ore from Terra Nova Mine might also be classed under this head, as it is used largely in the manufacture of sulphuric acid, but as its highest value is in its copper and iron contents, and as it also carries an appreciable amount of gold and silver, I have concluded to place it under the same heading as the Tilt Cove ore which it much resembles.

Nothing further was done in the way of exploiting the large deposit of pyrite at Rowsell's Harbor, Labrador, but the Dominion

Iron Co. still hold their option upon it, which they have recently been trying to dispose of to an American Syndicate. It is more than probable the coming season will witness some output from this property.

Barite from Collier's Bay Mine is beginning to figure well in our mineral production, the output running into four figures, viz., 4,300 tons raised last year, of which 2,760 tons were sent to the Canadian and United States markets.

The manufacture of roofing slate is rapidly growing in importance, last year's production exceeding that of 1902 by 700 tons equal to 2,100 squares, and in value by $19,000.00.

New machinery has been installed for the more economic treatment of the slate. Instead of the old method of cutting the rock by hand it is now sawn into the required dimensions with a minimum amount of waste.

A small quantity of slate was also manufactured at the quarry near Hickman's Harbor, Random Island, but none has been exported as yet. This quarry, as well as that at Humber Arm, Bay of Islands, will in all probability become producers this year.

The slate deposits at Black Duck Cove, Random Sound and St. Jones, South West Arm of Random, have been inspected during the past summer and most favorably reported upon. Mr. Davies, one of the firm of Davies Bros., of Port Madoc, North Wales, large dealers in Welsh slate, paid both properties a visit last spring and spoke highly of their possibilities. It is opinion that our slate is bound to come to the front in time, on account of its superior excellence. There being many other deposits of slate in various sections of the Island of similar character to those above mentioned, it would appear as if the prognostication of Mr. Davies, that there is a great future for the slate industry of Newfoundland, is likely to prove correct.

In the matter of building stone, considerably more granite was quarried than in the preceding year. There appears to have been a falling off in the amount of blue Signal Hill sandstone used, but I cannot get at the exact figures of that output. The Messrs. Reid used most of their granite in bridge construction along the line. There was no paving stone manufactured last year.

The brick industry showed a slight decrease, caused by the unfavorable weather during the early part of the season, followed later on by the burning of the plant of the Newfoundland Brick and Tile Co. at Elliott's Cove which materially affected the output. The demand for the local product is on the increase; the quality has much improved, and the time is fast approaching when there will be no further necessity for importing, at least the ordinary baked brick at all.

Gold mining, per se, may be said to have fairly commenced within the year. Although the results to date are not all that was expected, still it has been demonstrated that gold exists, not only in the baser metals, but also in quartz-leads, in a free state, and at least in one instance in the form of placer deposit. The Sop Arm mine, White Bay, is the only one that has so far shown an output worth recording. Goldenville, near Ming's Bight, where the gravel and surface deposits are being treated by washing, has not turned out a success, but it is believed that much of the exceedingly fine gold of this locality is lost by the crude methods adopted in recovering it. Be that as it may, the first washings made in the previous year were certainly of a very promising character.

The mine at Cinq Cerf Brook is chiefly a copper proposition, and contains a very rich class of ores, consisting of bornite, erubescite and chalcopyrite, disseminated through a band of quartzite rock mixed with chloritic and talcose slate. Free gold in the form of small nuggets was occasionally come across embedded both in the copper ores and quartz rock. It does not appear, however, that the precious metal is in sufficient quantity to constitute a gold mine, yet almost every specimen so far tested showed its presence, from mere traces up to values of $6.00 or $7.00 per ton. At best, in its present stage of development, it can only be classed as a low grade ore. As yet only portions of the surface have been stripped of its over burthen and a few shallow pits sunk along the outcrop, but nothing that could be considered a fair test of the property has been accomplishd. More recently a large quartz vein charged with copper pyrites and zinc blende has been discovered on the property, which has a very promising appearance.

Although the operations of the Newfoundland Petroleum Co. at Parsons' Pond have not arrived at the productive stage, there is every reason to hope that ere long petroleum will figure largely in these annual statistics. The Company have had much to contend with in the past, not the least drawback being the unreliable character of some of the persons in charge of the drilling.

Last season but one hole was put down to a depth sufficient to tap the petroliferous strata. When it reached 1,204 feet, a good flow of oil was encountered, which is considered the best yet met with. Two other holes reached depths of about 600 feet, and though no oil was struck, the abundance of gas given off was considered by the superintendent of the drilling operations undoubted evidence of oil at lower depths.

None of the recently drilled holes have been torpedoed. An attempt to explode the deep hole of the preceding year, which reached 2,160 feet, failed for some reason, yet this latter was found to contain 900 feet of oil last fall.

Up to date six holes have been completed and two partly drilled. All with the exception of the latter are oil producers. What the actual yield per well would amount to, nothing but continuous pumping for at least a couple of months can fully determine.

Notwithstanding the many drawbacks the Petroleum Co. have had to contend with in the past the results to date are not at all discouraging. It was estimated by Mr. Powell, the experienced superintendent, during the latter part of the past season, that the last hole put down would average five barrels a day, and he believed, were all the completed wells exploded and put to pumping, they would yield fully thirty (30) barrels.

In view of the rapidly increasing use of petroleum and its products, the outlook for the Newfoundland Petroleum Co. is wearing a much brighter aspect, and it is now considered that the establishment of a refinery is fully warranted.

Fifty barrels of this petroleum were sent to Scotland towards the end of the year to be distributed amongst two or three refineries and thoroughly tested. The results, which is looked forward to with much interest by all concerned, has not yet been received.

Nothing has been done in the way of developing our chromite deposits of late years, but the Humber Consolidated Mining Company has commenced the construction of a tramway from the main line of railway near George's Lake to their chromite mine at Benoit Brook, a distance of about 16 miles. It is their intention to transport the ore by this means to Humber Arm, Bay of Islands, for shipment.

The right of way is cut and two miles of the line graded. Two locomotives and some fifty ore and flat cars were imported last fall. At the junction with the main line called Chrome Junction a depot has been established, and it is contemplated completing the construction of the tramway the coming season.

The talc deposits near Manuels and Fox Trap, Conception Bay, received considerable attention in the early part of last year, but owing to litigation, the work of development was retarded. A line for a tramway to connect the deposit at Talc Mountain with the railway near Manuels was surveyed, and preparations for working on an extensive scale initiated.

The number of persons actually engaged in mining and quarrying during the season indicates an increase over the previous year of 267, while the accidents were less and number of fatalities the same.

As near as can be ascertained the following figures represent the actual numbers employed in the respective mining occupations, &c.:—

	No. Employed.	No. Accidents.	No. Fatalities.
Iron Mining	844	11	1
Copper do	624	5	4
Pyrite do	250	1	1
Slate Quarrying	120	0	0
Granite do	70	0	0
Gold Mining	54	0	0
Barite do	30	0	0
Brick Making	55	0	0
Miscellaneous	20?	0	0
	2,067	17	6

TABLE I.

Mineral Production of Newfoundland for the Calendar Year 1903.

Name of Product.	Quantity raised.	Manufactured or used in country.	Value of minerals exported.	Total value of production.
Barite	4,300 tons	....	$5,520	$ 8,600
Brick	1,550,000 M	1,550,000 M	....	14,120
Building Stone	4,000 tons	4,000 tons	....	4,000
Cobble and Spawls	4,800 tons	4,800 "	....	2,240
Copper Ore	87,790 tons	....	343,050	343,050
Gold Quartz	1,000 tons	149 oz.?	....	3,000
Granite	5,400 tons	5,400tons	....	32,400
Iron Ore	588,795 "	....	588,795	588,795
Limestone	1,200 tons	6,200 bus.	....	600
Pyrite	42,000 "	....	210,000	210,000
Slate	4,200 "	12,600 sq.	63,000	63,000
	....	....	$1,210,365	$1,269,805

TABLE II.

Showing Increase and Decrease in Comparison with Preceding Year.

PRODUCT.	QUANTITY.		VALUE.	
	Increase.	Decrease	Increase.	Decrease.
Barite	2,445 tons	....	$4,890	....
Brick	....	75,000 M.	....	$4,830
Building Stone	....	1,000 tons	....	1,000
Cobble and Spawls	4,300 tons	....	1,840	....
Copper Ore	16,305 tons	....	77,240	....
Gold Quartz	1,000 tons	....	3,000	....
Granite	2,445 tons	....	14,670	....
Iron Ore	....	133,072 tns	....	133,072
Limestone	55 tons	....	255	....
Paving Stone	....	2,250 tons	....	18,000
Pyrite	16,000 tons	....	80,000	....
Slate	700 tons	....	19,000	....
	....	....	$200,895	$156,902

TABLE III.

Showing Comparative Valuc of the Mineral Products for the past Three Years, based upon the Metallic Contents of the Metalliferous Ores and the ruling Market Prices. In the case of the Non-Metallic Substances, the Value of the Raw Material only is given.

PRODUCT.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Barite.	....	....	315 tons	$3,150	2,760 tons	$19,320
Brick..	1,105,000 M	$13,050	1,625,000 M	18,950	1,550,000 M	14,120
B'ld'g Stone	5,000 tons	5,000	5,000 tons	6,000	4,000 tons	4,000
Cobble and Spawls....	500 tons	500	500 tons	500	4,800 tons	2,240
Copper	2,755 tons	1,018,207	2,860 tons	715,008	2,710 tons	789,152
Gold	2,180 oz	43,609	4,[illegible]00 oz	82,680†	6,844 oz†	141,471†
Granite......	3,240 tons	19,710	2,955 tons	17,730	5,400 tons	32,400
Iron..........	439,135 tons	7,026,160	390,472 tons	5,992,905	309,085 tons	4,768,598
Lime	7,800 bush	975	3,100 bush	345	6,200 bush	600
Pav'g Stone.	140,000 blks	14,000	180,000 blks	18,000	....	....
S. A. Pyrites *Ores......	90,412, tons ?	1,295,905?	126,608 tns ?	1,857,972 ?	171,790 tns ?	2,520,519
Silver.. ...	.... ..	....	....	....	4,411 oz	2,560
Slate...	2,000 tons	22,500	3,333 tons	44,000	4,200 tons	63,000
	....	$9459,616	....	$8,757,240	....	$8,357,980

*Sulphuric Acid. †Estimated.

In the above table the gold and silver contents of the cupreous ores are estimated upon the following basis. Those from the Tilt Cove and Terra Nova mines average about $2.50 per ton each in the precious metals. The ore from the York Harbor mine is said to carry about $3.00 worth, while the Sop Arm mine yielded $3,000 last year.

The pig iron includes that recovered from the pyrites ores, together with the product of the Bell Island haematite.

The sulphuric acid is based upon the sulphur contents of both the iron and cupreous pyrites ores. The latter may be taken ton for ton, but the Pilley's Island ore per ton is said to produce two tons of acid. This product was worth last year $14,67½ per ton. There is also produced from this ore a certain amount of alum, which, being of low value, is not taken into account.

General Remarks on the Mineral Industry of the Country.

A study of the foregoing tables reveals some very significant facts which are well worthy of consideration. It will be seen that while the figures of table I. give the value of the raw materials only as they leave the country, *i.e.*, in the case of the metallic ores, their final value when reduced to their commercial products, equalled approximately $8,357,980 or nearly seven times that of the crude ores.

If from the above figures we deduct the freight and smelting charges which may be assumed at about 25 per cent. of the total value, there is still left $6,099,560, to which must be added the value of the non-metallic substances requiring no treatment, amounting to $115,220, or after delucting all costs and charges, a total of $6,214,780.

These figures point very conclusively to the great loss the country sustains each year by the shipment abroad of her mineral products in their crude condition. Could means be devised to have these ores treated at home, and the metal contents marketed, the country would be greatly benefited thereby, and in the course of a very few years the mineral industry would become one of the most prosperous in the Island.

These natural resources are assets of prime value, and it appears to me should be turned to the best possible account, so that at least a fair proportion of the wealth produced therefrom could be retained in the country. The mere raising and exporting of the minerals as at present, is depriving it of nearly all the fruits of the industry. A mere modicum of this wealth falls to our share, just what it costs to mine and put on board ship, probably not exceeding altogether $350,000.

I have frequently referred to this subject in former reports, and have pointed out that one step in the right direction to attain that end, would be the construction of a customs smelter for our copper ores, in some central locality in the great copper district of Notre Dame Bay. It would mean much to the future of that industry and would be followed, I have little doubt, by others for the manufacture of sulphuric acid from the pyrites ores, and the extraction of the precious metals from the baser materials. There are many small deposits of cupreous pyrites ores in and around that part of the country which of themselves are not sufficiently extensive to warrant mining o na large scale, but which would pay well if worked in a small way, could the ores be marketed on the spot. Almost every ton could then be utilized, and many persons would find remunerative employment especially during the winter months in raising it.

As most of the copper pyrites ores of the country contain more or less gold and silver, these could be extracted and refined in the country and would in most cases pay all the mining costs and charges, leaving the value of the sulphuric acid, copper and iron as clear profit to those interested in the enterprise. What such an establishment would mean to the future of the mining industry of the country can not be realized just now, yet I have no hesitation in stating that in the course of a very few years it would double or treble the present figures.

A refinery for our petroleum deposits on the West Coast would be another step in this direction, and I would respectfully suggest that any encouragement that could be given towards either in the way of a small bounty would be money well spent. It is the only way the country can ever hope to realize the benefit of its undoubtedly magnificent mineral resources.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

N. B.—I append a list of the companies at present operating our mines and quarries, and the localities of the several scenes of operation, which may prove of interest.—J.P.H.

BARITE.

Collier's Bay Barite Co. ....Collier's Bay, Trinity Bay.

BRICK YARDS.

Newfoundland Brick & Tile Co. ....Elliot's Cove, Random Island, T. B.
Pelley Brothers ....George's Brook, Smith Sound, T. B.
James Pitman ....Brick Yard. Smith's Sound, T. B.
Smith Brothers ....Snook's Harbor, Random Island, T. B.

COAL.

Barachois Coal Co., Ltd. ....Bay St. George.

CHROMITE.

Humber Consolidated Mining Co. ..Chrome Pt., Benoit Brook, P.-a-P.

COPPER ORE.

Cape Copper Co. ....Tilt Cove, Notre Dame Bay.
Newfoundland Exploration Syndicate ..Terra Nova Mine, Baie Verte.
Humber Consolidated Mining Co. ......York Harbor, Bay of Islands.

GOLD.

Sop Arm Mining Co. ....Sop Arm, White Bay.
Goldenville Mining Co. ....Goldenville, Ming's Bight.

GRANITE QUARRIES.

Reid Newfoundland Co. ....Topsails, on R. R. Line.
William Ellis ....Petites, South Coast

IRON ORE.

N. S. S. Co., and D. I. & S. Co. ..Great Bell Island, Conception Bay.

LIMESTONE.

John Score ....Cobb's Arm, N. W. Island, N. B. Bay.

PETROLEUM.

Newfoundland Petroleum Co., Ltd. ......Parson's Pond, Shallow Bay.

PYRITE.

Newfoundland Exploration Syndicate ......Pilley's Island, N. D. Bay.

SLATE.

Wilton Grove Slate Co. ....Smith's Sound, Trinity Bay.

CHAPTER XXV.

Report for 1904.--The Mineral Statistics of Newfoundland.

Geological Survey Office,
St John's, Nfld.,
March 24th, 1905.

HON. J. AUGUSTUS CLIFT, K.C.,

Minister of Agriculture and Mines,—

SIR,—In presenting this my seventh annual report on the mineral statistics of the island, it is gratifying to be in a position to record another substantial increase in the output for the last calendar year. As may be seen by the accompanying tables, the upward tendency pointed out in previous reports, has been fully maintained.

Though the usual delays occurred in getting in the returns, yet, with few exceptions, the persons engaged in the mining industry, have promptly supplied the necessary information, for which I take this opportunity of again thanking them. Owing, however, to the necessity of awaiting the close of the year for the complete returns and to the difficulties of navigation which usually occur after that period, especially northward, it is impossible to compile these reports at an earlier date. I trust, however, though somewhat late, they may not be found without interest, as exhibiting the condition and value of this important branch of the country's industrial pursuits.

It will be observed that although in a few instances there appears to be a falling off, both in the quantity and value of certain commodities, such as Barite, Slate, Granite, Building-stone, &c., this is greatly counter-balanced by the increase in other directions.

According to the figures now in my possession, the total value of the raw materials of last year's output amounted to the handsome smu of $1,353,953.00, being an increase over that of 1903 of $84,148.00. This most satisfactory result has more than fulfilled the prognostications with regard to the growth of this important industry, as set forth in my former reports, all of which have been amply borne out.

During the first four years of the new century, the mining development has gone on increasing steadily. Thus in 1900 the total value of the mineral production was only $792,099; in 1901 it jumped to $1,202,272; in 1902 it was $1,217,686; in 1903, $1,269,805, and 1904, $1,353,953. Taking the increase from year to year which totals $561,854, it gives an average annual increase of $140,463.50.

The percentages &c., of this increase stand as follows:

TABLE I.

Table Showing Percentage of Increase per capita value of Mineral Products, and Proportionate Earning Power of those Employed in Production, etc.

Year.	Percentage of Increase.	Per Capita Value	Proportionate Earning Power of Persons Employed.
		$ c.	$ c.
1901	51'78 p.c.	5.53	672.86 ?
1902	1'28 p.c.	5.56	676.49 ?
1903	4'28 p.c.	5.75	611.36
1904	6'62 p.c.	6.10	570.08

These latter figures in proportion to the number engaged in the mining production, I think, show as great an actual earning power as that of any mining country in existence to-day.

The abnormally high percentage of increase in 1901 over 1900 was owing to the fact that the latter year was one of depression in the mining industry of the country, caused by the closing down of the Pilley's Island Pyrites Mine, and the Coal Mine near Howley, but above all by the prolonged strike of the iron ore operatives at the Bell Island Mines.

During the past year some new features of importance have been imported into the industry. The amount and value of local sand, used chiefly in the construction of the new waterworks, and the first shipment of talc from the country are noteworthy. The latter promises to develop into a very important feature of the industry in the immediate future. But perhaps the most noteworthy fact connected with the mineral output for the year, is the production of 700 barrels of Petroleum, the result of a few months pumping test at Parsons' Pond Oil Field last summer. It is to be hoped that this encouraging result may eventually lead to the establishment of a refinery for treating the petroleum on the spot.

The first Gold Brick ever produced from Newfoundland ore, so far as I am aware, was obtained from a sample lot of 23 tons sent to Brookfield, N. S., by the Goldenville Mining Co., for treatment. Though the brick only contained about 11 ounces of gold, still the result of the test was very satisfactory, and affords some reason to hope that the gold production of the country may yet figure prominently in our annual statistics. The attempt at Gold Mining in Sop's Arm, White Bay, two years ago has been abandoned, owing to the low average yield, and at present I do not know of any other property being exploited as a gold proposition.

There were engaged in mining and quarrying last year, as near as can be ascertained, about 2,375 persons, being an increase over the preceding year of 308. Their several occupations, the number of accidents, and fatalities are specified as follows:—

TABLE II.

	No. Employed.	Accidents.	Fatalities.
Iron Mining	1,131	8	1
Pyrite Mining	285	7	0
Copper Mining	569	13	2
Slate Quarrying	137	1	1
Talc "	100	0	0
Granite "	38	0	0
Brick Making	40	0	0
Barite Mining	28	0	0
Petroleum Drilling	12 ?	0	0
Gold Mining	10 ?	?	?
Miscellaneous	25 ?	?	?
	2,375	29	4

The percentage of accidents, as per above figures was 1.22 per cent., while the fatalities were .16 per cent.

TABLE III.

Mineral Production of Newfoundland for the Calendar Year 1904.

NAME OF PRODUCT.	Quantity raised.	Manufactured or used in the country.	Value of Minerals Exported.	Total value of production.
			$	$
Barite	2,000 ts*	....	4,750	5,000
Brick	1,236,000 M.	1,236,000 M.	....	11,432
Building Stone.	3,100 ts.	3,100 ts.	....	4,650
Cobble and Spawls	4,000 "	4,000 "	....	2,000
Copper Ore	107,839 "	....	395,723	466,739
Gold	11 ozs	....	....	209
Granite	1,945 ts.	1,945 ts.	....	11,550
Iron Ore	589,739 "	....	585,739	589,739
Petroleum	700 bls.	300 bls.	....	1,134
Pyrite	60,200 ts.	....	210,700	210,700
Sand & Gravel	2,320 "	2,320 ts.	....	5,800
Slate	2,700 "	....	37,800	37.800
Talc	1,562 "	....	7,000	7,000
Not Specified	....	....	200	200
		Total	$1,241,912	$1,353,953

In every case the long ton of 2,240 lbs. is used.

TABLE IV.

Showing Increase and Decrease in Comparison with Preceding Year.

PRODUCT.	QUANTITY.		VALUE.	
	Increase.	Decrease	Increase.	Decrease.
Barite	....	2,300		3,600
Brick	....	314,000 M.	....	2,688
Building Stone	....	900 ts.	650	....
Cobble and Spawls	....	800 "	....	240
Copper Ore	20,049	....	123,689	....
Gold	....	138 ozs	....	2,791
Granite	....	3,455 ts.	....	20,850
Iron Ore	944 ts.	....	944	....
Petroleum	700 bls.	....	1,134?	....
Pyrite	18,200	....	700	....
Sand and Gravel.	2,320 ts.	....	5,800	....
Slate	....	1,500 ts.	....	25,200
Talc	1,750	....	7,000	....
		Total	$139,917	$55,269

TABLE V.

Comparative Value of Mineral Production for 1903-1904, based upon the Metallic Contents and Ruling Market Prices, except in the case of non-Metallic Substances, the Values of which are the Average Selling Prices of the Crude or Manufactured Materials.

PRODUCT.	1903		1904.	
	Quantity.	Value.	Quantity.	Value.
		$		$
Barite	2,760 ts.†	19,320	2,000 ts	13,300
Brick	1,550,000 M.	14,120	1,236,000 M.	11,432?
Building Stone	4,000 ts.	4,000	3,100 ts.	4,650
Cobble and Spawls	4,800 "	2,240	4,000	2,000
Copper (metallic)	2,710 "	789,152	3,920‡	1,091,534
Gold	6,840 oz*	141,471	6,242 oz*	124,623
Granite	5,400 ts.	32,400	1,945 ts.	11,550
Iron (pig)	309,085 "	4,768,598	320,198 ts.	5,331,296
Lime	6,200 bus	600	?	500?
Petroleum	....	....	700 lbs.	1,134?
Pyrite (Sul. Acid)	171,790 ts.?	2,520,519?	201,682 ts.	2,924,389?
Sand and Gravel	....	....	2,320 ts.	5,800
Slate	4,200 ts	63,000	2,700 "	37,800
Silver	4,411 oz*	2,560	?	3,000?
Talc	....	....	1,562½ ts.	7,000
Not Specified	....	....	....	200
	Total	$8,357,980		$9,570,208

*Ton of 2240 lbs. *Estimated.

NOTE.—The values given in table V. differ from those in Table III., which is explained by the fact that the latter is a statement of the value of the crude materials, while the former gives the value of the refind or manufactured metals.

The differences in quantities as e.g. gold, is explained by the fact that Table V. includes not only the gold raised in the country, but also that extracted from ores such as copper, etc., when treated outside the country.

GENERAL REMARKS ON THE MINING INDUSTRY.

A few particulars with regard to individual mining enterprises and the condition of the industry generally during the past year, also a reference to those prospective mineral substances which appear to be available for the intelligent investment of capital, may not be out of place.

BARITE.

The deposit of this mineral at Collier's Cove, Trinity Bay, which has been worked the past three years, continues to turn out a good grade of material, but as the development progresses the quantity of ore raised seems to diminish somewhat. No doubt this is due to the slower extraction consequent upon the underground mining. Last year's output fell short of that of 1903 by 2,300 tons. Some 2,000 tons were raised altogether, all of which, with the exception of about 100 tons, were shipped to the Canadian and United States markets.

This material is in considerable demand for certain chemical and manufacturing purposes, and some of the higher grades of German Barite run up from $14.50 to $17.50 per ton in New York. Its more important uses at present are in the production of Barium Chloride and Oxide. It is still more largely used, especially in Europe, for the manufacture of a pigment known as Lithophone, which is a compound of Zinc-oxide or Sulphate, Barium Sulphide and some alkali metal.

The mineral is of pretty common occurrence in Newfoundland, though much of it is discolored by iron or other impurities. During the past autumn I was shown specimens of very snow-white barite from the West Coast, which to all appearances was of first-class quality. Were it carefully prospected for, there is good reason to believe that the country might in time become a large producer.

BUILDING STONE, COBBLE AND SPAWLS.

Under these headings there is a considerable industry carried on, but it is difficult to get at all the facts. It is purely of a local character, being confined to the city of St. John's or its immediate vicinity. I am not aware whether any demand exists for this class of material outside of the city.

Most of the Building Stone is derived from the Signal Hill and South Side ranges chiefly from the bluish and reddish sandstones of the Avalon series.

The demand for nearly all this stone comes from the contractors and builders of the city, and it is used chiefly in the construction of foundation walls for houses, etc. A small portion only is purchased by the Municipality for retaining walls and such like purposes. Of late years concrete is taking the place of this stone to a considerable extent, and has sensibly diminished the demand. Within the past year also, one of our city architects, Mr. Barter, has commenced the manufacture of an artificial stone, "Litholite," which appears to possess many favorable qualities, and may in time take the place of both brick and stone for building purposes.

This latter industry has rapidly developed in the United States of late, and has now reached gigantic proportions. All kinds of stone can be closely imitated, and, moreover, cast in moulds of any desired pattern, thus doing away with the expense of cutting or carving by hand. The probabilities are that in course of a few years this artificial product will entirely replace ordinary stone for structural purposes. Cement being the chief ingredients of its manufacture, and that material now being produced in enormous quantity, both from natural rock and from admixtures of various clays, &c., and sold at such a very low figure, it becomes possible to produce the "Litholite" at much less cost than any stone can be quarried and dressed for market. Here, however, where the cement has to be imported, and freight and duty paid thereon, it has yet to be demonstrated whether this new class of building material is able to drive the admirable Signal Hill rock out of the market.

The Cobble Stone, or water worn boulders, of the Signal Hill rock is used chiefly in the paving of gutters, side drains, and for bordering of flower plots, etc. It is nearly all purchased by the City Council.

The Spawls are the chips or flakes left after dressing the sandstone, and are purchased by the Council for macadamizing the city streets. When crushed to a suitable size this material is admirably adapted for road metal.

Considerable gravel, or rather a finer form of beach material, is used on flat-roofed houses throughout the city every year, but the quantity or value cannot easily be ascertained.

The Brick Industry.

The Newfoundland Brick & Tile Co. have abandoned their work at Elliot's Cove, Random Island, and transferred their plant to St. John's, where they have commenced the manufacture of a sand or cement Brick. The company has also changed its title to the Newfoundland Brick & Manufacturing Co. Their output for the year fell very much short of the preceding year, viz.: by 414,000, or $3,468 worth.

The three other Brick-makers of Smith Sound, Trinity Bay, increased their outputs by about 100,000, so that the total falling off in value equalled $2,788.

There is room for considerable expansion in the brick industry, as I understand the supply is not at all equal to the demand. Clays suitable for all kinds of brick and earthenware are abundant in many parts of the country, and almost any of the innumerable articles imported having clay as their basis could easily be manufactured at home.

The ceramic art, as it is termed, is perhaps the oldest in existence. It dates back to pre-historic times, and has been practiced by almost every race of people in all ages. To-day it is one of the foremost and most important of modern industries. It has been brought to an extraordinary state of perfection in recent times, and its utility is of paramount importance to civilization. Some idea of the value of the clay products may be gathered from the statistics of Great Britain and the United States. In the former country in 1902 it amounted to £1,758,884, and in the latter, in 1901, it reached $87,747,727.

Our own annual importation of all earthenware products must be very considerable, and it would appear as if here there might be a favorable opening for the establishment of a very promising local industry.

Chromite.

Nothing further has been done in exploiting our chrome deposits. The Humber Consolidated Mining Co., who hold a lease for Chromite near Benoit Brook, had their hands so full with the York Harbor Copper Mine last year that they apparently had no time to devote to the former; at all events, the branch railway leading to this property, commenced the previous year, was not pushed forward.

It is somewhat strange that this valuable mineral, which is in considerable demand, especially for the manufacture of ferro-chromium and chromate of potash, and the preparation of refractory brick for furnace lining, etc., should not attract the attention of mining capitalists interested in such products. There are several known deposits of value in the island, and some of them are within easy reach of good shipping points.

The Province of Quebec, Canada, is a large producer of chromite, and a ready market is obtained in the United States for the entire output. In the year 1903 there were mined 3,020 tons in that province, valued at $45,300, a sum equal to nearly $15.00 per ton of crude ore, which should be a strong inducement to capitalists as there are few metallic ores now-a-days which exceed this value.

Copper Ore.

The Union Mine at Tilt Cove is again to the fore with an output of 73,082 tons Cupriferous Pyrites, while Pilley's Island is credited with 165 tons. There were raised at the new Copper Mine at St. Julien's, N. E. Coast, 280 tons, 80 of which were a high grade Chalco-pyrite. None of this latter ore has been shipped to market, the development being only in its initial stage as yet. The property has been optioned to a New York Company, and some eight or ten men have been employed, sinking and driving during the past six months. It was visited and examined during the season by a German expert, who entertained a most favorable opinion of it.

The output of Cupriferous Pyrites from Terra Nova Mine, Baie Verte, reached 19,312 tons, all of which went to the United States markets. This ore being very low in Copper has been classed by the Customs authorities under the head of Pyrites, and coupled with the Pilley's Island ore, but as its Copper content is in reality not much below that of the Tilt Cove ore, I prefer to place it with the latter as a copper ore. All this class of ores which contain sufficient sulphur are used in the manufacture of Sulphuric Acid, as well as the ordinary Iron Pyrite, but their Copper content being of considerable value is carefully extracted and saved.

The Mine at York Harbor, Bay of Islands, operated by the Humber Consolidated Mining and Manufacturing Co., has more than come up to expectations. During the past year active development has been pushed forward by the energetic management. An immense body of ore, some 57 feet in thickness, has been uncovered in the lower levels, the full extent of which has not yet been determined. The ore averages about 7 per cent. cu., besides containing an appreciable amount of Gold and Silver. Judging from the present aspect of this mine, it promises to become the greatest Copper proposition yet developed in the country. Some 15,000 tons of ore were raised, of which 8,200 were shipped to the United States.

The total output of Copper Ore from all the mines gave a yield of 107,839 tons, an excess over last year of 20,049, and by far the largest amount of Copper Ore the country has ever produced in one year.

The price of metallic copper in the markets ruled fairly high last season, averaging about 12 cents per lb., and reaching 15 cents per lb., during the closing months of the year. The great demand for Copper consequent upon the rapidly increasing use of Electricity as a motive power, seems to afford a most promising prospect for the future of Copper Mining here and elsewhere. Though several substitutes have of late been put upon the markets, it has yet to be demonstrated whether any of these can ever take the place of this most useful and valuable metal. Its well-known conductivity seems to have specially marked it out as the metallic substance best adapted to all purposes in connection with Electrical Engineering Science.

Gold.

The only attempt at gold mining made during the past year was that at Goldenville, near Ming's Bight. Through the courtesy of Mr. R. J. Foote, Secretary of the Goldenville Mining Company, I have been furnished with the following particulars relative to their operations, and a copy of a test made at Brookfield, N. S., where some 23 tons of ore had been sent for treatment.

The lode rock carrying the gold consists of a matrix of mixed hematite, iron pyrites, and quartz, and averages about 8 feet wide.

They are now sinking and drifting on this band, and have a large amount of ore exposed, ready for stoping.

During the summer, 23 tons of ore were sent to the Brookfield Mining Co. to be thoroughly tested. Mr. Foote himself accompanied the ore and watched the whole process carefully. It was carried out under the competent management of Mr. H. S. Badger, the company's assayist, with the following result:—

1st—By amalgamation, Bullion recovered, 8ozs. 4dwts. (retorted gold).
2nd—Treatment of tailings by Cyanide process:—

Assay value of sands ....$3.20 per ton.
" " slimes ... ...11.00 "

The value of tailings sampled at end of plates, $4.95 in gold and 21 cents in silver, or a total of $5.16.

3rd—Cyanide Test:—

Number of tons treated 1785
Average value, by separate sample and assay $4.43
Recovered in Bullion ... .3 ozs., 9 dwts.
Time of treatment ....54 hours.
Cosumption of Cyanide ... .3 lbs. per ton.
Percentage of recovery .... 82 per cent.

4th—The total recovery equalled 11 ozs. in melted gold at $19.00 per ounce, or $209.00. Value recovered per ton equalled $9.08.

A test made on concentrates from this ore gave $46.20 per ton in gold. The total cost of treatment was about $2.40 per ton. If as much more be allowed for mining and shipping, there is still left the handsome margin of profit of $4.28. This is a very favorable showing, and under careful management and treatment of the ore on the spot, should prove a profitable investment, provided, of course, the ore continues to average anything like that of the above figures. It is to be regretted that the Sop Arm Gold Mine, which gave so much promise at first, should have dropped to so low a percentage, only about 3 dwts. per ton, that it did not pay to work; consequently, operations were suspended.

The rich Bornite deposit at Cing Cerf which contained free gold in the form of considerable sized nuggets, was not operated during the year, though it would seem to offer a fair prospect for investment. I understand that it is contemplated giving this property another trial during the coming season.

I have been unable to ascertain anything with respect to the amount of Gold recovered from our Copper ores during the past year, but if they continue to average as much as usual, i.e., about 1.5 dwts. per ton, the figures should reach between 6,000 and 7,000 ozs., worth $20.67 per oz. The latter figures are of course only approximate, and their correctness cannot be vouched for.

Iron Ore.

The iron ore industry continues to flourish and there was a small increase in the output over that of the preceding year. Owing to the fact that the Nova Scotia Company's operations are now chiefly confined to underground workings, and the extraction of the ore is much more tedious and expensive than heretofore, that company's output fell off considerably, but the Dominion Company increased theirs by the large amount of 94,632 tons which brought the total up to 589,739 tons. This gives an increase on the whole year's output of 944 tons, but as 4,000 tons still remain over, unshipped, the actual amount marketed was 585,739 tons. It is of course only natural as the ore upon the surface becomes exhausted, and it has to be won from underground mining, that the result must show an annual decline from this time forth. It is found, however, that the ore body increases in thickness and quality as the underground work proceeds, and that much ore can be won from the submarine areas.

The demand for the Bell Island iron ore continues to hold good, a very large percentage of it going to Rotterdam, as usual. In Scotland also the ore is finding favor and a market has been opened for it in the United States.

There seems some prospect of the deposits on the western portion of Bell Island being opened up ere long. This property was visited during the autumn by an expert who inspected it, and is said to have entertained a favorable opinion of it. A further investigation is proposed next spring when a diamond boring drill is to be brought into requisition to fully test the ground.

The Nova Scotia Steel Company made an attempt to mine the ore at Workington on the North Side of Conception Bay, during the summer, but failed to find it in sufficient quantity to warrant their continuing the work. It is much to be regretted that this mine has not proved a successful venture as the ore is of a very superior quality. Mr. Chambers, of the Nova Scotia Steel Co., informs me that it is an ideal character of Hematite, "just that class of iron ore that iron manufacturers are looking for."

Peat.

The various attempts to manufacture peat fuel on this side of the Atlantic especially in Canada, have not met with that measure of success which was anticipated at first. Several different processes have been tried, each possessing certain merits of its own, but though the products have met with ready sale in districts where other fuel is scarce and dear, yet so far no peat fuel industry on a commercial basis has been established. Nevertheless, the belief is growing that ultimately the efforts of those experimenting in this direction will be crowned with success. This belief is strengthened by the fact that in several countries of Europe, notably in Great Britain, Norway, Denmark, Germany, and Holland, its manufacture is now well established, and long beyond the experimental stage. In Holland especially, it has been a complete success.

Some of the most up to date methods of these latter countries are being introduced into Canada, and last year the Dominion Government caused a special investigation to be made into the extent and probable value of their available peat resources. From the report of Mr. R. Chalmers, Ll.D. who was told off for this especial work, I gather much valuable information. "Approximately there "are 37,000 square miles of peat bogs within the several provinces "of the Dominion. Many analyses of the peats have been made "which prove them to be of first class material. It is fully believed "that the time is approaching when those peat resources will become assets of great future value to the country."

The latest process for the manufacture of peat fuel, and the one which seems to most nearly realise the aim of those interested in the business is by the use of the Electrical current as a drier and carbonizer. "The peat is first deprived of a great part of its contained moisture by being rapidly revolved in a rotary cylinder, "aided by internal heat. Electrodes connected by conductors with "a dynamo are then inserted into the cylinder, in such a manner "that the mass of centrifugally-dried peat becomes the medium "through which the circuit is completed between the electrodes. "The resistance offered by the peat generates heat sufficient to carbonize the material, producing a mass of black globules. This "carbonized material then passes to a machine where it is moisten-

"ed by some sort of chemical and kneaded into a putty-like mass "when it is pressed into briquettes."

It is claimed for this process that the carbonizing of the peat by the electric current does not destroy any of the valuable elements of the peat, as is the case when cokeing is performed by ordinary fire heat in which a large proportion is lost, being either consumed or driven off in the form of gas. Fuel so prepared is said to have a thermal value of 9,000 units, and to be fully equal, ton for ton, for steam generating purposes to Welsh coal.

It is also stated that it can be produced for $1.21 per ton, whereas coal at the pits' mouth costs $2.02. These results are based upon the most favorable local conditions for operating with an electric current generated by steam, but where good water-power is available the cost could be materially reduced.

I need scarcely point out that here in Newfoundland we possess an unlimited supply of the very best quality of peat, while water-power is obtainable on almost every river in every section of the island.

Petroleum.

The operations at Parsons' Pond oil field during the past season, according to the report of the superintendent, Mr. Powell, were of a nature to afford much encouragement to those who have so persistently prosecuted the work of drilling for the past ten years.

One hole which had been partly drilled the year previous to a depth of 600 feet was continued down to 2,050 feet. Oil was struck at depths of 1,470 and 1,750 feet. This well yielded on an average two barrels of petroleum per day. In conjunction with three of the older ones, it was then put to pumping, and after a two months' test the following was the result:—

Tank well, yield per diem	1½	barrels.
1,200 foot well, per diem	1½	"
Spottswood well, per diem	1	"
2,050 foot well, per diem	2	"

A new well on the north side of the lake, also commenced the year before, was continued down to a depth of 1,550 feet, when the best show of oil yet met with in the district was encountered. This well was pumped continuously for nearly five months and gave a steady yield of 4½ barrels daily. The oil produced was entirely different from any previously met with in the region. It was of a light amber color, and of great body. Mr. Powell does not think it will show a high percentage of lighting oils, but believes it to be exceptionally rich in the more valuable lubricating oils, paraffine, waxes, and other by-products. He states that he tried it as a lubricator on the engines and found it so satisfactory that he used nothing else afterwards. This oil is of a much higher class than the ordinary Pennsylvania illuminating oil, and is also much more valuable. Another well on the same side of the lake was drilled to a depth of 1,400 feet, but yielded very little.

The five wells pumped gave a total yield per diem of 10½ barrels, although as yet none of them have been torpedoed. It is thought that after undergoing this operation the yield would be greatly increased.

Altogether 700 barrels of petroleum were obtained from the five wells, of which 400 barrels are stored in tanks on the ground, the other 300 barrels having been consumed as fuel to run the drill with.

PYRITE.

The returns from Pilley's Island did not reach me till a few days ago, owing to the snow blockade which has deranged the mail service to such an extent. The output of Pyrite for the past year was far in excess of any that preceded it, being 60,200 tons of ore valued at $210,700. The Baie Verte returns also came to hand by the same mail, but for reasons already given I have included this under the head of Copper Ore.

I could not learn much about the pyrites mine at Rowsell's Harbor, Labrador, which is now in the hands of the Dupont Powder Company of Wilmington, Deleware. I understand that during the summer some sixty men were employed developing the property, and a considerable amount of work was performed. The deposit is reported to be a very large one, and the ore high in sulphur. It also contains a small percentage of Gold.

Several shafts were sunk and drifts made along the course of the lode, and some twenty or thirty tons of ore, as a test sample, were shipped to the United States. During the summer several shiploads of machinery, provisions, and requisite implements, etc., were sent down. Owing to the scarcity of timber, portable houses for the miners were also taken to the locality, and erected during the open season.

A small force of men under Captain Bartlett are wintering on the spot, and pushing on the underground work. It is expected the coming season will witness the commencement of regular shipments of ore. In the course of a very few years this new source of pyrite is likely to add very materially to the mineral output.

Radium.

In connection with the mineral development of the island, it may be worth noting that within the past year some new sources of the remarkable element, Radium, have been discovered in Canada. Heretofore, it was supposed to be confined to certain ores of uranium, especially Pitch-blende, and under the supposition that this would prove the chief source of the rare element, the Austrian Government had prohibited the exportation of this ore from Bohemia and Hungary, where it occurs in some quantity. Under these circumstances the discovery of other radio-active substances more especially on the Western continent, was hailed with much satisfaction in scientific circles.

To Mr. Obalski, inspector of mines for the Province of Quebec, Canada, is due the credit of bringing to light these new discoveries. A mineral which he identified as Cleveite, from a mica mine on the lower St. Lawrence, "produced distinct radiographs upon "sensitised photographic plates, of coins, and other objects, after "the rays emanating from the specimen had traversed opaque "bodies of wood and metal. It was afterwards found that the min-"eral perceptibly discharged the electroscope, clearly indicating "the possession of pronounced radio-active properties." An analysis of this mineral gave 70.71 per cent. of uranium.

Mr. Obalski also discovered that the ashes derived from a species of carbonaceous material, called Anthraxolite exhibited strong radio-activity. He read a paper describing and illustrating his discovery before the Toronto University, which created quite an unusual amount of interest, and drew forth a great deal of discussion from several eminent scientists present. In the course of this discussion Prof. McLennan of the University of Toronto, instanced the fact that while experimenting in the laboratory on some petroleum products of Canada, he found that the emanations from a certain class of these products exhibited distinct radioactivity, and that the lower down in the geological series the petroleum was derived from it showed the strongest indications.

It is highly probable that some of those radium-containing substances may be found to exist either in this island or on our Labrador territory. Two of the substances named at least occur on the island, viz.:—Anthraxolite, and Petroleum, the latter of which is derived from the lowest known series of rocks that have yet yielded petroleum in any appreciable quantity. Ores of uranium seem to favor granite rocks, and may be expected to occur in the Archæan series so widely distributed on the Labrador Peninsula and the northern and central portions of our own Island.

In view of the very great value of this rare substance, ores containing it will be eagerly sought for and their discovery hailed with much pleasure by scientists. Mr. Obalski even suggests the advisability of the Dominion Government offering a bounty to encourage the search for such ores. The Swedish Government have already put this idea in practice, by giving bonuses for specimens found. I have read that radium has been discovered in considerable quantity in that country, in an Alkaline metallic earth containing uranium.

SLATE.

The slate returns from tne Wilton Grove quarry exhibit a considerable falling off, being but a little over half the output of 1903. This was chiefly owing to a disastrous fire which occurred in the early part of the season, by which much of the plant of the quarry was destroyed and the development work thereby greatly retarded.

Nothing was done with any of the other slate properties in Trinity Bay, so far as I can learn. At the Summerside slate quarry, Bay of Islands, quite a lot of work was accomplished in stripping and preparing the way for active operations. Mr. Owen, the manager, informs me that the deposit has now been fully proven to be of great extent and of first class quality, and that quite a lot of slate was manufactured, though as yet none has been shipped abroad. Another quarry was also opened on the south side of the Humber Arm, by an American company, at a place called Crow's

Gulch, on the strike of the same belt. Some fifteen men are now employed unstripping this slate, and they expected to begin actual quarrying next spring. Mr. Owen, who is a practical man of long experience, speaks quite confidently of the prospects of these quarries, which he pronounces to contain slate of the very best quality.

Talc.

The deposit now being operated near Manuels, south side of Conception Bay, though not properly speaking a true talc, has been so named and classed in a commercial sense, and appears so under that heading in the customs exports. Properly speaking it is a silicate of alumina and potash, with little or no magnesia, and would appear to approach nearer in composition to a material known as agalmatolite, or figure stone of the Chinese, than anything else.

The company operating this property, and known as the North American Talc Co., were actively engaed all summer constructing an overhead tramway from the mine to the railway, and also a loading pier near Seal Cove, about 10 miles further up the bay. A staff of men were employed most of the time quarrying the rock at Johnny's Pond, and sorting it for shipment. It was, however, late in the autumn before they were in a position to ship their first cargo, which amounted to 1,750 tons. This was sent to Portland, Maine, where the company has a large establishment for grinding the material and converting it into marketable condition.

The result of this first shipment is not, so far as I am aware, made public yet, nor is it known whether the product will fulfil all that is claimed for it or otherwise. As a paper filler, it is said to be fully equal to the best Talc, while it is also said to possess valuable properties applicable to the manufacture of porcelain and china-ware, etc. Should the expectations of this company be realised, there is certainly room for a great enterprise in the exploiting of these Talc (?) deposits, which extend over a considerable area of country and must contain many millions of tons of the material.

Miscellaneous.

It is unnecessary to enumerate here the various other metallic and non-metallic substances which are known to occur in the country. These have been fully dealt with in former reports, especially those of 1898-99 and 1900. Some at least of these materials deserve the attention of capitalists, and I may here say that I have frequent enquiries for information regarding them. This has been particularly the case in respect of ores of Zinc Molybdenite, Pyrite, Asbestos, Fluorspar, etc.

Of the many beautiful Granites, Sandstones, Marbles, Serpentines, Slates and other building or ornamental materials which the country possesses in abundance, I feel that they only require to be known properly, to have the attention drawn towards them which their merits deserve. The surest wa yto obtain this end is by exhibiting good specimens on every available occasion where expositions of natural products take place, particularly in countries likely to become purchasers of the raw materials. It is to be regretted that we have not availed much of such opportunities in the past, though frequently solicited to do so. The Canadians are fully alive to the value of this mode of advertising their varied and valuable mineral resources. Not only are local exhibitions held in the several provinces, but almost every year they take part in some great international affair of this kind, with marked results of a beneficial character.

In conclusion, it may not be amiss to draw attention to the need of a properly constituted system of Governmental inspection of our mines. The number of bread-winners now employed in this industry, with those depending upon them, must represent at least 10 to 12,000 individuals, which is fully 6 per cent. of the total population of the Island. The frequency of accidents of a serious character and the rather excessive proportion of fatalities of late, certainly calls for consideration. No doubt most of those occurrences are due entirely to the carelessness of the miners themselves, especially in handling dynamite. They seem to utterly ignore all rules and warnings, and it appears as if some means should be devised to compel conformity with ordinary precautionary measures.

I have the honor to be, Sir,

Your obedient servant,

JAMES P HOWLEY.

CHAPTER XXVI.

Report for 1904.—Exploration and Boring Operations in the Central Carboniferous Basin near Grand Lake.

Geological Survey Office.
St. John's, January 25th, 1905.

HON. J. AUGUSTUS CLIFT, K.C.,
Minister of Agriculture and Mines.

SIR,—I beg to hand you the following report upon the past season's operations in the central or Grand Lake coal basin.

Before entering upon the description of the work in question, it may be advisable to give a short general resume of the preceding operations in this particular district. This would seem to be the more necessary, as few persons have any idea of what has been accomplished, or of the difficulties that had to be met and overcome in carrying on the investigation from the outset. It will also tend to elucidate the whole subject more thoroughly, and, it is hoped, be the means of removing some misapprehensions which appear to exist.

Previous to the advent of the railway, the region surrounding the Grand Lake was by no means easy of access. To reach it from St. John's or return therefrom, usually occupied a full month each way. To accomplish the journey with a whole season's outfit of camp equipage—provisions, tools, etc.—was a very arduous undertaking; yet it was under such conditions the earlier explorations were carried out.

The country surrounding the head of the lake, and for many miles to the North and East, is a low-lying flat or undulating plain, covered with marshy swamps, small ponds, and wooded ridges. A vast deposit of superficial debris, consisting of sand, gravel, and innumerable boulders, covers this plain in every direction. Many of the boulders are of enormous size and cannot be removed by any ordinary means. The thickness of this surface deposit varies considerably, frequently exceeding one hundred feet, and in some instances even one hundred and fifty feet, as was found to be the case near the shore of Grand Lake. Nowhere on the surface is there anything to afford the slightest indication as to the probable depth at which the underlying rock formation may be reached. To do so by sinking pits is therefore, to a great extent, a matter of conjecture, or otherwise of mere chance. Yet close observation extending over several years' study of every feature, and knowledge obtained from previous attempts often futile, has afforded data whereby some sort of a conclusion on this head can be reached, and this knowledge was availed of during the past season to a considerable extent.

The first authentic account of the existence of coal in this region was obtained by the late J. B. Jukes, M.A., F.G.S., F.C.P.S., an eminent geologist, who, in the year 1840, made a cursory examination of portions of the western side of the Island. In company with an Indian guide he visited the Grand Lake, and upon a small brook flowing into it near its S. E. corner, since named Coal Brook, he observed one small seam of coal about six inches in thickness. He conjectured from the character and attitude of the rock formation there exposed that there should be other and more valuable deposits somewhere in the district.

From this date till the advent of the late Alex. Murray, C.M.G., F.G.S., no further attempt was made to explore the country. In 1865 Mr. Murray traversed that section between Hall's Bay and Bay St. George by way of Indian Brook, Sandy Lake and river, and the Grand Lake, all of which he surveyed and mapped out. He visited the place where Jukes had seen the coal, but in the interim it had been completely hidden by fallen debris and was not then visible. Numerous fragments of coal were however observed strewn along the shore, near the head of the Grand Lake. The next year he ascended the Main Humber River as far as the big fall, but though the Carboniferous series was ascertained to spread over a vast extent of the Humber Valley, it was only the lower and unproductive portion that was met with. The comparatively low angle of inclination at which the strata dipped toward the southward left little room for doubt that higher strata, bringing in possible true coal measures and available coal seams, must be looked for in that direction. A later investigation on the upper reaches of the Humber, carried out by myself in 1879, confirmed this conclusion In the latter year the Government purchased a boring outfit, and employed a Scotch driller to put down some holes near the head of Grand Lake, where the loose coal had been seen.

Owing to the difficulty of getting heavy material on the ground in the then condition of the country, the season was far advanced before drilling operations were actually commenced, and but one hole was put down that year, to a depth of 250 feet. Two small coal seams were passed through, the largest being but sixteen inches thick. During the following year (1880) two more holes were bored further up the Sandy Lake River, with no better results. It became quite evident that a mere fringe of the coal measures only had been struck.

Up to this date all the evidence obtained was rather of a negative character, yet it was not without value. The area in which workable seams might be expected to occur had now been narrowed down to that portion of the district lying between the Grand and Sandy Lakes. This, however, was the most difficult part of the entire region to explore, owing to the nature of the surface, the absence of any means to penetrate the thick woods or move heavy machinery about. But what added most to the difficulty was the complete absence of any outcrops of the rock formation which would afford the slightest clue to the structure beneath.

The mystery remained unsolved, and not until 1891-2 was another attempt made to unravel it. In the latter years a more systematic plan was adopted, and a determined effort entered upon to prove something conclusive. The Geological staff, with a crew of eight or ten men, and an outfit of picks and shovels, again visited the Grand Lake. The lake itself and all the small brooks flowing into it on the south side were carefully re-surveyed, and most minute investigation carried out. Close up under the foot hills, lying to the south of the lake, some rock exposures were discovered. Upon stripping these, by removing the timber and then the surface soil down to the bed rock, good sections were exposed to view. They consisted of true coal measures doubled up in the form of a sharp, narrow synclinal trough, holding seams of coal of varying thickness. On Aldery Brook thirty outcrops, representing fifteen separate seams, were found. Three miles further east, on Coal Brook, another section showed eighteen outcrops, or nine distinct seams, while on Kelvin Brook, two miles still further east, six more outcrops were discovered. Ample evidence was obtained of the continuity of this coal trough between the above named points. Details of this work are to be found in the reports for 1891-2 under one cover.

Beyond Kelvin Brook the country assumes such a low flat character, and is so completely covered with superficial debris in all directions, that notwithstanding the most diligent search, no other outcrop of the coal measures could be anywhere met with. It became quite evident that the use of a boring machine would have to be again resorted to for the further testing of this promising coal basin.

The Government, at my suggestion, now reserved the area supposed to contain coal from lease or grant to private parties, and in the following year 1893, purchased a Sullivan Diamond Drill for the purpose of testing the ground more thoroughly. The delays in shipping, and the difficulties in getting the machine on the ground were so great that it was the month of August before it reached its destination at the head of Grand Lake. Drilling was commenced near the Lake-shore on Kelvin Brook, but such an incredible amount of drift material was encountered, and such a vast accumulation of boulders were lodged beneath the surface soil down to depths of over 130 feet that after three separate attempts to penetrate to the bed-rock, the place had to be abandoned and the whole outfit moved a mile further South. Here the bed-rock was struck at a depth of 105 feet, and the bore hole carried down to 335 feet altogether. It became evident that the section passed through was too low down in the series to expect any coal seams of value. A few thin streaks of coaly matter and some black shales were met with, but nothing that could be called a true seam. The information obtained clearly indicated that the true coal measures lay still to the Southward, and were here confined to a narrow strip lying close along by the range of hills which bounded the valley on that side.

It was a great mistake not to have continued the boring operations after that date, but various circumstances including the unfortunate Bank crash of the following year, caused a suspension of the work for the time being.

During the season of 1895 the railway construction having reached the vicinity of the Grand Lake, I was informed by Mr. R.

G. Reid, Sr., that in the gravel-cuts between Kitty's Brook and the crossing of the Sandy Lake river, numerous fragments of loose coal were come across, and at his earnest solicitation the Geological staff were again sent out to try and locate the seams from whence this coal was derived. It was well up in August before we arrived on the ground, and after a cursory examination of the surface, a point near Goose Brook was selected for trial. With the aid of pick and shovel, work was commenced near the railway track, and after a short while a coal seam was discovered which on being fully uncovered gave the following section:—

	ft.	ins.
Fire-clay	4	0
Coal with clay streaks	0	10
Clay	0	1
Coal fairly good	1	1
Clay	0	2
Coal, soft and shaly	1	5
Total	7	7
Coal	3	4

Indications of other seams in the same locality were not wanting, but the season was too far advanced to effect much more work with such inadequate means as were at our disposal.

This find was a great step in advance and afforded a clue to the true structure in this part of the region, which was invaluable. We now had hold of the coal basin again in a part of the country far removed from the hill range, and at a point 3½ miles east of Kelvin Brook, or just eleven miles on the strike from the furthest western extremity of the trough. It proved beyond question that the conclusion which had been arrived at as to the prolongation of the coal trough into the flat country was correct, and that the liklihood of the trough widening out in its eastern extension was very probable. Had this clue been followed up at the time we would now be in possession of much more information of this central coal basin, but the prosecution of the investigation was again deferred.

Under the terms of the railway contract of 1898, the whole of this coal reserve was handed over to the Messrs. Reid who commenced mining operations on some of the seams at Aldery and Coal Brooks, also on the seam last discovered near Goose Brook. They continued to work them till 1900, taking out some 8,000 tons of coal which they used on their locomotives. They did not make any effort to further explore the coal field by means of the boring rod which was clearly the proper way to arrive at any definite conclusion as to its extent or dimensions.

By the 1901 contract this coal reserve again reverted to the Colony, and in 1903 the Messrs. Harmsworth, by an arrangement with the Government, undertook to explore it and apply the boring machine to test the ground. An expert from Philadelphia visited the place and inspected some of the seams operated by the Messrs. Reid, but no boring was instituted nor was any attempt made to further explore the region.

This is the history of the Grand Lake Carboniferous district down to the past season.

Coal Exploration of 1904.

The Government having appropriated $10,000 during last session of the Legislation for the further prosecution of the work, a Davis Calyx drill was purchased from a company who had imported it a few years ago, and an expert drill-man from New York was employed to run it. As soon as this man arrived he was despatched to Baie Verte where the machine was stored, to procure it. Numerous delays occurred before it could be placed on the ground near Goose Brook. At Pilley's Island the steamer *Greyhound* was found unserviceable, and it was several days before she could be put in a condition to make the trip North. In the meantime, before she arrived back at Lewisporte, a great forest fire had laid waste the entire district. At Notre Dame junction everything had been swept away, including the station, telegraph office, and portions of the railway track. In consequence of this disaster no communication could be had with the drill-man, Brady, nor was it till several days had elapsed that I learned of his whereabouts. I then started for Goose Brook where he had preceded me. Mr. W. Haddon who had been despatched in charge of the crew several days previously, had orders to select a suitable camping ground, cut wood for firing the boiler and make other necessary arrangements for the season's work. Another week elapsed before the railway connections were fully re-established, or the machine could be brought along. When at length it did reach us it was found to be in a very incomplete condition. The wooden frame and drill head were intact and in good order, but the engine proved to be a second-hand one and not belonging to the outfit at all. There was a box of tools some small fittings, and but 100 feet of drill rods, while the capacity of the machine was between 800 and 1,000 feet. The most essential parts of the outfit were entirely absent. There was no boiler to generate steam with, no pump, no stand or casing pipe, no forge, anvil, vise, besides a great dearth of connection pipes, valves, joints, cutting bits, &c. The engine lacked a governor for regulating the steam-pressure, and a lubricator for keeping it properly oiled.

All these essentials had to be procured before it was possible to enter upon boring operations. The Angel Engineering Co. furnished most of the smaller items, but the boiler, pump, drill rods, core barrels, cutters, &c., had to be ordered from New York.

Numerous delays in shipping and railway carriage brought us up to an advanced date in the season before everything was in readiness for boring. Long previous to this time the ground had been prepared, and a hole sunk to the bed-rock at a suitable point near the railway track, about a half mile east of Goose Brook.

Boring was commenced on August the 13th. The strata first met with was extremely hard, being chiefly a coarse, gritty sandstone, through which our progress was very slow. After cutting through some 35 feet of this character, the rock became finer grained and was more easily bored. This again was succeeded by shale and clay with occasional thin sandstones. The shale was characterized by holding fossil plants, stigmaria rootlets, and a few thin coaly streaks. Nodules of kidney iron-stone were of frequent occurrence in the more clayey strata, all of which clearly indicated the presence of coal seams at lower depths.

When a depth of 91 feet had been attained, the sides of the hole began to cave in badly. About this time also our drill-man, who had been complaining for quite a while with some throat affection, became so ill that he was obliged to come on to St. John's for medical treatment. He was ordered to proceed at once to New York to consult a specialist, and we were thus left in a very awkward position. A few days previous to his leaving, Mr. Andrew

Aylward, a practical mechanic, well versed in the handling of steam, and running of marine engines, &c., joined us. He had no previous experience, however, with boring machines of this character, yet there was nothing left to do but give him full charge of it.

It was now found that the hole was so badly caved in that all efforts to clear it proved unavailing. We were compelled to abandon it and commence all over anew. The heavy machinery had to be disconnected and moved several feet; new connections made and stand pipes readjusted. All this work caused considerable delay, but we were ready for boring again on the 23rd of September. From that date, by feeling our way carefully along, we made very good progress, and were again down 90 feet when we were called home.

The section passed through in this hole was of course similar to the first, and did not afford any new data.

The boring machine is certainly a good one, and with a few improvements in the way of cutting tools, can do very effectual work. It was found that while the chilled steel shot was admirably adapted for cutting hard sandstone, or clean rock, it had very little effect upon soft shale or clay. The shot became embedded in the soft material and took no effect on the rock; on the other hand, the toothed-cutter, provided for this class of material, was not much more serviceable, as the teeth became clogged. It would appear from the above facts that the machine is open to considerable improvement in this respect.

The greatest drawback, however, to the successful prosecution of a work of this kind is the necessity of sending abroad for almost every item required in the course of operations, and the delay that is certain to occur in procuring them. Almost every day's drilling, or every change of strata, calls for some special tools or fittings which may not form part of the regular outfit, and unless such can be quickly procured, the work is apt to be hung up for the time being. During the season tools for such purposes had to be improvised from such materials as were at hand on several occasions.

Previous to the arrival of the boring machine, and all throughout the season, such of the crew as were not engaged about the drill were kept busily employed sinking pits, making a road for transporting the heavy material from place to place, cutting firewood for the boiler, &c. Nearly a mile of good road was constructed, and an enormous amount of trenching and sinking performed. Although baffled in most instances in the attempt to reach the rock formation, owing to the great depth of the superficial deposit, and the influx of water almost everywhere, nevertheless we were so far successful as to obtain a good general idea of the underlying structure.

The section exposed in these cuttings, together with that obtained by the boring, aggregated at least 1,000 feet in vertical thickness. Fully 800 feet of this strata cannot be otherwise classed than as a portion of the true coal measures. They consist of sandstones, coarse and fine, with alternate strata of shale and fire-clay, containing fossil plants, stigmaria rootlets, characteristic of this portion of the great Carboniferous series. Fragments of coal were come across in almost every cutting, and streaks of coal or coaly matter in most of the fire-clays. Two genuine coal seams, besides some smaller ones, were uncovered, but at such depths down, sometimes from 18 to 20 feet, that it was all but impossible to properly test them. One of these seams, which is about 60 feet lower down in the section than the old seam of 1895, upon which the Reids did some work, gave the following measurement:—

	ft.	ins.
Underclay	8	0
Clay coal and shale mixed	2	8
Carb, shale and clay	1	4
Coal fairly good but shelly	1	4
Top clay and shale	0	6
Total	13	10
Coal	2	6

Sixty-five feet in front of the old seam another occurs, in which there is one foot two inches of coal, underlaid by a thick bed of fire-clay. Thus we have here in a vertical thickness of only 130 feet of the measures three separate coal seams of fair size, though of rather poor quality. There is reason to suspect the existence of other seams lower down in the section, which could not be reached with pick and shovel.

The most important result of the season's operations is the clear and unmistakable evidence now obtained of the existence of a larger and more promising trough of the coal measures, or rather extension of the original trough, than was hitherto known. It is true that as yet we have only got hold of the southern side of it, and have no definite idea how wide it may be, or how far it extends. These are points still to be determined. At all events an unbroken section of fully 1,000 feet all dipping in one direction, towards the north, is here displayed. There is no indication that the centre of the trough has been reached, and to all appearances there may be a thousand or more feet of still higher strata in the section, all of which must be repeated on the other side of the trough.

Another important point ascertained is the fact that this portion of the coal trough is far removed from the hill range; it occupies the flat country and therefore has room to expand both laterally and longitudinally over a very considerable area, nor is it so liable to be badly faulted. It may be added that the work of the past season bears out exactly what has been stated in former reports as to the widening out of the trough in this direction, &c.

I shall not be surprised if on fuller examination this coal basin will be found to attain a thickness of measures not far short of the Sydney coal trough which comprises between 1,800 and 1,900 feet. Owing to the higher angle of inclination it will not here of course occupy so extensive a superficial area, nor does it follow that it should contain the same number or character of coal seams.

The season throughout was an exceptionally fine one, and most favorable for the prosecution of the work. The months of July, August and September were excessively hot and dry, the heat at times being almost tropical in its intensity. During all my long experience in the interior I do not remember such a period of prolonged heat.

During the progress of the work a substantial shack was erected in which, when leaving, all the machinery tools, &c., except the boiler, were stored. The boiler was housed in where it stood, and everything carefully protected from the weather.

In view of the importance of the possession of available coal in the island, and the effect it must inevitably produce on the future of the mining development generally, I would again strongly urge the advisability not only of reserving this coal area, but of the Government acquiring, if possible, all the areas or prospective areas in which coal is likely to occur elsewhere in the country.

I would respectfully suggest that in future no fee simple grants of the coal be issued to any person, so as to avoid the locking up of this valuable asset indefinitely. These areas should only be leased on an annual royalty to capitalists who would undertake to operate them, and who would enter upon their development with as little delay as possible, the lease to cease so soon as the lessees failed to fulfil their obligations. I do not think it would be advisable to lease all the areas to one company, as it might be to its advantage to operate but one mine and pay all the royalties thereon. Unless something of this kind is carried into effect ere it be too late, the mining industry may be seriously if not irreparably injured.

These remarks are founded upon the history of Nova Scotia and Cape Breton, whose valuable coal areas were for a lengthened period held by absentees in England, under old leases from the Crown, to the great detriment of those provinces. In the end the Provincial Governments were compelled to repossess them at an enormous cost. With such an example before us we should try to avoid falling into a similar error.

Trusting these remarks will be received in the light in which they are intended viz., in the best interests of the country.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XXVII.

Report for 1905.—The Mineral Statistics of Newfoundland,

GEOLOGICAL SURVEY OFFICE,
St. John's, N.F.,
March 24th, 1906.

HON. J. AUGUSTUS CLIFT, K.C.,
Minister of Agriculture and Mines,—

SIR,—

The difficulty and delay in procuring full and accurate statistics of the mineral output seems to increase instead of diminish as time goes on.

Although the usual blank forms were sent out early in December last, some of them were not returned till quite recently, others not at all up to date. It seems impossible to overcome the reticence of some parties, who assume that nobody has a right to enquire into what they regard as their private business only. This is a mistaken idea, as such statistics are calculated, all the world over, to advertise and enhance the value of commodities, which may not be generally known to exist, or which few people would otherwise take heed of.

When it is known that these reports are now much sought for outside the Colony, and almost every mail contains applications for copies, and that numerous letters of enquiry concerning mineral substances mentioned in the reports, which otherwise might never be heard of, are constantly being received, it must be admitted that they are serving a useful purpose.

It is only fair to state that the reluctance alluded to is confined to a few parties only, principally in St. John's. All the larger mining concerns, outside the city, readily afford me any information asked for. My thanks are due, and are hereby tendered, to all those who have so promptly filled in and sent back the returns, also to Mr. John Noonan, of the Customs Department, who kindly furnished me with the Customs exports of minerals, as per their returns.

Owing to the circumstances above alluded to, the statistics for the past year are necessarily incomplete. Notwithstanding this fact, the figures in my possession show an increase in value, over those of 1904, of $14,340. Although this increase is small, it nevertheless points to a continuance of the upward tendency in the mineral development of the Island as indicated by the returns for several years past.

The number of persons actually engaged in mining and quarrying, during the year, cannot be ascertained with any degree of certainty, as only the larger companies have furnished full returns. It will be seen by the following table that the figures are approximately the same as those of 1904.

TABLE I.

NATURE OF OCCUPATION.	NO. EMPLOYED	ACCID'TS	Fatalities.
Iron Mining	1,145	19	3
Copper Mining	570	2	......
Pyrites Mining	230	15	3
Slate Quarrying	130	......	......
Talc Quarrying	55	......	......
Brick Making	40?	......	......
Petroleum Drilling	22	......	......
Gold Mining	30?	......	......
Coal Boring	12	......	......
Miscellaneous	50	......	......
	2,284	36	6

The number of accidents and fatalities, which occurred during the year, shows an increase, in the former, of 7, and, in the latter, of 2, or a total death rate, for every thousand persons employed, of 2.62. Very few of the British Colonies show so high a death rate as this.

It is satisfactory to learn that the recommendation in last year's report with reference to the proper inspection of mines has received the favorable consideration of the Government, and that legislation on this important matter is about to be introduced during the present session of the Assembly.

TABLE II.

Mineral Production of Newfoundland for the Calendar Year 1905.

NAME OF PRODUCT.	QUANTITY RAISED.	MANUFAC'RED OR USED IN COUNTRY.	VALUE OF MINERALS EXPORTED.	TOTAL VALUE OF P'DUCTION
Brick	1,335,500 M	1,335,500 M	$	$ 9,690
Building Stone	1,000 ts.	1,000 ts.		1,500
Cobble and Spawls	4,100	4,100		1,700
Crushed Stone for Concrete, &c.	10,000	10,000		5,000
Copper Ore	78,720		358,880	358,880
Iron Ore	689,970		689,970	689,970
Pyrite	50,720		229,530	229,530
Sand and Gravel	1,048	1,048		2,620
Slate	11,852 s.	220 s.	44,164	45,000
Talc	6,000 ts.		24,000	24,000
Not Specified			403	403
		Total Value	$1,346,947	$1,368,293

M., thousand ; ts., tons, of 2,240 lbs.; s., squares.

NOTE.—The above table represents the declared value of the raw materials as they leave the country, *i.e.*, aboard ship. Those materials used in the country are valued at their selling prices in the local markets.

TABLE III.

Showing Increase and Decrease in Comparison with Preceding Year

PRODUCT.	QUANTITY.		VALUE.	
	Increase.	Decrease.	Increase.	Decrease.
Barite		2,000 tons	$	$ 5,000
Brick	99,500			1,742
Building Stone		2,100 tons		3,150
Cobble and Spawls	100 tons			300
Crushed Stone	10,000		5,000	
Copper Ore		29,119 tons		107,859
Gold		11 ozs		209
Granite		1,945 tons		11,550
Iron Ore	100,231 tons		100,231	
Petroleum		700 brls?		1,134?
Pyrite		9,480 tons	18,830	
Sand and Gravel		1,272 tons		3,180
Slate	1,250 tons		7,200	
Talc	4,438 tons		17,000	
Miscellaneous			203	
		Total	$148,464	$134,124

SUMMARY OF MINING OPERATIONS DURING THE YEAR 1905.

The activity in the mining industry continued unabated during the year, and although there was a falling off in some individual enterprises, nevertheless, the result on the whole may be considered fairly satisfactory. The increase shown by the above tables is not a fair criterion of the statistics of the industry, being incomplete as already explained.

BARITE.

Work on the Barite mine at Collier's Cove, Trinity Bay, was suspended during last summer, the venture not proving as successful as was anticipated, consequently no shipments were made.

BRICK.

The Brick yards of Trinity Bay turned out about the average of former years, while the Brick & Manufacturing Co., of St. John's, who are now making a cement brick, considerably increased their output. Owing, however, to competition arising in the manufacture of artificial stone, and a smaller demand for brick, the prices realized were not as good as in the previous year.

BUILDING STONE.

I have only received returns of 1,000 tons of the ordinary Signal Hill Sandstone, but am convinced the quantity quarried must have been much greater. The desultory character of this industry, and the difficulty of obtaining any reliable information regarding it, even the names of all the parties engaged in it, are matters frequently referred to before. So far as I could ascertain, there was no granite quarried last year, nor yet any paving blocks made.

COBBLE AND SPAWLS.

The Municipal Council purchased about the usual quantity of these materials, the former for paving the side drains in the city, the latter for maccadam to repair the streets with. Besides these items there were some ten thousand tons of stone crushed for concrete purposes in connection with the new water works.

Copper Ore.

The production of copper ore fell off by 29,119 tons, yet, owing to the enhanced price of metallic copper in the markets, the value of the output was not proportionately affected. Copper ruled high last year and is still showing an upward tendency. It ranged from 15.13 to 18.40 cts. per lb., or an average for the year of 15.73 cents, being nearly three cents per lb. over the price for 1904, or to be more exact just 2.74 cents extra. The market has opened the present year (1906), at $18.50, and there is every indication that it may still go higher. This high figure is due no doubt to the constantly growing demand for this metal for electrical purposes. Every year witnesses a further and further application of this great innovator, into the various industrial and other pursuits of modern requirements. Unless then some cheaper substitute equally suitable for such purposes, is forthcoming, there is little danger of copper losing its hold on the markets in the near future.

The Union Mine, at Tilt Cove, is at length beginning to show signs of exhaustion after its 42 years of continuous operation. A few years more are likely to see the end of this famous old mine, unless, in the meantime, new bodies of ore should be discovered in the locality. It is, however pleasing to note that other copper properties are coming to the front, which give promise of taking the place of Tilt Cove mine in the course of a short time. One of these is the new copper mine at York Harbor, Bay of Islands. Unfortunately, up to date, it has been badly handled, which is the history of nearly every mine that has been opened in the country, in its earlier stages. The company who had been operating this mine during the past two years seems to have had neither the experience nor the capital to make it a successful speculation. It is understood that as soon as some legal formalities connected with its re-transfer to the original owners are completed, a new and strong syndicate are prepared to take it over and work it vigorously.

The high value of copper products has stimulated the search for ores containing this metal, on all sides, and much prospecting took place last year, with the result that several new finds have been made. One of these at a place called Goose Cove (Hare Bay) is of more than ordinary interest. It was referred to by the late Alexander Murray, C.M.G., in his report of 1864, but owing to the anomalous condition of affairs, under the old French fishing treaties, no one thought it worth while prospecting the locality. All that section of our coast was virtually debarred from mining enterprise, and no capitalists could be found to risk their money under the circumstances. Now, happily, that this vexed question has been relegated to the things of the past, by the recent settlement between the English and French nations, we may look forward to active interest being taken in the development of this section of Newfoundland. Many known deposits of valuable minerals occur on or near this, so called French Shore, which have lain dormant for centuries, from the causes above referred to.

Some of the abandoned copper mines of Notre Dame Bay are again receiving attention. The Newfoundland Exploration Syndicate operating the Pilley's Island and Baie Verte mines, have taken over the old Bett's Head and Little Bay mines, and have a force of men now employed at each place clearing away the rubbish and unwatering the old workings, preparatory to re-opening them. So far as the work has progressed at Bett's Head, it is found that considerable ore still exists in the first and second levels, and it is generally believed that in both places bodies of ore occur below the lowest workings.

It is the intention to sink new shafts outside the original mines and then drive in from beneath so as to reach these deposits.

Gold.

Goldenville, near Mings, is the only property on which any attempt at gold mining was conducted during the year. I have not been furnished with particulars of the operations, and can only learn casually, that during the summer but little development took place. The time was chiefly occupied in preparing the ground for the erection of a stamp mill and necessary plant for crushing and treating the ore. A road had to be constructed from the shore to the mine, to enable them to get the machinery on the ground. This proved a very heavy undertaking, which has occupied all the autumn and winter to accomplish. The proprietors expect to be in a position the coming season to treat all the ore they have so far mined, and go on vigorously with the underground work. I understand that the main shaft is down about one hundred feet, and a drift of another hundred feet carried along the course of the lode. One of the company informed me that the lode increased in thickness as they drifted upon it, and that it will average from ten to twelve dwts. of gold per ton.

Some prospecting was done at the Cinq Cerf locations during the summer, and Mr. Devereaux, mining engineer, visited the place in the interest of New York capitalists. He thought so well of the prospects that he has formed a small syndicate to take over the mine, and now has about sixteen men employed building shaft houses, and otherwise preparing for active development. This deposit consists of a fair percentage of a rich copper ore (bornite), intermixed with copper and iron pyrites, but it has also yielded many specimens of free gold in the shape of considerable sized nuggets. Several new claims have been recently taken up in the same locality.

IRON ORE.

Great activity took place in the mining of iron ore on the part of both the companies operating the Bell Island mines. Their combined output reached 689,970 tons, which was only exceeded twice before since the mines have been working viz., in 1901-1902 when it reached respectively 738,206 and 728,721 tons.

The amount of ore still on the Island is considerable, yet at the present rate of production the deposits on the dry land must soon become greatly reduced. Already the companies are looking forward to such a contingency and are leasing the submarine areas on the north of the Island, beneath which the ore bands are known to dip. So far, no company has been found to take up the properties on the western half of the Island. The ore here occurs in thinner beds and is somewhat leaner in quality, but sooner or later it will be found profitable to work these deposits.

A short time ago I saw a prediction made by an American scientist to the effect that all the known iron deposits of value, would be exhausted within the next hundred years. Of course that is a long time to look forward to, but if the iron industry continues to grow at its present rate of progress, there is no knowing what gigantic proportions it may soon assume. In fact, so intimately is the progress of the world at large bound up with the manufacture of this most useful of all metallic substances, that the failure of an adequate supply of the raw material might be attended with dire consequences.

But there need scarcely be any anxiety as to the sources of a future supply of ore. It is more than probable other large deposits will be discovered, in territories little explored as yet, and in any case, methods will undoubtedly be perfected for utilizing those lower grade ores, or such as are known to contain certain deleterious substances, which at present renders their economic reduction too difficult and expensive.

There is a vast abundance of magnetic ore in Canada, Newfoundland, and on certain parts of the Labrador peninsula, which up to the present time has not been utilized. Experiments in concentrating and otherwise treating these ores, with a view of enriching them and getting rid of the obnoxious ingredients, are constantly being made, and it is confidently predicted that eventually, success is sure to be the outcome. The recent favorable results attained in electric smelting, may lead to solving the problem of satisfactorily reducing this class of ores, which under the old methods of smelting baffled all the efforts of metallurgists.

Last year the Dominion Government sent a commission to Europe under the charge of Prof. Eugene Haanel, Superintendent of Mines, to enquire into the working of electric smelters, with a view to ascertaining how far the process might be applicable to the iron ores of Canada. The Commission visited the plants in operation at Gysinge and Kortfors in Sweden, LaPraz and Livet in France, and Turin in Italy, and upon their return furnished an exhaustive report to their Government. The result of their investigation was considered so satisfactory, that on the strength of it, Dr. Heroult, the patentee of the French furnace, was invited over to establish one at Sault Ste. Marie. Quite recently, it has been announced that the experiment has proved a complete success, even with ores hitherto considered almost useless. The higher temperature available through the electric energy produced, and the freedom from clinker such as had to be contended with in ordinary coke smelting, renders it possible to treat this class of ores.

What these experiments may mean to the future of the iron industry of Canada is beyond computation at present but there is every reason to think that it will eventually completely revolutionise the iron trade. It is believed also that electric smelting will be found equally applicable to other ores, such as copper and nickel.

PETROLEUM.

The efforts of the Newfoundland Petroleum Co., Ltd., to further test their oil property at Parsons' Pond last year, met with a fair measure of success. Two wells were sunk on the northeast side of the pond to depths of 2,850 and 1,535 feet respectively. The former of these was partially drilled the preceding year, to a depth of 1,760 feet, but did not yield any appreciable quantity of oil. The new well began with a natural yield of about 6 barrels per day, but on being exploded it dropped to 1 barrel and then rose gradually again to 2½ barrels. The fine well which the previous year yielded steadily 4½ barrels of superior oil had ceased to flow. It was found that the petroleum, owing to its heavy body, had become coagulated, or converted into wax, owing to the quantity of water that had found its way into the hole during the interim. To use the oilmens' term, it had been "drowned out," which was a most unfortunate circumstance, as it was one of the best wells of the series.

Late in the season the property was visited by two American experts, one to explode the wells with nitro-glycerine, the other to select a site and make arangements for the erection of a refinery. An up to date pumping apparatus was installed, and tanks to the capacity of 3,000 barrels imported for storage. The pumping was commenced shortly before the season's work closed and arrangements were made to continue it throughout the winter. In January, the superintendent Mr. Whalen, revisited the place, and in 11 days pumped about 70 barrels from the last well put down.

On the advice of the refining expert, the Company did not immediately conclude the negotiations for the purchase of the plant, as he said there was no necessity to do so just yet. He recommended continuous pumping, so as to prevent the wells choking, and storing the oil until all the tanks were full. The oil would not deteriorate to any appreciable extent, and the refinery could easily catch up in a short time, its capacity being about 100 barrels per day. Both these men expressed the most favorable opinion of the property, in fact were quite enthusiastic over the prospects.

The persistent efforts of this company to establish an oil industry in the country is worthy of every consideration. Much capital has been expended up to date, not the least portion of which was caused by the difficulties encountered in getting supplies, etc., to the locality. No modern means of communication, such as roads or telegraphs, exist, and as a consequence, the company are greatly hampered in carrying out their development work.

The use of crude Petroleum as a gas producer and as fuel is fast assuming immense proportions. In California, where coal is scarce and dear, petroleum is coming into almost universal use. According to the "Mineral Industry," 1904: "All the railroads of the state, steam, electric and cable, use oil fuel to generate power almost exclusively. There is hardly a manufacturing plant in California that has not discarded coal, finding it more economical to use the new fuel. All the mining and milling companies in California and Arizona have substituted oil for other fuels. . . All the illuminating gas throughout California is made from oil, being cheaper, better and less dangerous than coal gas. During the past year a number of ocean steamships have been altered from coal to oil-burners, notably the great vessels of the American Hawaiian Steamship Company, which run between the Hawaiian Islands and San Francisco and then to New York. These vessels carry about 10,000 barrels of oil for the trip, making no stop for over 12,000 miles after leaving San Francisco. It has been demonstrated that vessels using oil increase their speed about one knot, due, no doubt, to the fact that the steam pressure can be kept continuously the same, as it cannot when furnace doors are being frequently opened for the introduction of coal."

Oil having an asphaltum base, has been largely used also in California of late for road making, or rather for overcoming the dust nuisance. The same authority quoted above, says: "All the counties, through their boards of supervisors, are using every exertion to oil not only the country roads, but also the streets in the smaller cities and towns. These roads, after having been put in condition at a cost of about $200 per mile, require sprinkling but once a year. The Southern Pacific and Santa Fe Railroad companies oil their tracks, so that travelling in California is devoid of cinders and dust. Oiled roads, if properly constructed as to foundation and drainage, shed all water, retaining a smooth, elastic surface."

The use of oil as fuel in both the British and American navies is no longer in the experimental stage. Vessels have been constructed with furnaces specially adapted for its consumption, while others have had their furnaces altered for the same purpose. It is not improbable that in the course of the next decade or two, oil will be the universal fuel on all navies of the world.

PYRITE.

The Pilley's Island mine was worked successfully during the year, though the output did not equal that of 1904. The quantity of ore raised was 50,720 tons, showing a decrease of 9,480 tons, yet the value seems to have exceeded that of the latter year by $18,830. It is to be regretted that the mine at Rousell's Harbor, Labrador, which gave such good promise at first, did not fulfill the sanguine expectations entertained of it. The Dupont Powder Co., of Wilmington, Delaware, who had secured an option upon it, kept the development work going all last winter, but when the season for navigation arrived, it was found that the seemingly large lode of ore had rapidly diminished in size, and in some parts cut out altogether, in fact, the indications generally were such as to cause the company to abandon the mine and remove all the plant from the locality.

Some attempt was made last season to open up the deposit of pyrite at Goose Arm, Bay of Islands, but I have been unable to ascertain any particulars of the work accomplished.

The prospect of an additional source of supply of that very useful commodity sulphur, from the lower grade sulphide ore, pyrrhotite, seems now assured. Hitherto the attempts at "desulphurization of this ore by its own heat of combustion," did not prove satisfactory, but it is now claimed that it has been successfully accomplished at Sault Ste. Marie, on the Sudbury nickelferous ore which contains, besides its copper and nickel contents, about 15 p.c. to 20 p.c. sulphur. There is an abundance of these ores in this Island hitherto entirely overlooked, which, should the experiment alluded to demonstrate that they can be economically utilized, cannot fail to open up a new mining industry ere long. Already, I understand, "The Newfoundland Exploration Syndicate" operating Pilley's and Bay Verte mines, have taken over a Pyrrhotite deposit near Nick's Nose, S.W. Arm of Green Bay, and have a force of men at work testing it.

SLATE.

The Wilton Grove Slate Quarry in Trinity Bay turned out about 3,858 tons, or 11.852 squares, valued at $45,000, being an increase of 1,158 tons and $7,200. None of the other quarries on this side of the Island were operated last year, but I understand work is still progressing in the Humber Sound, Bay of Islands, and that a good band of slate has been opened at Crow's Gulch, south side of the Arm. As yet no slate has been manufactured in this latter locality, nor have any shipments been made to date. It is well known that there is an abundance of excellent slate in the country, and sooner or later this industry is bound to attract capital. Newfoundland is admirably situated to build up a large slate trade with Europe, having a great advantage over any other slate centre on this side of the Atlantic in point of distance from the old world markets.

TALC.

The Talc deposit near Manuels was worked during part of the summer, and some 6,000 tons shipped to the United States. What the result of this shipment was has not been made public. The mine is at present closed down and no work has been done there for some months past. The company have expended large sums of money in development, construction of loading pier, overhead tramway, sidings, etc., and it is to be hoped they will make a success of the venture, and recoup themselves for their outlay.

Antimony, zinc and lead, having made a slight advance in value during the year, it might be well for prospectors to pay some attention to ores of these metals, which are not of infrequent occurrence in the Island. Molybdenite is another substance now much sought after. The supply is not at all equal to the demand. Its occurrnce has been frequently mentioned both here and on the Labrador, and as it is a high priced mineral, a dilligent search for it might well repay the trouble and expense.

I have the honor to be,

Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XXVIII.

Report for 1905.—The continuation of the Coal Boring Operations in the Central Carboniferous Area near Goose Brook, Humber Valley.

HON. J. AUGUSTUS CLIFT, K.C.,
Minister of Agriculture and Mines.

SIR,—

During the past season the coal boring operations commenced in 1904 near Goose Brook were continued, and I now beg to submit the following report thereon.

With a view to making an early start last spring, I sent in a requisition in March for such necessary apparatus and fittings as were required for the further prosecution of the work, and urged that in order to afford time for procuring those articles without unnecessary delay a speedy decision might be come to.

In the month of May I was authorized to procure the articles in question and begin preparations for the work. No time was lost in doing so. Orders were immediately placed with the Angel Engineering Co., agents for the Canadian Rand Drill Co., for a new engine and hoist to replace the old, worn out and unsuitable machine used the previous year. Several smaller items which could not be procured or made in the country itself, were also ordered at the same time, but though the Messrs. Angel assured me from time to time that they were constantly urging despatch upon the part of the Rand Drill Co., none of these articles reached us until the season was nearly over, and then in such an incomplete condition that they could not be used.

Under these circumstances there was nothing left to do but to make the best shift possible with such material as we had on hand. Having procured a few articles here, and with some repairs of the old fittings we proceeded to the coal area in the last week of June. It took some time to overhaul the machinery and tools, clean them all up, get them on the ground ready for use, and to procure a supply of firewood preparatory to actual operations.

We made a commencement of boring at the hole put down the previous year, which it will be remembered had reached the depth of 90 feet. Great difficulty was experienced at first in clearing the hole. It was found that during the winter it had caved in badly and there was now from 25 to 30 feet of "sluge," mud, sand and gravel in the bottom of it. This proved more difficult to remove than the solid rock. It would not core, and was too dense to wash up; but it was the hard granite pebbles that had fallen in which gave us most trouble; they would not cut, we could not break them, and they were too large to wash up. The stand pipe also was found to leak badly at the bottom, allowing the water to escape and the loose sand to work in beneath it. This necessitated taking up the pipe twice, clearing out every bit of sand and mud down to the bed rock, then cutting a groove in the solid rock for the end of the pipe to rest in; after which we cemented it around with concrete and allowed it to set. By this means we succeeded in making a tight joint, and after a while we got up most of the gravel and were enabled to reach the bottom of the hole.

The boring was now continued downwards with fair progress, but as much material always remained in the hole which could not be got rid of, it became more and more difficult to reach the bottom each time we withdrew the rods. We had reached a depth of 130 feet, when a worse cave in than usual, so completely jambed the rods, it became impossible to withdraw them. For several days every effort was put forward to try and extricate these rods. Two or three sets of strong spruce levers, four in a set, were placed under clamps on the projecting ends of the rods, and the whole force of men exerted all their strength to try and prise them up, but all to no purpose. So great was the strain that each set of prises broke off, though they were over a foot through, and were of the toughest kind of spruce trees.

Seeing the uselessness of any further attempt, we had to abandon this hole and move the machine and all the gear to a new locality, about two chains further north, in the direction of the dip of the strata. After a while, by careful manipulation, we recovered about 100 feet of the drill rods, leaving about 30 feet, including the core barrel and cutter, still fast in the hole.

The rock pierced in this hole consisted chiefly of shale, with occasional thin beds of fine grained gray sandstone, containing numerous fossil rootlets, all typical of the true coal measures. Small fragments of coal apparently derived either from fossil trees or thin layers of coal were continually washed up, and the very last time the rods were withdrawn, one lump, about the size of a hen's egg, of extra good coal, was found in the core barrel.

When everything was in readiness at No. two bore, we commenced to drive our stand pipe, but here we were met with such an accumulation of sand gravel and large granite boulders, that it took nearly three weeks to reach the bed-rock. Several times when we believed we were on the bottom we commenced to bore only to find that it was a boulder, underneath which the sand and gravel would wash in and jamb the rods. By dint of continuous chopping, boring, driving and pumping we at length got down to the solid rock.

Drilling now commenced favorably, and soon good progress was made. The rock, which consisted chiefly of coarse gray grit and sandstone, cored well, but after reaching about fifty feet it became finer grained, passing into tough shale with alternate thin layers of fine sandstone, through which our progress was considerably retarded. After this we again struck coarse grit, but after passing 100 feet, more and more shale mixed with fire clay was encountered. In such rock as this the tools always cut slower, owing to fine tough material clogging the bits, and plugging them so tightly as to necessitate frequent withdrawals in order to clear them. The shot also became embedded in this tough pug and could not take so good an effect on the rock.

We continued this hole down to 150 feet, when striking a white sandstone similar in every respect to that which formed the uppermost strata of No. 1 hole, and thus having completed the section between the two, it was not deemed necessary to go any deeper. All the rocks of this section exhibited numerous fossil plants, and in some of the more clayey beds thin strings of coal were cut, none however, of any consequence.

Having selected a new loation about 10½ chains to the North and West of No. 2 bore hole we now disconnected the machinery and moved everything to the latter place. The work of preparing the ground, digging deep holes for water supply and overflow, etc., and getting the engine, boiler and drill in proper position, occupied considerable time. When all was in readiness we commenced to drive our stand pipe. This proved the most difficult undertaking yet, as owing to a more than usual depth of surface deposit of the same character, as previously encountered, with a still greater accumulation of large granite boulders, all our efforts to penetrate to the bed rock proved unavailing. For days and weeks we continued to drive, chop and pump, using several charges of dynamite to break up the larger boulders, but all to no purpose. When we had reached a depth of nearly forty feet, our stand pipe, from the continual heavy driving, became so bent and crooked that we could not pass the drill rods through it, and having no more piping of the same size available, and moreover the season having now far advanced we were obliged to abandon the attempt and return home.

From various circumstances, founded upon the experience gained in this and the preceding year, I had concluded that with such apparatus as was at our disposal it would be useless to try and put down deep holes here, and that the same results might be obtained in less time, and with less difficulty, by boring a series of comparatively shallow holes, at short intervals apart. Owing to the soft nature of most of the strata met with and the consequent frequent falling in of the sides of the hole, it was impossible to reach any great depth without casing pipe, and this we had no means of putting down. Then again the high angle of inclination at which the strata inclined northward, would enable us to obtain a connected series of sections, within a small depth from the surface, and should available coal seams be struck it would not be difficult to locate their outcrops. For these reasons, the sites selected for putting down bore holes were such as would afford considerable sections of the rockformation, without the necessity of penetrating to any great depths, surface conditions having in each case much to do with actual location of the sites selected. In fact the main object aimed at was to test thoroughly each successive section, so as to leave no part of the probable coal measures in this district untried. Having first ascertained by means of pick and shovel work, the base of the coal measures, and their true dip and strike, in this part of the Grand Lake area, the work since accomplished has been of a systematic character, not a mere random exploration, and so far as it has progressed, I feel confident that every coal seam of any size or value whatever in that part of the section has been located.

The prospect of the occurrence of larger and better seams in this coal field will depend altogether upon what thickness of superior strata still exists in the locality. To all appearances the thickness must be considerable, as no change of dip was as yet observed in any of the workings, the inclination being still towards the northward at about the same angle of dip.

Unfortunately, as we proceed in the direction where higher strata are to be looked for, the surface deposits increase rapidly in depth, and become more and more difficult to penetrate. I have concluded that the only way to overcome this difficulty, should the work be continued, is to sink shafts through the loose debris down to the bed rock, and then commence to bore. To do this, however, will necessitate timbering the shaft all the way, and constant use of a good steam pump to keep it clear of water, otherwise it cannot be effected.

Throughout the season, whenever the crew were not employed about the machine or in cutting firewood, they were constantly kept costeaning with pick and shovel, in continuation of last year's work. Numerous pits and trenches were sunk in the hope of reaching the bed rock, and a vast amount of material removed, but in most cases we were baffled in our attempt by the depth and toughness of the overlying deposits, and above all the extraordinary influx of water. Hand pumps were of no avail to keep this water down, and hole after hole had to be abandoned, owing to the inabilty of the men to continue sinking them under such conditions. However, the bed-rock was reached in a few places, and each time some new and valuable information was obtained. At a point about 345 feet west from the seam discovered last year, three small seams were uncovered, one of which gave a thickness of two feet, but it was doubled up in a sharp fold, and was of inferior quality. The other two were about a foot each in thickness and were of a soft shaly character. A fourth of similar character was uncovered a short distance in front of No. 1 bore hole, while several thin streaks of coal were found at various points. In almost all the excavations numerous loose fragments occurred, sometimes in lumps as large as a hen's egg and often of superior quality, indicating that they had been derived from seams somewhere in the vicinity.

The result of the season's work has increased our knowledge of the structure considerably, and has added several hundred feet to the section uncovered in previous years. It has conformed all that has been stated as to the increase of the coal measures in an northerly direction. So far there is no indication of any change in the angle or direction of the dip, and unless faults occur, which have not yet been detected, there should still be a considerable thickness of higher measures in this district. If we may judge from the surface conditions, we are yet a long way from the centre of the trough. Possibly, there may be a series of undulations here, repeating the measures more than once. This seems to be indicated by the presence of the sharp fold already alluded to, as occurring where the two foot coal seam was uncovered.

The failure of the boring operations in revealing the presence of any good workable seam so far, should not be taken to indicate the non-existence of such seams, by any means. It may be instanced that in Nova Scotia, boring for coal has been carried on continuously for the past ten years or more with no better results, although many deep holes were put down, in some cases to depths of 2,400 feet, without revealing any coal whatever. In other cases, nothing beyond mere thin layers of no commercial value were passed through. Last summer, however, one splendid seam of 26 feet in thickness was met with, which it is considered repays all the expense of carrying out the boring operations many thousand times over.

The following is the list of requisites:

1 Steam pump, 1 hand pump (iron).

2 New 3" core barrels, 2 3" toothed cutters.

1 Reducing coupling, for end of spindle shaft, new roller tops for spindle.

2 Chain tongues, 2 jacks.

1 Pipe clamp, 1 new shot hose, new shot cock.

1 set pipe dies 1", 1½" and 2".

Bolts and nuts to match ½", ¾", ⅝", by 2" and 3" long.

1 cwt. steel shot, waste, oil.

Rubber pump valves, new couplings for 4 and 6 pipes.

60 feet 5" drive pipe, in lengths of 2, 3, 4, 6, 8 and 10 feet.

1 Drive head and 1 drive shoe to match 5" pipe.

Should the work be carried on the coming season, I would suggest that these things be ordered as soon as possible. Judging from past experience the time taken to get orders from abroad filled, renders the successful carrying out of a work of this kind all but impossible, unless they are sent in at least six months in advance, and then it would be almost necessary to visit the manufacturers to see that one was getting what was really wanted.

I have the honour to be,

Sir,

Your obedient servant,

JAMES P. HOWLEY.

ST. JOHN'S, January 15th, 1906.

CHAPTER XXIX.

Report for 1906.—The Mineral Statistics of Newfoundland.

GEOLOGICAL SURVEY OFFICE,
St. John's, N.F.,
March 15th, 1907.

THE HON. J. AUGUSTUS CLIFT, K.C.,
Minister of Agriculture and Mines,—

Sir,—

I have delayed furnishing the usual annual report of the Mineral Statistics of the Island, in the hope of being in a position to present as complete a statement as possible. There are certain returns, however, I have been unable to obtain up to date, so I have concluded not to delay the report any longer, but to give such figures as are now in my possession.

Those that I have failed to obtain are really only of minor importance, having reference chiefly to stone quarried near the city, and such materials as sand and gravel, litholyite, etc., amounting in all to a few thousand dollars in value.

There is one matter with regard to the gathering of these statistics, I wish to draw your attention to, in the hope that some more uniform system of valuation of the raw materials be adopted. If the figures are to be of any real value, something should be done to effect this end.

I have frequently referred to the great discrepancy existing between the figures furnished to myself, and those of the Customs Department. They never agree, and in some cases the divergency is so very great that it becomes a question as to how far any of these statistics are to be relied upon. The discrepancies are not so apparent in the quantities of ore raised and shipped, as in the values given. Mr. John Noonan, Statistical Clerk of the Customs Department, who kindly furnished me with a copy of his returns, assures me that his figures are the declared values given to the Customs Officers at the several mining centres. His values always exceed mine, and in some cases are so far in excess as to make marked difference on the total output. I shall just give a few instances by way of illustration. Eighty-one tons of Antimony shipped last year, are valued in the Customs returns at $23,950—in these furnished myself at $4,050. Pilley's Island returns are given in the former at $213,370 as against $84,396 in the latter, being a total excess for these two alone, of $148,874. On the other hand, my returns from Bay Verte Mine and Bell Island combined, show an excess over theirs of $104,240. In the case of the Bell Island output, the increase is accounted for by the enhanced value of the ore consequent upon the enormous demand for iron products now-a-days. In correspondence with one of the mine managers at Bell Island, it was pointed out to him that this growing demand should necessarily have an effect on the price of the ore, and in reply he informs me that in view of the somewhat higher market value just now, he thought $1.10 per ton instead of $1.00 as previously estimated, would more nearly represent the correct figure. This adds materially to the value of the Bell Island output for last year.

With such conflicting figures then as are at my disposal, there is no alternative but to accept those furnished me direct by the managers of the mines. I cannot assume to alter them, or place a valuation of my own upon their products.

The returns in my possession indicate a total value for the mineral production of the Island during the calendar year 1906, of $1,462,344, or an increase over that of the preceding year of $94,051, being the largest since 1901.

The number of persons employed in mining during the year was about the same, while the number of accidents and fatalities were less by three in each case. This speaks well for the management of the mines.

I am again indebted to those in charge of the various operations for the information supplied, also to parties in the city who have kindly favoured me with particulars of prospecting operations and other interesting data.

The following tables will afford in a more succinct form the main features of the industry during the year.

TABLE I.

NAME O FOCCUPATION.	No. Employed	Accidents.	Fatalities.
Iron Mining	1,370	30	1
Copper Mining	450	3	2
Pyrites Mining	210	9	0
Slate Quarrying	95	0	0
Brick Making	31	0	0
Gold Mining	22	0	0
Antimony Mining	25	1	0
Coal Boring	14	0	0
Petroleum Drilling	9	0	0
Miscellaneous	50?	0	0
	2,276	43	3

This table indicates a decrease in the death rate per thousand, of from 2.62 in 1905, to 1.31, which approaches more nearly the normal percentage of other British colonies.

TABLE II.

Mineral Production of Newfoundland for the Calendar Year 1906.

PRODUCT.	Quantity raised.	Manu-factured or used in Id.	Value of Minerals Exported.	Total value of Production.
Antimony	100 ts.		$4,050	$4,050
Brick	906,000 M.	906,000 M.		8,260
Building Stone	500 ts.	500 ts.		750
Cobble and Spawls	1,000 "	1,000 "		1,000
Crushed Stone	5,000 "	5,000 "		5,000
Copper Ore	75,989 "		360,345	360,345
Gold Ore	900 "	147 oz.	2,800	2,800
Iron Ore	884,986 "		959,765	966,625
Limestone	1,200 "	12,600 b.		1,200
Pyrite	28,132 "		84,396	84,396
Sand and Gravel	1,000 "	1,000 b.		2,500
Slate	2,536 "	64½ "		25,418
		Total....	$1,411,356	$1,462,344

ts. Tons of 2,240 lbs.; M., Thousands ; b., bushels ; oz., ounces.

The above figures represent the declared values of the raw materials, f.o.b., at the mines, except in the case of brick, slate, lime, etc., used or manufactured in the country.

TABLE III.

PRODUCT.	Quantity.		Value.	
	Increase.	Decrease.	Increase.	Decrease.
Antimony	100 ts.		$1,050	
Brick		429,500 M.		$1,430
Building Stone		500 ts.		750
Cobble Stone & Spawls		3,100 "		700
Copper Ore		2,731 "	1,565	
Gold Ore	900 ts.		2,800	
Iron Ore	195,016 "		276,655	
Limestone	1,200 "		1,200	
Pyrite		22,508 ts.		145,134
Sand and Gravel		48 "		120
Slate		1,414 "		19,582
Talc		6,000 "		24,000
			$283,270	$191,716

Some Features of the Mining Industry during the Year 1906

A few particulars with regard to this industry during the year, and its present status may prove of interest.

By a reference to the above tables it will be seen that Antimony figures amongst the returns for the first time since 1891. A small shipment was made in that and the previous year, from Moreton's Harbor mine, since when operations were suspended, chiefly as I understand, on account of the low price and small demand for the ore. During the past year, this mine has been re-opened, and a small force of men, under a new company has been employed in operating it. Quite a lot of ore was taken out, but most of it was low grade. About 100 tons of picked ore was produced, which would average between 45 or 50 per cent. Of this amount 81 tons were sent to New York. I could only obtain an approximate value of $50 per ton for this shipment, but I believe it should be much higher. Antimony of 50 per cent. is quoted in the markets at $100 to $105 per ton, according to the latest figures in the *Chicago Mining World.*

The manufacture of Brick shows a considerable falling off, as is also the case in the amount of building stone quarried, Cobble and Spawls used, etc. Concrete is replacing stone to a very large extent in the construction of foundation walls for houses, hence the smaller demand for the ordinary Signal Hill sandstone.

Copper ore shows a small decrease of 2,731 tons, but the greatly enhanced value of metallic copper, which during the year averaged 19.60 cts. per lb., as against 15.73 for the preceding year, has been the means of bringing up the total value of our copper output, so that there is an actual increase of $1,565.

The output from Tilt Cove Mine last year was 66,189 tons, being an increase of 469 tons, but the value rose from $262,880 to $330,945, being $68,065 in excess of the previous year.

The Bay Verte Mine increased its output by 1,300 tons, but the value given is less than half as much, showing a decrease of $21,600. York Harbor Mine was closed down during the year and made no output.

A good deal of prospecting for copper took place last year, and some good prospects are reported to have resulted. One of these, on Little Bay Head, not far from the old Little Bay mine, seems to promise well, judging from reports. The deposit at Goose Cove, Hare Bay, referred to in last year's report, has been further developed, and is said to be fully up to expectations. I have seen an analysis of this ore which gave 6.77 per cent. copper, $2.48 in gold and 57 cts. in silver per ton.

The St. Julien's copper mine has been bonded to a New York Company, and is to be exploited the coming season. Another N. Y. syndicate, the Guggenheim Exploration Company, has taken an option on the native copper property at Oderin Island, Placentia Bay, and will begin the work of development early in the spring. This latter corporation is a world-famed one, and no doubt if the prospects are sufficiently encouraging, they will give the property the full benefit of their experience.

Prospects for the development of our copper deposits were never brighter, and should the high price for the metal be maintained, as appears highly probable, it is not unreasonable to look forward to a consderable boom in copper mining in the near future.

Although the result of the gold mining venture at Goldenville, near Ming's, did not turn out quite up to expectations, yet on the whole, there is no reason to believe that the property might not be made to pay good dividends, were it properly equipped to treat all the ore in an up-to-date manner, with the latest and most improved gold-mining plant. As yet, the company has but one small ten-stamp mill and a Wifley concentrator on the ground. This plant was only installed in May last, and was kept running for four months, with but one shift per day. It produced during that time, gold bullion to the value of $1,500, also concentrates to a similar amount. A small cyanide plant is absolutely necessary to treat the concentrates before the full values in gold can be recovered.

The deposit is of the bedded type, and is composed of magnetite slate, quartz and pyrites. It dips north at an angle of about 60 degrees. The auriferous lode has been traced for fully a mile through the Company's property, with a width varying from 5 to 13 feet. A trial shaft was first sunk 50 feet on the Eastern extremity of the deposit, then a working shaft was sunk at a point half a mile further West, and continued down to a depth of 100 feet. When this shaft had attained a depth of 17 feet, a shipment of 23 tons of ore was made to the Brookfield mine, Nova Scotia, for the purpose of having a mill test made. This, upon being treated by amalgamation and cyanide process, yielded 10½ ounces of melted gold valued at $192.78, as per N. Y. Assay Office certificate, whch is equal to a recovery of $8.38 per ton, in addition, five tons of slimes carried a total value of $55.00, which was not saved.

The result proved so favorable that the shaft was continued, and at a point 80 feet below the surface, levels were driven East and West on the lode, the former to 80 feet and the latter to 51 feet.

During the sinking of this shaft the ore taken therefrom was continually sampled, and an average of each sent to New York for assay, from which the following results were obtained:

1. Quartz, output from shaft, 50 to 69 feet........	$12 60
2. Pyrite, concentrated from above sample......	50 80
3. Quartz, output from shaft 69 to 84 feet........	14 26
4. Pyrite concentrated from above sample......	46 09
5. Magnetite, output from shaft 69 to 84 feet....	1 03
6. Slime, separated from sample 3............	3 20
7. Quartz,from which pyrite & slime was removed	11 20
8. Quartz, output from shaft 84 to 100 feet......	12 81
9. Magnetite	62
10. Special sample pyrite, clear of quartz........	26 04
11. Quartz, output East and West drives.........	5 34
12. Magnetite and slate to waste heap............	1 43
13. Special sample magnetite	1 20

14. Special sample Pyrite from various parts of ore heap	45 23
15. Pyrite concentrated from sample 11	31 45
16. Quartz and pyrite from lode ½ a mile East of shaft	1 84
17. Quartz and pyrite from lode ½ a mile East of shaft	1 43
18. Quartz from vein North of iron lode	9 25
19. Quartz and magnetite output from West drive	4 74
20. Slate output from East drive	4 12
21. Quartz output from East drive	4 73
22. Slate output from East drive	1 44
23. Quartz output from West drive	3 67
24. Magnetite output from West drive	1 16
25. Magnetite output from West drive	2 67
26. Quartz from side of East drive	4 73
27. Pyrite, concentrated from sample 19	27 75
28. Pyrite concentrated from sample 22	17 48

The result of these twenty-eight assays gives an average of $12.44 per ton, which presuming the specimens to have been a fair run of the lode matter, may be considered a very good showing.

I have been favored with the above figures and extracts from the manager's report, by Mr. R. B. Job, who has kindly permitted me to make use of them. This being the first report from a gold mine in actual operation in the Island, it was deemed worthy of a more extended notice than usual.

I have no information of what has been done at the Cinq Cerf mine during the past season. I have learned casually that it was visited by an expert from the United States, whom it is stated was so favorably impressed with it, that he took an option on the property for his principals.

The output of iron ore from the Bell Island mines, as can be seen by the tables, greatly exceeded that of any year since the inception of these mines. The value of the ore, as already referred to, has advanced 10 cts. per ton, and this has had the effect of greatly increasing the figures of the total output for the year.

The mining is being actively prosecuted during the winter, and the coming year's output is expected to reach the million ton mark. The Nova Scotia Company are at present engaged driving a submarine tunnel beneath the waters of the bay, on the North side of the Island, to reach their ore deposits a mile from the shore. I understand they are making good progress, and so far have not met with any serious difficulty from the ingress of water.

There seems to be a prospect of the deposits of ore on the West end of the Island being opened up this season. An option has been granted to an English company, who propose spending a considerable sum in thoroughly testing the property with a diamond drill. The Hematite deposits on the North side of Conception Bay are again receiving attention, and there seems to be a prospect of some further development taking place there soon.

It is reported that Messrs. Harmsworth have some miners employed at Red Indian Lake, opening up a galena deposit, which is said to offer very favorable prospects, but I have no particulars of their operations.

There has been a great falling off in the amount of Pyrite mined at Pilley's Island last year. It reached but little more than half that of 1905. I have before referred to the values assigned to this ore, as being much less than formerly. Either the figures have been wrongly stated, or the quality of the ore marketed must have greatly deteriorated. Pyrite of the usual grade of Pilley's Island ore is quoted at from 11 to 12 cts. per unit, or for a 53 per cent. ore about $6.36 per ton. Not having any information with regard to the cost of mining, or freight charges, I am unable to state what would be a reasonable value to place upon this ore, but I am inclined to think that $1.50 should cover all the costs and charges, which would leave $4.86, or say $4.50 as the probable value.

The Newfoundland Petroleum Company, Ltd., continued to prosecute the drilling operations at Parsons' Pond, and two new wells were put down, on either side of the pond; both combined giving about 3,000 feet of actual drilling. The first hole did not prove as satisfactory as usual, very little oil being struck. The second hole was not completed when the cable gave out and put a stop to the work. This latter, so far as it progressed, seemed to promise well, and it was noticed that a more than usual quantity of gas issued from it, so much in fact, that it might almost be regarded as a natural gas producer. It showed several small streaks of oil in the 1600 feet of depth attained, and gave a yield of about ½ a barrel per diem. It is believed had this well been sunk to the usual depth of 2,000 or more feet it would have proved one of the best yielders yet drilled.

The pumping operations of last winter did not prove so successful as was anticipated. Owing to the severity of the weather, and the difficulty of getting back and forth across the pond, proper attention could not be given to all the pumps, as a consequence, some of the apparatus became frozen up, stopping the work. This caused several of the wells to be flooded with water and "drowned out." A few of them continued to yield about half a barrel, and one maintained its yield of four barrels throughout.

The Petroleum Company have been hampered for want of sufficient capital, and the difficulty of inducing persons to take stock in a venture which is not yet on a paying basis, yet the prospects are certainly encouraging, and it would be regrettable were the industry to die out. It appears to me, here is a case where a little Governmental assistance might well be extended, to help out the exploration of the oil field. The Company have now expended a large sum to prove the property, and are deserving of every legitimate assistance. The failure of the venture will mean great loss to many, while its success on the other hand would open up an industry which might mean much for the prosperity of the country.

The production of slate in Trinity Bay fell off considerably. No attempts were made to open up the other deposits in that section, though they were visited and favorably reported upon by slate experts from Wales during the summer. Work is still progressing at the two quarries on either of the Humber Arm, Bay of Islands, which are I understand now under new management. Although much work has been done in this latter locality, no actual shipments of finished slate have as yet been made. The slate of Bay of Islands is pronounced to be of a very superior quality, and there appears every prospect that a profitable industry will soon be established here.

There was no Talc mined last year, the work having been suspended, and up to the present date there appears to be no intention of resuming operations. What the causes of this suspension are I am unable to state. The material is pronounced to be all right, as to quality, and there seems no reason I am aware of, why it should not find a ready market. Possibly the absence of sufficient capital and enterprise is what is lacking.

Enquiries are constantly being made from outside sources for the rarer metals, such as tungsten, molybdenite, vanadium, etc.,

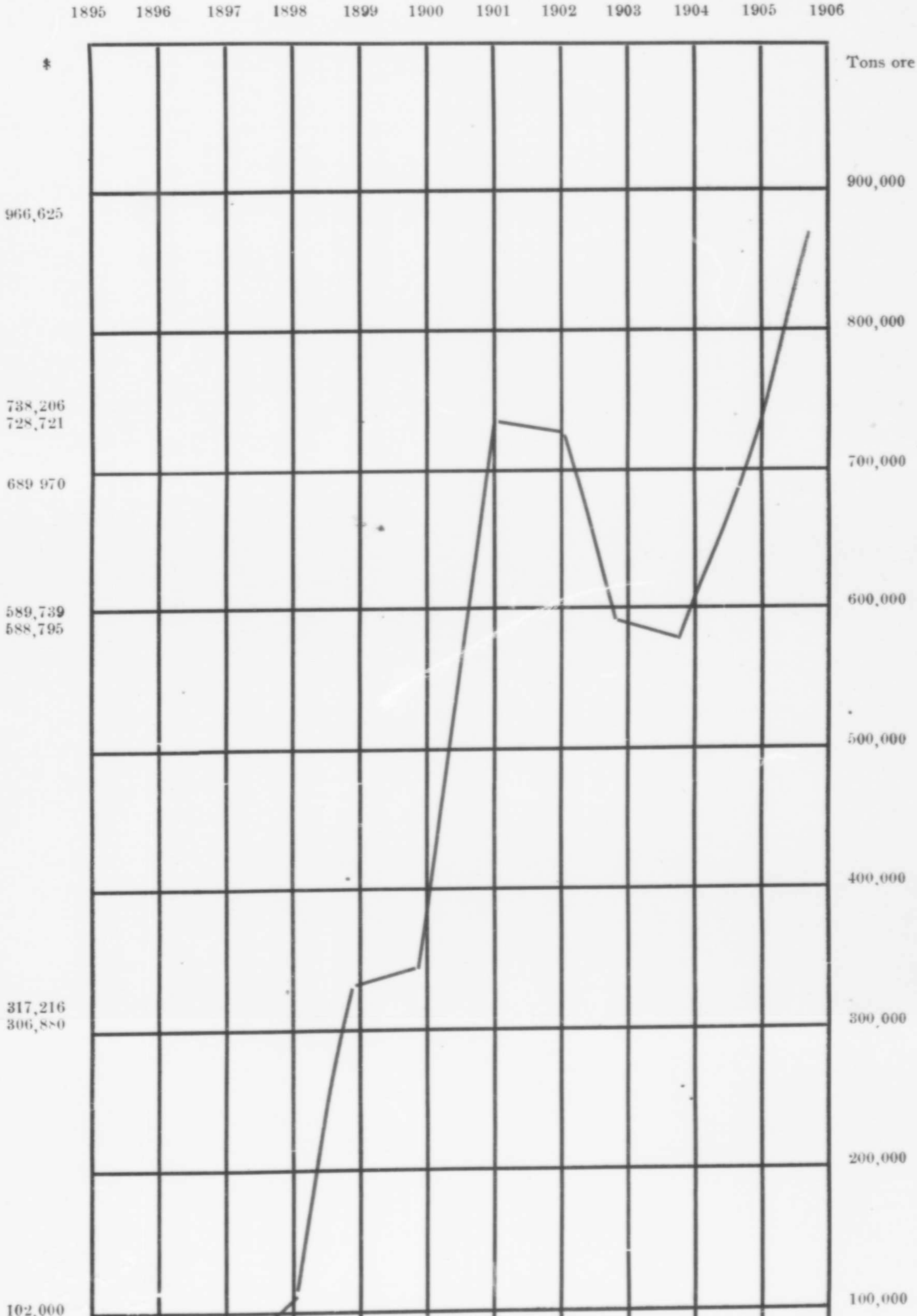

Diagram showing the growth of the Iron Industry.

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there being a steady growing demand for all these substances, and it would be well for prospectors to keep a look out for them.

It is worthy of note that Platinum may now be added to the list of Newfoundland minerals. At my suggestion last year, Mr. R. B. Job took to England some specimens from his chromite claims near Mount Cormack, to have them tested for this rare and valuable substance, with the result, that they were found to contain a small percentage of platinum. Although it was not present in sufficient quantity to render its extraction of economic importance, yet its presence at all, gives hope that it may upon further development be found so. Platinum is quoted at from $38.00 to $38.50 per ounce, and such a high priced metal is well worth being sought for.

On the whole, the mining industry of the country is advancing in importance year by year, and seems destined in the future to rank amongst one of our foremost industrial pursuits. Every encouragement should be given to further its expansion, as outside the fisheries, there is no pursuit so congenial to our people as mining, nor yet any which holds out better prospects of remunerative employment.

I have the honor to be,

Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XXX.

Report for 1906.—Coal Boring Operations near Goose Brook.

Geological Survey Office,
St. John's, N.F.,
January 25th, 1907.

HON. J. A. CLIFT, K.C.,
Minister of Agriculture and Mines.

Sir,—

The coal boring operations of the past season resulted somewhat more favorably than those of the preceding one. Although not successful in locating any seams of a workable character, nevertheless, the general results obtained may be considered very promising.

Three holes were put down at intervals of 850 and 1700 feet apart, along a line parallel with the Railway track, and about ¾ of a mile Eastward of Goose Brook. The first of these was a continuation of No. 3 hole of 1905. It had reached a depth of 92 feet when it was abandoned. The second hole was bored to a depth of 91 feet, when it was considered advisable to abandon it also. The third hole had reached a depth of only 77 feet, when the season's operations closed. This was necessitated by the rainstorm during the first week of November, which completely flooded us out, rendering it impracticable to continue the work.

Enormous difficulty was encountered at the outset in trying to penetrate the immense superficial deposit which covered the underlying rock formation. At first an attempt was made to sink a shaft through the debris, but after reaching a depth of sixteen feet, it was found utterly impossible to proceed with the means at our disposal. The great quantity of large boulders encountered, the loose character of the gravel, and the continuous influx of water, baffled every effort to attain a greater depth. Although the shaft was well timbered all around, the pressure exerted by the running gravel on every side, burst in the stout timbers, and the gravel forced its way beneath to such an extent, that the shaft could not be kept clear, while three hand pumps constantly kept going, failed to reduce the water so as to enable the men to work satisfactorily.

When Mr. Adolph Lundsten, the drill-man, sent by the Davis Calyx Co. arrived on the ground, seeing the futility of the attempt to reach the bed rock by means of an open shaft, he decided to abandon this method, and try to bore down the casing pipe instead. This necessitated procuring a specially constructed reducing plug to fit the pipe and also the spindle rod. To save unnecessary delay I hurried into town and had the plug made at the shortest possible notice, by the Terra Nova Engine & Boiler Co. It proved completely satisfactory, and here I might add, that all the work performed for us during the season by this firm was of an equally satisfactory character.

We now commenced to bore down the casing pipe through the boulders and gravel, slowly but steadily gaining depth, until an unfortunate accident again caused considerable delay. A sudden jar of the machine broke several teeth out of the bevel wheels, which put a stop to the drilling until repairs could be effected. New bevel gear had to be ordered from New York, but while waiting its arrival, temporary wheels were cast by the above-named firm, which enabled us to get along with the work in the meantime.

The bed rock was at length reached at a depth of 42 feet, and soon better progress was made. At first, the drill passed through a tough sandstone and grit rock, after which an immense thickness of more or less shaly strata was encountered. This latter caused much trouble by constantly breaking away and caving in, and frequently jambing the drill rods; moreover, it would not core, but became so ground up, that it was only by the washings any idea of the rock could be arrived at. Every few feet of depth gained necessitated stopping the drill to bore down the casing pipe. This was slow and tedious work, as it had to be chiefly accomplished by hand. We would not again risk boring the heavy pipe with the machine under such a full head of steam as was necessary, so resorted to this method to obviate the danger of further breaking the running gear.

At length the shale was passed through, and was succeeded by a fine grained bluish sandstone, from which we obtained a little core. This sandstone was again underlaid by shale with thin layers of sandstone and grit. The cores obtained from these latter rocks confirmed the suspicion, now entertained, that we had here a reverse dip, pointing towards the southward, and that the rocks being passed through were clearly below the position of the coal seams already ascertained to exist in this trough. A little further boring left no room for doubt on this point. A dark mottled shale with chocolate coloured streaks, bearing an exact resemblance to a similar shale known to underlie the coal seams on the South side of the trough, being struck.

While passing through the thick layer of shaly strata, some few fossil plants were observed, and occasionally small fragments of coal were washed up. These indications were such as to warrant our proceeding with the hole so long as there appeared a prospect of striking a seam of coal, but when it was ascertained definitely, that the section bored through held out no hope of such occurring, it was immediately abandoned, and a move made to a new location further West, near the side of a small pond, and close to our camp.

Here again similar difficulties were encountered in penetrating the immense superficial deposits, but having profited by our former experience, in contending with these, better progress was made. Unfortunately, when we had all but reached the bed rock, one of the pipes broke off at the joint, which compelled us to draw up and begin over again. At length, having got through the surface deposits we struck a hard gritty sandstone, pitching at a high angle. After passing through this, to our no small astonishment, we again met boulders and gravel. It could only be concluded that the sandstone was a large loose mass that had been lifted from its bed, and turned up nearly on its edge, or that a cavern had been worn out beneath, into which the boulders and gravel found their way. It entailed a great amount of labor to bore the large pipe through this hard mass of grit, and get it below this second gravel deposit, but it was a length accomplished, and the bed rock finally struck at a depth of 32 feet. It was not, however, till reaching a depth of 40 feet that we succeeded in striking solid ground. At 42 feet, tough clay, "pug" was met with, after which shale and sandstone alternated to the bottom of the hole. The shale, which was chiefly of a dark grayish colour, sometimes nearly black, contained many impressions of fossil plants, and one or two dirty coaly streaks. It gave us no end of trouble by constantly caving in, and it was only by using the utmost caution the core barrel and drill rods were saved at times. No good cores were obtained from this hole, and we did not succeed in ascertaining, with certainty, in which direction the strata inclined. Quite a lot of loose coal was washed up from the gravel before reaching the bed rock, and again when the second layer of gravel was struck. This would seem to indicate the existence of a seam of coal somewhere in the immediate vicinity. The rocks also were of a decidedly more promising character than those met with in the first hole, and were evidently belonging to a higher portion of the series. Presuming such to be the case, it pointed to the fact that we had struck the opposite side of an anticlinal roll, where the true coal measures were coming in again, forming a second trough, or wave-like undulation. The value of this new trough would greatly depend upon the angle of inclination, and the direction of the dip. If the strata proved to be less inclined than heretofore, and the direction again pointed towards the Northward, there would be a strong presumption of a wider trough occurring, with a greater development of the coal measure than anything yet discovered in this district.

I greatly desired to bore this hole deeper, but the drillman assured me that without considerable more casing pipe, and of a more suitable character, to attempt doing so would involve the risk of losing all the tools.

Although the season was now far advanced, and there was little hope of accomplishing much more drilling, I determined to make at least a commencement of a third hole. A position was selected further west alongside of a small brook, where the surface indications seemed most favorable. It was hoped that if we succeeded in reaching the bed rock here, there would be a chance of proving whether the supposition of having struck a second and wider trough was correct or otherwise. Great hopes were entertained that such would prove to be the case, nor was the result disappointing.

It was fortunate that in putting down this third hole, we did not encounter such a depth of superficial debris, nor any such accumulation of large boulders as in the two first instances. While it was still difficult to penetrate to the underlying rock, owing to the tough nature of the surface deposit, nevertheless our progress was much more rapid. At the end of the fourth day the bed rock was reached, previous to which much loose coal was washed up from the gravel. The first cores brought up consisted of pieces of light gray sandstone, containing carbonized impressions of plants, indicating that at least one of our surmises was correct, and that we had here true coal measures. As the boring progressed, this became more and more apparent, cores of dark gray shale filled with fossil rootlets were obtained, and at depths of 47, 50, and 56 feet respectively, three small seams of coal were passed through. We did not succeed in obtaining cores of these but from the washings were enabled to conclude that they were but a few inches in thickness, the largest being about five inches, while the coal itself was of excellent quality. Fine coal dust continued to wash up from the borings, derived no doubt from thin layers or carbonized plant remains, which were abundant throughout the section. Towards the bottom of the hole some gray and whitish sandstones were intercallated with the shale, all containing plant impressions. The cores from these latter gave a clue to the angle of inclination of the strata, which proved much flatter than heretofore.

As already stated upon reaching a depth of only 77 feet, twenty-nine of which was superficial deposit, the great rainstorm of November set in and effectually put a stop to further operations.

During the entire season, the pick and shovel men were kept constantly employed trenching along either side of the railway track, and an enormous amount of work was performed by them. Such, however, was the depth and character of the superficial deposits, that in a very few instances, only, were they successful in exposing the underlying rock. In the latter part of the season, they were employed in continuing the road towards Goose Brook, to enable us to move along the machinery. This road has to be constructed in advance, and as much of the ground is low and marshy, it necessitates corduroying the softer places with timber cut and carried from the adjacent forest. This, after being laid down, requires to be covered with about a foot of gravel, so as to form a solid road bed. Some three-quarters of a mile of road was thus constructed, and this work will have to be continued all the time, otherwise the moving of such heavy material cannot be accomplished.

During the latter part of September, it was deemed advisable to make a re-survey of Sandy Lake, which is such a large and marked feature of the topography of the coal region. It had never been thoroughly surveyed before. When the late Alex. Murray passed through it on his journey across country from Hall's Bay to Bay St.

George, he merely measured the south shore, and took a few bearings on prominent points, in order to get a general idea of the shape of the lake. A regular trigonometrical survey was now undertaken, which proves the lake to be a much larger body of water than it was hitherto represented to be. It is rudely triangular in shape, with several large bays, containing many islands, particularly on the west side, and is altogther a most picturesque sheet of water. As its name implies, it is for the most part very shallow, and has numerous sandy or rocky bars extending far out from its shores. Extensive beaches of fine sand and accumulations of immense boulders fringe its margin on every side, these being the result of glacial action, which has left its impress all over the region.

The main outflowing river, Sandy Lake stream, debouches from the S. W. angle, Birchy Pond river, the principal inflowing stream coming in at the opposite or S. E. angle. Several large and small tributaries, the drainage system of the surrounding country, act as feeders to the lake. The largest and most important of these is Kitty's Brook, which flows in on the South side through a deep ravine in the Laurentian range, which forms the southern boundary of the Humber Valley. It is by way of this ravine a route was found for the railway into the lowlying Humber region, after crossing over the height of land, near the Topsails. It crosses Kitty's Brook about six miles from Sandy Lake. Another fair-sized brook enters the lake at its extreme N. E. angle, which traverses the country in the direction of White Bay.

At one time, the shores of the lake were well timbered all around, but of late years fire has denuded most of it, completely destroying a fine area of pine and spruce on the southern, and large part of the western, sides. To the North and East, there still remains a forest of green timber, but I fear, sooner or later this also is destined to a similar fate.

Some few years ago, a line of road was surveyed, cut out, and partly graded, from the head of Sandy Lake to the head of White Bay, but it has been allowed to fall into disuse. This is much to be regretted, as the construction of a good road here would be the means of connecting, not only White Bay with the railway, by an easy route, but would afford facilities for passenger traffic, mails, etc., to and from a large and important section to the North-eastern portion of the Island. A day must arrive when the exigencies of trade, commerce, intercommunication, etc., will call for the construction of a branch line of railway, from the main trunk line to White Bay, then this same route will be found the easiest and most direct obtainable.

Report of the Boring and Other Operations in this Section of the Grand Lake Carboniferous Area to Date.

In 1895, when the Railway was under construction across the Humber Valley, the presence of so much loose coal in the gravel cuts along this section attracted attention. It was deemed a matter of much importance to try and locate the seams from whence this coal was derived. At the earnest request of Mr. R. G. Reid, sr., the Government was pleased to direct the Geological Staff to undertake this work. A point was selected about one mile East of Goose Brook, near the railway track to begin operations. In a short while one seam of coal was discovered, close to the railway track, and before the season closed a second seam was uncovered, a short distance to the northward. For some reason, the further investigation of this region was deferred, and after the contract of 1898 became law, the Messrs. Reid commenced to sink a shaft upon the first seam mentioned. I have never been able to ascertain exactly what the result of their work here was, and only learned incidentally, that a shaft was sunk upon the slope of the seam, and quite a quantity of coal extracted therefrom. This coal was of poor quality, being much intermixed with clay and shale, which necessitated a good deal of handling after being mined. The Reid Company suspended operations in 1900, and nothing further was done till 1904, when the Government again resumed the work of exploration. In that year a Davis Calyx drill was procured with which to thoroughly test the ground, and the boring has been continued up to date. The reports for 1904-5 gave particulars of the work performed in these years, while that of the past season (1906) is detailed above.

In 1904 three new seams were added to the section, one of which was of considerable thickness, but was so intermixed with shale and clay as to render it of little economic importance. The operations of 1905 did not reveal any new seams of workable dimensions, though at least 200 feet of strata were added to the section. The first hole bored the past season clearly demonstrated that some disturbance, either in the nature of an anticlinal roll in the strata, or an uplift of lower measures caused by a fault or break, occurs. It became further evident that the trough in which the coal seams were found, was only a minor one, and of very limited lateral dimensions. In fact, it appeared to be but a sharp narrow fold where the carboniferous series, towards its southern edge, became doubled up against the Laurentian gneiss.

Being under the impression that this could not be the only, nor yet the principal trough of the region, and that as a further remove was made, away from the crumpled up edge of the series, other and more extensive ones would be found to occur, the bore holes were so located as to ascertain whether such was the case. The second and third holes afford ample proof that in this supposition the deductions drawn were well founded. Whether the trough now discovered, will prove more satisfactory than the first, or bring in a greater thickness of true coal measures, has of course yet to be determined. All the indications are certainly more promising in every respect.

Possibly, even this may not be the only, nor yet the main trough of this coal region. There is a great extent of flat country lying between the scene of operations and the Sandy Lake River, yet to be tested, and it is more than probable some portions of this at least, will be found underlain by coal troughs of greater or less extent.

Before leaving the locality, all the machinery was carefully cleaned and stowed away for the winter, the boiler was hauled up on dry land and housed in from the elements. The last hole was then filled with cement, to be allowed to settle and harden, the object being to bind together any loose material that may have fallen in, as well as, to fill up cavities which may have been caused by the washing. In reboring on a future occasion, it is hoped by this means to insure a clean smooth hole, with good firm edges, down to the bottom.

In the further prosecution of the boring operations, it would be well to be provided with duplicates of all such parts of the machine as are subjected to most wear and tear, or otherwise most liable to give out. The loss of time entailed in procuring such articles when needed, has hitherto proved a great detriment, and has very much retarded the work.

Mr. Adolph Lundsten, the drill-man, gave every satisfaction. He is a careful, cautious worker, a man who thoroughly understands his business. It will be very desirable to secure his services again, if they can be obtained, for the further prosecution of the work during the coming season.

I have the honor to be,

Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XXXI.

Report for 1907.—Coal Boring Operations near MacGregor, Grand Lake, Carboniferous Area.

Geological Survey Office,
January 6th, 1908.

HON. J. AUGUSTUS CLIFT, K.C.,
Minister of Agriculture and Mines.

Sir,—

I am pleased to inform you that the coal boring operations near Goose Brook during the past season resulted more favorably than heretofore.

Although several unavoidable delays occurred in the early part of the season, owing to the breaking down of certain parts of the machine, and the non-arrival of the casing pipe ordered at an early date, nevertheless more actual boring was accomplished than in any two previous years.

Two holes were put down—one to a depth of 194.7 feet, the other to a depth of 256 feet. Seventy-seven feet of the former were drilled in 1906, so that the actual depth made in that hole this year was 117 feet, with which the 256 feet of the second hole aggregated 373 feet altogether, or an average of 3.3 per day. As, however, the boring was suspended on two or three occasions for several days at a time, owing to the above-mentioned causes, and the number of working days thereby reduced to 85, the real average per day, that the machine was in operation, was about 4.38 feet, which under all the circumstances, may be considered fairly good work.

We commenced drilling on the 20th of June at No. 3 of last year, near a small tributary of Goose Brook. This was the same hole we were compelled to abandon the previous November owing to the desperate state of the weather at that time.

Having first cleaned it out down to the bottom, good progress was made to a depth of 100 feet, which was reached on the 25th.

It then began to cave in badly, necessitating the withdrawal of the old 4-in. pipe and putting down the new three and a half inch casing pipe. By the 28th it was down thirty-eight feet when an unfortunate accident occurred. The main journal of the spindle rod, one of the chief parts of the running gear, became broken by the great strain upon it, and though we tried to effect temporary repairs, it soon gave out again, and could not be made further use of. A telegram was immediately despatched to the Davis Calyx Drill Company, New York, for a new journal and while awaiting its arrival, the pipe was screwed down by hand to within ten feet of the bottom of the hole.

The new journal did not arrive till the 16th of July. In the meantime the men were employed in procuring firewood and extending our road to Goose Brook. We commenced to bore again on the 16th, and the work progressed favorably till a depth of 194.7 feet was reached. At this stage the core barrel became so badly jambed that in trying to get it up it twisted off and remained in the bottom of the hole. It became so worn from use that the plug connecting it with the calyx barrel gave out.

We now had to abandon this place and remove the machine to a new site about four hundred feet to the eastward, where favourable surface conditions seemed to exist. The withdrawal of the casting pipe from the first hole was a difficult undertaking, and several days elapsed before we succeeded in recovering it all.

By the 22nd of August, the machine being again in working order, we commenced to put down the large 5 in. stand pipe, but it proved the most tedious and difficult task yet encountered. Such was the depth and character of the outlying drift deposit, all efforts to penetrate it were for a long time unavailing. Huge boulders and coarse gravel were encountered at almost every foot, and as these were cut through, they would become loosened, and turned over, necessitating cutting the same boulder several times. The pipe had to be withdrawn two or three times and reset. On the 7th of Sept. the spindle journal again gave out, and as it was too late in the season to procure a new one from the manufacturers of the machine, we were obliged to get a temporary one made at the Terra Nova Engine and Boiler Works, St. John's. This reached us on the 23rd. In the meantime we had succeeded in screwing down the five inch casing pipe to the bed rock, a depth of twenty-one feet. Boring was now started with a four-inch core barrel and cutter, and all went well until October 16th. At a depth of one hundred and thirty-five feet the sides of the hole began to cave in so badly, and the drill rods became so frequently jambed, the 4 in. tools had to be laid aside, the small three and a half casing pipe screwed down to the bottom of the hole, and the 3-in. core barrel and bit brought into requisition for the remainder of the season. By the 10th November we had reached a depth of two hundred and fifty-six feet, when the weather conditions and the lateness of the season made it advisable to close down the work.

A shed having been erected over the machine where it stood, all the loose materials were carefully stored away for the winter.

During the progress of the drilling operations, the road to Goose Brook was completed, half a mile ahead, so as to be in readiness for moving the machine forward as new boring sites were located.

The details of the sections passed through in the two bore holes are given below, and the accompanying diagram, on a scale of ten feet to one inch, will more fully illustrate the same.

I have in course of preparation, on a scale of one hundred feet to one inch, a ground plan and section of all the work accomplished in this particular part of the Grand Lake carboniferous area within the last few years. I trust it will afford a more adequate idea of what has been accomplished than any written description, and will obviate the necessity of recapitulating the substance of former reports.

Our drillman, Mr. Ellison, gave every satisfaction. He proved himself a most experienced and careful expert in that particular capacity.

RECORD OF BORE HOLE NO. I.

	STRATA.		COAL.
Surface deposit of sand, gravel and boulders......	28	0	
Dark grey fine-grained micaceous sandstone, with numerous carbonized plant impressions	15	0	
Dark Bituminous shale with fossil plants	4	0	
Coal Seam			4"
Shale filled with plant impressions	2	8	
Coal Seam			3"
Shale with fossil rootlets	5	9	
Coal Seam			5"

Alternations of shale and fine sandstone with numerous plant impressions and streaks of coal...	20	7		
Shale with kidney ironstone	16	20		
Ironstone with a little shale	10	0		
Coarse whitish grit	4	9		
Fireclay	1	3		
Coarse white grit	2	0		
Arenaceous shale	3	0		
Fine grayish sandstone	2	0		
Chiefly shale	8	0		
Shale and ironstone	1	0		
Fine gray sandstone with coal partings	5	0		
Coarse grayish grit	11	2		
Shale with kidney ironstone and some coal streaks	32	7		
Shale and ironstone	11	3		
Coal seam				3?
Shale with ironstone and coal streaks	9	4		
Strata	193	4	1	3
Coal	1	3		
Total	194	7		

RECORD OF BORE HOLE NO. 2.

	STRATA.		COAL.	
Superficial drift, sand, gravel and boulders	21	0		
Coarse whitish grit	27	0		
Shale	19	0		
Coal Seam				3
Shale with coal partings	6	9		
Shale with kidney ironstone	4	0		
Coal Seam				9
Shale	5	3		
Coal Seam			3	0
Shale with kidney ironstone	4	0		
Shale with kidney ironstone with coal streaks	30	0		
Chiefly Shale	8	0		
Arenaceous shale and fine sandstone	3	0		
Fine and coarse sandstone	5	0		
Coarse grit		3		
Arenaceous shale	2	9		
Shale with coal streaks	3	2		
Coarse gray grit	16	0		
Shale with coal partings	9	0		
Coarse gray grit	8	0		
Shale with kidney ironstone	10	0		

Coarse gray grit	5	0		
Shale and ironstone	4	0		
Coarse grit	7	10		
Shale with ironstone and coal partings	20	9		
Coal Seam				6
Dark carboniferous shale with ironstone and fossils	17	9		
Shale with thin coal streaks	3	0		
Shale and ironstone	29	0		
Strata	252	6	4	6
Coal	4	6		
Total	256	0		

It will be seen by the above sections that the strata passed through are typical of the coal measures proper, and correspond almost exactly with those of the Cape Breton series. The preponderance of shale and ironstone is a very marked feature, while the great abundance of carbonized plant remains, and the frequent occurrence of thin coaly layers throughout the more shaly portions give promise of other and thicker seams occurring.

The failure to strike any large seams so far, should by no means be taken to indicate their absence. If we turn to Cape Breton to institute comparisons, it will be found that Mr. Brown in his section of the North Sydney Coal Measures, enumerates no less than 23 distinct coal seams therein, only four of which are considered of workable dimensions. Of the remaining nineteen, four only are over a foot in thickness. All the others range from two inches to one foot, fourteen of the fifteen averaging only six inches each.

The section passed through in No. 2 bore hole, between fifty and seventy feet, might be considered as one seam, which exhibits at least 3½ feet of coal of good quality, three feet of which might be recovered in actual mining. Unfortunately no good cores were obtained, nearly all the coal being ground up into small fragments by the friction of the core barrel, and the presence of hard lumps of grit and ironstone. The prospect of securing satisfactory cores with tools of such small dimensions as those now in use, is not favorable.

Efforts have been made since my return home to induce persons handling boring drills in the United States and Canada to contract for the further prosecution of the work, but so far without avail, nor do I think from present appearances any such firms can be found willing to do so. In the event of our having to continue the work ourselves, I would strongly urge the necessity of procuring a second Davis Calyx drilling outfit for next season. The advantage of having two such machines in operation at the same time are manifold. One engineer could easily superintend the running of both machines, with the assistance of an intelligent mechanic and a few extra men. The drills would never be situated far apart, and in the event of one breaking down at any time, the other could be kept going, and thus avoid the vexatious delays which have hitherto so much retarded the work. Should this suggestion be adopted, the thorough exploration of this promising coal field would be very much facilitated.

In ordering a new outfit, it would be well to have duplicates of all such parts as are liable to most wear and tear. One of the chief drawbacks to the successful prosecuting of the work heretofore is the necessity of having to send to the manufacturers for every item in case of accident, and the great loss of time in obtaining the articles from New York.

I have the honor to be,

Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XXXII.

Preliminary Report upon Coal Boring Operations, 1908.

Geological Survey Office,
December 29th, 1908.

HON. J. A. CLIFT, K.C.,
Minister of Agriculture and Mines

Sir,—

In accordance with your request, I beg to furnish you with a short preliminary report of the Coal-Boring operations during the past season.

The Government having decided to give the further prosecution of the work out to contract, Mr. J. W. Randall, of White Plains, N.Y., a thoroughly reliable drilling expert, was awarded the same.

As soon as Spring opened, Mr. Randall lost no time in getting the work underway. He was to furnish two powerful machines with all necessary equipment and men to operate them, also to have the use of the small machine, the property of the Government already on the ground.

Early in May he sent forward one drillman with two helpers to start boring with the latter machine, which stood in position over the last hole put down the previous year. They were instructed to continue this hole downwards and make what depth they could pending Mr. Randall's arrival with the larger machines.

At the end of last season this hole had reached a depth of 256 feet, which was continued to 287 feet, when it became so bad that no further progress could be made without reaming and getting the casing pipe to the bottom. An attempt was made to do this, but owing to the absence of suitable tools for the purpose in the drill outfit, the hole had to be abandoned after making 31 feet, and the machine moved to a new location some 256 feet further back and nearer our camp.

The details of the bore-hole above-mentioned, together with a section of the rocks passed through were furnished last year. The cores from the 31 additional feet now attained, consisted chiefly of sandstones and shale, all belonging to the true coal measures.

The new position now taken up is referred to as No. 1 hole of this season. It was carried down to a depth of 278 feet, beyond which the small drill was unable to penetrate, owing to the bad character of the ground and the insufficient capacity of the machine.

The section passed through consisted of a surface deposit of sand, gravel and boulders to a depth of 41 feet, succeeded by a great thickness of argillaceous and arenaceous shale with occasional dark carbonaceous bands, and a few layers of kidney ironstone. Here and there thin beds of sandstone occurred, being more frequent towards the bottom of the hole. Many fossil impressions were found in the shales, and at depths of 45 and 116 feet two small coal seams of about four inches respectively were passed through. Some of the more carbonaceous shales also contained thin irregular streaks of coal.

Seeing that this small machine was entirely inadequate to cope with such conditions as prevailed here, Mr. Randall decided to abandon its use and house it in where it stood. In any case, it is now getting pretty well worn out after five years' constant hard usage.

Mr. Randall with the two large machines and the remainder of his crew and outfit arrived on the ground early in June, and immediately commenced operations at two other points I had already located. One of these, called No. 2 hole, is situated alongside of a small rivulet about midway between No. 1 and Goose Brook. The other, No. 3, is close by the latter brook near where the railway spans it.

At both these locations an enormous depth of boulders and coarse gravel was encountered, so much so that after nearly two months' desperate work No. 2 had to be abandoned after reaching a depth of 130 feet without striking the bed rock. It became quite evident that some disturbance, some great break or fault occurred here causing such a depression in the surface of the underlying rock formation. This supposition was borne out afterwards in the broken and slick-ensided condition of the cores taken up in No. 3 hole.

In the meantime, seeing the great difficulty of contending with such a great depth of surface deposit, with the machines in use, Mr. Randall proceeded to the United States to procure another drill of a different type, called the Keystone, better adapted to cope with such conditions.

As soon as he returned with the Keystone drill it was sent down the river side to a point 1130 feet north of No. 3 hole, and a new one, No. 4, started, with a larger 8 inch pipe. This hole was drilled and the pipe driven 80 feet till it was well into the bed rock, then the Keystone was brought back to No. 3 and the core machine there transferred to No. 4 hole.

Previous to this No. 3 had reached 71 feet, but had to be stopped at that depth, being unable to penetrate further.

With the aid of the Keystone this hole was finally put down and the large pipe driven well into the bed rock, which was not reached till a depth of about 118 feet was attained. One of the core drills was now put on this hole, and the Keystone again removed down the river 1583 feet beyond No. 4, where another hole, No. 5 was started.

Nos. 3, 4, and 5 were now continued uninterruptedly till the end of November when the work closed down for the season.

At No. 3 the rocks met with were very much broken and as a consequence it was with the greatest difficulty any progress could be made. Constant falling in of the sides of the hole occurred jambing the tools and causing endless trouble in withdrawing them. Very little core was obtained and this consisted of some coarse grit and sandstone with a small portion of arenaceous shale. A few fossils only were seen, and no coal except just at the surface of the bed rock, where several loose fragments were washed up.

No. 4 hole proved to be the most successful and most promising yet put down. It reached a total depth of 541 feet, and judging from the cores obtained indicated that here we had struck a higher portion of the Coal Measures than had hitherto been met with. The section passed through consisted mainly of shale and fine grained sandstones with occasional thin strata of grit and several considerable bands of kidney ironstone. The shales were chiefly of an argillaceous and arenaceous character, but there were also many higher carbonaceous layers. Most of these shales were crowded with carbonized leaves and rootlets, some portions being simply a mass of comminuted plant remains. Both the shales and sandstones at time exhibited good sections of fossil trees, all characteristic of the True Coal Measures. At depths of 32, 111, 124, 184, 220, 302 and 306 feet actual seams of coal showing the following thicknesses were passed through, in their order of succession downwards:

No. 1	Coal	2 ft. 6 in.
No. 2	Coal	1 ft. 0 in.
No. 3	Coal	2 ft. 4 in.
No. 4	Coal	4 in.
No. 5	Coal	1 ft. 0 in.
No. 6	Coal	6 in.
No. 7	Coal	1 ft. 6 in.

All these coals were of good quality, some being exceptionally clean and bright and apparently comparatively free from sulphur or other deleterious substances. The whole section indicates at this point a considerable thickness of Coal Measures proper, and the cores from the bottom are still of such a favourable character as to make it quite clear we have not yet reached the limit of the coal bearing strata. I would therefore strongly urge that this hole be continued beyond the contract limit of 600 ft., or in fact till the bottom of the measures was reached. To do this effectually it would be advisable to start a new hole with a larger sized pipe, as at present the smallest size that can be used with this drill, viz., 4 in., is now down to within a few feet of the bottom, and cannot be carried much further.

No. 5 hole on which the Keystone drill only was worked, reached a depth of 200 feet, through boulders, gravel, sand and clay; the latter indicating sandstones and shales of the usual character. A few layers of dark carbonaceous shale, with some small fragments of coal came up in the wash, but no true coal seam was struck. Still the material washed up left no doubt of the coal measures being here also. It is the intention when the work is resumed next season, to put one of the core drills on this hole, so as to obtain a satisfactory record of the borings.

Other sites for future holes have been located, and there need be no unnecessary delay in prosecuting the work next spring.

The total number of feet bored during the season was as follows:

In last year's hole	31 feet
In No. 1 present season	278 feet
In No. 2 present season	130 feet
In No. 3 present season	188 feet
In No. 4 present season	541 feet
In No. 5 present season	200 feet
Total	1,368 feet

I have the honour to be,

Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XXXIII.

Report on Coal Boring Operations for the Year 1908.

Geological Survey Office,
St. John's, Newfoundland,
March 6th, 1909.

HON. S. D. BLANDFORD,
Minister Agriculture and Mines.

Sir:—

At the conclusion of the boring operations in 1907, the Government having decided to put the further prosecution of the work out to contract, I was requested to communicate with parties in Canada and the United States with a view to ascertaining whether a reliable person could be had to undertake it. The Ingersol Rand Drill Company strongly recommended Mr. J. W. Randall, of White Plains, New York, as one who had had extensive experience and was in every way thoroughly reliable. Mr. Randall was at once communicated with, and, at the desire of the Government, requested to come here to confer with them about the matter. He arrived early last winter, and after making himself familiar with all the conditions surrounding the undertaking, he finally entered into a contract to put down three thousand feet of borings at a certain figure per foot, the holes not to exceed six hundred feet in depth, or to be less than one hundred feet. He was to supply two large powerful drills, besides having the use of the small one owned by the Government, and to find all necessary men and tools to operate the same.

Early in May he sent forward three of his men, who, on their arrival here, proceeded with as little delay as possible to MacGregor. They were to start work with the small drill, pending the arrival of the larger machines, and endeavour to put the hole over which it stood down to a depth of three hundred feet or more. This hole had reached a depth of two hundred and fifty-six feet at the close of the season of 1907. About the middle of May, Mr. Randall himself, with the remainder of his men, and outfit, reached St. John's, and no time was lost in getting all on the ground. Work was well under way by June 1st, and was prosecuted vigorously from then till the end of the season. In a short preliminary report, already furnished the Government, the main facts of the operations were given, and I now have the honor of furnishing the details in full, accompanied by sections of the bore holes, which will aid in fully illustrating the same. When the small drill had attained a depth of two hundred and eighty-seven feet, the hole became so bad that it was found after various attempts that it could not be bored further. It was accordingly abandoned, and the machine moved to a new position close to the pond near MacGregor, where No. 1 hole of this season was commenced. Boring was continued here until September 26th, when a depth of two hundred and seventy-eight feet was attained, which was found to be about the full capacity of this drill in the class of rocks met with here.

In the meantime, the two larger drills were working away at two points further west, one about midway between No. 1 and Goose Brook, the other close by that brook, where the railway bridge spans it. These are called Nos. 2 and 3 holes. Great difficulty was found in getting down at each of these places, owing to the enormous depth of boulders and gravel met with. No. 2 had to be abandoned after reaching a depth of one hundred and thirty feet, without striking the bed rock. It had taken two whole months to penetrate thus far, and as it now became very evident that we had struck a fault or break of some kind, which was the cause of such a deep depression in the surface of the underlying strata, it seemed useless to lose any more time at it.

No. 3 hole, near the bridge, proved equally difficult to get down, but it was, nevertheless, continued till the end of the season. No bed rock was met in this hole, until a depth of one hundred and twenty feet was reached. Then the rock was found to be much broken and slicken-sided, indicating considerable disturbance of the underlying formation.

Seeing the difficult nature of the surface deposits and the inadequacy of the ordinary shot drills to cope successfully with such a depth of boulder debris, Mr. Randall proceeded to the United States about the middle of July to procure a new machine of a different type, called the Keystone, which works with a heavy chopping bit attached to a long cable, on the principle of the jumper drill. He returned with this machine towards the end of August, and having got it together, it was first sent down the river to a point eleven hundred and thirty feet north of No. 3, where a new hole—No. 4—was started.

This machine is fitted with a traction engine, and can be easily moved from place to place, once a way is cleared for it, by removing the fallen timber and other obstructions. It proved very efficacious in coping with the heavy deposits of boulder drift, and in the course of a few days' chopping and driving, reached the bed rock of No. 4. One of the large Calyx drills was now put on this hole, and the Keystone moved back to No. 3. Once the rock formation is reached, the Calyx shot drill is preferable, owing to the cores brought up affording an opportunity of studying the rocks passed through. The Keystone, as may be inferred, chops up everything it encounters, into fine sand and mud, and the nature of the rocks can only be guessed at by the wash from the hole. The Calyx, on the contrary, affords an actual section of the underlying formation, foot by foot, and thus enables us to judge of its character as the hole progresses downwards.

To go back to No. 3 hole. Here the enormous depth of from one hundred and eighteen to one hundred and twenty feet of surface deposit had to be chopped and driven through before any indication of the rock was met with. It was a most difficult task to penetrate this enveloping mantle, composed as it was of granite boulders, large and small, with coarse gravel and sand. It was not until October 8th that the stand pipe finally reached the bottom of this superficial drift.

The second large Calyx was now put on this hole, and the Keystone moved down the river northerly to a distance of one thousand five hundred and eighty-three feet beyond No. 4, where No. 5 hole was commenced. These three holes, viz., Nos. 3, 4 and 5, were now continued without intermission till the end of November, when the work for the season closed down.

The total number of feet bored in all the holes was as follows:

During the month of May... .... 24 feet
During the month of June ... ... 95 feet

During the month of July	104 feet
During the month of Aug.	237 feet
During the month of Sept.	305 feet
During the month of Oct.	270 feet
During the month of Nov.	303 feet
	1,338 feet

This does not include thirty-one feet made in the hole, put down in 1907, being exclusive of the contract.

DETAILS OF BORE HOLES.

No. 1 Hole.

	Strata	Coal
Surface Deposit	41' 0"	
Sand Stone	4' 4"	
Coal		0' 4"
Shale	3" 4"	
Fine Grained Sand Stone	6' 0"	
Shale	19' 0"	
Ironstone	1' 0"	
Shale	9' 0"	
Dark Grit	2' 0"	
Shale	5' 0"	
Ironstone	0' 5"	
Shale	24' 7"	
Coal		0' 4"
Fine and Coarse Sand Stone	4' 8"	
Ironstone	2' 0"	
Coarse Grit	6' 0"	
Arenaceous Shale	39' [illegible]	
Ironstone	0' 5"	
Fine Grit	1' 7"	
Shale	6' 0"	
Fine and Coarse Grit	1' 3"	
Arenaceous Shale	11' 9"	
Fine Grit	4' 0"	
Coarse Grit	0' 10"	
Fine Grit	6' 2"	

Fine and Coarse Grit and Shale	8'	0"		
Ironstone	1'	0"		
Sand Stone and Shale	18'	0"		
Shale	19'	0"		
Ironstone	0'	5"		
Shale	11'	7"		
Fine Grit	2'	0"		
Coarse and Fine Grit	5'	0"		
Coarse Grit	5'	0"		
Ironstone	1'	0"		
Coarse Grit	7'	0"		
Strata	277'	4"	0'	8"
Coal	0'	8"		
Total	278'	0"		

No. 2 Hole.

Boulders and Gravel	132'	0"

No. 3 Hole.

Boulders, Gravel and Sand	136'	0"
Broken Shale, Sand Stone and Grit	52'	0"
Total	188'	0"

No. 4 Hole.

	Strata		Coal	
Boulders and Gravel	19'	0"		
Sand and Clay with Loose Coal	13'	0"		
Coal			2'	6"
Clay, Sand and Shale	9'	0"		
Carbonaceous Shale	2'	6"		
Arenaceous Shale	7'	0"		
Arenaceous Shale and Clay	58'	0"		
Coal			1'	0"
Shale	5'	0"		
Arenaceous Shale	7'	0"		
Coal			2'	4"

Shale	2'	8"		
Arenaceous Shale	5'	0"		
Ironstone	2'	0"		
Carbonaceous Shale	4'	0"		
Carbonaceous and Arenaceous Shale	10'	0"		
Ironstone	3'	0"		
Carbonaceous Shale	7'	0"		
Carbonaceous and Arenaceous Shale	10'	0"		
Argillaceous and Carbonaceous Shale	4'	3"		
Coal			0'	4"
Arenaceous Shale	4'	5"		
Clay and Ironstone	13'	0"		
Clay, Shale and Ironstone	10'	0"		
Ironstone and Shale	8'	0"		
Coal			1'	0"
Carbonaceous Shale	8'	0"		
Carbonaceous Shale and Ironstone	2'	6"		
Arenaceous and Carbonaceous Shale	67'	6"		
Carbonaceous Shale	3'	0"		
Coal			0'	6"
Shale	4'	0"		
Coal			1'	6"
Shale	1'	6"		
Clay	1'	6"		
Carbonaceous Shale with Coal Streaks	3'	9"		
Carbonaceous Shale with Coal Streaks	15'	3"		
Arenaceous Shale and Sand Stone	5'	0"		
Sand Stone and Shale	15'	0"		
Argillaceous Shale	5'	0"		
Arenaceous Shale	10'	0"		
Arenaceous Shale and Fine Sand Stone	25'	0"		
Arenaceous and Carbonaceous Shale	46'	0"		
Arenaceous and Carbonaceous Shale and Sand Stone	54'	0"		
Sand Stone with Thin Coal Streak	2'	0"		
Arenaceous Shale	5'	6"		
Dark Sand Stone	9'	6"		
Arenaceous and Carbonaceous Shale	10'	0"		

Coarse Grit	6' 6"	
Black Carbonaceous Shale	3' 0"	
Black Carbonaceous Shale and Sand Stone	10' 0"	
Coarse Gray Grit	4' 0"	
Strata	530' 10"	9' 2"
Coal	9' 2"	
Total	540' 0"	

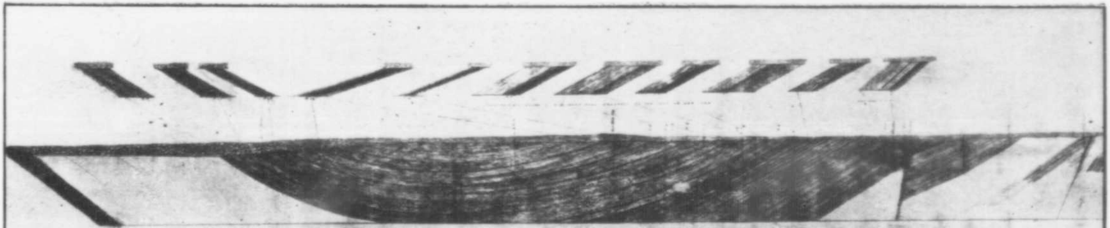
No. 5 Hole.

	Strata.	Coal
Boulders, Gravel and Sand	39' 0"	
Coarse Grit	6' 0"	
Broken Shale and Clay Chiefly	155' 0"	
Total	200' 0"	

The seams discovered during the season are nine in number, which, with eight others in 1896-7 and three previous to that date, make twenty seams altogether in this Goose Brook section. They aggregate about twenty-three feet of coal in all. Most of these seams are, however, too small to be taken into consideration, but those which average one foot and upwards are nine in number, as follows:—

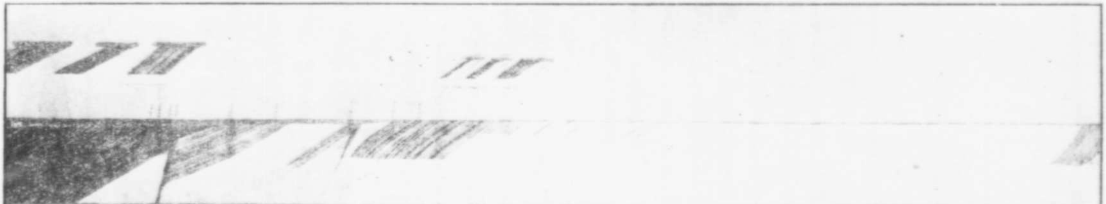
No. 1 Seam	2' 6"
No. 2 Seam	3' 4"
No. 3 Seam	1' 6"
No. 6 Seam	2' 8"
No. 12 Seam	2' 6"
No. 13 Seam	1' 0"
No. 14 Seam	2' 4"
No. 16 Seam	1' 0"
No. 18 Seam	1' 6"

Most of the coal contained in these seams is of excellent quality, some of it being of a superior class. There is little room for doubt that the further prosecution of the boring test will reveal the presence of other seams of great or less value, and by the time the

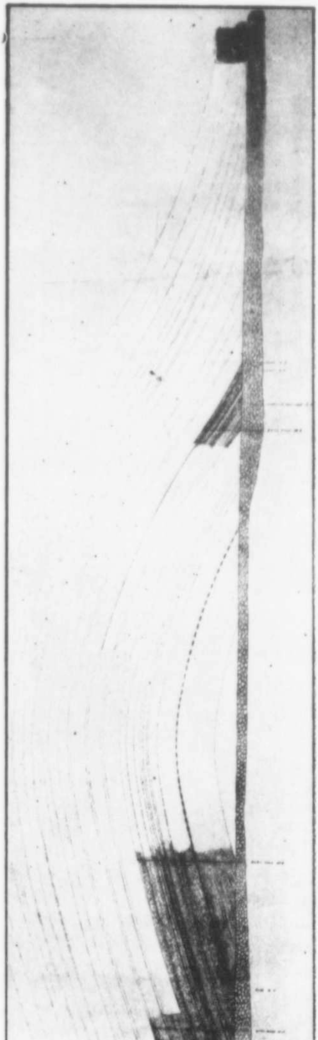


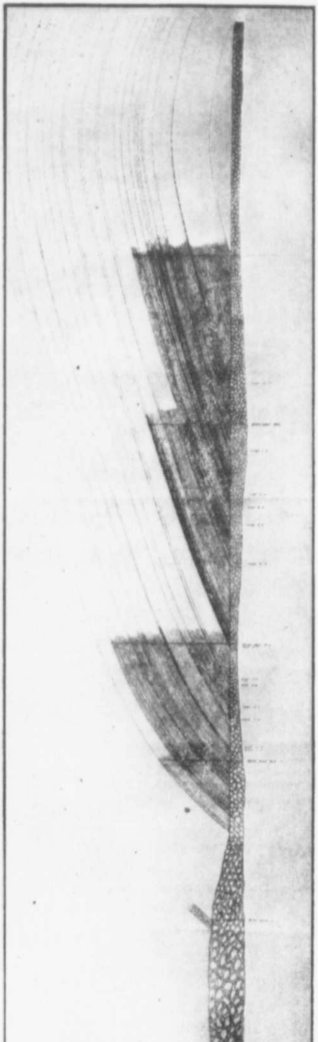
SECTION OF THE COAL MEASURES NEAR GOOSE BROOK

SCALE 100 FEET TO ONE INCH



SECTION OF THE COAL MEASURES NEAR GOOSE BROOK AS REVEALED BY THE BORINGS 3.

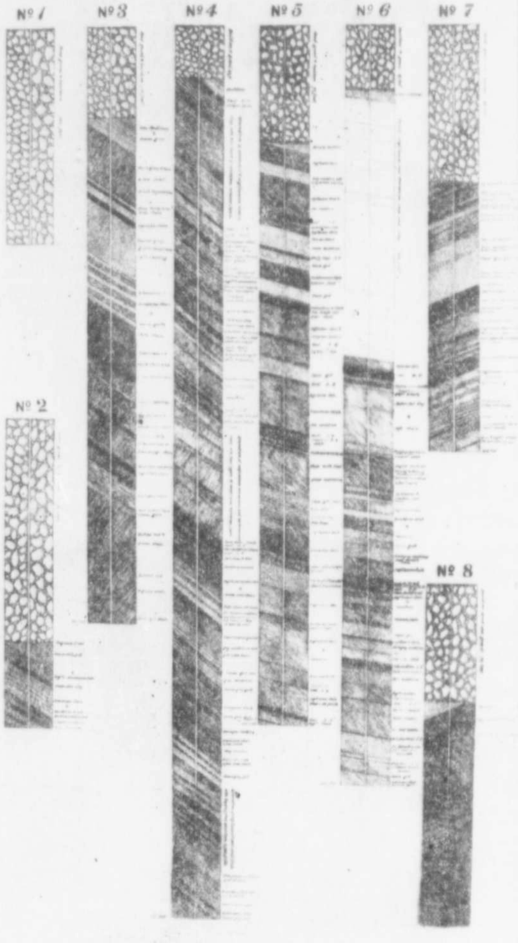




SECTIONS OF BORE HOLES

NEAR THE GOOSE BROOK

1908 & 1909



SCALE 10 FEET TO ONE

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three thousand feet of the contract is completed I fully expect several more will be added to the above number.

While few of those seams may be considered at the present time of workable dimensions, yet a time will come when any seam over one foot in thickness, providing the quality be good and the facilities for extracting the coal prove favourable, will be availed of.

In this connection I may mention that they are at present working coal seams in New Brunswick which only average eighteen inches in thickness. During the years 1900-2, these mines produced respectively, 10,000, 17,630, and 18,795 tons of coal. It is calculated that the area occupied by this small coal seam contains 7,563,390 tons. Estimating the Grand Lake coal area in the same manner, thus, sixteen miles in extent by an average width of half a mile, i.e., forty chains, would give total acreage of five thousand, one hundred and twenty, and allowing one thousand, five hundred tons of coal for one foot of thickness per acre, we get as a result for the entire area, 7,680,000, which, multiplied by seventeen feet, the mean average of thickness of all the seams combined, so far discovered in the Grand Lake coal basin, gives a grand total of 130,560,000 tons.

Of course this is altogether an approximation, based upon what is known of this coal field to the present time. Then, again, owing to the smallness and inferior character of many of the seams, it is not probable that more than one-half of this coal can ever be utilized. Even so, we still have the enormous amount of some 65,280,000 tons of coal to rely upon with almost absolute certainty in this central carboniferous area.

I have the honour to be,

Sir,

Your obedient servant,

(Sgd.) JAMES P. HOWLEY.

CHAPTER XXXIV.

Report for 1909.—Coal Boring Operations near Goose Brook.

Geological Survey Office,
St John's, Nfld.,
January 15th, 1910.

HON. S. D. BLANDFORD,
Minister of Agriculture and Mines.

SIR,—During the past season the Coal Boring operations near Goose Brook were continued until the end of October, when the 3,000 feet contracted for by Mr. J. W. Randall of White Plains, New York, were completed.

Altogether six holes were put down, one of which had been commenced the previous year. These six are situated along the right bank of Goose Brook, and together with two other holes bored in 1908, form one continuous line of section across the coal measures at this particular point of their distribution All the other holes previously drilled are without this section, and have already been fully reported upon.

The eight holes along the course of the Brook are numbered in consecutive order on the accompanying plan, and the details of each are given in the side column.

Assuming the strike of the measures to be the same as was ascertained some years ago, and the inclination of the strata to be in a northerly direction, or to be more exact, N. 10° W. magnetic, a line drawn on this bearing would intersect the trough at right angles. The relative distances between the bore holes along such a line are as follows:—

DISTANCES APART OF THE BORE HOLES.

	Feet
From 1 to 2	618
From 2 to 3	654
From 3 to 4	478
From 4 to 5	898
From 5 to 6	685
From 6 to 7	1764
From 7 to 8	1584
Total distances	6681

Allowing for the presence of some lower and unproductive measures at either end of this section, the trough here is fully 6,000 feet wide.

When the contractor arrived in the early part of May last, he was directed to commence operations by putting down two holes, one to the south of the railway track, the other about midway between Nos. 3 and 4 of the preceding year, also to continue No. 5 and obtain a core from it for inspection. This latter hole had been drilled to a depth of 200 feet with the Keystone machine, but as the indications up to that point were not of a very promising nature the Calyx Drill was not put on, consequently, no core had been obtained. I was now desirous of ascertaining the true character of the strata passed through, which could not be satisfactorily determined from the Keystone wash.

On my arrival on the ground, in the latter part of June, I found No. 1 hole down 110 feet, but there was no sign of the bed-rock as yet. This hole was continuel to 130 feet, through sand, gravel and large boulders, which became more and more difficult to penetrate as depth was attained. There being still no indication of the underlying rock, it was deemed useless to try and sink it further, and it was therefore abandoned. The second hole had reached a depth of 360 feet, when the drill rods became jammed, and the work had to be stopped until two powerful hydraulic jacks were obtained from New York, there being nothing in the equipment capable of starting them. On examining the cores taken from this hole, I became satisfied, that they indicated about the base of the true Coal Measures, if not a stage lower, and as the prospect of striking coal at a lower depth did not seem promising, it was therefore concluded to abandon this also, particularly as there was great danger of breaking or losing the drill rods.

A new hole was now started between Nos. 4 and 5 of last year, and the Calyx Drill put on No. 5. Both these holes were drilled to depths of 421.6 and 457 feet respectively. Later on two other holes were bored, further down the river, one to a depth of 256, and the other to a depth of 206.6 feet. This made a total of 1,631 feet for the season, which with 1,370 feet bored in 1908, or 3,001 altogether, completed the amount contracted for.

In four of these holes coal was struck at several different depths, as can be seen by reference to the plan. The seams vary in thickness from a few inches up to six feet, but the character of the larger seams is not as a rule very good, owing to an admixture with carbonaceous shale, though the quality of the coal itself is excellent.

The details of each individual bore hole in the section are as follows:—

NO. 1 HOLE (South of Track.)

	FT.	IN.
Sand, Gravel and Boulders	130	0
Total	130	0

NO. 2 HOLE (Bored in 1908.)

	FT.	IN.
Sand, Gravel and Boulders	136	0
Coarse White Sandstone, Argillo-Arenaceous Shale, Indurated Clay, Arenaceous Shale and Sand Stone, (broken and slicken-sided)	52	0
Total	188	0

NO. 3 HOLE.

	STRATA	
	FT.	IN.
Sand, Gravel and Boulders	55	0
Very Hard Sandstone or Quartzite	13	0
Dark Argillaceous Shale (a few fossil plants)	32	0
Dark Sandstone	2	0
Slate and Shale	2	0
Dark Sandstone	5	0
Slate and Carbonaceous Shale	3	0
Coarse Grits and Sandstone	32	0
Slate and Carbonaceous Shale	27	0
Coarse Grit	2	0
Slate and Carbonaceous Shale	5	0
Arenaceous and Carbonaceous Shale, and fine Sandstone	38	0
Sandstone	2	0
Slate and Arenaceous Shale	7	0
Coarse Grit	15	0
Argil. and Arenaceous Shale alternating	16	0
Dark, Hard Sandstone	1	0
Argillaceous Shale	13	0
Carbonaceous Shale	12	0
Dark, Mottled Red and Green Arenaceous Shale	2	0

Dark Green Coarse Grit	3	0
Mottled Green and Red Arenaceous Shale	24	0
Reddish Arenaceous and Agrillaceous Shale	33	0
Greenish Arenaceous Shale	16	0
Total	360	0

NO. 4 HOLE (Bored in 1908.)

	STRATA		COAL	
	FT.	IN.	FT.	IN.
Boulders and Gravel	19	0		
Sand and Clay with loose Coal	13	0		
Coal			2	6
Carbonaceous Shale	2	0		
Clay, Sand and Shale	9	0		
Arenaceous Shale	7	0		
Arenaceous Shale and Clay	58	0		
Coal			1	0
Shale	5	0		
Arenaceous Shale	7	0		
Coal			2	4
Shale	2	8		
Arenaceous Shale	5	0		
Ironstone	2	0		
Carbonaceous Shale	7	0		4
Carbonaceous and Arenaceous Shale	10	0		
Ironstone	3	0		
Carboneaceous Shale	7	0		
Carbonaceous and Arenaceous	10	0		
Argillaceous and Carbonaceous Shale	4	3		
Coal			0	4
Arenaceous Shale	4	5		
Clay and Ironstone	13	0		
Clay, Shale and Ironstone	10	0		
Ironstone and Shale	8	0		
Coal			1	0
Carbonaceous Shale	8	0		
Carbonaceous Shale and Ironstone	2	6		
Arenaceous and Carbonaceous Shale	67	6		
Carbonaceous Shale	3	0		
Coal			0	6
Shale	4	0		
Coal			1	6
Shale	1	6		
Clay	1	6		

Carbonaceous Shale with coal streaks	3	9		
Carbonaceous Shale with coal streaks	15	3		
Arenaceous Shale and Sandstone	5	0		
Sandstone and Shale	15	0		
Argillaceous Shale	5	0		
Arenaceous Shale	10	0		
Arenaceous Shale and fine Sandstone	25	0		
Arenaceous Shale and Carbonaceous Shale	46	0		
Arenaceous Shale and Carbonaceous Shale and Sandstone	54	0		
Sandstone with thin coal streak	2	0		
Arenaceous Shale	5	6		
Dark Sandstone	9	6		
Arenaceous and Carbonaceous Shale	10	0		
Coarse Grit	6	6		
Black Carbonaceous Shale	3	0		
Black Carbonaceous Shale and Sandstone	10	0		
Coarse Gray Grit	4	0		
Strata	531	4	9	2
Coal	9	2		
Total	540	6		

NO. 5 HOLE.

	STRATA FT.	STRATA IN.	COAL FT.	COAL IN.
Boulders, Gravel and Sand	71	0		
Hard Grey Sandstone	3	0		
Argillaceous Shale	11	0		
Sandstone (with Fossil Trees and Leaf impressions)	7	0		
Argillaceous Shale	6	6		
Argillaceous and Arenaceous Shale	15	6		
Coal and Carbonaceous Shale (mixed)			1	6
Carbonaceous Shale	3	0		
Argillaceous Shale and Ironstone	4	0		
Fine Grained, Grey Sandstone	4	6		
Coarse Grained, Grey Sandstone	6	6		
Fine Sandstone with coal streaks	3	6		
Coarse Grit	7	0		
Carbonaceous Shale (numerous Fossil Plants	11	0		
Sandstone and Grit	8	0		
Carbonaceous Shale (with coal streaks and Fossil Plants)	11	6		
Argillaceous Shale and Fine Sandstone	12	10		
Coal			0	4

Argillaceous Shale	13	4		
Coarse Grit	10	0		
Coal			0	2
Argillaceous Shale	30	8		
Ironstone and Coal	0	10	0	2
Ironstone and Shale	6	6		
Carbonaceous and Argillaceous Shale (Fossil Plants)	6	0		
Argillaceous and Arenaceous Shale (Fossil Plants)	24	6		
Coarse Grit and Ironstone (Fossil Trees)	16	6		
Argillaceous Shale (with two thin coal layers about two inches each)	3	6	0	4
Argillaceous Shale with Ironstone	3	2		
Argillaceous Shale and Ironstone	21	6		
Coarse Grit	13	6		
Argillaceous Shale	11	6		
Shale and Grit with coal streaks	10	0		
Argillaceous Shale filled with Fossils	5	0		
Argillaceous and Arenaceous Shale and Ironstone	20	0		
Sandstone and Arenaceous Shale (Fossil Plants)	10	0		
Argillaceous Shale	17	0		
Coal			2	6
Argillaceous Shale with coal streak	6	6	0	6
Strata	415	10	5	8
Coal	5	8		
Total	421	6		

NO. 6 HOLE.

This hole was drilled to a depth of 200 feet, through boulders, gravel, sand and shale, last year, without striking any coal. From 200 feet to 457 feet the section is as follows:—

	STRATA		COAL	
	FT.	IN.	FT.	IN.
Bored last year (1908)	200	0		
Argillaceous Shale	6	2		
Coal			4	4
Argillaceous and Arenaceous Shale and Ironstone	7	0		
Argillaceous Shale (numerous Fossils)	12	0		
Clay and Shale	22	0		
Hard Grey Sandstone (Fossil Tree impressions)	4	0		
Carbonaceous and Argillaceous Shale	2	0		
Argillaceous Shale containing Ironstone Nodules ..	6	0		
Argillaceous and Fine Sandstone, etc., (A few				

Fossils)	14	0		
Sandstone and Ironstone (Fossil Trees)	7	0		
Argillaceous Shale	7	0		
Sandstone, Shale and Ironstone	17	0		
Coarse Grit	4	0		
Hard Grey Sandstone (with Fossil Plants and Trees)	8	0		
Argillaceous and Arenaceous Shale	11	0		
Carbonaceous Shale and Coal with Fossils	5	0		
Coal			1	0
Carbonaceous Shale with coal streaks	2	0		
Argillaceous and Arenaceous Shale and Ironstone	8	0		
Argillaceous and Arenaceous Shale and Ironstone, with numerous Fossils	13	0		
Coarse Grit	8	0		
Arenaceous and Argillaceous Shale	1	0		
Hard Sandstone or Quartzite	6	0		
Soft Sandstone	1	0		
Argillaceous Shale and Ironstone	6	0		
Coal and Carbonaceous Shale (mixed)			3	0
Carbonaceous Shale and Ironstone	2	0		
Soft Sandstone	9	0		
Arenaceous and Argillaceous Shale and Ironstone	9	5		
Coal			0	7
Arenaceous and Carbonaceous Shale and Ironstone	7	0		
Arenaceous Shale and Ironstone (Fossil Plants and numerous Plant impressions)	13	0		
Carbonaceous Shale and Coal			1	0
Sandstone and Coarse Grit (Fossil Trees)	11	0		
Arenaceous Shale and Ironstone	11	0		
Shaley Coal			0	6
Coarse Grit	1	0		
Arenaceous Shale (numerous Fossils)	7	0		
Strata	447	7	10	5
Coal	10	5		
Total	457	0		

NO. 7 HOLE.

	STRATA FT.	STRATA IN.	COAL FT.	COAL IN.
Sand, Gravel and Boulders	95	0		
Argillaceous and Carbonaceous Shale (filled with Fossils)	9	0		
Argillaceous Shale	1	0		

Arenaceous Shale and Ironstone	5	0		
Arenaceous and Carbonaceous Shale	4	0		
Hard, White Sandstone (containing fossil tree impressions)	3	0		
Arenaceous Shale and dark Sandstone	14	0		
Soft, light colored sandstone	9	0		
Hard sandstone or Quartzite (carbonized trees)	2	0		
Coarse grey grit, in heavy beds	20	0		
Carbonaceous Shale	1	6		
Coal and Carbonaceous shale (mixed)			6	0
Carbonaceous shale with coal streaks	4	6		
Arenaceous shale and dark sandstone	6	0		
Hard, Grey sandstone or Quartzite	8	0		
Ironstone, clay and shale (mixed)	1	0		
Arenaceous Shale	1	0		
Quartzite or silicious sandstone	2	0		
Argillaceous and Carbonaceous Shale	10	0		
Carbonaceous Shale with coal streaks	9	0		
Argillaceous and Arenaceous shale and Ironstone	17	0		
Carbonaceous Shale (filled with fossil plants) ..	12	0		
Coal			2	0
Carbonaceous Shale (numerous fossil plants) ...	6	0		
Carbonaceous and Arenaceous Shale (with coal)	6	6	0	6
Strata	247	6	8	6
Coal	8	6		
Total	256	0		

NO. 8 HOLE.

	FT.	IN
Boulders, Gravel and sand	70	0
Sandstone	5	0
Argillaceous Shale and Clay	11	0
Argillaceous and Arenaceous greenish shale (a few fossils)	51	0
Mottled, greenish arenaceous shale and sandstone	16	0..
Mottled, red and green shale	53	6
Total	206	6

The result of the boring test has now clearly demonstrated the existence of at least two separate coal troughs in this region. The first is long and narrow, with high angles of inclination, and it is that which extends along close to the foot-hills on the south side of the Humber Valley and shore of the Grand Lake. This trough which for the sake of distinction, I shall call the Aldery Brook and Coal Brook trough, has been frequently referred to in former reports, so that it is unnecessary to repeat what has already been set forth. Where it crosses the Goose Brook it would appear to be cut off by a fault. This is indicated by the deep depression in the underlying rock surface found in No. 1 hole of this season, and in Nos. 2 and 3 of 1908, where the enormous depths of nearly 140 feet of superficial glacial debris occurs. Again where the bed-rock was entered in No. 2 hole, it was found to be much broken and slickensided, affording conclusive evidence that some such disturbance has effected the measures at this particular point.

The general character of the strata as shown by the cores brought up from Nos. 2 and 3 holes, is undoubtedly that of the base of the coal measures or top of the millstone grit formation. No. 4 hole, bored in 1908 shows the beginning of the second or Goose Brook trough, of true coal measures, and Nos. 5, 6 and 7 bring in higher and higher sections of the strata with their contained coal seams. No. 8 the furthest down the river, again exhibits lower rocks similar to those of No. 3 hole, apparently with a reverse dip towards the northward. In all probability these strata roll over in an anti-clinical fold, and are succeeded again between this and Sandy Lake River by other and perhaps more important troughs. At least all the facts seem to point that way, but it is only by the extensive use of the boring rod the question can ever be determined.

The presence of two or three small coal seams near the mouth of Kelvin Brook, and the shore of Grand Lake, was ascertained in 1879, and the quantity of loose coal washed up from the bottom, after a storm, leaves little room for doubt that a trough underlies the extreme eastern end of the Lake which I am inclined to believe will prove to be the largest and most important of the series.

It was long ago prognosticated in some of my former reports that the further we removed from the hill range on the south, the lower would be the angle of inclination of the strata, and as a consequence the coal measures would be found to spread out considerably and occupy larger and larger areas. This has now been fully borne out by the work recently accomplished.

Five new seams have been added to those previously known to occur in this Goose Brook trough, making thirteen (13) altogether. Though few of them are of any great thickness, yet there are some which appears to me might be worked to advantage, especially in view of the success attained in New Brunswick where seams of from 18 to 30 inches only are wrought.

The quality of most of this coal is excellent, and it appears to be very low in sulphur or other baneful ingredients. That it will prove a good household and steam coal may be surmised from its clean bright character. I believe it will produce a good quality of coke for smelting purposes, but I do not expect to find that it will be much of a gas producer, as it appears to approach more the anthracite character than the ordinary run of bituminous coals.

The importance of this coal field, in the future development of the Island, cannot be over estimated, but on account of the abnormally difficult conditions prevailing all over this region the work of successfully prospecting it must necessarily prove slow. Now, however, that the Government are in possession of three first-class machines, with every necessary equipment, the further prosecuting of the work might proceed much more rapidly than heretofore. Sufficient data has certainly been gathered to warrant either the Government or a company of capitalists to enter upon the development of the principal seams known to exist, and I think it would be a great mistake to abandon the boring until the entire area in which coal is likely to be found is fully tested.

In conclusion, I must not omit to mention the honorable and faithful manner in which the contractor, Mr. Randall, carried out the work. The untiring labour and assiduity displayed by him and his assistants under such exceptionally difficult circumstances cannot be too highly spoken of. His long experience in drilling proved him to be thoroughly competent to carry out such an arduous undertaking, which could only be accomplished by sheer hard labour and resourcefulness, while his equipment was up-to-date in every respect.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.

CHAPTER XXXV.

Report for 1909.—The Mineral Resources of Newfoundland.

St. John's, Nfld.,
March 1st, 1909.

Newfoundland is a country that has undergone many vicissitudes during the earlier geological epochs. Its rock structure consists chiefly of the most ancient series comprised within Archaean, Eozoic, and Palaeozoic times, such as the Laurentian, Huronian, or Pre-Cambrian, Cambrian, Silurian, Devonian and Carboniferous. It is consequently one of the oldest countries in the world.

It has passed through the fire, so to speak, and large areas are found to be occupied by igneous, eruptive, and igneo aqueous materials, otherwise highly metamorphosed sediments, indicating prolonged volcanic action at different periods of its structural history.

Still later, during the Post-Pliocene glacial epoch, an immense ice-mantle seems to have enveloped the whole surface of the country, and when, under more congenial conditions of temperature, this ice cap began to give way, its onward movement, descending from the higher elevations towards the sea on every side, acted like a cyclopean ploughshare. It tore up, pushed, or carried along everything that came in its way, scattering broadcast over the surface, in every direction, innumerable granitic and other boulders, grooved striated and polished the underlying rock surface, in a word, planed down the entire face of the country. Evidences of this great denuding agent are abundant all over the country, and it was the effect of this same agency which moulded it into its present contour of smooth, rounded, rolling ridges and low valleys. There are no sharp, serrated peaks, such as are seen in non-glaciated countries, anywhere visible. Here and there only, throughout the interior, a few isolated, truncated bosses of granite or trap, rear their heads above the general level. These are known locally as "Tolts," and would seem to correspond closely with the American "Butte," or South African "Kopje."

In several respects the geological structure of this Island bears a striking resemblance to that of parts of Old England. On its eastern seaboard we have the structure of Wales repeated in the Cambrian deposits. Sediments of almost identical character, holding similar fossil organisms, are found on the shores of all the principal Southern and Eastern bays, even the celebrated Carnarvon slate deposits are repeated here.

Fossils of the Silurian and Carboniferous ages, while closely allied to those of both the Eastern and Western Continents, nevertheless, possess some local peculiarities, which seem to point to a transitionary or intermediate stage, between the two. This would go to bear out the oft repeated expression that, "Newfoundland is the stepping stone between Europe and America." Geographically also, it bears to this continent a relative position strikingly similar to that which Britain holds to Europe.

It would be but reasonable to expect that in a country so composed of the most ancient rock formations, one that has undergone so many changes, a country tossed, heaved, and disrupted in the throes of its birth, and subjected to the roughest usage during its youth, mineral wealth of no mean order should occur. Such has been abundantly proven to be the case; although as yet mining may be almost looked upon as still in the infant stage. What was once considered an indicative of its utter barrenness, turns out, in the light of modern scientific research, in reality, to place Newfoundland in the category of one of Nature's treasure houses.

Almost every known metallic substance has been found in the country, and as it becomes still further explored, there is a strong presumption that the few remaining minerals, not hitherto met with, will be added to the list.

The following brief particulars of our mining industry to date may not be without interest.

Copper.

Copper mining ranks first in point of time, as it did until recently in importance. It may be said, however, to have commenced as reecntly as 1864, when the Union Mine at Tilt Cove was opened. Previous to that date, some desultory mining did take place it is true, but I can find recorded, during the ten years preceding that time, an output of some 628 tons only.

The Tilt Cove Mine, in Notre Dame Bay, has been a constant producer since its inception to the present date. It was followed in 1875 by the opening of the Bett's Head Mine, and in 1878 by that of Little Bay. Several others of less importance, all situated in the same great bay, became small producers at later periods. Other sections of the country have more recently attracted attention owing to their promising copper deposits. The Western Copper Company's Mine at York Harbor, Bay of Islands, though not as yet vigorously worked, seems destined to become a large producer in the near future. Within the past year, a new copper mine has been opened by some English capitalists, at a place called Goose Cove, in Hare Bay, near the northern extremity of the Island, and up to the end of 1908, some 700 tons of ore were raised. It is expected by the spring to have at least 1200 tons ready for shipment.*

Altogether the statistics of our copper mining up to date, give a total output of 1,319,594 tons of ore, 78,015 tons regulus, and 5,418 tons of ingot copper, shipped from all the mines. The percentages of metallic copper contained in these ores have varied considerably, running from 3 or 4 up to 30 per cent. I cannot obtain an average, but taking it at about 10 per cent., the total yield of metallic copper should be in the vicinity of 140,366 tons.

Numerous indications of copper occur all around the coast and on some of the outlying islands, some of which may yet develop into paying properties. Very rich ores of copper glance, tetrahedrite, and erubescite are found in the Huronian series, on the southern parts of the island. One of these, in the immediate vicinity of St. John's City, is just now attracting attention, and a local company is being formed to exploit it. The ore is a very beautiful erubescite, running 58 per cent. in copper. Native copper occurs both in Conception and Placentia Bays in small quantity, and at one place in the latter bay, seems to offer a fair prospect for a pay-

*Still more recently or within the past couple of years some new developments in copper of a most promising character have taken place. One property in the S. W. Arm of Green Bay is now so far developed as to open up a strong lode of ore. It has been sunk upon for over 200 feet and cross sectioning along the lode reveals a large body of ore.—Aug. 1912.

ing proposition. It occurs on an island called Oderin, which is made up chiefly of greenstone and amygdaloidal trap, much of which is impregnated with finely disseminated scales or particles of copper. Some portions of the rock are quite rich in the metal, and at one point, where a break occurs, many lumps of mass copper were found amongst the debris that had tumbled down from the cliffs.

Until quite recently, it was believed that copper deposits, or for that matter, all mineral deposits, were confined to the immediate seaboard, but recently, discoveries have been made by The Newfoundland Development Company (Harmsworth) of lead and zinc, on one side of Red Indian Lake, and copper on the other, showing how fallaceous this idea was. Red Indian Lake is in the very heart of the interior, and as the country becomes more and more opened up, no doubt other valuable finds will be recorded. No prospecting, worthy of the name, has yet taken place beyond a few miles from the coast.

Iron Ores.

In a report prepared for the information of the Imperial Government in 1895, on the occurrence of iron ores in Newfoundland, it was shown that deposits of this mineral of almost every known variety were found here. These include magnetite, hematite, limonite, specular and jaspery iron ores, clay, iron stone, bog iron, ochreous ores, etc. So far none of these have been exploited to any extent, with the exception of the remarkable deposit of hematite on Bell Island, in Conception Bay. Perhaps nowhere in the world is there to be found a deposit paralleling this one. It is altogether of such an unique character, in its extent, and the interesting geological conditions under which it occurs, that a brief description of its principal features may prove of interest.

Great Bell Island is one of a group of three islands situated in Conception Bay, near its south side. It is the largest and lies furthest out from shore; is about six miles long by about two miles wide, having a surface area of twelve square miles. It forms, with the other two islands, the remnant of what was once a great trough of Cambrian rocks, which occupied the entire area of the bay. The former existence of this trough is plainly indicated by the presence of narrow fringes of its basic members, stretching along the shores of the bay on either side. On the south side, a fringe of about one mile wide extends along shore some ten miles, facing the bay and dipping towards the water, while on the north side, on the outer headlands, isolated patches of similar rocks are met with, dipping in the opposite direction, also towards the water. The islands above mentioned form the highest portion of this former trough now visible, but the centre of the trough must still lay out beneath the water, some three or four miles north from the great Bell Island. Numerous typical fossils of the upper Cambrian series are found on this island, the strata which lie pretty flat, have a general inclination towards the north at an angle of 8° or 9°.

It may be readily inferred that the greater portion of this trough has been denuded, chiefly by ice action, the debris being carried out to sea. Ample evidence of this fact is everywhere apparent, by the presence of perched boulders, the rounded and grooved contour of the surface, which is polished and striated in many places, even the ore beds themselves having been subjected to this denuding agency.

Interstratified with the shales and sandstones, composing the structure of the island, there are altogether twelve bands of ore, ranging in thickness from one to ten feet. The two largest bands near the top of the section, are situated on the northern slope of the island, and occupy the segment of an ellipse. So accessible are these beds, and so little capping of rock or debris covers their out crops, that almost every ton of ore they contain can be recovered. The Nova Scotia Steel and Coal Company were the first to operate a mine here. They commenced work in 1895, when they shipped their first cargo of ore. In 1899, they sold out the lower and larger bed to the Dominion Iron and Steel Company, since when the work of mining has been vigorously prosecuted by both companies. Up to the end of last year they had shipped between them 7,000,000 tons of ore, and have still in reserve, on the land area alone, about 25,000,000 tons. Most of the Dominion Company's ore goes to the gigantic smelting establishment of that company in Sydney, Cape Breton, while that of the Nova Scotia Company finds its way to various markets in both Europe and America. The pig iron and steel produced at the Sydney work, is finding favour in all directions. Last summer I saw car loads of steel rails from thence in transit to the upper provinces for the laying down of the new Grand Trunk Pacific Road, and more recently ship loads have been sent to India, for a similar purpose.

Both these companies are the holders of large submarine areas, covering the ore deposit under the bay. That of the N. S. Company comprising 33 square miles, and of the Dominion Company 5½ square miles. In view of the rapid diminution of the ore on the land area of the former company, they have, during the past two years, been driving out under the water, in order to reach their claim, which is situated three-quarters of a mile from the shore, the latter company holding a claim for the first mile contiguous to the shore of the island. Two main parallel drifts, commencing on the land, and following the slope of the ore bands seaward, have now reached well within the company's boundary. In driving this slope the ore has been found to maintain its general character throughout, but to increase both in thickness and quality as the centre of the trough is approached.

I have taken some trouble to make an approximate estimate of the probable quantity of ore this entire trough may contain. By the aid of the dips and strikes of the strata it is possible to form a fair idea of the extent of the trough. Unless some unforeseen disturbances should occur cutting off the ore, or throwing it out altogether, and provided the ore bands maintain their thickness and regular stratified character throughout, a fairly reliable result can be arrived at. According to this mode of figuring then, I find the trough should contain the enormous amount of 3,635,543,360 tons. Of course this estimate takes into account all the ore bands now known to exist on the island.

I shall not hazard any opinion as to the amount that may be recoverable, that I should say will largely depend upon the conditions met with, the engineering skill to cope with any difficulties that may present themselves, and the adequacy of the machinery employed to keep the mine dry and fully ventilate it.

Since the above was published the returns of iron ore shipped from Bell Island are as follows:

1909, 1,004,050 tons, value	$1,104,455
1910, 1,108,108,762 tons, value	1,219,638
1911, 1,171,992 tons, value	1,289,191

CHROMITE.

This is another mineral substance of which the country is known to possess several large deposits. They are chiefly situated at a distance from the seaboard, and as yet only one attempt to mine the ore has been made, near Port a Port Bay, on the West Coast. Between the years 1895 and 1899, some 6,000 tons of a high grade ore were raised and shipped to market. Since then the industry has not been prosecuted, but several new and extensive deposits have been discovered, inland from the same bay, and again on the head waters of the Bay D'Est and Gander Rivers. Analyses of some of these ores has proven them to contain a small percentage of platinum.

PYRITE.

The ordinary iron pyrites (Bisulphuret of iron) is a very abundant mineral, and occurs in association with all the copper ores around Notre Dame Bay. Pyrrhotite and Mispickel are also quite common ores, the former containing a small percentage of nickel, the latter some gold. Only the first mentioned has ever been mined to any extent, chiefly at a place called Pilley's Island in Notre Dame Bay. There were shipped from this mine, between the years 1883 and 1907, both inclusive, 518,280 tons, all of which went to the New York market for the production of Sulphuric Acid. The ore ranged high in sulphur, averaging about 53 per cent.

NICKEL.

Copper Nickel, Cloanthite, and Nickel pyrites were found in association with the Tilt Cove copper deposits and at one time a small quantity was extracted and marketed. Some 320 tons were produced between 1869 and 1876. Small quantities of Cobalt accompanied this Nickel. Possibly, some of the Pyrrhotites may be found to contain paying quantities of Nickel, they are exceedingly like the Sudbury ores in appearance.

ANTIMONY.

A most promising deposit of Stibnite occurs at a place called Moreton's Harbor on New World Island in Notre Dame Bay. Some attempt to mine it took place at one time, several years since, when a few thousand tons were extracted. The ore was a high grade one, but I presume the low prices ruling for this material was the chief cause of the Company's ceasing to operate the mine. At all events, it has been lying undeveloped for several years past.

Lead.

Ores of galena are of frequent occurrence on almost every side of the island, though but little attention has been paid to them of late. There was a time when some considerable activity in lead mining took place, especially at a place called LaManche in Placentia Bay. This mine up to 1893 produced 18,762 tons. At two other places in this same bay, Lawn and Little Placentia, operations were caried on for a short time on similar deposits and considerable ore produced, but there are no returns available.

Manganese.

Extensive deposits of low grade manganese are found along the south side of Conception Bay, in conjunction with the limestone near the base of the Cambrian series. A few attempts have been made to test these deposits, but no regular mining has as yet been entered upon.* Wad or bog manganese is found in many places, but no high-grade Pyroiusite has so far been discovered here.

Amongst other ordinary metallic substances known to occur in the island, I shall merely mention the following: Zinc, Cadmium, Bismuth, Tin, Rutile, Molybdenite, etc. With the exception of the two last named the rest are only found by assay tests of other substances, such as lead and zinc ores.

Precious Metals.

Gold is not mined at the present, per se, yet the country affords ample evidence of being auriferous. Nearly all our copper ores contain a small proportion of the metal, and free gold has been found on every side of the island, usually in quartz veins. Various attempts have been made to exploit these from time to time, but have not so far been attended with much success. During the years 1904-5-6 a mine was operated at a place called Mings, north of Cape St. John, which seemed to afford great promise for a while. The lode was a mixed one, composed of magnetic, pyrite,

*At the present time, June, 1909, a more effectual attempt at mining this ore is being made.

quartz and jaspery slate rock. The first trial assay of 23 tons of this ore yielded 10½ ounces of free gold in addition to which the slimes carried a value of $55.00. A shaft was sunk upon this lode to a depth of something over 100 feet, and a drift run along its course another 100 feet. Assays were made of sample lots of the ore taken from various depths, as this work proceeded, which gave as a result an average value of $12.44 per ton. Two gold bricks, one of 11 and the other 37 ounces were produced, and the prospects began to look very favorable for a time, but from want of sufficient capital or other cause the mine has been closed down. Another attempt to mine gold bearing quartz in a talcose schist, was made at Sop Arm, in White Bay, during the year 1903, when about 150 ounces of gold were obtained. A few other instances of unsuccessful gold mining took place in different sections of the country, but all ended similarly. Nevertheless, I am inclined to believe, had some of these properties been carefully and economically handled, with up-to-date appliances for recovering all the values, they might have developed into paying propositions. Quartz veins are numerous all over the island, but no systematic prospecting for gold by persons well skilled in that particular business has ever taken place.

As already stated, nearly all our copper ores contain some gold. In the case of the ore from the Tilt Cove mine it is known to carry about 1.5 dwts. per ton. This is recovered during the process of treating the ore at the Cape Copper Co.'s works, Breton Ferry. No actual statistics of the amount or value can be obtained, but it is known to have reached in some years, from 3,000 to 5,000 ounces.

Silver.

Silver occurs in combination with both copper and galena in many places. Some of the latter ones are highly argentiferous, and have been known to run as much as 400 ounces in the ton of metal. At Lawn, in Placentia Bay, in mining lead, a pocket or "vugh" was met, containing loose earthy chloride of silver, mixed with which was some native, and ruby silver (proustite). Some of the silver contained in the Tilt Cove copper ore was recovered along with the gold, but there are no statistics.

Coal Deposits.

A great deal has been said and written about our coal deposits, but coming as it did chiefly from persons who knew nothing about the subject, was of course of an unreliable character. It may prove of interest to have a plain statement of the actual facts with regard to this subject from one who has had most to do with the exploration of these coal fields.

There are in Newfoundland three distinct carboniferous areas, one in the Codroy Valley, another in the country lying to the south of Bay St. George, and the third on the upper reaches of the Humber River, in the region extending between Grand and Sandy Lakes. The first named is of very limited extent, being a mere segment of a trough, cut off by a great fault. There are two little patches of about a mile each in longitudinal extent, but the greatest thickness of the true coal measures does not exceed 250 to 300 feet in all. Nevertheless, within these narrow limits there are six seams of coal, all standing in a vertical position. Four of the six are of small dimensions, but the remaining two are quite large. One at its outcrop showed 9½ feet of good clean coal, while the other at one point was 23 feet wide, consisting of layers of coal, shale and clay, and containing 15 feet of fairly good coal. They did not, however, maintain this thickness throughout, but were found to vary considerably, the first had dwindled down to 5 feet, with only 3 feet of coal, while the larger seam, which was uncovered at five different places along its strike, gave an average thickness of 7½ feet. The nine-foot seam was drifted upon for ninety feet, and about 100 tons taken out. Some of this coal was used by the Railway Company on their locomotives, with excellent results as a steam producer. It was found, however, in running the drift, that the seam soon became pinched up to about 3 feet, after which it widened out again to 6½ feet, but at the end of the drift ran chiefly into shale.

The Bay St. George coal area is in the form of a narrow trough situated some eight miles inland from the south shore of the bay. It strikes generally about N. 80° E., S. 80° W., magnetic, being almost parallel with the coast line. The full extent of this trough is not yet known, but it has been traced for about five miles longitudinally. Three brooks, which have cut channels across it, afford the only available sections of the measures. On the most westerly of these, called Middle Barachois, a good section of about two miles in extent is exposed. When this was stripped with pick and shovel, twelve separate coal seams were revealed, on the north side of the trough, most of which were again uncovered on the opposite side also, dipping towards the former. The seams ranged in thickness from a few inches up to over five feet, and the coal in several was of first class quality. On Robinson's River, two miles further east, and on a tributary of the latter, two and a half miles still further east, small exposures of the coal measures are again met with. The Robinson's River section contained three seams, one of which gave a thickness of 4 feet 2 inches of good solid coal, and on the Northern Feeder, four seams were uncovered. Only one of these latter was of any importance. Although but 1 foot 6 inches in thickness this coal was of an exceptionally superior quality, being clean, bright and semi-anthracite in character. It was found to be low in sulphur, burnt with a bright clear flame, in an open grate, and left but a small percentage of ash.

The coal seams so far known to occur in this trough, over one foot in thickness, are as follows:

	Ft.	Ins.	
Murray Seam	5	4	All on the Middle Barachois River
Rocky "	1	5	
Clay "	1	8	
Slaty "	1	4	
18 inch "	1	6	
Jukes "	4	6	
Cleary "	2	2	
Howley "	4	2	. On Robinson's River.
Shears "	1	2	.. On Northern Feeder.

The aggregate thickness of all these seams in this trough is 27 feet, which should they maintain this average throughout, give as a result, for every mile of superficial area they may be found to underlay, 25,920,000 tons of coal.

In the Humber Valley the Carboniferous series spreads over fully five hundred square miles of country, but by far the greater portion of this is occupied by the lower and unproductive members of the series. Here again, the true coal measures are confined to a long, narrow trough, which extends along the south side of Grand Lake some four or five miles, and thence strikes North-Easterly into the flat country, lying between Grand and Sandy Lakes.

This trough has now been traced over eleven miles on its strike, and in all probability it terminates in Sandy Lake, some six or seven miles further on.

The country hereabout is very difficult to explore, owing to the immense accumulation of superficial debris in the shape of sand, gravel and boulders, spread out over the surface in all directions, effectually concealing the structure beneath. Of late years, the Calyx boring drill has been brought into requisition, to test this coal field, and we are gradually acquiring a better knowledge of its extent and possibilities.

What has been ascertained up to the present time is as follows: One small section was uncovered on Aldery Brook, south side of Grand Lake, two miles from its head. Here the trough is very narrow, and lies close up against the Laurentian Hill range. It does not exceed altogether, a quarter of a mile in width, yet it contains thirty outcrops of coal, all crowded together, in a nearly vertical position. Owing to the doubling up of the strata these outcrops, in reality, only represent fifteen distinct seams. They vary from a few inches up to six-and-a-half feet in thickness. The largest seam was drifted upon for 150 feet, and a good deal of coal of excellent quality taken out. Several of the other seams also were partly opened up, and some good coal extracted from them.

Six seams in this section exhibited at their outcrop the following dimensions:

	Ft.	Ins.
One seam	2	0
"	1	6
"	1	8
"	6	6
"	3	0
"	2	6
	17	2

One-and-a-half miles further east on Coal Brook, eighteen outcrops were observed, representing nine separate seams. Here the trough begins to widen out somewhat and the angle of inclination of the bedding assumes a dip of 50° or less. Six of the above seams were of the following dimensions:

	Ft.	Ins.
One seam	1	4
"	3	5*
"	1	0
"	1	6
"	2	4
"	1	0

On Kelvin Brook, two-and-a-half miles still further east along the strike, a small section only, on the south side of the trough, exhibited six seams, three of which showed:

	Ft.	Ins.
One seam	3	8
"	2	6
"	6	2

Three and three-quarter miles eastward, where the railway crosses the trough, near Goose Brook, three seams were discovered by sinking pits through the gravel and sand. These were all on the south side of the trough, dipping nearly north, at a much lower angle, indicating a considerable widening out of the measures. Owing to the utter impossibility of accomplishing any further effective work here with pick and shovel, recourse was next had to the boring rod. During the past few years ten holes were put down at short intervals apart, which resulted in finding several new seams. Seventeen seams were bored through during the past two years, which, with the three previously mentioned, make twenty altogether so far discovered in this Goose Brook section. As in the other cases, they vary considerably, running from a few inches up to something over three feet. Nine of them ranged from one foot upwards, thus:

*The Reid N.F.R.R. Company mined this seam for a while and extracted therefrom about 7,000 tons, all used on locomotives.

	Ft.	Ins.
One seam	2	6
"	3	4*
"	1	6
"	3	0
"	2	6
"	1	0
" "	2	4
"	1	0
"	1	6

Much still remains to be accomplished before the full extent and importance of this promising coal field is thoroughly worked out. But enough is known to warrant the assumption that here we have a possible asset of great future value to this country. I would not at present attempt even an approximate estimate of the amount of available coal within this area, but have no hesitation in pronouncing the opinion that it must mount into many millions of tons.

I append a few assays of these coals made several years ago which will give some idea of their composition:

From Bay St. George.

	Cleary Seam	Jukes Seam.	Howley Seam	Shears Seam
Moisture	3.548	3.036	2.784	4.90
Volatile matter.	30.897	30.344	29.784	33.12
Fixed carbon...	55.229	60.142	54.468	not given
Sulphur...........	3.946	1.963	3.047	0.44
Ash	6.380	4.515	10.430	316
	100.000	100.000	100.000	Coke 61.371†

*This seam was also mined to some extent by the Messrs. Reid and a few thousand tons taken out.

†The evaporative power of this coal expressed in pounds of water evaporated by one lb. of coal at 212 F. was 12,371, which considerably exceeds that of North Sydney, or the best Scotch, Welsh or English coals.

FROM ALDERY BROOK, GRAND LAKE.

	No. 2.	No. 6.	No. 7.	No. 9.	No. 15.	No. 16.	No. 17.	No. 20.
Moisture	10.22	5.80	10.77	13.71	15.78	5.82	4.32	7.41
Volatile Matter......	24.39	31.44	16.55	26.83	30.30	33.62	16.84	30.73
Fixed Carbon	48.51	57.86	33.89	51.06	45.29	55.28	72.66	52.49
Ash	15.72	4.08	37.86	7.56	8.08	4.49	5.53	7.71
Sulphur..	1.16	.82	.93	.84	.55	.79	.85	.66
	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Coke in closed vessel	65.39	62.76	72.68	59.56	33.92	60.56	78.84	61.86

Specimens from the principal seams on Coal and Kelvin Brooks gave the following results:

	FROM COAL BROOK.		FROM KELVIN BROOK
	No. 3.	No. 4.	No. 1.
Moisture	9.93	5.02	8.44
Volatile Matter	24.01	31.25	28.54
Fixed Carbon	49.15	54.03	50.07
Ash	16.14	8.66	11.53
Sulphur	.77	1.04	1.42
	100.000	100.000	100.000
Coke in closed vessel.	66.06	63.73	63.92

I shall merely mention the occurrence of other non-metallic substances of value, few of which have received any attention up to the present time, while others have been exploited in a small way only. These comprise Asbestos, Baryte, Feldspar, Garnet, Graphite, Grindstones, Gypsum, Hone stones, Infusorial earths, Kaolin Lithographic stone, Mica, Petroleum, Salt, Talc, Steatite, &c.

In 1902-3-4, there were shipped some 6,615 tons of Barytes, and in 1904-5, 6,000 tons Talc. In 1904 the Parson's Pond Oil Fields produced 700 brls. Petroleum, but a much larger quantity has been pumped from the wells since then, of which there is no record. Last year several hundred barrels were utilized at the Gas Works in St. John's to enrich the gas production of the coal used, with, I understand, most favorable results.

The Slate of this country is of superior quality, and has been pronounced fully equal to that of Carnarvonshire, Wales, by those competent to judge. It fetches in the English markets the highest price of any imported slate. It is an abundant material, and is found in large deposits on both the eastern and western sides of the island. Quite a lot of excellent slate has been produced from the quarries in Trinity Bay during a number of years past. Recently a new quarry has been opened on the Humber Arm, Bay of Islands, and the slate therefrom is, if anything, superior to that of Trinity Bay. So far no attempt has been made to utilize this material otherwise than for roofing purposes, but there is no doubt it is equally suitable for any other purpose to which slate is applied. Between the years 1865 and the present date, 153,702 squares of roofing slate have been manufactured at these quarries, a small percentage only being used locally, the remainder all going to the English markets where it found ready sale. Most of this slate is of a dark purple colour, but some of it is reddish, and also some of an unfading pea-green colour. It is said to be the best slate in America.

An infinite variety of building and ornamental stone is found here, such as granites, porphyries, sandstones, free stones, limestones, marbles of many shades of colour, including pure white statuary, serpentines, soapstone, &c.

Pipe clays, brick clays, fire clays, terra cotta clays, china clays, red and yellow ochres, and a variety of other substances likely some day to become of economic importance, go to make up the sum total of the known mineral resources of this, England's oldest colonial possession.

JAMES P. HOWLEY.

CHAPTER XXXVI.

Report upon the Petroliferous Region, Situated on the North-West Coast of Newfoundland.

Geological Survey Office,
St. John's, N. F.,
June 8th, 1909.

HON. SIR E. P. MORRIS, K.C., LL.D., KT.,
Prime Minister.

SIR,—In compliance with your request, I beg to furnish you with the following report upon the Petroliferous district of the West Coast.

Facing the Gulf of St. Lawrence, on the western side of this Island, the coast line from the vicinity of Bonne Bay almost to its northern extremity, Cape Norman, is occupied by a low and comparatively level strip of land, particularly so from about St. Paul's Inlet to Hawkes Bay. About midway between the two latter points, at a place called Shallow Bay, some thirty miles north of Bonne Bay, a large salt-water lagoon, known as Parsons' Pond, occurs. It stretches inland at right angles to the coast eight miles, to the base of the Long Range Mountains, and has a superficial area of about nine square miles. Its shores are low and flat, and at some parts fairly well wooded, especially towards the foot-hills of the mountain range. It is here the claims of the Newfoundland Oil Developing Company are situated: they surround the pond on either side in a strip of about a mile wide, and comprise a total area of some twelve square miles.

During recent years, drilling operations to develop the possibilities of this region for oil have been conducted by the above company, the results of which, to date, will appear further on.

GEOGRAPHICAL STRUCTURE.

Geologically, the rock formation of this strip of country consists of a series of sandstones, shales, and thin-bedded limestones, arranged in a succcession of sharp, narrow folds, repeating the same strata several times, with what is termed an overturn dip. This gives them the appearance of being all inclined in the same direction, towards the mountains. The base of the series, which at Cow Head consists of heavy-bedded, nodular grey limestone, is again seen rising to the surface at the foot of the mountain range, where the strata assume an almost vertical attitude. The entire low-lying tract between the coast and the mountains is underlaid by the softer and less durable sandstones and shale, etc. The whole series appears to be referable to what is known in Canadian geology as the Quebec Group, particularly to the Levis and Sillery divisions thereof, with perhaps some higher members of the Lower Silurian Series. The more shaley portions of the formation are characterized by numerous fossil organisms, chiefly those fine pencil-like markings known as graptolites—a species of zoophyte, or animal plants. A few small lingula also occur, more particularly in the thin limestone bands. Those organisms either grew on the muddy bottom of a shallow sea or floated about loose in the waters, during the period of deposition. The graptolites are so abundant in some of the shales as to constitute a considerable portion of their bulk, and cause them to assume a dark brown carbonaceous appearance. I have been thus particular in describing those fossils, because, I have reason to believe, they were the chief source from whence the petroleum was derived.

The origin of the Hydrocarbons, of which petroleum is perhaps the most important, has been the cause of a great diversity of opinion amongst scientists. Some contend that they were purely of mineral origin; others that they were derived from vegetable or animal substances, or of both combined. The majority incline to the latter opinion, and certainly my own observation in this region seems to point to the same conclusion. At all events, the fact of the petroleum occurring in those rocks so filled with animal-plant remains, such as would appear likely to yield, under decomposition and great pressure, this hydro-carbonaceous substance, is very significant. Whether this conclusion be the correct one or not, it is very noticeable that the darker colored shales containing most fossils, were found to be most bituminous. The thin limestone bands were not destitute of the substance either, but were frequently so impregnated with petroleum as to give off a strong odour when freshly broken, and small drusy cavaties occur here and there in these same rocks, filled with crude petroleum of about the consistency of treacle. The sandstones seemed to be apparently destitute of fossils, and showed little indication of a petroliferous character. Judging from the foregoing, I am led to the conclusion that the shales and limestones are the chief repositories of the substance, and it is from those strata, or set of strata, which exhibit the most highly bituminous character, the best results may be expected.

Hitherto, though oil has been known to occur at many different geological horizons, no productive wells, that I know of, have been located in any formation lower down than the Trenton Limestone, of the Lower Silurian Series. The latter is that from which the large output of oil in the State of Ohio is derived. The other productive fields of North America are the Petrolea and Oil Springs, Enniskillen County, Ontario, situated in the Corniferous Limestone, Devonian Series, of more recent date. The Pennsylvania and New York deposits are derived, partly, from the Devonian and sub-carboniferous series, while in Colorado the oil producer is Cretaceous, and in California of Tertiary age, both being much more recent in point of geological time. Again, in southern Russia, the oil region is situated in formations of comparatively recent deposition.

It might be inferred from the above facts that our Newfoundland deposits were at too low an horizon to expect oil in any quantity, but, says the author of the "Mineral Resources of the United States," "There have been so many surprises in petroleum that any statements made must be regarded as only setting forth the indications as to producing localities at the present time." By this it is plain he does not pretend to say that the present known localities or geological series of formations are the only ones likely to be productive, and that he would be prepared at any time to learn of entirely new and hitherto untried rock formations yielding oil. Being desirous of having further expert opinion on this head, I wrote the late Dr. G. M. Dawson, C.M.G., head of the Geological Survey of Canada, asking what he thought of the prospects for petroleum in available quantity so low down as the Levis Shales. His reply was: "I may say that I cannot see anything against such "occurrence, provided the rocks themselves are not so much altered "as to render it improbable. This would appear to be the case, as "petroleum actually exists in them, and the question of quantity "would become, I suppose, rather a matter of structure and com-"position of the rock series than anything else." In another letter he says: "Assuming that the Levis shales are about equivalent "to the Calciferous formation, and knowing that oil occurs abund-"antly in some parts of the Trenton formation, there can really be "nothing against its occurrence at a couple of stages lower in the "same conformable series, if the physical conditions are suitable." These statements coming from so high an authority have removed, to a considerable extent, any doubts, I may have entertained as to the possible productiveness of this petroliferous region.

With regard to the structure and composition of the series and other physical conditions found to exist here, I find that, though so very far removed, both geographically and geologically, from the California oil region, they bear a very striking resemblance to each other, and, above all, the condition in which the rocks occur, viz., folded into sharp troughs with high angles of inclination, is identical.

History of the Development of Parsons' Pond Oil Field.

The history of the attempts to develop this petroleum region is briefly as follows:

Many years ago a person named Silver had his attention drawn to an oily substance floating on the surface of the water, which seemed to issue from the mud at the bottom of the lake, and which proved, on examination, to be petroleum. Mr. Silver, who was a mill owner, and a man of some means, procured a drilling outfit and had a hole put down near the lake shore, some six miles from its outlet. What the result of this boring was I have never been able to ascertain, but it is certain some oil was struck. The drilling tools were of the most antiquated character, and no doubt very badly handled as well.

About the year 1893 the Newfoundland Oil Company was formed, who secured a lease of a large area of the territory surrounding the lake. They commenced drilling near the site of the old hole, and though oil was obtained, the whole business was so badly conducted, and, as a consequence, so much money wasted, the company were thereby greatly discouraged in their further prosecution of the work. The following year they procured the services of a Mr. Spotiswood, a man of well-established reputation, to visit the place and make an inspection of the property. Mr. Spotiswood's report was of a very favorable character, but he condemned in strong terms the crude methods and out-of-date appliances hitherto used, and gave instructions how the work should be carried on. He was then employed by the company to conduct the further operations himself. He took charge in 1896, and soon made things look more promising. In cleaning out the hole already put down, preparatory to commencing work, he found everything in a very bad state. The piping was broken and telescoped, the drill rods parted, and tools left down in the hole. It took him a great part of the season to withdraw the broken pipes, fish up the tools, and get everything in proper working order. Most unfortunately for the company, poor Spotiswood, who was a delicate man, took sick and had to give up work before the season closed. He entered the hospital in St. John's, where he soon died, without handing in his report.

While the writer was engaged in making a trigonometrical survey of the lake and surrounding country, and a close investigation of its geological features, frequent visits were paid to Mr. Spotiswood and the scene of his operations. We then compared notes and interchanged views as to the various matters which came under our observations. The drilling and its results being Mr. Spotiswood's especial business, I of course did not pay particular attention to it. A sort of professional etiquette, well understood amongst scientists, hindered me from making such minute enquiries into his operations as I otherwise would have done had I anticipated his untimely end. His demise was a great set back to the company, and as there was no one else cognizant of the exact nature of the work performed, I was asked to furnish such particulars as I had gathered from him during my sojourn on the ground, coupled with my own observations. This was given in the form of a short report, which the company published. Since then I have constantly watched with much interest the progress of the development work, and offered suggestions, as requested, from time to time.

The hole put down by Mr. Spotiswood was yielding, at the time I was there, according to his statement, a paying quantity of oil. He pronounced it to be of excellent quality, being a sweet oil, very free from deleterious substances. Before he left the place he commenced another hole nearer the lake shore, but was unable to complete it.

The company now set to work more vigorously to develop their property, and during the subsequent years, up to 1906, several new holes were drilled, all of which showed more or less oil. I understand nine wells have been drilled altogether,—exclusive of that put down by Mr. Silver,—four on one side and five on the other side of the lake. A good deal of mismanagement and want of experience has characterized this work throughout, and some of the best yielding wells have been ruined by neglect or otherwise. They were allowed to lie idle and fill with water for several years. As a consequence, some of them ceased to yield oil, being, to use an oilman's term, "drowned out."

No regular attempt to pump these wells was made till 1904, when proper machinery was installed for that purpose, and a fair test given them. It appears from the superintendent's report of that year that four of the wells on the western side of the pond, after a two months' trial, yielded steadily an aggregate of six (6) barrels daily, while No. 1 well, on the eastern side, during a five months' test, gave a daily average of 4½ barrels. Over seven hundred (700) barrels were pumped in all, some three hundred (300) of which were used as fuel, with good results.

An attempt had been made the year previous to "shoot" one of the wells on the west side with dynamite, but the charge failed to ignite, and remained at the bottom, leaving the hole in too dangerous a condition to be operated; nevertheless, it remained full of oil.

All the petroleum obtained was of superior quality, that from No. 1 well, east side, in particular, being a rich, heavy lubricating oil of a light amber colour, and containing much paraffin, wax, etc. The drillman pronounced this the roughest oil he had ever seen. He used it on his engines, and found it so satisfactory, even in its crude state, that he discarded the use of his other machine oil thereafter. This well also produced a steady yield of gas, all but sufficient to keep the machinery running.

In 1905 No. 2 well, eastern side, was continued down to a depth of 1,090 feet, No. 3 to 70 feet, as a water well only, and No. 4 to a depth of 1,535 feet. This last well began with a natural yield of about six barrels per diem. Four of the wells were now exploded, two on the east side and two on the west side of the pond, with results of a curious, and not altogether satisfactory nature. No. 3, west side, which was giving only 3/4 of a barrel before exploding, increased to 1 1/2 barrels, and later to 6 1/2 barrels. No. 4, same side, which gave 2 barrels the previous year, but had run dry, showed no improvement, and still ceased to produce anything. No. 1, east side, which had yielded 4 1/2 barrels, of such superior character, had become choked by the conversion of its rich heavy oil into wax. This also failed to produce after explosion, while No. 3, east side, yielding 6 barrels before, dropped to 1, and then slowly increased to 1 1/2 barrels. It was now allowed to rest for a few months, when it was again put to pumping, and was found to have improved considerably, giving from 2 1/2 to 3 barrels daily.

The rather discouraging results of this experiment threw a damper upon the company's operations, and since that date little more has been done than to keep the yielding wells to pumping. No new wells have been drilled the last couple of years, and at present a caretaker only is employed to look after the plant.

Much of the oil stored in tanks had been lost, owing to carelessness in construction or otherwise. Some of the tanks became frozen up, and were burst apart, allowing the oil to escape. During the past two years some 800 or 900 barrels of this petroleum were shipped to the Gas Works in this city, to be used in conjunction with coal for enriching the gas supply, and the result has proven very satisfactory. The company has lately been remodelled and its name changed to that of The Newfoundland Oil Developing Company, Limited.

In view of the unfavorable results of the exploding test, it becomes a question as to whether it be advisable to resort to this expedient at all. There may be exceptional cases where the experiment might produce favourable effects, but the strong probability of its proving otherwise should, I imagine, call for the exercise of much caution before resorting to this method. A thorough knowledge of the geological structure, and of the mode of occurrence of the petroleum, appear to me of essential importance in this connection. Perhaps the safest rule to adopt would be not to explode any well which was yielding a remunerative quantity of oil, even though a small one. I look upon a slow, evenly maintained, seepage from the petroliferous strata as indicative of more permanency than a sudden gush of oil at first. Any well yielding five or six barrels per day should certainly not be tampered with so long as it produced anything like that amount. On the other hand, wells which showed little or no oil, or such as may have run dry, might be brought to produce by exploding them.

Those that have ceased to yield after being so treated should not, in my opinion, be utterly abandoned. It is quite possible that by sinking to a greater depth other and lower petroliferous strata may be tapped, and oil again come in. The experiment would be at least worth trying.

From all that has been ascertained it is clear that the experimental work, more particularly in the earlier stages, has been conducted in a very unskilful manner, and that the apparatus used was, for the most part, out-of-date. Yet this is but the history of most of the initial attempts at mining development.

The foregoing applies more particularly to that portion of the region surrounding Parsons' Pond, a small section only of which has as yet been tested by the drill rod. Similar geological conditions are known to be applicable to a large extent of the territory on either side of the pond, and oil may reasonably be expected to occur at many other parts of their distribution. For that matter, indications of petroleum are met with along the whole extent of coast, from the vicinity of Port a Port Bay, for a distance of at least 200 miles northward. Towards the western extremity the strata are so much disturbed and altered by igneous and metamorphic action as to afford little prospect of oil in available quantity occurring. Portions of the petroliferous strata are seen at many points caught up in, or twisted and contorted by the intrusion of trap dykes, etc., yet in every case these sections indicate the presence of petroleum, some of the rocks being saturated with it.

From this it may be inferred that it is the more northerly portion of the coast which affords the greatest promise. The operations in the immediate vicinity of Parsons' Pond have clearly demonstrated the existence of oil in no inconsiderable quantity at that point. Sufficient work has been accomplished there to prove beyond question that the territory is a petroliferous one. No well, so far, sunk has proved entirely destitute of some show of oil, which cannot be said of every oil field. It appears to me only a question of putting down a sufficient number of wells to make it a paying proposition. If the yield during 1904-5 be taken as a criterion to form a basis for calculation, the wells then operated gave a total of 10½ barrels per diem, or an average of over 2 barrels per well, and it is but reasonable to suppose that other wells yet to be sunk will afford at least as good results. Were the property adequately and efficiently developed so as to reach a point where it would yield say 250 barrels daily, this I consider amply sufficient to warrant the erection of a refinery upon the ground, for the treatment of the product before shipping. Its value would be thereby greatly enhanced, as it is well known that most of the profits in oil are derived from the by-products, all of which are lost to the producers when the material is marketed in its raw state.

If the mismanagement and crude methods hitherto so apparent were remedied, and more up-to-date apparatus used in the drilling, I see no reason why, eventually, a prosperous oil industry should not develop in this promising region.

I append a few of the analyses made from time to time which will afford some idea of the character of the product.

Analysis Made at the Chemical Laboratory, Acadia Mines, by William Smail, E. A. Sec., September 1st, 1902.

Specific gravity	150 deg. C. -O. 879
Water and Light Oils	2.44 per cent.
Normal Oils	54.00 " "
Lubricating Oils Tailings, etc.	43.66 " "

Analysis Made for Mr. Spotiswood, by J. T. Donald, Montreal, September, 1894.

Specific gravity	.885 or 28 deg. B.
Water	Traces
Gasolene	None
Naptha	None
Burning Oil	14.50 per cent.
Heavy or Lubricating Oil	82.50 " "
Solid Residuum	3.00 " "
Sulphur	.098 " "

Analysis Made by Boverton Redwood, London, England, February, 1897.

Crude petroleum from Newfoundland—colour: Dark Brown by transmitted light, moderate fluorescence, imparting a characteristic Green colour by reflected light. Odour not unpleasant.

Specific gravity at 60 deg. F ... .O. 842
Flashing point, close test ... .128 deg. F
Cold Test, ceases to flow at ....15 deg. F

Results obtained on fractional distillation (each fraction 1-10th by volume of the crude oil):—

No. of Fraction	Temperature of Distillation	Sp. Gr. at 60 deg. F.
1	365 deg. to 468 deg. F	.770
2	468 deg. " 518 deg. "	.785
3	518 deg. " 572 deg. "	.800
4	572 deg. " 630 deg. "	.814
5	630 deg. " 690 deg. "	.825
6	690 deg. " 766 deg. "	.839
7	766 deg. " 817 deg. "	.852

Fraction six (6) solidified when cooled to 32 deg. F., owing to the crystalization of solid hydrocarbons, and the succeeding fractions were solid at ordinary temperatures from the same cause.

Percentage of commercial products by weight:—

Benzine	Nil
Kerosene—Sp. Gr. .799 Flashing point (close test)..	47.6
Intermediate and heavy lubricating oils with solid hydrocarbons (paraffin)	50.4
Coke	2.0
	100.0

These results conclusively show that the sample may be properly described as a crude petroleum of excellent quality. The yield of Kerosene is sufficiently high, and might readily be increased if desired, by "cracking." In addition, lubricating oils of various grades, and a fair proportion of solid hydrocarbons (paraffin) might be obtained, or if "cracking" were resorted to with the object of increasing the yield of Kerosene, the residue might be employed as a source of gas oil and fuel oil.

(Signed) BOVERTON REDWOOD.

Analysis Made by Irving A. Bachman, Ph.D., Analytical and Consulting Chemist, Allentown, P.A. (from sample of one barrel).

Colour—brown black, with green cast.

Odour—when agitated it is that of naptha mixed with sulphur compounds.

Specific gracity—0,833 at 15 deg. C. On long standing the heaviest oil settles to the bottom in a viscid oil of a brown colour.

CHEMICAL ANALYSIS.

Carbon	84.13 per cent.
Sulphur	1.01 " "
Bromine absorption	9.89 " "
Hyrdogen	13.33 " "
Ash	0.07 " "

Distillation at Atmospheric Pressure.

110 deg. to 150 deg. C. afforded 9.95 pe rcent. oil of .7272 Sp. Gr.
150 deg. to 220 deg. C. afforded 16.81 per cent. oil of .7649 Sp. Gr.
220 deg. to 257 deg. C. afforded 11.05 per cent. oil of .7890 Sp. Gr.
257 deg. to 300 deg. C. afforded 9.09 per cent. oil of .8088 Sp. Gr.
300 deg. to 350 deg. C. afforded 8.51 per cent. oil of .8200 Sp. Gr.

Total	55.41
Residue	43.00

Distillate at

110 deg. to 150 deg. C. afforded oil of .7272 Sp. Gr. yielded .08 per cent. Sulphur.

150 deg. to 220 deg. C. afforded oil of .7649 Sp. Gr. yielded .13 per cent. Sulphur.

220 deg. to 257 deg. C. afforded oil of .7890 Sp. Gr. yielded .22 per cent. Sulphur.

257 deg. to 300 deg. C. afforded oil of .8088 Sp. Gr. yielded .26 per cent. Sulphur.

300 deg. to 350 deg. C. afforded oil of .8200 Sp. Gr. yielded .29 per cent. Sulphur.

The oil of .7272 Sp. Gravity afforded Bromine absorption of .51 per cent.

The oil of .7649 Sp. Gravity afforded Bromine absorption of 1.11 per cent.

The oil of .7890 Sp. Gravity afforded Bromine absorption of 3.29 per cent.

The oil of .8088 Sp. Gravity afforded Bromine absorption of 4.81 per cent.

The oil of .8200 Sp. Gravity afforded Bromine absorption of 9.09 per cent.

The distillation below 220 deg. C. was clear and colourless, but above that temperature, became tinged with yellow.

The analysis resolves itself into the following per centages of commercial products:—

Gasolene, naphtha and benzine	10.00 per cent.
Kerosene	36.00 " "
Lubricating oils	40.00 "

The lubricating oils are of high density, very rich in the higher paraffin compounds, and will give an oil of good body and fine texture.

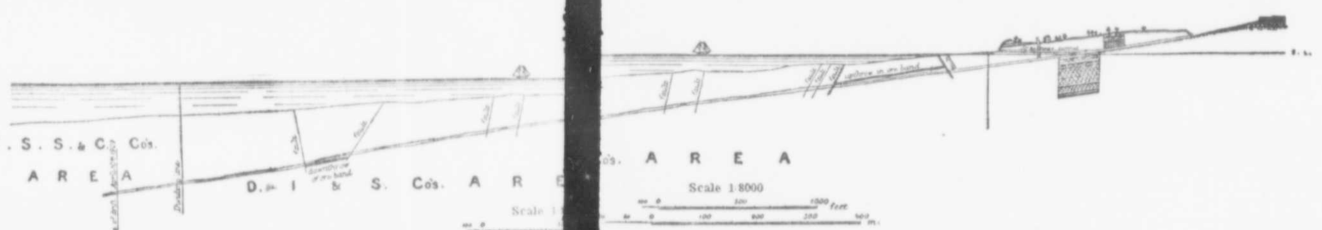
The examination proves the oil to be somewhat different from the average Canadian petroleum in that it is a lighter oil, yielding more light oil. The oil is analogous to the Ohio oil, being heavier than the Pennsylvania oil, and lighter than the Canadian oils.

(Signed) IRVING A. BASHMAN.

I have the honour to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.



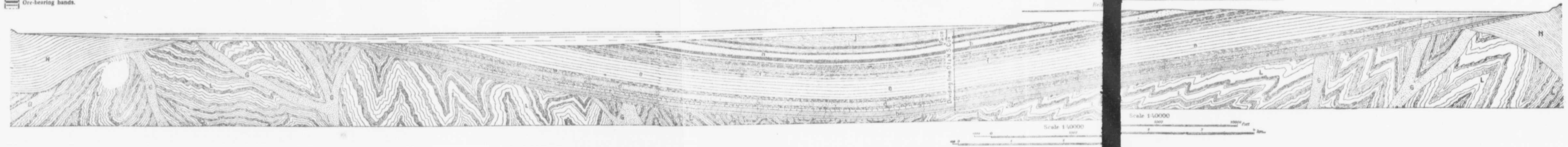
Plan and Vertical Section of No. 2 Slope and Subm...

... Slope and Submarine Workings N. S. S. & C. Co. Ltd. Wabana Mine.

Bell Island.

REFERENCE.

j Supposed alternations of sandstone and shale.
i Shales with thin sandstone layers and iron ore.
h White quartzose sandstone, thick and thin beds.
g Sandstones and shales alternating, bands of iron ore
f Chiefly shale. One band of ore.
e Gray, brown and blackish shale,
d Kelly's Island sandstone.
c Dark grey shales.
b Red and green shales.
a Red and flesh coloured limestone.
H Huronian series.
L Laurentian.
G Granitic intrusions.
Ore-bearing bands.



Trough of the Cambrian Series in Conception Bay, Newfoundland, showing mode of occurrence of the Hematite Iron Deposits.

Prepared by James P. Howley, F. G. S. Director of the Geological Survey of Newfoundland.

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CHAPTER XXXVII.

The Iron Ores of Newfoundland, with Special Reference to the Iron Deposits on Great Bell Island, Conception Bay.

In the year 1895 I furnished a report to His Excellency, Sir Herbert Murray, K.C.B., for transmission to the Colonial Office, on the iron deposits of this Island. The report was published by the Imperial Government.

It will be seen by this report that Newfoundland possesses deposits of almost every known variety of iron ore, but with the exception of Pyrites, no attempt to utilize these had taken place previous to that date. Although the latter was mined chiefly for its sulphur content, to be used in the manufacture of sulphuric acid, yet a good deal of the iron was recovered, and was found well adapted to foundry purposes. The total yield of pyrites up to the end of 1907 was about 518,280 long tons. It averaged about 53 per cent. sulphur and about 35 per cent. metallic iron.

Some 6,000 tons of Chromite was mined and sent to market between the years 1895 and 1899, but whether the iron contained in this ore was utilized or not I am unable to say.

The cupriferous pyrites ores of the country contain between 30 per cent. and 35 per cent. of iron, and I understand that some of this is also recovered at the smelting works, as well as the sulphur. None of the other pyrites ores such as Mispickel, and Pyrrhotite, both of which occur very frequently, have received any attention as yet.

There are immense deposits of titaniferous magnetite on the western part of the island, running as high as 65 per cent. in mettalic iron, and absolutely free from both sulphur and phosphorus, but owing to the presence of from 4 to 16 per cent. of titanic acid, no attempt has been made to mine these. Magnetic iron sand is met with in many parts of the island, as well as along the coast of Labrador, the interior of which is said to contain vast deposits of low grade iron ore. Clay or Kidney ironstone is of frequent occurrence in the Carboniferous series, often in considerable beds, One of these, on *Aldery Brook,* near Grand Lake, measures 35 feet in width. In boring for coal last year in the same region, numerous bands of this argillaceous ore were passed through, ranging from a few inches up to 2 and 3 feet in thickness. No assays of these ores have been made so far as I am aware, but they partake of the general character of those found elsewhere amongst the coal measures.

Specular Iron, Limonite, Ochreous Iron Ore, Bog Iron Ore and Jaspery Iron Ore are of frequent occurrence, and sometimes in considerable deposits. No attention has been paid to any of these latter.

The only real development of our iron deposits calling for special reference is that of the *Wabana Mines* at Great Bell Island, in Conception Bay. This remarkable deposit of red hematite has now become world famed owing to its great extent, high quality, and the unique circumstances under which it occurs. It probably has no exact parallel in the known world.

These mines are now being operated by the Nova Scotia Iron and Steel Company, and by the Dominion Iron and Steel Company of Canada. Work was commenced here by the former in 1895, and in 1899 they sold out part of their claim to the latter. Since then both have been vigorously prosecuting the work of mining, and up to the end of last year had raised and shipped between them some 7,000,000 tons of ore, and it is estimated there are still in reserve on Great Bell Island alone, at least 25,000,000 tons within the claim of both companies. Apart from the deposit on the land, there is an enormous submarine area, of which the Nova Scotia Company hold 33 square miles, and the Dominion Company 5½ square miles.

It may not be out of place here, nor prove altogether uninteresting to give a short description of the geological features surrounding this remarkable ore deposit, which the accompanying plans and sections (Fig. 1, and Plate) wll further illustrate.

Great Bell Island is one of a group of three islands in Conception Bay, lying near its south side. It is the largest and furthest from the shore, and is about six miles long by two wide, having an area of twelve square miles. It forms, along with two other islands (Kelly's Island, and Little Bell Island) the remnant of what was once a great trough of Cambrian rocks, which extended from shore to shore, filling the entire area now occupied by the waters of the bay. The former existence of this trough is indicated by the presence of narrow fringes of the basic members of the series, stretching along the shores of the bay, or as outlying patches resting uncomfortably upon the older Huronian, which forms the headlands on either side. These outlying patches dip in every case towards the waters of the bay. The islands above named occupy the highest portion of this former trough, now visible above water, but the centre of the trough must still lay out in the bay some three or four miles north from the Great Bell Island. Numerous and typical fossils of the Cambrian series characterize these rocks throughout. Its basic members are usually a dull red earthy limestone with red and green shale, holding Hyolithes, Archeocyathus, fragments of Trilobites, etc., which are succeeded by Olenellus and Paradoxides shales, and on the islands, by Fucoidal beds and Lingula flags. The latter fossils are very abundant towards the top of the section. Some geologists consider the forms from the higher strata to resemble Ordovician types, and on that account this portion is represented on the accompanying Geological map (Fig. 2) as the base of the Silurian series. The strata of which the islands are composed consist of alternations of thick and thin bedded sandstones with shaly partings. Toward both the base and top of the section the more shaly strata prevail, and it is in these the ore beds usually occur. There are altogether on the island, interstratified with these shales, some twelve distinct bands of ore, ten of which range from one foot up to fifteen feet in thickness. Only the two large bands towards the top of the section are as yet being mined. The average thickness of these is lower 10 feet, upper 8 feet. Both are situated on the northern side of the island, and occupy the segment of an eclipse, terminating in the cliffs on the same side. So situated are these beds, and so little capping of rock or debris overlays them, that every ton of ore they contain can be recovered without difficulty.

The strata generally lay pretty flat dipping towards the north at an agle of 8°, and the ore beds all pass beneath the waters of the bay, but do not reach the land on the other side. Judging from the normal inclination of the various portions of the series, where visible, the opposite outcrop of the lowest band would come to the surface again some five miles from the north side of the bay.

It is evident that the greater portion of this once extensive trough of Cambrian rocks has been denuded, chiefly by ice action, and the debris carried out to sea. This fact is clearly demonstrated on all sides, by the presence of numerous perched boulders, and the worn, striated, and often polished appearance of the surfaces, where exposed. Even the ore beds themselves exhibit this ice action in a marked degree.

In view of the rapid diminution of the Nova Scotia Company's deposit on their land area, that company during the past two years have been driving out under the bay to reach the submarine areas held by them, and are now well within their nearest block some 3/4 miles from the shore of the island. Two main parallel drifts following the inclination of the ore band, had reached by the end of last year about 4,000 feet. The ore was found to maintain its regular downward slope, and to increase both in thickness and quality, averaging at end of drift 9 feet thick.*

Mr. R. E. Chambers, the capable manager of the Nova Scotia Company's mine, has recently published, in the Canadian Mining Journal (Feb. 15th, 1909) a very interesting paper, giving an account of the development to date, with special reference to this submarine work, accompanied by a section of the drift which, with his permission, I shall make use of.

I have made an appropriate estimate of the probable amount of ore this trough may yet contain, taking into consideration all the beds over one foot in thickness. By the aid of the dip and strike of the strata, where accessible, it is possible to form a fair idea of the extent of the trough, and unless some unforeseen disturbance takes place, whereby the ore may be greatly diminished or thrown out altogether, and provided the bands maintain their thickness, and stratified character, throughout, the result arrived at reaches the enormous total of 3,635,343,360 tons.

I shall not hazard an opinion as to the amount that may be recoverable. That I should say will largely depend upon the conditions met with, the engineering skill to cope with such difficulties as may present themselves, and the adequacy of the machinery employed to keep the mine fully ventilated and free from water.

This ore deposit presents many remarkable features which are not often met with, and a description of which would, I imagine, prove of interest. The two main ore beds on the island lie right on the surface, with but a foot or so of clay and gravel covering them. Many acres of the bands can be laid bare by the removal of this clay. The surface then exposed, is an inclined plane, and presents the appeaarnce of a block pavement, owing to the peculiar jointing of the beds. The cleavage and cross cleavage has broken the ore into oblong, rhomboidal blocks, of various sizes.

As the mining so far has been chiefly open quarry work, when a face is established by cutting a trench down the slope, it is only necessary to put in a line of holes a few feet therefrom, which, when exploded, throw out hundreds of tons at a single discharge. The ore thus loosened falls naturally into blocks of a size easily handled. Should any prove too large or too heavy, a blow from a maul is sufficient to further reduce them to a suitable size. The ore is then shoveled into cars alongside, and by means of an endless wire cable is drawn across the island to the loading piers on the south side. Immense storage pockets capable of holding from 20,000 to 40,000 tons have been excavated out of the natural rock, from whence the ore is conveyed by a system of horizontal scoops attached to a chain, out to the end of the piers, and dumped into the hold of a ship laying alongside. About 1,100 tons per hour can be easily conveyed from the mine to the ship, and by increasing the speed it has reached as high as 1,400 tons. By this arrangement ships carrying 6,000 tons have been loaded in the space of a little over five hours, and vessels of less burthen in from two to three hours.

The bins are always kept full of ore so that on the arrival of a ship no delay occurs, and the quickest possible despatch is given. A human hand need not touch the ore during the whole operation, from the time it is loosened from its beds till it falls into the vessel's hold, being free from rock intermixture, there is no dressing or picking required.

Of course as the underground work progresses the facilities for handling the ore will necessarily change considerably, and the output be at a much reduced rate, but it will be always easy to keep up a ready supply in advance. Long before the surface ore is exhausted the underground workings will be in a position to fully maintain adequate stocks in the storage bins.

The ore has been proved an excellent one for the manufacture of pig iron and steel, being easily reduced with but an ordinary amount of fluxing material. It averages about 54 per cent. metallic iron, and is comparatively free from deleterious substances. Nearly the entire output of the Dominion Company goes to their gigantic smelting establishment at Sydney, C. B., while much of the Nova Scotia Company's is marketed abroad to Philadelphia, Rotterdam and elsewhere. The steel rails produced at the Sydney works are finding favor in many parts of the world. Last summer I saw car loads in transit to Upper Canada for the laying down of the new Grand Trunk Pacific road, and recently ship loads of these rails have been sent to India for similar purposes.

There is another deposit of Hematite on the north side of Conception Bay, amongst the older Huronian series, which is of a much superior quality even to that of Bell Island. In fact, Mr. R. E. Chambers pronounced it an ideal ore for smelting purposes. A few years ago some mining took place here by an English company, but owing to the deposit being found of a pockety nature, and not in a regular well defined lode, the work was abandoned after a short time. Yet much loose ore is found scattered along the surface in the form of float or drift, which has been traced for many miles. Possibly, a more careful investigation of this area may yet reveal larger deposits of economic importance in the locality.

According to the schedule laid down in your circular letter, I would include in group A all the ore still remaining on Great Bell Island, amounting according to my calculation, to at least 112,816,-940 tons. In group B, the ore contained in the submarine areas under Conception Bay, being approximately about 3,522,526,420 tons. In group C, all the other deposits mentioned, and of which no reliable estimate can be formed, though certainly running into many hundreds of millions of tons.

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*Since the above was written the lower bed has developed a thickness of over 24 feet.

CHAPTER XXXVII.

Report to Imperial Government on the Mineral Resources of Newfoundland.

No. 1.

SIR H. MURRAY TO MR. CHAMBERLAIN.
(Received January 13, 1896.)

Government House,
St. John's, Newfoundland.
December 27, 1895.

SIR,—With reference to a conversation I had with you before I left England on the subject of the mineral resources of this Island, and with reference to the instructions which you then gave me on the subject, I now forward a report from Mr. Howley, the head of the Geological Survey of the Island, on the mineral formation of Bell Island in Conception Bay.

2. I also forward plans of the Island in illustration of the report; and some specimens of the ore picked up by chance are also forwarded.

3. It will be seen by the report that part of the minerals of the Island have been leased to a Canadian company; the portion under lease to them is marked in the plan by the dotted black lines; but the minerals in the western portion of the Island are still unlet: they are, I understand, in the hands of about four individuals.

4. In working the minerals on this Island there seem to be two main advantages:—

1. The ease with which the ore is obtained, it being close to the surface; the bed which the Canadian company is now working is so, and I am informed that in bed No. 1 the ore is less than two feet from the surface.
2. The proximity of the beds of ore to deep water. The Canadian company have constructed the necessary works to enable them to ship the ore in the manner described in the report at what is marked on the plan as the "Loading Pier"; but equal facilities are said to

exist for the construction of another pier at Lance Cove, and a pier built there would be rather more sheltered than the one at "Loading Pier," partly owing to the lie of the Island itself and partly owing to the protection given by the two small adjacent islands.

5. I do not know whether the ease with which the ore can be obtained and shipped would compensate for the cost of freight across the Atlantic so as to enable it to compete with the Spanish and other ores in European markets, but I forward the report in the hope that you may think it worth while to draw the attention of the Crown Agents to the facts in connection with these minerals, so that they may be brought to the knowledge of London capitalists.

6. In expressing this hope I am aware, though I regret it, that owing to the ease with which the ore can be obtained the working of the mine will not lead to the employment of any large amount of labour, employment which it is so desirable to obtain for this Colony; the mine now being worked by the Canadian company hardly employs the spare labour already existing on the island, but if it is worked by an English company that company may gradually extend its operations to other minerals in the Colony.

7. Any exports of ore from this Colony are at present handicapped with the duty which it has to meet on its importation into Canada, and I think also into the States.

8. Any communication on the subject of the mines which are in the market in Bell Island might be addressed to the Rev. Father McGrath, Manuels, Newfoundland.

I am, &c.,

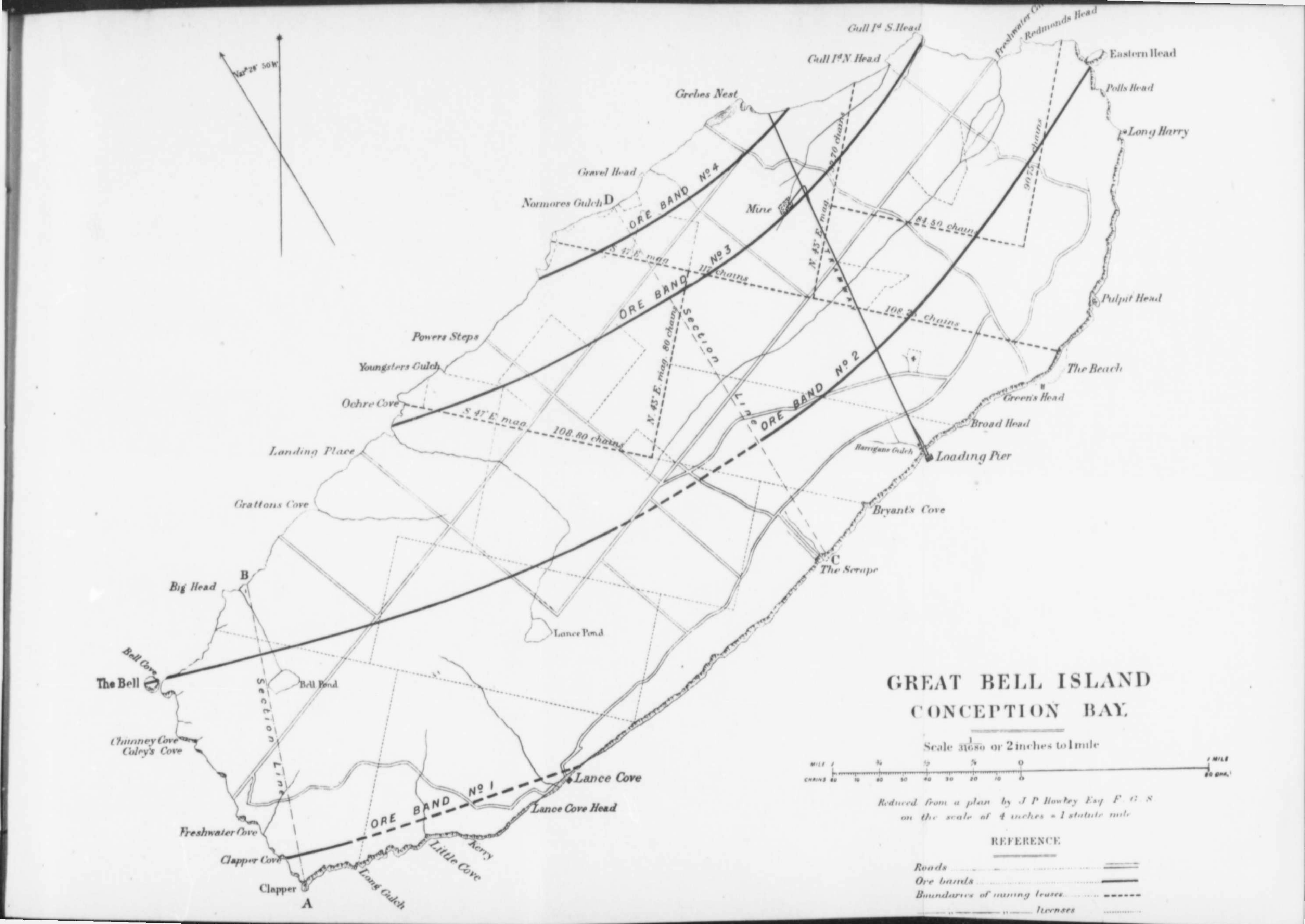
H. MURRAY.

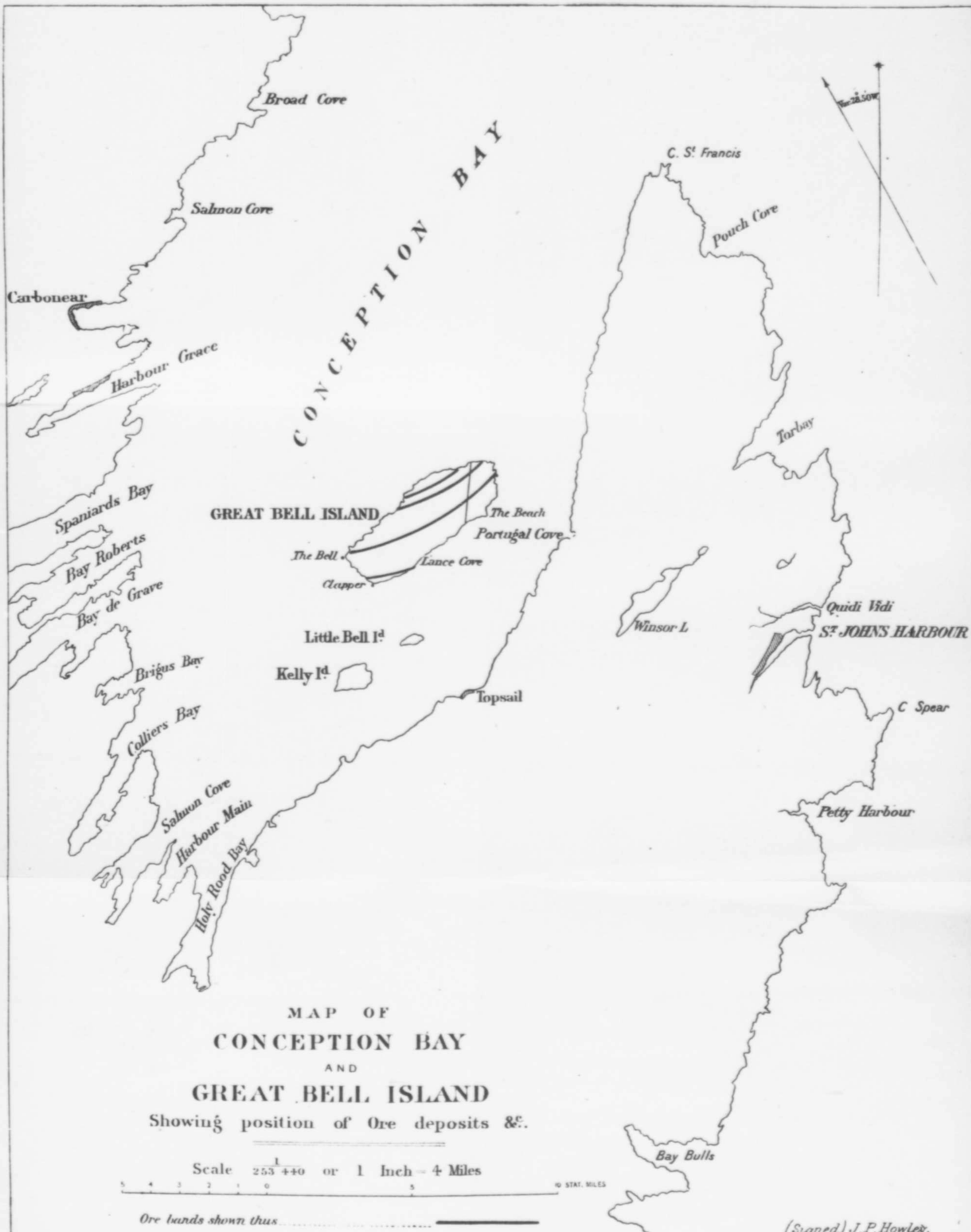
Enclosure 1 in No. 1.

Geological Survey of Newfoundland,

St. John's, Newfoundland,
December 12, 1895.

SIR,—Your request for a special report upon the mineral characteristics, &c. of Bell Island in Conception Bay, necessitated a visit to that locality, and several days' close investigation of its


GREAT BELL ISLAND
CONCEPTION BAY.
Scale 1/31680 or 2 inches to 1 mile
Reduced from a plan by J. P. Howley Esq. F. G. S.
on the scale of 4 inches = 1 statute mile
REFERENCE
Roads
Ore bands
Boundaries of mining leases
licenses
Gull Id. S. Head
Gull Id. N. Head
Redmonds Head
Eastern Head
Polls Head
Long Harry
Grebes Nest
Gravel Head
Normores Gulch
D
Mine
ORE BAND No. 4
ORE BAND No. 3
ORE BAND No. 2
ORE BAND No. 1
84.50 chains
117 chains
108.30 chains
108.80 chains
S. 47° E. mag.
N. 43° E. mag. 80 chains
Section Line
Pulpit Head
The Beach
Green's Head
Broad Head
Loading Pier
Harrigans Gulch
Powers Steps
Youngsters Gulch
Ochre Cove
Landing Place
Grattons Cove
Bryant's Cove
C
The Scrape
Big Head
B
Lance Pond
Bell Cove
The Bell
Bell Pond
Chimney Cove
Coley's Cove
Lance Cove
Lance Cove Head
Freshwater Cove
Clapper Cove
Clapper
A
Long Gulch
Little Cove
Kerry

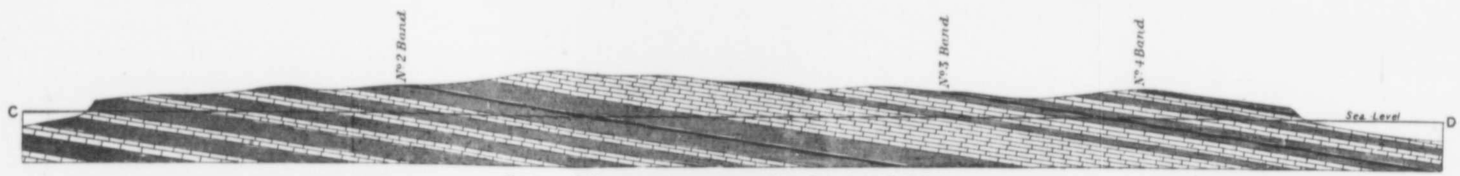


I. D. W. O. Nº 1185 (a)

Lithd at the Intell. Div. War Office, July 1896

SECTIONS ACROSS GREAT BELL ISLAND FROM SOUTH TO NORTH

SECTION A.B. SHOWING POSITION OF ORE BANDS Nº 1 & 2



SECTION C D SHOWING POSITION OF ORE BANDS Nº 2 3 & 4

Horizontal Scale 1 inch to 866 feet.

Vertical Scale 1 inch to 1000 feet.

I.D.W.O. Nº 1185 N

Lithᵈ at the Intell. Div. War Office, July 1896.

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structure. It is now over twenty-five years since an examination of the island was made, long before its iron deposits were considered to be of commercial value, although their existence was known as far back as the beginning of this century. Anspach in his history, published in 1819, mentions the fact of "an iron mine occurring at Back Cove, Bell Island."

The following report of the results of the recent examination will, I hope, meet the approval of the Government.

Great Bell Island forms the largest and most easterly of the group of three, viz.:—Great and Little Bell Islands and Kelly's Island, which occupy a position in the Bay of from three to five miles off its southern shore. It is of an oblong form, six miles long by an average of two miles wide, thus giving a total superficial area of twelve square miles. The shores of the island are for the most part very abrupt, presenting mural cliffs all round, except at two points on the southern side of the island, Bell Island beach, and Lance Cove, where the principal settlements are located. The cliffs range from 100 to 300 feet in height, and the highest elevation on the island, inland, reaches 495 feet. The contour of the surface is comparatively level or rolling, consisting of low rounded parallel ridges with valleys between. They tend generally obliquely across the island, in an east by north and west by south direction, magnetic. Though much of the surface of the island is cultivated, there is still a large proportion unoccupied, and covered with wood or swamp. Much of the original forest is denuded, but a very vigorous growth of young fir is rapidly replacing it.

Not till within the past few years did its ore deposits attract the attention of capitalists from outside. The holders of licenses to search for minerals were fortunate in leasing their claims to the Nova Scotia Steel Co., Limited, who have just entered upon mining operations on an extensive scale. To the obliging manager of the mine, Mr. Chambers, I am indebted for much valuable information and assitance in carrying out my recent investigation. His plans and sections, showing the extent and position of the ore deposits on their claims, were admirable examples of geological work, and were so clear and explicit in their details as to leave nothing to be desired. I had an opportunity of verifying all this work during my stay. In fact, it formed a groundwork for the study of the structure of the whole island, and thereby saved me much time and labour.

Geologically, the island is composed of a series of shales and sandstones alternating. The shales prevail towards the base and top of the section, while the central portion of the island is occupied by a wide belt of hard white-weathering sandstone or quartzite rock, which cleaves into beautiful blocks and flags, suitable for building or paving purposes. The prevailing angle of inclination of the strata is about 8°, the general direction being N. 28° W. magnetic. The strike however, is not quite straight, but forms a segment of a circle with a gentle curve northward at either end. Here the dips change somewhat, pointing more to the east and west.

The lowest strata forming the base of the section crop out on the extreme south-western end of the island, while the highest occupy a strip of the shore on the north side, near the north-east corner. The total thickness amounts to about 2,340 feet. The first 1,000 feet consists chiefly of shaly strata with thin irregular layers of sandstone interstratified, which become more and more numerous, and of thicker dimensions towards the top. These are succeeded by the white-weathering sandstone or quartzite mentioned above, as striking through the central portion of the island. It attains a thickness of about 700 feet. The quartzite is in turn overlaid by sandstones and shales in about equal proportions, constituting the remainder of the section, and is about 640 feet thick. These rocks hold numerous fossil organisms, all referable to the Upper Cambrian series of Wales. The Lingula flags are well represented. Mr. Matthew, of New Brunswick, to whom a set of fossils from this island was sent for identification, is even inclined toregard some of the higher strata as Ordovician, Lower Silurian.

With regard to the deposits of iron, there are four well-defined beds of ore, regularly stratified, forming part of the general section, and therefore distinct form lodes or veins as generally understood. Two of these occur in the lower shaly portion, and two in the upper, being separated from each other by several hundred feet of strata. The lowest ore bed crops out in the cliff at Clapper Cove, near the S. W. end of the island; where, however, it could not be reached for examination and measurement. It would appear to be about two feet thick. Its strike would carry it across the S. W. corner of the island towards Lance Cove, but it has not been traced out as yet, nor has its eastern outcrop been discovered. In all probability this occurs where the land is low, and the cliffs taper down to the shore of the Cove. Some 730 feet of strata intervene between this and the second ore bed. The latter crops out on the extreme N. W. corner of the island and is seen to cap the Bell Rock, lying off this point about 150 feet or so. Where the outcrop of this band occurs is again inaccessible, the cliffs being exceedingly dangerous to approach. It appeared to be about 4 feet thick. This ore band has been traced on its strike eastward some two miles and a half, by means of trial pits sunk along its outcrop. About a half a mile from the Bell Rock Point, two of these pits, about 500 feet apart, afforded good examples of the dimensions and character of the deposit. One was a surface cutting across the bedding, and was sunk to about 1½ feet. It showed alternate layers of rock and ore. The top layer consisted of one 8-inch and two 6-inch bands of ore, with partings of dark greenish micaceous rock between; while towards the bottom a few thin layers of ore of good quality occur. The next opening was a shaft, sunk vertically to a depth of some 10 or 12 feet, which exhibited the following section downwards:—

	Ft.	In.
Ore on surface	1	6
Rock	0	5
Ore	0	10
Rock	0	10
Ore	0	11
Rock	1	2
Ore	0	3
Rock	0	2½
Ore	0	4
Rock	0	2
Ore	1	9
Rock	0	1
Ore	0	6
Rock	0	4
Ore	0	·3

Rock	0	2
Ore	0	3
Rock	0	3
Total	10	2½
Ore	6	7

This same band was seen to outcrop at the extreme eastern end of the island, where it caps a detached rock mass known as Eastern Head. Here it would appear to be about 2 feet thick. It was traced westward from this point for nearly three miles, leaving about a mile or so, where it passed beneath swampy land, or through dense woods unexplored. There can be no manner of doubt that it continues unbroken through the entire extent of the island, from Bell Rock to the Eastern Head, a total distance of six and a quarter miles. The area occupied by this ore bed should therefore aproximately reach about six and three quarter miles. It will be seen that while there is no doubt about the continuity of the ore-bearing belt, it varies considerably in thickness, as is also the case with all the other bands, but judging from the numerous surface outcrops, and the masses of loose ore turned up here and there in cultivating the soil, I should be inclined to think it averages between three and four feet of good ore throughout.

The third and fourth ore beds are confined to the upper shales, above the quartzite, the former occupying an area of about one and a half square miles, the latter, of a little over a quarter of a square mile. The outcrops of these two bands have been thoroughly traced out by Mr. Chambers and they are all contained within the Company's leases, except a mere corner of the lower band. They are both perfectly parallel to each other, forming a gentle curved line, and are separated by about 150 feet of strata. The lower band, No. 3, ranges in thickness from 4 to 12 feet, averaging about 6 feet 6 inches. The upper band, No. 4, ranges from 3 feet 6 inches to 6 feet 6 inches averaging about 5 feet 6 inches. According to a rough estimate made by Mr. Chambers, the two together are believed to contain about (40,000,000) forty million tons of ore. Several thin irregular layers occur between the two main bands, as well as above the upper and below the lower one, but those are not considered of much economic importance. Most of the associated strata are more or less impregnated with iron, though not sufficiently rich to be considered as ore..

The general character of all these deposits is pretty much the same, though varying somewhat in the percentage of metallic iron they contain. The uppermost, No. 4 band, is the richest, averaging 56 per cent. of metal. No. 3 averages about 50 per cent. But one analysis of No. 2, that I am aware of, has been made, which gave 48 per cent. of metal. No. 1 has not been analysed as yet. They are all a variety of brown hematite ore, of a dull colour, with a somewhat steely lustre on a fresh fracture, and having a peculiar fine granular structure. The bands are all distinctly stratified, conforming in every respect with the associated strata. Fossil shells, Lingula, are abundant on the top of No. 1, and are found more rarely in all the others. The ore partakes of the same cleavage as the sandstone of the section, being, if anything, even more jointed. It breaks out in rhomboidal junks of all sizes, often nearly square, more frequently oblong. It thus affords most unusual facilities for mining, and owing to its lying so near the surface, and being covered only with a thin coating of soil, it can be easily stripped, and the ore bed laid bare for acres in extent. Its jointed cleavage renders blasting unnecessary, except an occasional shot to loosen up the ore. Half a dozen men with mining picks could raise several hundred tons per diem without difficulty. The principal workings at present in operation are situated on No. 4 band, about 1¾ miles north from the loading pier. Here the manager's house, store and engine house are located. A double track tramway connects the mine with the south side of the island, where the pier stands, at a point on the shore called Harrigan's Gulch; just inside Bell Island beach. The cars for transporting the ore are made of iron, and are capable of containing 1¼ tons each. They are manipulated by means of an endless wire rope passed round a drum in the engine-house. A 90 horse-power engine does the work of hauling out the full cars and pulling back the empties. They are secured to the wire rope by iron grips at each end of the car. When a loaded car reaches the pier it is received in a kind of crib, and by means of a lever is upset with ease, the contents falling into one of the bins while the car uprights itself and is passed on to the other track, the engine is so situated that it can be used in other work about the mine, such as raising ore, pumping, &c. when necessary. At the end of the tramway a suspension bridge of over 300 feet, carrying the rails, connects the pier or loading block with the cliff above. This block is situated sufficiently far off to afford ample water for large vessels to lay alongside. It is a very substantial structure of open trestle-work, built of Georgia pitch pine, and well ballasted at the base. It stands about 90 feet above the water-line. It contains ten bins capable of holding 200 tons of ore each, or in all two thousand (2,000) tons. Each bin is fitted with a trap door at the bottom to retain the ore, and from the outside four iron shutes guide it into the hold of a vessel lying alongside the pier. When full of ore, it is calculated a vessel can be loaded in a few hours, as it is merely necessary to raise the traps and allow the ore to slide aboard. The whole plant as it now stands has a capacity of about 200 tons per diem, that is to say, so much ore can be raised, run out, and put aboard ship in that time, but Mr. Chambers informs me that when in full working order and fully equipped with cars, &c., the output can be increased to at least 500 tons. During my visit the first attempt to transport ore took place, and about 200 tons were run out, but some slight hitches occurred which necessitated a few alterations and improvements in the running gear before everything could be expected to work satisfactorily. In order to facilitate operating the tramway telephonic communication between the mine and the loading pier was found to be necessary, and this had just been completed when I left. A vessel is expected in a few days to take the first load of ore to market.

Although not a high-grade ore by any means, the abundance of it so near the surface, with the unusual facilities for raising and shipping, should render it a most valuable property. Its chief value to the present Company, I understand, consists in its ready fusibility, thereby acting as a flux for the less tractable ores of Nova Scotia. Moreover, as these latter ores contain little or no phosphorus, and the former rather more than is necessary, a mixture of the two in the furnace affords about the requisite quantity of this substance in the resultant pig for the production of a good class of steel. The Nova Scotia Steel Company, Limited, of New Glasgow, are but the lessees of the property. They pay a royalty of five cents per ton on all ore raised to the original holders of the grants. These grants are four in number, comprising an area of one square mile each. The remainder of the island is held under licenses to search for minerals by several different parties. The facilities for working and shipping ore from these claims are equally as favourable as those described above. Were it hereafter considered advisable to smelt these ores on the spot, the island is admirably situated for the purpose, and many eligible sites for the erection of such works are available.

In conclusion I may add that I know of no more promising deposits of this class of iron ore in this country, nor do I think there are many in North America more favourably situated in every respect.

I have, &c.,

JAMES P. HOWLEY.

Hon. R. Bond,
H. M. Colonial Secretary.

Enclosure 2 in No. 1.

Extracts from "St. John's Evening Herald" of 27th December 1895.

The success attending mining operations at Bell Isle, and the excellent quality of the product, give ground for the hope that the continuance of work there may result in a large increase in the output, and a consequent augmentation of the prosperity of that flourishing settlement. We learn that every satisfaction is being experienced with the people, who are turning out capital miners, and the island promises to benefit very largely from the discovery of these hematite deposits.

It is rather a pity, in this connexion, that coal cannot be found in such close proximity as to make it possible to establish smelting furnaces and refine the ore right at the pit mouth. This would be a matter of immense importance, and it would exercise no small influence on the Colony's future if the coal areas of the interior could be worked at a figure that would enable the output to be transported to an adjacent point to Bell Isle and sold at a price that would make possible the establishment of blast furnaces there.*

No. 2.

COLONIAL OFFICE TO THE MUSEUM OF PRACTICAL GEOLOGY.

Downing Street, January 24th, 1896.

SIR,—I am directed by Mr. Secretary Chamberlain to transmit to you the accompanying report† which has been received from the Governor of Newfoundland regarding the mineral resources of Bell Island, together with specimens of ore picked up there.

Mr. Chamberlain would be glad if you would favour him with any observations that may occur to you upon this report.

I am, &c.,

JOHN BRAMSTON

No. 3.

SIR H. MURRAY TO MR. CHAMBERLAIN.

(Received January 21, 1896).

Government House,
St. John's, Newfoundland.
January 3, 1896.

SIR,—With reference to my report of the 27th ultimo† respecting the mineral deposits in Bell Island in Conception Bay, I have now the honour to forward a more detailed report, dated the 30th ultimo, from Mr. Howley, the head of the Geological Department in this Colony, on the subject of the deposits of iron ore to be found in this island. I forward it in the hope that you may think it worth while to place it in the hands of the Crown Agents for the Colonies, with a view to the attention of capitalists in the City being drawn to the prospects of mining adventure in this Colony.

I am, &c.,

H. MURRAY.

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*The railway comes along the Coast; I should think within five miles of the Island. H.M.

†No. 1.

Enclosure in No. 3.

Geological Survey Office,
St. John's, Newfoundland,
December 30, 1895.

May it please Your Excellency,—In reporting on the iron deposits of the Island, I may state that hitherto little attention has been given to this class of ores, under the impression that their value, from an economic point of view, was infinitesimal in comparison with copper, lead, and other more valuable minerals. Not till within the last year or so, has any attempt been made to utilize these ores, if I may except the pyrites deposit of Pilley's Island, which has been mined chiefly for its high percentage of sulphur. The ore is chiefly used in the manufacture of sulphuric acid. It however yields a considerable percentage of very excellent pig iron, both for forge and foundry work.

Of this class of iron ores there is a great abundance in many parts of the Island. It ocurs in all the copper mines of Notre Dame Bay, forming considerably more than half the bulk of the deposits. At Tilt Cove, a mass of pyrites, said to be about 200 feet thick, and containing about two or three per cent. of copper, has been worked for some time. Another enormous mass of similar ore occurs at the Terra Nova Mine, Baie Verte, which has been abandoned for a number of years. It was worked as a copper mine only, but the percentage of that metal was found to be too low to render it a paying speculation. Another large deposit of pyrites occurs in Port au Port Bay, West Coast. It has not been operated, but gives promise of being fully equal to that of Pilley's Island. Pyrites occur in very many localities and in almost every one of our great bays in more or less quantity. Magnetic Pyrites, Pyrrhotite, is also a pretty abundant ore, especially in association with the copper deposits, and chloritic slates and serpentines. It has been found, on analysis, almost invariably to contain a small percentage of nickel, and in this respect might well be worthy the attention of capitalists. It is from a similar class of ore in the Sudbury District of Lake Huron, Canada, that so much nickel is now derived. Arsenical Pyrites, or Mispickel, is rather a common mineral also, but not in any such proportion as the preceding.

With regard to the more generally useful ores of iron the island possesses the following: Magnetite, Chromite, Hematite of several varieties, such as Specular iron, Red Hematite, Red Ochre, Jaspery iron ore, and clay ironstone. Bog iron is not infrequent in some parts of the interior.

The deposits of magnetite are sometimes enormous. One band at Union Mine, Tilt Cove, ranges from 4 to 30 feet in thickness and is of a very superior quality. Another large body of this ore occurs at Mings Bight. It is also found in many other localities, both on the coast line and in the interior, but the most extensive deposits known are found on the west coast near the Bay of St. George. One enormous mass of this ore has been located about three miles inland from the head of this bay. It is over fifty feet thick, and is seen cropping out on both sides of a ravine running up the steep sides 700 feet or more. Millions of tons of loose ore in huge blocks, which have become detached from the mass, encumber the bottom of the ravine. An analysis of this ore, furnished me by Mr. Bishop, the owner of the property, gives 65.05 per cent. metallic iron; but it contains a varying percentage of titanic acid, which is considered a very deleterious ingredient. It is however absolutely free from sulphur and phosphorus. Here is a copy of the analysis by Mr. W. H. Pike:—

Metallic iron	65.05	per cent.
Titanic acid	4.00	"
Silica	5.00	"
Sulphur	free.	
Phosphorus	free.	

This is probably about the most favourable assay obtained. I do not know what the average may show.

That the ore is not confined to this one locality is attested by the fact that numerous boulders of a similar character are strewn over the surface of the country along the seashore, and especially along the courses of the many streams flowing from the mountainous district to the eastward known as the Long Range. The mountains are chiefly of Laurentian age, composed of various granitic syesnitic, gneissic rocks from whence the ore has been derived. Judging from the scattered *debris,* it would appear to range from

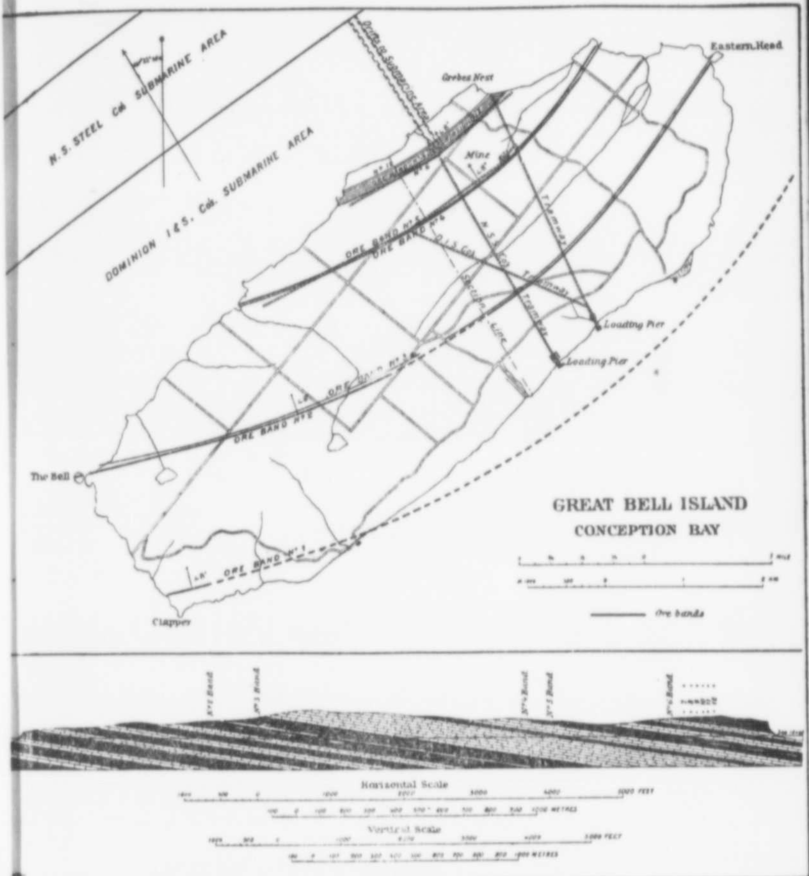

N. S. STEEL Co. SUBMARINE AREA
DOMINION I & S. Co. SUBMARINE AREA
Eastern Head
Grebes Nest
Mine
ORE BAND No 2
ORE BAND No 1
Loading Pier
Loading Pier
The Bell
Clapper
GREAT BELL ISLAND
CONCEPTION BAY
Ore bands
Horizontal Scale
Vertical Scale

Fig. 1.

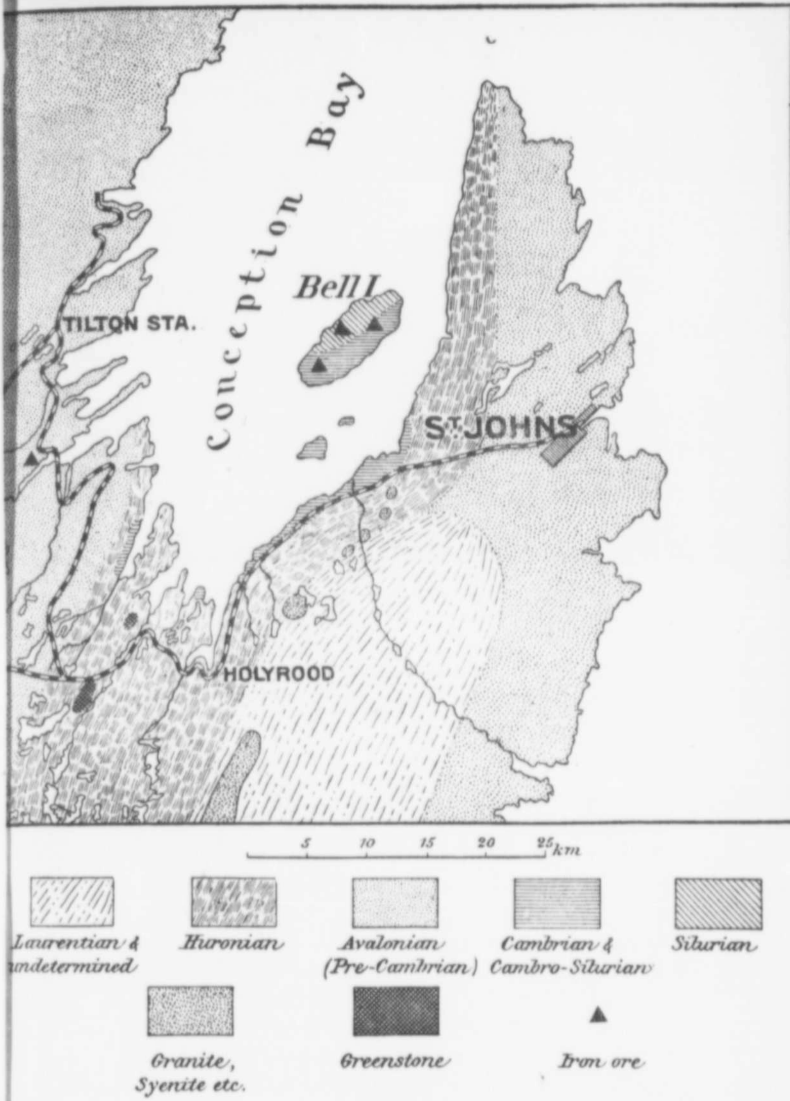

Conception Bay
Bell I.
TILTON STA.
ST. JOHNS
HOLYROOD
5 10 15 20 25 km
Laurentian &
undetermined
Huronian
Avalonian
(Pre-Cambrian)
Cambrian &
Cambro-Silurian
Silurian
Granite,
Syenite etc.
Greenstone
Iron ore

Fig. 2.

Port au Port Bay to the Highlands of St. Georges Bay, or perhaps to the Codroy Valley, a distance of some 50 or 60 miles. Quite a large deposit of magnetic iron is indicated at a point in the interior near the head of the Bay D'East River, amongst a set of serpentine and chloritic rocks. Many large fragments of the ore were observed there some few years ago, but the deposit was not traced out.

Chromic iron, chromite, occurs very frequently, especially associated with the Magnesian group of rocks, usually termed here the Serpentines—more properly the Quebec Group of the Canadian geologists. It has been found in Notre Dame Bay in the vicinity of the copper deposits, and in several other parts. It was observed in the interior on the Bay East River, and at Port au Port Bay quite an extensive deposit has recently been discovered. I understand this latter property is now in the hands of an American company, who are about to open it up next spring.

Hematite and its varieties are also of common occurrence in various parts of the island. A good class of this ore occurs at the Tilt Cove location, but I am not aware of the extent of the deposit. It analyses 69.41 per cent. of metallic iron. The ore is known to exist in Trinity and Conception Bays at several points; but by far the largest and most important deposit yet discovered is that on the Great Bell Island, already fully reported upon. Here, four well-defined bands, ranging from 2 feet to 12 feet thick, form regular layers of the stratification. The analyses of three of these show 48 per cent. 56 per cent. and 58 per cent. of metallic iron respectively. The mode of occurrence, facilities for working and shipping this ore, have been all set forth in the report alluded to.

Jaspery iron ore, mostly of a low grade, is abundant, and there is reason to believe this class of ore will be found, upon further investigation, of better quality, and of considerable importance. It occurs chiefly in a similar set of rocks to those holding the extensive deposits of Minnesota: the Keewatin Series.

Clay ironstone, which is confined to the carboniferous areas of Bay St. George, and the Grand Lake Region, forms extensive deposits, especially in the latter region. Nodular bands of several feet in thickness are frequent amongst the coal measures on the south side of Grand Lake. In one of the sections on Aldery

Brook, the strata for a thickness of 124 feet is more than half made up of this ore in layers of from a few inches to 3 feet in thickness. The ore has not as yet been anaylsed, and I cannot therefore give the percentage of metallic iron it contains. Bog iron ore is met with in several parts of the interior in the form of irregular layers or incrustations, usually in marshy or peaty ground. Some of these deposits are pretty extensive, though not usually very thick. Magnetic iron sand has been frequently seen on the West Coast, or on the shores of the larger lakes, but not in very extensive deposits. Rarer varieties of iron, such as Spathic iron, Siderite, Vivanite, Ilmenite, &c., occur sparingly, mere specimens only having been met with.

In the vicinity of Conception Bay there is a pretty extensive deposit of an earthy iron ore, containing about 50 per cent. manganese, which might be available for the manufacture of spiegeleisen.

I have little doubt that should more interest be manifested in the working of our iron ores in the near future, many hitherto neglected deposits will be found on investigation to be of considerable value; while a systematic search for such ores will, I am convinced, result in the discovery of many others as yet unheard of.

I have, &c.,

JAMES P. HOWLEY.

No. 4.

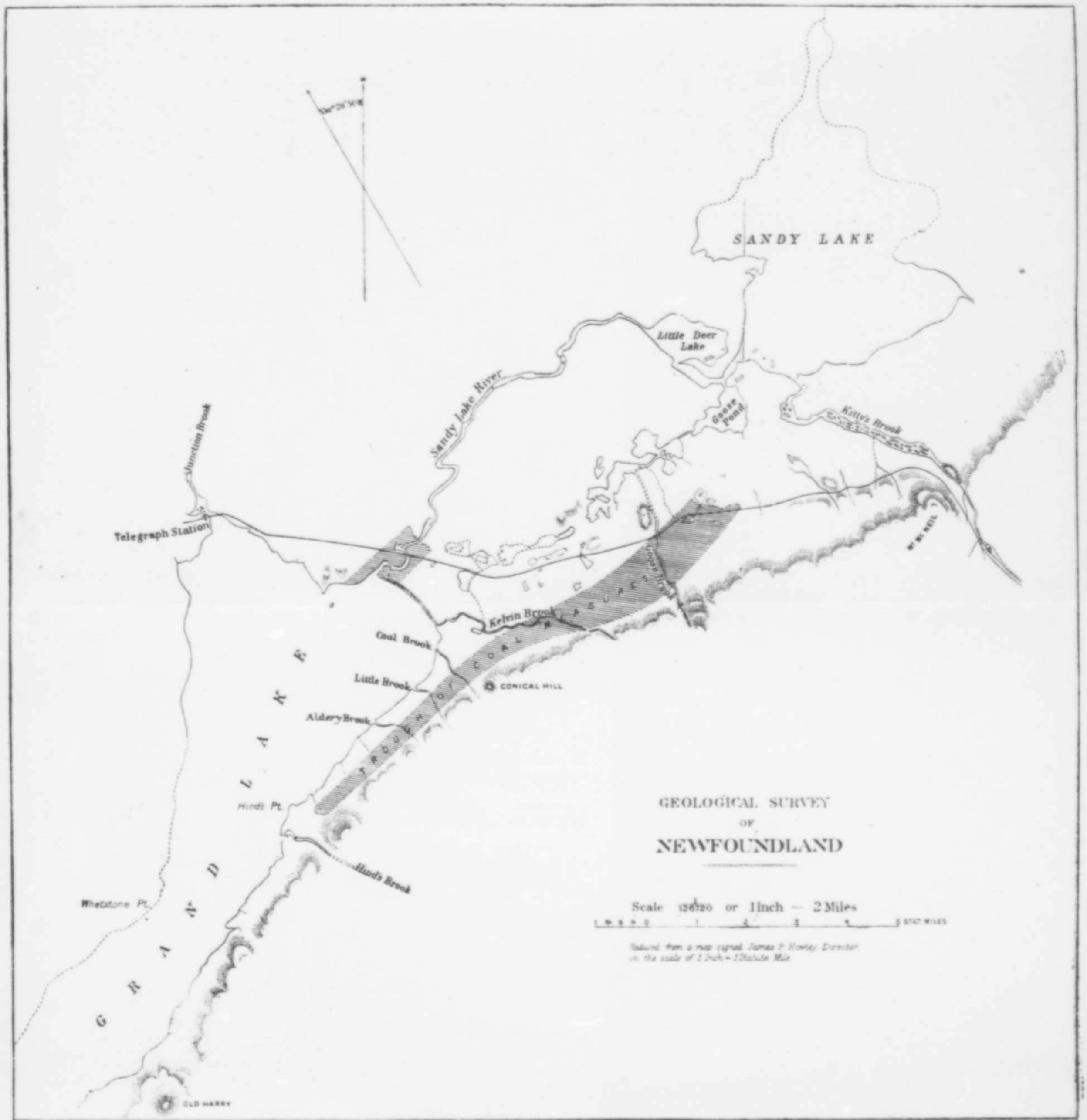
SIR H. MURRAY TO MR. CHAMBERLAIN.

(Received Jany. 21, 1896.)

Government House,
St. John's, Newfoundland,
January 3, 1896.

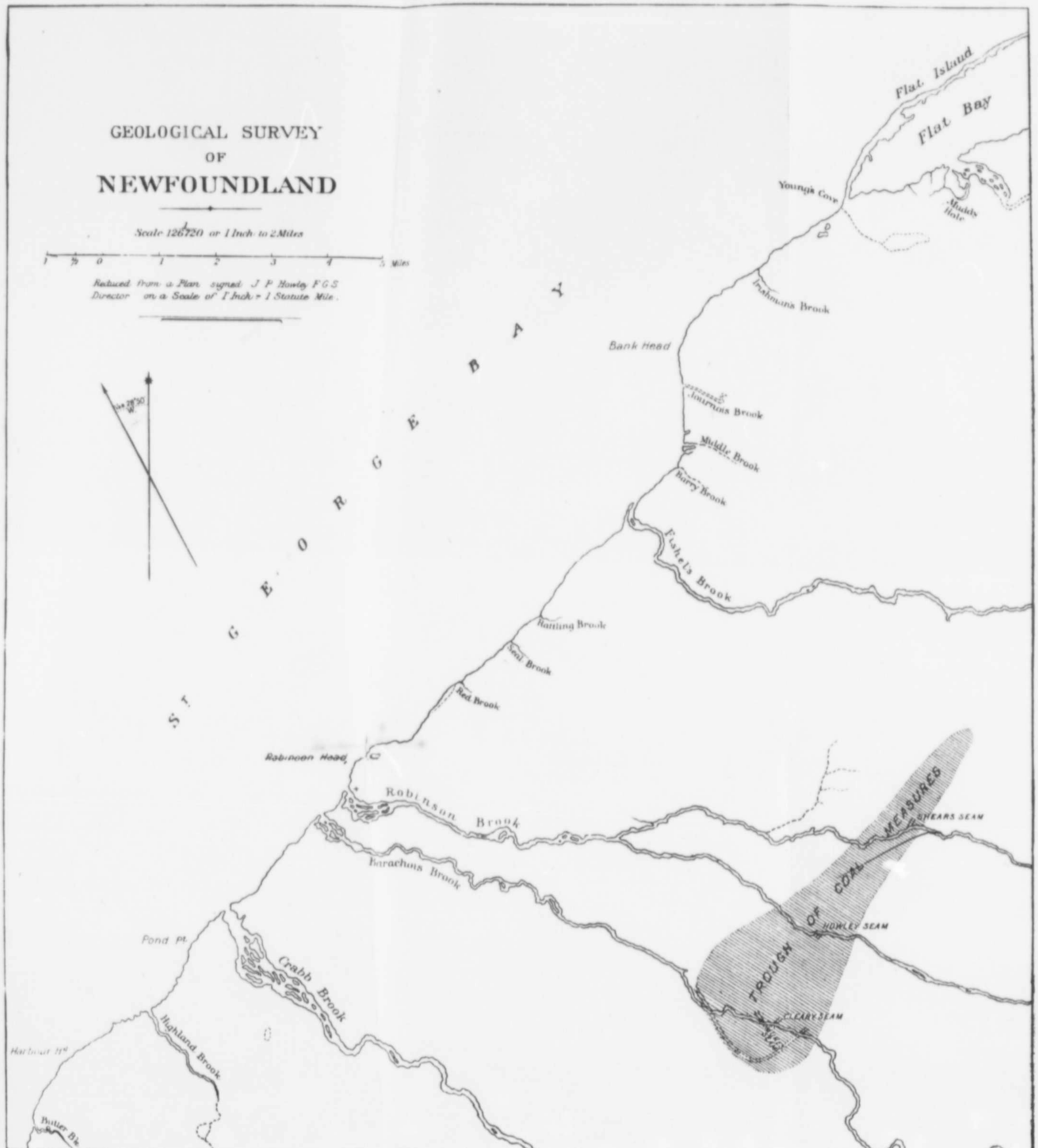
SIR,—1. As so many statements have appeared in the newspapers respecting the coal seams in this Colony, it may be your wish to be put in possession of the facts relating to it which have been ascertained up to the present date by the Geological Department of the Colony.

2. I therefore enclose copy of a report, dated 29 November



I.B.W.O. No. 1185

Lithd at the Intell. Div. War Office, July 1896.



I.D.W.O. No. 1185(9)

Lithd at the Intell. Divn, War Office, July 1896.

last, from Mr. Howley, the head of the Geological Department, to the Colonial Secretary, with two tracings in illustration of the report.

3. It will be seen from the report that there are at present two distinct coal areas, one on St. George's Bay, and one in the Grand Lake district.

4. The railway has been already built a good distance beyond the Grand Lake district. The coal area is on both sides in close proximity to the line; but the coal obtained in it will have to be conveyed over 45 miles of the line before it will reach a point on the Humber river at which it could be shipped; the gradient of the line is, however, on this part very favourable for its transit.

5. The railway has not yet reached the St. George's Bay area, but it will probably do so this year; but when it does, it will keep within reasonable proximity of the area, and its course may be deflected so as to come still nearer to it. But there will be under any circumstances not less than 35 miles of railway carriage for the coal before it can be shipped at Port au Basques.

6. For any continuous shipment of coal all the year round Port au Basques will have to be used, as it is free from ice all the year round.

7. It is believed, after local tests, that the Newfoundland is a stronger and better coal than the Sydney coal, with which in the market it will have to compete, but as the latter coal is run straight from the mine into the ship, the former will be heavily handicapped by the cost of the railway carriage, unless mining labour can be obtained more cheaply in Newfoundland than in Sydney. It therefore remains a question whether Newfoundland coal—plentiful as it may be—can compete with the Sydney coal even for the supply of the wants of the Colony.

8. It is very desirable that this question should be tested at as early a date as possible. Mr. Reid, the railway contractor, has tendered to work a certain portion of the Grand Lake area, but no terms have as yet been agreed upon between him and the Government. I hope, however, that one will shortly be arrived at so as to enable Mr. Reid to commence working in the spring. This would give additional employment in the Colony, besides that which will be afforded next year, and during part of 1897, in the construction of the railroad.

9. As Mr. Reid is bound under his contract to operate the line for ten years after its completion, he has, as it seems to me, the practical control of the conditions under which the coal can be worked, as he can regulate the rate at which coal can be carried on the line by any competitor during the period of his contract.

10. Specimens of the coal appear to have been analysed in 1892 by Mr. Fitton, a mining engineer in England; *see* page 53 of the pamphlet* on the mineral resources of the island by Mr. Howley which I enclose.

11. I had intended to forward with this report some of the latest specimens of the coal which has been received in St. John's, but on the whole I am indisposed to do so, as it is not clear whether the specimens in hand fairly represent the quality of the coal which may be obtained at a greater depth. That it is a *strong* coal there seems no reason to doubt, but it seems at present open to doubt whether it is of the anthracite quality sufficiently to make it suitable for use in the Royal Navy or in the mail steamers on the North American or the West India Stations. If it should prove to be so, there will probably be a good opening for it.

12. If it is considered desirable that specimens should be sent to enable the Admiralty to form some, though perhaps not a final opinion on the subject, I will do so on the receipt of instructions to that effect.

13. While on the subject of the coal areas in this Colony, it may be satisfactory to you to be informed that actually on the line of railway—the line passing through them in cuttings—there are very extensive deposits or formations of the finest sand for use in metal mouldings, and of the clay which is used in the manufacture of terra cotta. The sand has been tested in the foundry near, and is found to be far superior to that imported from the States. Mr. Reid hopes to place this sand before long on the English market, samples having been sent to Glasgow. As to the terra cotta clay, no steps have, I believe, been as yet taken by him.

I am, &c.,

H. MURRAY.

* "The Mineral Resources of Newfoundland." By James P. Howley, F.G.S., 1892.

Enclosure No. 4.

Geological Survey of Newfoundland,
St. John's, Newfoundland,
November 29, 1895.

SIR,—In compliance with your request, I beg to furnish you with the following condensed report upon the coal areas of the St. George's Bay and Grand Lake districts, with the accompanying tracings to illustrate the same. These comprise all the facts relating to this subject, so far as has yet been ascertained from actual study in the field. It will be seen that the full extent and importance of these coal areas remains yet to be determined. In a country beset with so many obstacles to successful exploration, the intricate problem of working out all the details of the extensive carboniferous series of rocks, and locating the minor troughs of true coal-bearing measures, is no small task. It will take several seasons' work to place us in a position to say positively how much coal is really available for use in either locality.

But one season, that of 1889, was actually devoted to developing the extent of the coal measures in the Bay St. George area, with the following results:—

Sixteen coal seams were uncovered on the Middle Barachois River, all of which, owing to the doubling up of the strata in the form of a trough, are repeated, by being again brought to the surface with an opposite inclination. The trough is narrow, being, so far as is ascertained, about two miles wide on this brook.

On Robinson's Head River, two miles distant, the south side only of the trough was seen, and three seams of coal uncovered.

On Northern Feeder, a tributary of the latter river, and at two and a half miles further eastward, four seams were seen which would appear to be near the centre of the trough. The extreme points, east and west, at which coal was actually observed in place, are about six miles apart. How much further the trough may extend has still to be determined; nor is the full width known with any degree of certainty. Of the twenty-three coal seams mentioned above, the greater number are of small dimensions, ranging from a few inches only to a foot in thickness. Those over a foot in thickness are the following:—

	Ft.	In.	
(1) On Middle Barachois River:—			
Juke's Seam, containing	4	6	of coal
Cleary Seam, containing	2	2	"
18 inch Seam, containing	1	6	"
Slaty Seam, containing	1	4	"
Rocky Seam, containing	1	8	"
Murray Seam, containing	5	4	"
(2) On Robinson's Head River:—			
Howley Seam, containing	4	2	"
(3) On Northern Feeder:—			
Shears Seam, containing	1	2	"

The Juke's Seam, which is the best in the section, averages as above, 4 feet 6 inches of good, bright, clean coal; but at one point it was found to swell out to 14 feet, containing 8 feet of coal. It was traced for about a quarter of a mile along the strike.

The Howley Seam comes next, and contains 4 feet 2 inches of excellent coal. The Cleary Seam, 2 feet 2 inches, is also a good quality of coal, while the Shears Seam, though only 1 foot 2 inches at its outcrop, is of a superior character, being almost a semi-anthracite. The Murray Seam, though the largest in the section, is not so good as the others. All the known seams in this trough aggregate a total thickness of 27 feet. This should give, for every square mile of area there may be found to occupy, 25,920,000 tons.

A small trough of the coal measures occurs on the north side of St. George's Bay also, in which two seams of coals were uncovered. They were not, however, of workable dimensions. The country here is very flat, and covered with so much drift material that very little rock is exposed; and without the use of the boring rod it will be impossible to ascertain the extent of the trough.

The carboniferous area at the head of the Grand Lake on the Humber River has received more attention, and has been more fully studied out than either of the above; yet, owing to the very flat character of the country, and the enormous acumulation of superficial deposits over the greater part of it, much remains to be accomplished before it can be definitely determined how much of the region is occupied by the true coal measures. It is a most difficult region to explore, with very few exposures of the bed rocks, and as a consequence, the progress of our knowledge regarding the actual coal deposits has been necessarily slow. What has been ascertained up to the present time may be summed up as follows:—

On the south side of the Grand Lake a long, narrow, sharp trough of the coal measures has been traced from a point about four miles up the lake, extending eastward towards the head of the lake, and into the flat country beyond for a total distance of eleven miles. Several small brooks flowing into the lake intersect this trough at right angles, and some good sections are exposed on their banks. On Aldery Brook, the most westerly of these, thirty outcrops of coal were uncovered by coasteaning the surface. So sharp is the trough here, that the coal seams are crowded into a very narrow compass. Here also, as in St. George's Bay, the doubling up of the strata repeats the coal seams, which in reality are only fifteen in number. Most of them are again very small, and average only a few inches in thickness. The following are the best in the section:—

	Ft.	In.	
No. 6 seam, containing	2	0	of coal.
No. 7 seam, containing	1	6	"
No. 8 seam, containing	1	8	"
Big seam in centre of trough	14	0	"
No. 14 seam, containing	2	10	"
No. 15 seam, containing	2	2	"
No. 16 seam, containing	2	9	"
No. 25 seam, containing	1	7	"

(Nos. 16 and 25 are on the southern side of the trough.)

All the outcrops exposed in this section aggregate about thirty-six feet of coal.

On Coal Brook, two miles further east, the section uncovered shows 16 outcrops of coal, aggregating about 18 feet in all. Some of the upper and lower seams of Aldery Brook are not visible here. The trough is considerably wider, and the angle of inclination of the strata much lower. No. 4 seam, Coal Brook, from which was obtained the car-load of coal brought in on the Northern and Western Railway, is a good seam, containing 3 feet 5 in. of coal.

On Kelvin Brook, three miles still further eastward, eleven outcrops of coal were uncovered, all apparently on the southern side of the trough. One of these seams contains 7 feet of excellent coal, another 2 feet 6 inches, and another 3 feet 8 inches. The northern side of the trough could not be reached on this brook, owing to the depth of superficial deposits; nor do we know as yet what width it attains here.

During the past season, coal was again struck close to the railway track, four and a half miles eastward of Kelvin Brook, on the line of strike. Only two actual seams were uncovered; one containing 3 feet 4 inches of coal, another 1 foot 6 inches. Indications of the presence of other seams, which could not however be reached with pick and shovel, were also seen. These again are all on the southern side of the trough, with a northerly inclination. The much lower angle of dip here gives rise to the supposition that the trough widens out very considerably as it leaves the hill range and enters the low flat country. Altogether it has now been traced for eleven miles east and west. How much further east it extends has yet to be determined, but there are good reasons for believing it runs out at least to Sandy Lake, four miles further.

That another and independent trough occurs about four miles to the north, in the vicinity of Sandy Lake River, and probably spreads out westward underneath the waters of the Grand Lake, there is no room for doubt. The boring operations of 1879-80 proved the existence of coal seams near the mouth of the above river, where it enters the lake, and numerous fragments of coal are continually being washed up from the bottom of the lake. On the other hand, the boring of 1893, near the mouth of Kelvin Brook, revealed the presence of an anticlinal ridge, of lower and unproductive measures, separating the northern and southern troughs.

The above contains the actual facts, so far as our knowledge of these coal areas enables me to state with certainty. Much has yet to be accomplished before it would be judicious to hazard an opinion as to the full extent and value of these two promising coal fields.

Hoping the information contained herein may prove satisfactory,

I have, &c.,
JAMES P. HOWLEY.

The Hon. R. Bond,
Colonial Secretary.

No. 5.

Sir H. Murray to Mr. Chamberlain.

(Received January 24, 1896)

Government House,
St. John's, Newfoundland,
January 8, 1896.

Sir,—With reference to my letter of 3rd instant, enclosing a report from Mr. Howley, the head of the Geological Department in this Colony on the subject of the mineral formatons in it, I forward herewith a specimen of iron ore which was only brought to him yesterday, but which he states to be of a valuable quality.

He calls it "Limonite iron" or "Brown Hematite," and he believes that it will average as much as 65 per cent. of iron.

The ore comes from the western coasts of the Island near Bonne Bay, but the amount of it is at present unknown.

I think it right, however, to forward it you at once, while such steps are being taken as you may consider best to make known to English capitalists the value of the mineral formations in this Colony.

I am, &c.

H. MURRAY.

No. 6.

Geological Survey to Colonial Office.

(Received February 3, 1896.)

28, Jermyn St., S.W.,
February 1, 1896.

Sir,—With reference to your letter of the 24th ultimo,* on the subject of the mineral resources of Bell Island, Newfoundland, I have read Mr. Howley's report, and have the following observations to make regarding it.

Mr. Howley is a geological surveyor of long experience who has done great service in the exploration of Newfoundland. I would therefore put implicit trust in his observations contained in this report. From these observations it is clear that a large area of

*No. 2.

workable iron ore occurs in Bell Island; that owing to the low angle of inclination much of the ore can be worked at the surface and that the several seams are thick enough to be easily mined when surface workings are no longer practicable. It appears from the report that a company has already started to work the ore. If this company can profitably do so, and ship it from the mines, I think that other companies may probably be induced to take concessions. There is evidently ore enough to furnish workings for a number of companies for many years to come.

I am, &c.

ARCH. GEIKIE,
Director-General.

Report and relative documents returned herewith.

No. 7.

SIR H. MURRAY TO MR. CHAMBERLAIN.

(Received February 5, 1896.)

Government House,
St. John's, Newfoundland,
January 15, 1896.

SIR,—With reference to my report of the 8th instant,* in which I enclosed a specimen of brown hematite ore (limonite), I have to state that since that date I have ascertained that a large quantity of that ore is imported from Spain by Sir W. Armstrong's Company.

2. I stated in that report on the authority of the head of the Geological Department in this Colony (who, however, has no means at his disposal of testing ore) that that ore would produce 65 per cent. or more of iron.

3. I find that there is a very large deposit of this iron ore on the south side of the Bay of Islands, close to the coast, which, if the Treaty Shore question caused no difficulty, could be easily worked and shipped at York Harbour in the Bay of Islands.

4. I was informed this morning by a man who is interested in getting this mine worked, and who has had, he stated, consider-

*No. 5.

able mining experience both at the mines at Lake Superior, and at Marquette in Michigan, that at Lake Superior the ore of the quality which I now forward, which is the same as that sent with my report of 8th instant,* yielded 75 per cent.

5. As the cost of freight to England must decide whether it is possible for the minerals of this island to compete with the ore now imported from Spain and from Sweden, I have inquired as to the rate per ton paid for freight on copper ore sent to Swansea. Of this there has been considerable experience.

6. Mr. Smith, formerly agent for Messrs. Bennett, who were the owners of the Union Mine in Tilt Cove, Notre Dame Bay (on the east coast of the island), informs me that when he was agent for the mine some years ago, the rate per ton of the copper ore to England was between 6s. and 7s., but that he believes it is less now; this is probably the case, as freight at present is low.

7. This agrees with the statement made to me this morning by the man above-mentioned, that the iron ore from the Bay of Islands on the west coast could be shipped to England at the rate of $1½=6s. 3d.

8. It also agrees with a statement made to me by Mr. Reid, that sand for moulding purposes (minerals) could be shipped from the west coast at 6s. a ton.

9. I hope that this information may be of use in case you should think it worth while to communicate with the Crown Agents respecting the mineral resources of this Island.

I am, &c.

H. MURRAY.

No. 8.

COLONIAL OFFICE TO THE GEOLOGICAL SURVEY.

Downing Street,

February 8, 1896.

SIR,—I am directed by Mr. Secretary Chamberlain to acknowledge the receipt of your letter of the 1st instant,† with some observations on a report by Mr. James P. Howley upon the mineral resources of Bell Island, Newfoundland.

*No. 5. †No. 6.

2. Mr. Chamberlain desires me to thank you for your letter, and to say that as some further despatches have now been received relating to this subject and to discoveries of minerals in various other parts of the Colony, he will be much obliged if you will be so kind as to favour him with any remarks that may occur to you upon these despatches also, which are enclosed herewith,* together with the specimens of iron ore referred to. The Governor has been requested by telegraph to send home authenticated specimens of coal as soon as possible.

I am, &c.

EDWARD FAIRFIELD.

No. 9.

SIR H. MURRAY TO MR. CHAMBERLAIN.

(Received February 26, 1896.)

Government House,
St. John's, Newfoundland,
February 7, 1896.

SIR,—With reference to my report of the 3rd ultimo,† respecting the coal areas in this island, and to your telegram of this day's date, I forward by the S.S. "Ulunda" a box containing specimens of coal, which has been labelled by Mr. Howley, the head of the Geological Survey. Should it be considered by you desirable, I will send a similar parcel of coal specimens direct to the London Chamber of Commerce.

2. I also forward a small specimen of chromic iron ore, which I am told is very valuable for pigment production. It was broguht me by an experienced mining agent, who is in difficulty about working it on account of the French Treaty Shore question.

3. Mr. Howley informs me "that its principal use—at least "one of them—is the extraction of oxide of chromium for the manu-"facture of pigments, such as chrome green and yellow, which are "used largely in dyeing, calico printing, glass and porcelain paint-"ing, &c. As an iron ore it is of little value owing to the small per-"centage of iron it contains, and the abundance of richer ores. I

*Nos. 3, 4, 5 and 7. †No. 4.

"have mentioned this mineral in my report on the iron ores. It is "found in several parts of the island."

This report is the one (printed)* which I forwarded with my Despatch dated 3rd January 1896. See pages of the printed report numbered 19, 20, and 22.

I am, &c.,

H. MURRAY.

No. 10.

GEOLOGICAL SURVEY TO COLONIAL OFFICE.

(Received March 3, 1896.)

28, Jermyn Street, S. W.,
March 3, 1896.

SIR,—I regret that an unavoidable delay has occurred in my reply to your letter of 8th February last regarding the mineral fields of Newfoundland.

I have now considered the various papers enclosed with your letter. As stated in my communication of 1st ultimo† on the same subject, I believe Mr. Howley to be so experienced and reliable a geologist that his reports may be accepted as quite trustworthy. From his account of the iron ores of the Colony, it is clear that there must be great abundance of these ores and that they include a considerable variety. The pieces of limonite forwarded with your letter are undoubtedly good specimens of ore, though the average percentage of metallic iron which this ore would yield in practice may possibly not be so high as Mr. Howley estimates. Sir Herbert Murray's informant (letter of 15th January) must have been under a serious misapprehension as to the percentage of iron which this ore would give, 75 per cent. being above the possible yield even of the richest iron-ore.

With regard to the coal seams of the Colony enough is known to prove that coal exists in a number of seams of varying quality, but the exact extent of these seams and the geological structure of the ground in which they lie do not appear to have been yet satisfactorily ascertained. There can be no doubt that the development

*Not reprinted. See footnote at p. 72. †No. 8.

of the coal-fields will be of the utmost importance in the progress of the Colony.

If the question is to be considered whether any money is to be expended in opening up the mineral-fields of Newfoundland, I would strongly advise that the first object to be aimed at should be a thorough exploration of the areas containing coal. Upon the development of the coal-field all the other mineral industries will largely depend.

With regard to the iron ores, they may, of course, be shipped to England or other centres of manufacture. But I am afraid that in the present state of the iron industry there would need to be some exceptional circumstances in favour of Newfoundland to enable the Colony to compete successfully with other regions.

The various documents that accompanied your letter are returned herewith.

I am, &c.,

ARCH. GEIKIE,
Director-General.

No. 11.

COLONIAL OFFICE TO THE GEOLOGICAL SURVEY.

Downing Street, May 29, 1896.

SIR,—With reference to your letter of the 3rd March,* respecting the mineral resources of Newfoundland, for which I am to express to you Mr. Chamberlain's thanks, I am directed to forward to you a box containing specimens of coal that has been received from the Governor, together with a specimen of iron ore, the nature of which is described in the despatch† of which a copy is enclosed.

2. Mr. Chamberlain will be much obliged if you will be so kind as to favour him with any remarks that may occur to you in reference to these specimens.

I am, &c.,

JOHN BRAMSTON.

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*No. 10. †No. 9.

No. 12.

GEOLOGICAL SURVEY TO COLONIAL OFFICE.

(Received June 5, 1896.)

28, Jermyn Street, London, S.W.,
June 4, 1896.

SIR,—I have received your letter of 29th ultimo* with the specimens of coal and chromic iron ore therein referred to. As stated in my letter of 3rd March, the coal seams of Newfoundland are known to exist in various places, their qualities have been analyzed, and judging from the specimens now sent and from these published analyses, I have no doubt that the coal, if worked, would be a valuable source of revenue to the Colony. I have already pointed out that the extent and structure of the coal field do not appear to have been, as yet, adequately ascertained. Possibly Mr. Howley may be in possession of this knowledge. But if not, I presume it does not exist and, in that case, if it is proposed to expend any money for the development of the mineral resources of the Colony, I would suggest that a small preliminary expense should be incurred in making a general survey of the coal-field, with the idea of guiding the proper opening up of the ground for mining purposes.

The chromic iron ore is undoubtedly a valuable mineral. If the deposit from which the specimen now sent is easily accessible, of sufficient magnitude, and capable of being successfully worked, it would probably be a more valuable enterprise than the working of any of the hematite and brown iron ores, of which specimens were received early in the present year.

I have meanwhile retained here the various collections of specimens for reference.

I am, &c.,

ARCH GEIKIE,
Director-General.

*No. 11.

No. 13.

MR. CHAMBERLAIN TO SIR H. MURRAY.

Downing Street, June 23, 1896.

SIR,—I have the honour to acknowledge the receipt of your despatches* regarding the mineral resources of Newfoundland.

Your despatches, and the mineral specimens which you have from time to time sent to me, were forwarded to the Director-General of Geological Surveys in this country, and I now enclose, for the information of your Ministers, copy of the replies† received from Sir Archibald Geikie.

I propose to have all the correspondence on this subject printed and to send copies to the Imperial Institute, to the different Chambers of Commerce, and to the Press, in order that these discoveries, of which I have learnt with great satisfaction, and which I trust will materially increase the prosperity of the Island, may become generally known to the public and may in particular be brought to the notice of business men.

A copy of the printed correspondence will also be sent to the Admiralty, and the attention of the Lords Commissioners will be invited to the remarks contained in your despatch‡ of the 3rd of January, respecting the possible use of Newfoundland coal by the Royal Navy.

I have, &c.,

J. CHAMBERLAIN.

No. 14.

SIR H. MURRAY TO MR. CHAMBERLAIN.

(Received July 3, 1896.)

Government House, St. John's,

June 17, 1896.

SIR,—I have the honour to enclose to you herewith six copies of the speech with which I opened the Fifth Session of the Seventeenth General Assembly of this Colony on the 11th instant.

I have, &c.,

H. MURRAY,

Governor.

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*Nos. 1, 3, 4, 5, 7, and 9. †Nos. 6, 10, and 12. ‡No. 4.

Enclosure in No. 14.

OPENING OF THE LEGISLATURE.

Legislative Council, June 11, 1896.

His Excellency the Governor Sir Herbert Harley Murray, K.C.B., opened the Fifth Session of the Seventeenth General Assembly on Thursday, 11th instant, at 2 o'clock p.m., with the following

SPEECH.

Mr. President and Honourable Gentlemen of the Legislative Council:

Mr. Speaker and Gentlemen of the Honourable House of Assembly:

In addressing you for the first time as the representative of our Most Gracious Sovereign the Queen, I desire to express the gratification I feel in being associated with you for the promotion of the prosperity and advancement of this Colony.

In reviewing the events of the year that has nearly elapsed since the close of your last session, I would first call your attention to the satisfactory condition of our financial affairs.

The policy of retrenchment in the public expenditure, which was adopted by the Legislature last year, has been faithfully carried out by my Government, and, I am pleased to observe, without in any way affecting the efficiency of the Public Service.

The honest and conscientious fulfilment of this trust has resulted in the restoration of the credit of the Colony abroad, and in increased thrift and enterprise on the part of the people of this Colony.

The interest due to holders of our Colonial Bonds has been and will be promptly met, and after all obligations in connection with the Public Service for the present quarter have been provided for, there will be a considerable balance to the credit of the Treasury. The change that has taken place in the condition of the Colony within the past twelve months, and after one of the most severe financial disasters that ever fell upon any community shows that its recuperative powers are phenomenal. I most heartily congratulate you upon this aspect of affairs which, I consider, justifies our taking a hopeful view of the economic condition of the Island.

The success that attended the prosecution of the fisheries last year, although to some extent limited by reason of low prices, was an important factor in removing the commercial depression. Had the seal fishery of the past spring been an average one, no doubt the revival in trade would have been still more marked.

The shortage in the catch of codfish this season by foreign competitors has already had the effect of improving the markets for our staple, and the prospect thus afforded of better markets next year has encouraged suppliers to make large advances for the approaching fishing season.

The progress made by the railway contractor last year on the work of the western extension was entirely satisfactory. Seventy miles of railway were completed. It is probable that by the end of the present year the line will be built to Port aux Basques, which is the southern terminus. We cannot fail to recognize the importance of the railway system of the Colony, and the great and beneficent influence it is likely to exert upon the development of our material wealth.

It affords me pleasure to observe that the mining industry of this country is attracting the increased attention of foreign capitalists. The deposit of iron ore on Bell Island in Conception Bay is pronounced to be practically inexhaustible. A large amount of foreign capital has been invested in this property and a considerable amount of employment may therefore be anticipated in connection with the working of the mine. I am informed that other mineral deposits will be developed during the present year.

My Government expected to have been in a position to invite the Legislature to ratify an agreemnt for the working of the coal area near Grand Lake, but the action of the Newfoundland Railway Company in placing an injunction upon the disposition of the property may possibly retard the completion of the negotiations. The claim set up by the Newfoundland Railway Company is now before the Supreme Court, and it is to be earnestly hoped that there will be an early settlement of the question at issue.

Mr. Speaker and Gentlemen of the Honourable House
of Assembly:

The Receiver-General estimates the total receipts for the fiscal year which will end on the 30th June, 1896, at $1,550,000, and the total expenditure at $1,350,000, in which sum is included the interest on the Public Debt. This would leave a surplus for the entire year of about $200,000. The public accounts and estimates will be submitted to you at an early date, and I am confident you will make needful provision for the public service.

Mr. President and Honourable Gentlemen of the Legislative Council:

Mr. Speaker and Gentlemen of the Honourable House of Assembly:

My Government, appreciating that the mining and agricultural interests of the Colony demand just recognition and liberal encouragement, will recommend an enlargement of the free list.

You will be invited to make an increased vote for educational purposes so as to supplement the teachers' salaries, and also an allocation for the repair of roads and bridges.

In now leaving you to your deliberations I commend to your wise care and thoughtful attention the needs, the welfare, and the aspirations of the people whom you have the honour to represent, and I trust that Providence may direct your counsels to the furtherance of those ends.

HERBERT HARLEY MURRAY,
Governor.

CHAPTER XXXVIII.

The Coal Deposits of Newfoundland, by James P. Howley, F.G.S. (Taken from The Coal Resources of the World, Vol. II.; 1913).

The coal areas of Newfoundland are entirely undeveloped as yet, and it is of course impossible to furnish such details as would be available in a country with a well-established coal-mining industry. I shall therefore have to confine myself to an outline of the known Carboniferous areas, and a few details of the work of exploration so far conducted by the Geological Survey of the Island.

The existence of coal in Newfoundland was long known, but, being confined to the western side of the Island, over which the French exercised fishing rights conferred on that nation by the Treaty of Utrecht in the year 1713, no development of the coal could take place. By claiming an exclusive right to the foreshore along the entire western coast, they were able to place an embargo on any Company who attempted to ship minerals or other products therefrom, although they themselves did not possess the privilege of working the mines or cultivating the land. This anomalous state of affairs, now happily ended, was undoubtedly the means of preventing the establishment of a mining industry in that region.

In the meantime, our near neighbour, Cape Breton, not being similarly hampered, made great strides in coal mining, and long before our deposits became available, had established such a widespread industry, capable of supplying all the requirements of the trade and commerce of this section of North America, that none could be found to invest in coal mining in Newfoundland.

Although our own local consumption is a large one and rapidly increasing, so well established is the trade in coal with Cape Breton that it would now take some time before we could hope to compete with that Island on an equal footing.

This, then, is the chief cause of the undeveloped condition of our coal deposits and not the non-existence of that valuable commodity in available quantity.

I shall endeavour to prove that the country possesses coal resources of undoubted importance.

A glance at the geological map of Newfoundland will show that a large tract to the south of Bay St. George on the west coast, comprising an area of 1,100 square miles, is occupied by the Carboniferous series, which is clearly an extension of that of the Provinces of Nova Scotia and New Brunswick, being no doubt connected with the latter under the waters of the Gulf of St. Lawrence.

A second large tract is seen in the Humber River valley, surrounding the heads of Deer and Grand Lakes, and extending up the valley of the Humber to Adies pond, on the main Branch, and to Sandy Lake on the southern branch. The total area of this tract is about 500 square miles.

There are possibly some small outlying patches of this series, as yet undetermined, along the higher plateau of the Long Range mountains, but if so, their value from an economic point of view is not worth considering.

The series in the Bay St. George district has been subjected to many folds, probably due in part to subsidence. There is an entire absence of intrusive material anywhere visible in the Carboniferous areas of Newfoundland to account for the crumpling of the strata. This folding has resulted in producing several small synclinal troughs, in which portions of the true Coal-Measures are brought in. The first of these occurs on the upper reaches of the Great Codroy river and is of very limited extent, being faulted up against the Laurentian mountains, which bound the valley on the south. A mere segment of a trough is here represented, nevertheless it contains six seams of coal, standing in an almost vertical position. Four of the seams are of small dimensions, but the other two are quite large. One, at its outcrops, shows nine and a half feet of clean, good coal, while the other shows twenty-three feet of mixed coal, shale and clay, the coal aggregating fifteen feet thickness, and being of good quality. These seams do not maintain their thickness over any great extent of country, but were found to vary considerably. The first dwindled down to five feet with but three feet of coal, while the large one, which was uncovered at five different points along its strike, gave an average thickness of seven and a half feet. A drift was run along the course of the first named seam for about ninety feet by the Reid-Newfoundland Railway Co., and about 100 tons taken out. This was used on the Company's locomotives and gave excellent results as a steam producer. But the limited area of the trough did not warrant them in going into mining on an extensive scale. A great anticlinal, bringing up the lower, unproductive portion of the series, which here forms the Anguille mountain range, separates the Codroy valley from that of the Bay of St. George.

In the latter district, the Carboniferous spreads out over a large area similarly affected by a series of folds. The lower measures hold the coast on the south side of the Bay, and rolling over, some three or four miles inland, produce a trough of true Coal-Measures of much importance. The extent of this trough is not yet fully worked out, but what is known of it is as follows:

The trough is a long narrow one, its centre being situated some eight miles from the coast. On the Middle Barachois river it shows a width of about two miles, and its longitudinal extent, so far determined, is about five miles. The only sections exposed to view are seen on the banks of the various rivers which intersect the trough at nearly right angles.

On the Middle Barachois river twelve separate seams of coal are revealed, dipping up stream, all of which are again brought to the surface on the opposite side of the trough.

They range in thickness from a few inches to over five feet.

On Robinson's river, two miles farther east, three seams were uncovered, one of which gave a thickness of four feet two inches.

Two and a half miles farther east, on a tributary of the Robinson, called Northern Feeder, four seams were uncovered, but only one was of any importance. Its thickness at the outcrop was one foot two inches, but upon sinking a shaft upon the dip of the seam it was found to increase in thickness. This seam was of superior excellence, being a clean, bright, fairly hard coal of a highly bituminous character and containing a low percentage of ash.

The seams known to occur in the bay St. George trough which exceed one foot in thickness are as follows:

Murray Seam	5 feet 4 inches	On the Middle Barachois River.
Rocky Seam	1 foot 5 inches	
Clay Seam	1 foot 8 inches	
Slaty Seam	1 foot 4 inches	
18-inch Seam	1 foot 6 inches	
Jukes Seam	4 feet 6 inches	
Cleary Seam	2 feet 2 inches	

Howley Seam	4 feet 2 inches	On Robinson's River.
Shears Seam	1 foot 2 inches	On Northern Feeder.

The aggregate thickness of all the seams in this trough is twenty-seven feet, which should give about 25,000,000 or 26,000,000 tons per square mile.

Possibly other, smaller troughs occur in this region, but as yet they have not been located.

On the north side of St. George's bay between Indian Head and the isthmus of Port au Port, another small trough occurs in which a few thin seams have been found, but this section has never been fully explored.

The Humber or Grand Lake coal district lies about 100 miles north-east from Bay St. George, and, as already stated, covers an area of some 500 square miles. By far the greater portion of this area is occupied by the lower and unproductive measures. On the valley of the Main Humber the strata lies pretty flat and are arranged in a series of low synclinal and anticlinal folds, bringing the same strata again and again to the surface. None of the folds are deep enough or wide enough to bring in the true Coal-Measures. But near the very base of the series a belt of bituminous shale of considerable width and unknown extent has been found on analysis to yield an appreciable quantity of petroleum. Veins of a remarkably rich quality of asphalt occur here and there in these shales. Its composition shows a very near approach to the New Brunswick albertite, but it is higher in volatile matter and contains less ash. It has the consistency of pitch and is quite soft, being easily impressed with the thumb nail. In this respect, it differs from albertite, which is hard and brittle.

An English Company has been formed during the past season to exploit this shale and asphalt; and an expert sent out to investigate the deposit reports most favourably upon it. There is a great probability that the coming season will witness the commencement of an oil-shale industry in this region. The shale in question, lying so near the base of the Carboniferous, seems to correspond to the Horton series of Nova Scotia or Albert shales of New Brunswick.

On the southern branch of the Humber, around the head of Grand Lake, and extending thence eastward to Sandy Lake, the country is very low and flat, and is covered over by a vast accumulation of glacial debris. No outcrops of the rock formation are visible except in a few instances on the banks of small streams entering Grand Lake on its south side. Here, close up against the mountain range, which bounds the south side of the Humber valley, a long narrow trough of coal measures occur in a highly tilted position. The trough is at first almost in the form of the letter V and contains a number of coal-seams crowded together in a very limited space. Its strike carries it eastward into the flat country, where it is lost to view, but by means of costeaning and by the use of a Calyx boring machine, it has now been traced over eleven miles, and everything points to its continuing some five or six miles farther, terminating in Sandy Lake. The exploration of this field so far carried out has resulted in finding, on Aldery brook, some two miles up Grand Lake, fifteen seams of coal, all doubled up and repeated. They vary in thickness from a few inches up to six and a half feet. The quality of this coal, especially in some of the larger seams, is excellent. Six of the seams gave the following thicknesses at their outcrops:

One seam	2 feet
One seam	1 foot 6 inches
One seam	1 foot 8 inches
One seam	6 feet 6 inches
One seam	3 feet
One seam	2 feet 6 inches

The six and a half foot seam in the section was drifted upon for 150 feet by the Reid-Newfoundland Company and a good deal of coal of first-class quality was taken out. A few of the other seams were likewise tested and the coal extracted was also of excellent quality.

On Coal Brook, which enters the south-east corner of Grand Lake, one and a half miles east of Aldery Brook, a section was uncovered in which nine seams were exposed, all being again repeated on the opposite side of the trough. The angle of inclination here is considerably less, being between forty and fifty degrees.

Six of the seams in this section measured as follows:

One seam	1 foot 4 inches
One seam	3 feet 5 inches

One seam ... ... 1 foot
One seam ... ... 1 foot 6 inches
One seam ... ... 2 feet 4 inches
One seam ... ... 1 foot

The largest seam was mined to some extent by the Reid-Newfoundland Company and some 7,000 tons were extracted, all of which was used on their locomotives.

On Kelvin Brook, two and a half miles farther eastward, and on the same line of strike, a small section, on the south side of the trough only, was exposed, exhibiting six seams, three of which gave the following dimensions:

One seam ... ... 3 feet 8 inches
One seam ... ... 2 feet 6 inches
One seam ... ... 6 feet 2 inches

Three and three-quarter miles eastward, near Goose Brook, where the railway crosses the trough, three seams were discovered by costeaning some years ago, and one of them was mined to some extent by the Reid Company.

It being found utterly impossible to reach the bed rock anywhere else in this locality by the aid of pick and shovel only, boring machines were brought into requisition and ten holes in all were put down near Goose brook. These resulted in the discovery of seventeen more seams which, with the three already discovered, made twenty seams in this Goose Brook section. Most of them were, however, very small.

Nine seams ranged in thickness as follows:

One seam ... ... 2 feet 6 inches
One seam ... ... 3 feet 4 inches
One seam ... ... 1 foot 6 inches
One seam ... ... 3 feet
One seam ... ... 2 feet 6 inches
One seam ... ... 1 foot
One seam ... ... 2 feet 4 inches
One seam ... ... 1 foot
One seam ... ... 1 foot 6 inches

The trough here was found to assume a much lower dip and.

as a consequence, spread out considerably. Some of the coal here also was of excellent quality.

From all the facts so far ascertained, there is reason to believe that a much larger trough exists farther to the north, lying between Goose Brook and Sandy Lake river, especially towards the eastern end of Grand Lake. Numerous fragments and small lumps of coal are constantly being washed up on the shore of the lake, especially after storms, and many years ago an attempt at boring near the mouth of Sandy river, with an old-fashioned churn-drill, revealed the presence of a few small seams there.

Presuming this second trough to lie parallel with that on the south side of the valley, its strike would carry it out into the lake underneath the waters of which there is reason to believe a considerable area is occupied by the Coal-Measures proper. The eastern part of the lake here has a breadth of five miles, and as the water is quite shallow at this end, it would not be a difficult matter to tunnel out from the north shore and intercept any coal-seams that may exist here.

These two sections of the country, Bay St. George and the Humber valley, contain the only considerable developments of the Carboniferous series in the Island. There is a small outlying patch of Devonian or possibly sub-Carboniferous strata forming two small peninsulas, on the north coast, known as Cape Fox and Cape Rouge, in which some strata of a very black, bituminous, compact shale occur. This material closely resembles some of the gas coals of Scotland. It burns freely, giving off the odour of paraffin. It is, however, too high in ash to be reckoned a true coal, and has been called a cannel shale. An analysis made by Mr. H. M. Chance, of Philadelphia, gave the following result:

Bituminous Shale from Pillier, Cape Rouge Peninsula.

H. M. CHANCE, M.E.

Sp. gravity	1.54
Volatile matter	36%
Fixed carbon	35
Ash	29

Mr. Chance says he can scarcely call it cannel coal, though, approaching cannel in appearance and composition. "I should call it a cannel shale."

The foregoing contains about all the known facts relative to our coal prospects. It will be seen that there are several seams in the different sections large enough and of sufficiently good quality to be reckoned as workable coal-seams, while others, at present considered too small, may, in course of time, become sufficiently valuable to be utilized. There is always the probaility of some of the smaller seams developing a greater thickness as they are opened up, or possibly, where several seams are merely separated by partings of shale or clay, it may happen, as is frequently the case in most coal-fields, that they will eventually come together by the thinning out of the intervening strata.

When it is considered that seams of coal ranging from fourteen to thirty inches are at present worked in several parts of the world, the constantly increasing demand for this class of fuel, together with the great advance in price of late years, makes it not unreasonable to look forward to the time when many seams not worth exploiting at present will become valuable.

In view of the fact stated at the commencement of this paper, that no actual development worth mentioning has yet taken place, it is, of course, out of the question to give any statistics, as none exist.

In conclusion I append copies of a few analyses of our coals which have been made from time to time. Though far from being complete, these analyses will afford a general idea of the quality of the coal.

ANALYSES OF COALS FROM BAY ST. GEORGE

By G. T. HOLLOWAY, 57 Chancery Lane, London.

	Cleary Seam	Jukes Seam	Howley Seam	Shears Seam
Moisture	3.548 p.c.	3.036 p.c.	2.784 p.c.	4 90 p.c.
Volatile matter	30.897	30 344	29 271	33.12
Fixed Carbon	55.229	60.142	54.468	Not given
Sulphur	3 946	1.963	3.047	0.44
Ash	6.380	4.515	10.430	3.16
	100.000	100.000	100.000	....
Coke	....	....	....	61 98 p c.

NOTE—(The evaporative power of this coal expressed in pounds of water evaporated at 212° F. by one pound of coal as determined by Thompson's calorimeter was 1237 pounds, which considerably exceeds that of North Sydney, or the best Scotch, Welsh or English coals.

"The coke produced from this coal was hard and lustrous and of good quality. The ash was brownish and showed no sign of melting. The amount of sulphur is decidedly low, while its evaporative power, i.e., its heating value, is high.

"The coal may be described as a bituminous caking coal of excellent quality, suitable for domestic use, for coke making, or for steam raising purposes.")

Analyses of Coals from Kelvin Brook, Aldery Brook and Coal Brook, Grand Lake.

By WILLIAM H. FITTON, F.G.S., F.S.Sc., M.E., England.

	From Kelvin Brook	From Aldery Brook	From Coal Brook	From Grand Lake
	No. 1.	No. 2.	No. 3.	No. 4.
Moisture...... ...	8.44 p.c.	10.22 p.c.	9.93 p.c.	5.02 p.c.
Volatile matter	28 54	24.39	24.01	31.25
Fixed Carbon..	50 07	48.51	49.15	54.03
Ash	11.53	15.72	16 14	8.66
	1.42	1.16	.77	1 04
	100.00	100.00	100.00	100.00
Coke in closed vessel	63.92	65.39	66.06	63 73

From Aldery Brook

	No. 6.	No. 7	No 9.	No. 15.	No. 16.	No. 17.	No. 20.
Moisture	5 80 p c.	10.77 p.c	31.71 p.c.	15.78 p.c.	5.82 p.c.	4.32 p.c.	7.41 p.c.
Volatile matter.	31.44	10.55	26.83	30 30	33.62	16.84	30.73
Fixed Carbon........	57.86	33.8[illegible]	51.c6	45 29	5[illegible].28	72.66	53.49
Ash	4.08	37.86	7 56	8.08	4.49	5.33	7.71
Sulphur	82	93	84	.55	.79	.83	.66
	100.00	100.00	100.00	.00.00	100.00	100.00	100.00
Coke in closed vessel....	62.76	72.68	59.56	33.92	60.56	78 84	61.86

CHAPTER XXXIX.

The Coal Resources of Newfoundland.

Carboniferous rocks underlie two large areas in Newfoundland, the larger situated on the south side of St. George's Bay and the smaller on the shores of Grand Lake and in the valley of the Humber river.

In both areas, the strata have been severely folded and remnants only of the Coal-Measures, are found, in comparatively narrow and shallow, cynclinal troughs; the greater part of the Carboniferous areas being underlain by the lower unproductive beds.

In St. George's bay area, the most important coal-bearing trough lies parallel to the shore, its axis being about eight miles inland; the width of the area is about two miles, and its length, so far as determined, five miles. Nine coal seams, over one foot in thickness, have been found, with an aggregate thickness of 23 feet 3 inches. The quality of the coal in some of the larger seams is excellent: analysis of a 4½-foot seam gave; moisture, 3.036%; volatile matter, 30.344%; fixed carbon, 60.142%; sulphur, 1.963%; ash, 4.515%; the coal; therefore, falling in the Class B2 of the schedule.

In the Humber river district, a narrow synclinal trough of Coal-Measures, with a known length of eleven miles, occurs near the foot of the Grand Lake. The highly-tilted, coal-bearing beds contain as many as fifteen seams, nine of which, one foot or over in thickness, have an aggregate thickness of 18 feet 8 inches. The coal is of good quality and can be included in Class B2.

As sufficient information is not available, no attempt has been made to estimate the coal reserve.

The thickness of the coal and the known extent of the areas would seem to warrant a minimum estimate of 500,000,000 tons for probable reserve.

CHAPTER XL.

Our Coal Areas. — Lecture Delivered before the Board of Trade, April 1st, 1913, by James P. Howley, F.G.S.

It would seem almost preposterous for me to tell you anything about coal, or what are its uses. Everybody who has ever seen this dirty black substance being unloaded from shipboard, carted through the streets, dumped into our cellars, or burning in our grates, knows what it is like and that we use it to produce heat and light, etc., but how many enquire further into the nature and composition of coal, or all the many uses to which it can be applied?

The whole history of Coal is, however, a subject of a most interesting and instructive character. I will endeavour briefly to outline it, treat of its composition and tell something of its best known utilities.

The process by which it came into existence would be too lengthy to enter into fully here. I shall, therefore, merely give a brief outline of how this was brought about.

To begin with, Coal is almost exclusively a vegetable product, the principal element of which is carbon. Though now reckoned as a mineral, it was not always as we see it to-day. At certain periods of the earth's construction, a very rank vegetation grew upon portions of its surface. A moist, warm climate, and an atmosphere surcharged with carbonic acid gas, seem to have prevailed at the time, conditions eminently conducive to this growth of vegetation, of exceptional luxuriance, in contrast with which the most prolific tropical vegetation of the present time pales into insignificance. Gigantic trees and plants, which in our time are merely represented by shrubs, such as ferns, club mosses, equisitacea or horse tails, as well as many reeds, grasses, etc., entered into its composition. Some of these trees reach diameters of 3 feet or more, and attained to heights of from 40 to 100 feet. Reeds and ferns of magnificent proportions grew in great abundance, besides numerous other forms of plant life, most of them long since extinct.

All these facts are clearly attested by the well preserved fossil remains and impressions of those trees and plants now to be seen in rocks of the carboniferous period. The structure of the coal itself, when examined under a microscope, reveals the fact that it is simply a compressed mass of vegetable matter. It is composed of nothing, more or less, than the decayed leaves and bark of the plant life of the period. This vast accumulation of vegetable matter with the soil supporting it, then gradually became submerged, caused probably by shrinkage or other earth movements, and was covered over with deposits of sand, gravel, and clay. This, in time, produced a new surface, upon which another similar growth took place, to be buried in turn, as was the first. The process must have gone on for ages, as the numerous layers of coal, sand and clay indicate. The great weight of the covering matter compressed the layers of vegetable mould, and together with certain chemical changes brought about by decomposition, finally converted it into coal. How immensely thick these vegetable accumulations must have been, may be judged from the fact that it is estimated it took between 30 and 40 feet in thickness to produce, under pressure, one foot of coal. Imagine, then, at this estimate, what must have been its original bulk, when there are to-day many coal seams reaching a thickness of 30 feet or more. All this has been thoroughly studied out, by the most eminent scientists, and there can be no manner of doubt about their conclusions. The earth or soil which supported this vegetation is still to be seen underlying the coal seams, filled with the roots and trunks of the trees. Frequently large stumps or portions thereof, are seen with their roots still attached, buried in the underlying soil, while their trunks project upwards into the coal beds themselves. So perfectly are these fossils preserved, that every feature of their structure can be distinctly made out. In many cases the woody fibre of the trees, in the form of charcoal, is clearly perceptible. Fossil botanists are thereby enabled to determine their botanical structure, and give a name to each individual species, with just as much accuracy as others can examine and name the living growth of the present time. I might here state that this vegetation of the coal period differs entirely from what we now behold. Such common trees and shrubs as the Fir, Spruce, Pine, Larch, Birch, Alder, etc., had no existence. The only plants of our time at all resembling those of the above period are certain Fern trees of Australia, and some Bamboos or Canes, but they are not the same. It was thus, then, the coal layers, or seams as they are termed, came into existence.

These seams, upon analysis, are found to be composed chiefly of carbon and certain volatile substances, such as bitumen, oil, gas, etc., mixed with a greater or less proportion of earthy matter.

Perhaps a clearer idea of the process by which coal seams were formed, might be conveyed by a consideration of the well known peat-bogs, so abundant in our country. These are simply vegetable accumulations on the surface of the earth, composed chiefly of club mosses, spagnum, and other simple forms of vegetation in a state of decomposition. Could these peat-bogs be subjected to the same forces that were at work during the carboniferous period, such as great pressure under a thick cover of sand and gravel, aided by internal decomposition, they would eventually become coal.

Various attempts have been made, as you all are aware, to effect this by artificial means. What Nature in her grand laboratory accomplished long ago, insignificant man has attempted, and although fuel of a fairly good quality has been turned out, it is scarcely possible that real coal can ever be produced by human ingenuity.

The character of coal seams varies very considerably. They range from soft dull coloured, highly bituminous (cannel) or soft coal, to the hard, shining, black Anthracite (or hard coal) as it is termed. When the carbon contents reach 60 per cent. and bitumen nearly half as much more, the combination produces a good household coal. When higher in carbon, with a less amount of bitumen, it produces good steam coal, provided it is fairly free from deleterious substances, and when still higher in fixed carbon, with quite a small percentage of volatile ingredients, it becomes Anthracite. Still further, when the carbon alone is present without any volatile matter, it is no longer coal, but graphite, commonly called black lead. Not only is this substance not coal at all, but it is non-combustible, and on that account is largely used in making crucibles for the smelting of metallic ores. Other well known uses of graphite are for polishing purposes, for making our common lead pencils, and on account of its softness and greasy nature, it is employed to a considerable extent in connection with machinery, being much used to counteract the friction of the bearings, etc. This graphite, in its purer form, is very valuable and not over plentiful. The best now produced comes from the Island of Ceylon. It is extensively mined in Cumberland, England, and so precious was it considered at one time, that the mines were strictly guarded to prevent peculation of the material. A strong house was built over the shaft, the doors of which were bolted and locked, while the men were at work within. On coming to the surface at the end of a shift, they were closely searched and made discard their mining clothing before they were allowed to leave the shaft houses, lest they might have any of the precious material concealed about their persons. An armed guard was constantly stationed in a room overlooking this operation. There are numerous deposits of inferior graphite mixed with rock and earth in various parts of the world. We have a good deal of this quality here in Newfoundland. Nowadays, with modern machinery and modes of treatment, these can be utilized by being purified from earth and dross. This constitutes much of the stove polish in use.

Before leaving this part of my subject, I must not omit to mention that the chief ingredient of all coals, carbon, when in a crytalized condition constitutes the most precious of precious stones, the Diamond. It is a very curious fact that while most forms of coal are comparatively soft, this crystalized carbon, or Diamond, is the hardest substance in nature. It will cut or scratch any other mineral, and nothing but a diamond itself will cut another diamond, hence the expression, "Diamond cut Diamond."

But to return to coal proper, there is an infinite variation in the quality of the product. Coals with too high a percentage of earthy material are, as a rule, of poor quality, owing to the amount of ash and slag they leave behind during combustion. When considerable pyrites is present, as is often the case, it becomes very injurious to the furnaces. This pyrites, which is that bright, brassy material frequently seen on the cleavage places of some coals, is a compound of sulphur and iron. The sulphur, when liberated, during combustion, unites with the bars of the grate, and soon destroys them. Sulphur has an extraordinary affinity for iron in any form, and will pass from its original habitat, to combine with the iron. If any person wish to demonstrate this fact for himself, he need only procure a stick of sulphur, heat a piece of iron to redness and bring the two in contact, when he will see the iron eaten up, as it were, by the sulphur. A good, clean coal, then, must be as free as possible form pyrites and clay.

When speaking of coal, I am frequently asked whether such and such a seam is workable or of workable dimensions. It appears to me that few who ask this question have any real conception of what constitutes a workable coal seam. Most people appear to think that to be workable, a coal seam must be of a certain thickness, say 3 or 4 feet at least. This is altogether a mistake. Coal seams of only 2 or 2½ feet, when of good quality and favourably situated, are workable, whereas, others of 10, 20 or even 30 feet, of an impure character, are not so. Others, again, owing to their being split up into thin layers with frequent clay or shaley partings, or otherwise too pyritiferous, are of little account. The New Brunswickers are working to-day, with advantage, seams of 18 to 30 inches in thickness, and in some parts of England, seams of Cannel coal of from 6 to 14 inches are being worked, because they are good gas producers. So you will see that the quality of being workable does not always depend upon their thickness. No doubt a time will come when seams of a foot or less, will be more generally utilized particularly if several such small seams come sufficiently close to each other, to allow of their being worked as one.

We have now treated of the mode of production, occurrence and composition of coal seams. To elaborate further upon this part of my theme would be altogether beyond the scope of one short paper. Suffice to say, no substance in Nature has undergone such a number of changes in the process of its formation. It has passed through hundreds of different stages, each more varied than the other.

It may not be out of place here, and for the better understanding of the subject, to give a brief outline of the Geological structure of what is termed the Carboniferous series of rocks. This great series comprises a total thickness of between 14 and 15,000 feet in some places, and is divided into several groups. The lowest is called the Carboniferous Limestone formation. Next comes the Millstone grit, then the True Coal Measures, and on top of all the Permian or Upper Carboniferous formation, though the latter is now generally separated from Carboniferous. Of course not all these groups are present in one country, or in one district at the same time, for instance, while we find in Newfoundland the three first, or lower formations well represented, the Permian or Upper division is absent altogether.

The base of the series generally consists of thick layers of coarse conglomerate made up of rolled worn boulders, small rocks and gravel. It would appear to have formed an ancient beach, and is very similar to any of the coarse beaches to be seen on many parts of our coast line. The worn appearance of its constituents was caused by attrition of one piece of rock against another, which has removed their angles and rendered them round and smooth. No doubt the action of the waves washing on the beach caused this abrasion.

To all appearances, then, this conglomerate closely resembles our modern sea beaches, with this difference, that the mass, instead of being loose, is cemented together by clay and gravel which acted as a binder. Little, if any animal or plant life, seems to have existed during the laying down of this conglomerate. Indeed, we could scarcely expect it.

The succeeding carboniferous limestone formation is made up of sandstones, marls, limestones, etc., generally of a reddish, brownish or other dull colour. All indicate submarine deposits. The limestones in particular, contain numerous fossil shells of deep sea species. It is in this part of the series also the Gypsum deposits occur, and they are frequently accompanied by salt or brine springs. It is clear that during the laying down of these marine deposits no terrestrial vegetation existed. These two basic formations when taken together give a thickness, in Cape Breton, of between 1,800 and 2,000 feet, in which no coal seams occur.

The next succeeding, and perhaps, most extensive formation of the series, the Millstone grit, is chiefly composed of coarse grits and sandstones, with occasional fine grained and somewhat shaly beds. It would seem to indicate that the seas or estuaries were gradually filling up, no doubt accompanied by a general uprising of the bottom as well. It was a sort of progressive or transition stage towards the next and by far most important of the whole carboniferous period,—the laying down of the True Coal Measures.

A few fossil trees and plants appear embedded in the rocks of the Millstone grit towards the top, and in some place thin coal seams occur. The thickness of this formation varies much but may be taken as somewhere between 2,000 and 3,000, or say 2,500 feet, in Cape Breton Island.

But it is in the succeeding Coal Measure formation proper, that coal seams of real importance begin to show themselves. Most of the rocks of this division are sandstones and shales with their interbedded coal seams. The shales are usually of grayish, brownish, and blackish shades of colour. There can be no mistaking them on account of their numerous embedded fossil plants and trees. Here I might say that unless these sure indications of the probable existence of coal are met with in the rocks, it would be useless to look for it. If this fact were more generally recognized, there would not be so much money wasted in trying to find coal where it never existed or could exist.

This, then, is the really important division of the whole Carboniferous series. Like the preceding millstone grit, it also varies much in thickness. Sir Wm. Logan estimated at the Joggings section, on the shores of the Bay of Fundy, that it reached the enormous thickness of 4,673 feet, but in Sydney Harbour, C.B., it is only about 1,860 feet. Needless to say it is this section or formation of the Carboniferous Series which contains all the coal seams of importance, at all events on this side of the Atlantic.

Some few workable coal beds do occur in Scotland, low down in the Carboniferous Series, even beneath the Millstone grit formation.

The upper or Permian formation does not contain coal of any consequence. It would appear to represent a retrocession or gradual return to the non-productive periods at the base of the series.

Note.—Coal is not entirely confined to the so-called Carboniferous period, for it is known also to occur in several more recent rock series, especially the Cretacious. Most of the coals in these latter is what is termed lignite or brown coal, greatly inferior, as a rule, to the true coal of the coal measures. Much of the coal of Western Canada, China and India, etc., is of this class. While it is of very great value to the countries which possess it, still it can never equal that of the preceding Carboniferous era.

We will now pass on to the consideration of the utilitarian aspect of coal. Hugh Miller speaks of it as, "the stored up fuel of a world." Another authority poetically describes it as "stored up concentrated sunshine." While still others speak of it in somewhat similar felicitous terms. Indeed, one authority considers it "the most precious of all minerals." Perhaps there is no substance in nature that possesses more utilitarian properties than coal. "In it is stored up a force that saves the wear and tear of human muscle and sinew, does away with the fearful toil that makes slaves of men, and enables them to gain their daily bread by easier means."

Its utilization for generating steam has revolutioned the whole industrial aspect of the world. This great motive power, steam, is that which sets the machinery of our mills and factories in motion, speeds our locomotives with their enormous train loads of freight, over the surface of the earth, carries from distant points the products of one country, or one district to another, and propels the ocean greyhounds with their human cargoes at so rapid a rate, across the great expanse of waters, separating Continent from Continent. It is steam which enables the Press, that great modern aid to civilization and enlightenment, to reel off its miles of literature and disseminate it to the remotest corners of the earth. But all this is apparent to any thinking person.

Is it any wonder, then, that we should look upon the possession of this natural product as one of the greatest—if not the greatest blessings—conferred upon mankind?

Some thoughtless persons may imgaine that gold, silver and such like precious metals are of more value than coal. A little reflection would soon convince them of the contrary. We could do without the former and still advance, but without coal, the World's progress would soon be at a standstill. Without its aid in the reduction of metallic ores, especially of iron and copper, these latter would be comparatively useless. True, of late years electrical energy produced from the movement of great bulks of water (white fuel), so called, has been utilized in lieu of coal for heating, lighting and other purposes, but there are many uses to which coal is applied which can scarcely be superseded by electricity. Take, for instance, an ocean going steamer, she cannot carry a sufficient stock of electrical energy on board. Of course oil fuel of late is coming into use for steamship propulsion, yet petroleum is, after all, but another form of coal, or coal in a liquid state.

Considering the question in all its bearings, and the possible substitution of other power-producing forces in the future, we cannot get away from the fact that it will be a long time, if ever, that the world can look forward to coal becoming no longer a necessity.

I could elaborate almost indefinitely upon this phase of the subject, but it is so patent to even the most casual observer, that there is no necessity for my doing so.

Suffice it to say that any country possessing an abundant supply of this most useful substance, has within itself one of the greatest, if not the very greatest, factors for future progress and advancement. If, in addition to coal, it also possesses other mineral substances in abundance, which can be utilized in conjunction therewith, its future should be assured.

Although mineral coal has only been in general use for heating purposes for a little over a century, it has proven one of the greatest agents in the progress, advancement and civilization of our world.

If we look around for its effect on the prosperity of a country, we will find ample evidence on all sides, so much so, that it would almost appear as though its possession or non-possession marked the line between poverty and prosperity, greatness and nothingness, civilization and savagery.

"Show me a geological map of a country," said the great Dr. Buckland, "and I can point out where its future prosperity lies, and where its manufactures and kindred industries will be established." This applies particularly to its coal districts, should it happily possess such.

It has been said that Britain owes her greatness as much to her coal and iron deposits as to any other source. These hives of industry, such as Manchester, Sheffield, Newcastle, the Clyde, etc., all owe their great activity to coal. Lancashire, which at one time was, to a great extent, an uninhabitable morass, has, through its coal development, become one of the most populous shires of the United Kingdom, and has more inhabitants to the square mile than almost any equal area in the world.

Coal is unlike any other mineral product, inasmuch as it is a marketable commodity in its raw state, just as it comes from the pits' mouth. It requires no process of manufacture to render it available commercially. It is the very basis of all trades and manufactures, and no country entirely destitute of it can hope to advance in the same ratio, or hold its ground with those possessing an abundant supply of this most useful article.

It has long been demonstrated that Newfoundland is rich in Copper ores, and that in Bell Island alone, we possess one of the largest and most unique deposits of iron ore in the world, it only remains to be proven whether also her coal deposits are of that character and importance that would warrant us in looking forward to a great future industrial boom. I shall endeavour to convince the most skeptical that such is in reality the case, and should my effort prove successful, I shall feel amply rewarded.

As regards the existence of coal in this country, I would first ask the question: Why should there not be coal here?

The same series of rocks which contain the chief coal deposits of the world are found here, on the western side of our Island in the Codroy Valley, St George's Bay District, and on the Humber Valley. They contain in abundance, the self same species of fossil trees and shrubs that were shown to have produced coal seams elsewhere. Perfect examples of these are found embedded in the rocks in many places, and most beautiful impressions of the fossil leaves and rootlets are sometimes so abundant as to constitute thick beds of black Carbonaceous earthy shale, or impure coal. Some of these beds are literally crowded with fossils. These fossil roots, stem and leaves, are the true index to coal deposits, they contain the written "testimony of the rocks" holding their historic records. When properly interpreted they tell us the facts as related above. They may be likened to samples of the materials which go to constitute coal seams, which latter are the finished products. Would it not then be a peculiar circumstance should coal deposits not exist? Indeed it would be contrary to the order of Nature, or the evident design of the Great Architect of the Universe, but Nature makes no mistakes. The undeniable evidence of coal deposits upon investigation has proven that Newfoundland is no exception to the general rule. While it may not possess so much coal as other more favoured countries, nor yet such extensive and large seams, it has nevertheless, been clearly demonstrated that its coal deposits are of no mean order, and it now only requires the application of capital enterprise and skilled labour to bring about a genuine coal industry in the country.

We will now pass on to the consideration of our own Coal deposits. To begin with we have in Newfoundland three distinct and separate coal fields. The first is situated in the Valley of the Codroy Rivers; the second, inland from the South Shore of Bay St. George about 10 miles from the sea shore, or 8 miles from the nearest point of the Reid Railway; whilst the third is on the Humber Valley between the Grand Lake and Sandy Lakes.

There may be a few outlying patches elsewhere, but these will be too small to be of much economic importance.

In the first field, that of the Codroys, but a small section of the coal measures, as the coal bearing portion of the great Carboniferous series is called, occurs. Nevertheless, six seams of coal have been uncovered in this section and two of these are the largest yet come across in Newfoundland. One seam at its outcrop, showed a thickness of 9½ feet of good clean coal, while another gave 15 feet in total thickness, and averaged, so far as examined, 7½ feet. The other four are much smaller. All this coal is of excellent quality and some of it was used upon the locomotives of the Reid Railway giving every satisfaction as a steam producer.

The Messrs. Reid did some mining here, and took out about 100 or 150 tons, but finding the seams decreasing in thickness as they proceeded, the mining was abandoned by them for the time being.

Unfortunately this little coal field was found to be cut off by a great fault or break in the strata, but a small segment of a basin being left, jambed up against the foot hills of the Long Range of mountains.

In the second, or Bay St. George area, we have perhaps, the most promising, though not the most extensive coal field in the Island. This has been traced in a longitudinal line from W.S.W. to E.N.E. five miles and may extend a few miles further. The best exposures of coal are near the western end of the trough on the Middle Barachois (Barrisway) River. Here it shows a width of about 2 miles. In the section exposed along the banks of this river there are 12 separate coal seams ranging from a few inches to over 5 feet in thickness. They all incline inland but come to the surface again further up stream, with an opposite inclination i.e. pointing towards the coast. On Robinson's River, 2 miles further East, three seams were uncovered, one of which, the Howley seam, gave a thickness of 4' 2" good clean coal.

Two and a half miles still further east on a tributary of the Robinson River, known as the Northern Feeder, four seams were uncovered, one only of any importance. Although this was but 1′ 2″ at its outcrop, it was found to increase in thickness when sunk upon for a short distance. This coal, though of such small dimensions, is of superior excellence, being bright, clean, and fairly hard, but of a highly bituminous character. It was extremely free from sulphur or other deleterious substances, and should afford a first class gas coal.

What the full extent of this most promising coal field may be, has never been ascertained. Owing to the fact, that it was long held by private parties, no Government felt warranted in investigating it fully under the circumstances. Consequently, a boring drill has never been put upon it with a view to ascertaining its full extent and importance. We know, however, that at least two seams of over 4 feet thick each, the Jukes' and the Howley seams, are well worth working. The coal in them is of first class quality and they are so situated, more especially the Jukes', that a large portion of its coal contents could be removed by open quarry work.

The only thing required to render this Bay St. George field accessible for profitable working is a short branch rail or tramway to connect it with the Reid system or with the sea coast.

Together with the Jukes', Howley and Shears seams already referred to, and taking only into account seams of one foot and upwards in thickness, the section contains the following:—

ON MIDDLE BARACHOIS RIVER.

	Feet	In.
Rocky Seam	1	5
*Murray Seam	5	4
Clay Seam	1	8
Slaty Seam	1	4
18 inch Seam	1	6
Jukes' Seam	4	8
Cleary Seam	2	2

*Though this is the largest seam in the section, it is so split up by shaley partings and is of such poor quality as to be scarcely worth working at present.

On Robinson's River.

Howley Seam	1	2

On Northern Feeder.

Shears Seam	1	2

The aggregate thickness of all the seams in this trough is 27 feet which would give about 25,000,000 or 26,000,000 tons for every square mile they may underlay. A small outlying trough on the north side of St. George's Bay contains a few thin seams of little consequence, though possibly, there may be others there of larger dimensions and better quality.

The third, and decidedly most extensive coal field in the Island is that of the Humber or Grand Lake area. The latter lies nearly 100 miles in a straight line N.E. from the Bay St. George trough.

This Grand Lake area has been the most diffcult of all to explore. The country for many miles in every direction is so exceedingly flat, and covered with such a thick mantle of sand, gravel, and boulders, with scarcely an outcrop of the rock formation, as to render its thorough examination, one of the most difficult geological problems, perhaps to be found in North America. Nevertheless, after the most careful survey of the territory and a close study of all the facts that could possibly be ascertained, aided by the extensive use of pick and shovel, and finally of the Calyx boring rod, we have learnt sufficient to place beyond question the existence of a large and most important coal field. How large and how important has yet to be determined.

The work done to date in this region has revealed the existence of one narrow trough of coal measures, which has been traced 11 miles longitudinally, and from all appearances must continue 5 or 6 miles further. A few good sections were uncovered on the south side of Grand Lake, about a mile from the shore. The first of these on Aldery Brook, exhibited fifteen seams of coal, doubled up almost in the form of the letter U.

Most of the seams are quite small but those over a foot in thickness are:

	Feet	In.
No. 1 Seam	1	6
No. 2 Seam	1	8
No. 3 Seam	2	0
No. 4 Seam	2	6
No. 5 Seam	3	0
No. 6 Seam	6	6

The Reid Co. ran a drift along this latter seam for 150 feet, and took out over 100 tons of beautiful bright coal. This, with perhaps 50 or 60 tons more from other seams close by, is still lying in the woods, crumbling to pieces under the influence of the weather.

On Coal Brook, one and a half miles East of Aldery, the section exposed gave:—

	Feet	In.
No. 1 Seam	1	0
No. 2 Seam	1	0
No. 3 Seam	1	4
No. 4 Seam	1	6
No. 5 Seam	2	4
No. 6 Seam	3	5

The Messrs. Reid mined some 7,000 tons from the latter seam, and used it on their Railway.

On Kelvin Brook, two and a half miles eastward, and on the same line of strike, but a small section could be reached by pick and shovel, and here again nine seams were uncovered, three of which gave the following dimensions:—

	Feet	In.
No. 1	2	6
No. 2	3	8
No. 3	6	2

Three and three-quarter miles eastward of Kelvin Brook, close by the Railway track and about a mile beyond Goose Brook, three seams were uncovered some years ago, and one of them was mined to some extent by the Messrs. Reid. After they had abandoned the enterprise, the Calyx boring drill was brought into requisition, and sixteen holes were put down near Goose Brook, resulting in the locating of a new trough of the Coal Measures, containing thirteen new coal seams. Most of these were again small, but omitting those already mentioned near Goose Brook, we have:—

	Feet	In.
No. 1 Seam	3	0
No. 2 Seam	2	6
No. 3 Seam	1	0
No. 4 Seam	2	4
No. 5 Seam	1	0
No. 6 Seam	1	6
No. 7 Seam	4	4
No. 8 Seam	6	0

I would merely add here that we do not yet know the full extent of any of those coal fields, and it may take many years, if ever, to find out all there is yet to be learned about them. I am quite convinced from what I have seen, that there is yet at least one other trough of coal measures nearer the Grand Lake, of which we know nothing, as to its extent and value, or of its coal contents.

It has taken a long time to beat down the prejudice and remove the indifference displayed about our native coal deposits. Now that happily there seems to be a growing belief in their existence, I hope it will not take quite so long to get things in motion.

Just so our timber growth was once looked upon as useless, rotten scrub and unfit for any purpose, until a great captain of industry, in the person of Lord Northcliffe, was forthcoming, to demonstrate the contrary. He could see that in it we possessed a vast pulp and paper supply, and was willing to invest his millions in utilizing it. So it is with our coal, at present lying idle and useless in the bowels of the earth, believed in by few, decried by the many. Is it to remain there unutilized for all time to come? At present we are being bled beyond endurance for an inferior article of this absolutely necessary commodity.

I have done my part to bring the knowledge of these coal deposits to the public; I cannot do much more. It is now up to those who possess or can command capital to do the rest.

For my own part I see in this coal question more promise of remunerative results than in any other mining enterprise in the Island, not excepting the Bell Island Iron Mines.

I have the best of authority for stating that over $100,000 were expended on the latter before one cargo of ore was shipped, or before one cent was returned on the outlay. Even then, it was uphill work for a long time to secure a favourable footing for this ore in foreign markets. The English iron masters would not touch it, and the Americans had such an abundant supply of their own that they did not want it. But the energy and perseverance of the Nova Scotia Steel Co. overcame all obstacles and now the ore finds favor everywhere.

The whole question of the World's future coal supply is engaging the serious attention of scientists. The enormous rate of consumption of this absolutely necessary fuel in the World's industrial advancement is causing its diminution at so rapid a rate that fears are being entertained that the visible supply will not hold out to any lengthened period.

Acting upon this impression, a meeting is to be held in Toronto during the coming summer, of the International Geological Congress, to consider the matter fully. Persons from every country containing coal, or who know anything about their coal resources, have been invited to visit the Congress and read or furnish papers, setting forth as fully as possible what their country's coal prospects are.

I have received an invitation amongst others, either to attend in person or furnish a paper on our Newfoundland Coal areas, etc., and have already complied by forwarding the fullest information in my possession. Should I not be able to attend in person, this paper will be read before the Congress and incorporated in the publication of the proceedings later. It is to be hoped that it may have the effect of drawing attention as fully to this country's coal resources, as a previous one on our iron ore resources read at a Congress, held in Stockholm two years ago, had.

As regards the importance of our coal deposits, I shall quote here a few notes from two of the highest scientific authorities.

Some years ago I had quite a correspondence with the late Sir Wm. Dawson, Principal of McGill University, a great authority on Carboniferous geology, to whom I had submitted all my facts relative to our coal fields. He wrote me as follows: "Your Government might make a point as to the west shore, by informing the English Government of the value of the coals on the west coast and their prospective importance to Britain and Newfoundland, as well as to the other colonies. You have the nearest coal to England on this side of the Atlantic."

This was before the settlement of the French Shore question.

In 1896, Sir Herbert Murray, the then Governor, who took a deep interest in this question, asked me for a report upon our coal fields, which was forwarded to the Imperial Government, and submitted by the Colonial Office to the eminent head of the English Geological Survey, Sir Archibald Geikie. After studying all the facts contained therein, Sir Archibald in replying to Mr. Chamberlain, the then Secretary for the Colonies, said, amongst other things: "There can be no doubt that the development of these coal fields will be of the utmost importance in the progress of the Colony."

Upon the development of the Coal fields all the other mineral industries will largely depend.

It may prove interesting to give here a few notes of comparison between the Sydney, C.B., coal fields, and those of Newfoundland.

According to Mr. Richard Brown, F.G.S., who made an exhaustive study of the Cape Breton Coal Fields, the result of which was publsihed in 1871, his estimate of the total thickness of coal measure strata at Sydney Harbor was 1,860 feet.

In this section there are 23 distinct coal seams aggregating 36′ 3″ of coal, only four of which were then considered workable, viz., the Cranberry Head seam 3′ 8″; Lloyd's Cove seam 6′ 0″; Sydney main seam 6′ 0″; Indian Cove seam 4′ 8″. Of the remaining 19 seams, four only are over a foot in thickness, one of these, the stony seam, having 3′ of coal, but it was so split up by partings of clay and shale as to be considered valueless. All the remainder run from 2″ to 1 foot only. Fourteen of the nineteen scarcely average 6″ each.

From this it will be seen that the percentage of workable seams in Sydney is very small, and the average of coal to rock is about one foot of coal to every 51½ feet of strata.

So far as our investigations in the Bay St. George and Grand Lake coal areas have been prosecuted, the conditions and occurrence of coal in the series appear to be almost identical. In fact, the proportions of coal to strata in some cases would seem to be in our favour.

In Bay St. George section it has been shown that sixteen seams, aggregating 27 feet of coal altogether, have been located, and there is scarcely a doubt that others still exist which will require the use of the boring rod to locate. As stated already, no boring has yet been undertaken in this section.

According to the measurement of the sections in which coal occurs here, there is a thickness of some 2,963 feet, or about one foot of coal in every 110 feet of strata.

Of the sixteen seams mentioned, four are of the following dimensions: The Jukes', which averages 6′ 4″; Murray, 5′ Howley, 4′ 2″, and Cleary seam, 2′ 0″. It will thus be seen we have here at least four seams of workable dimensions, or the same number as at Sydney, but the latter are somewhat thicker, aggregating 20′ 4″ for the four seams, whereas ours aggregate 17′ 6″, the difference being only 2′ 10″. Of the remaining 12 seams in this Bay St. George section, five are over one foot thick, being one more than the Sydney section shows.

When we turn to the Grand Lake area we find in the various sections measured, an even better showing.

On Aldery Brook there are 15 coal seams exposed in a vertical thickness of about 1,200 feet or one seam to every 80 feet of strata. Six of these again show 2' 0", 2' 6", 3' and 6' 6"; 1' 8" and 1' 6" gating 17' 2", or 1 foot of coal in 70' strata.

At Coal Brook, nine seams occur in a thickness of 720 feet, or one in 80' of strata, six of which aggregate 10' 7", or 1 foot of coal to 68 feet of strata. Two of these show 2' 4" and 3' 5" respectively.

On Kelvin Brook in a section of 946' we have nine seams aggregating about 14' 0", or one seam to about 105' of strata, or 1 foot of coal to 67 feet of strata. Three of these are of the following dimensions: 2′ 6″, 3′ 8″ and 6′ 2″.

In the section near Goose Brook, 20 seams were located in about 1,300 feet of thickness, or one seam to 68 feet of strata. These twenty seams aggregate about 32 feet of coal, which gives an average of 1′ of coal to every 40½ feet strata, being 10 feet less of rock to each foot of coal, than the Sydney section shows.

So you will see that the comparisons of actual coal contents do not differ so very much, and on the whole the resemblance is very striking.

In conclusion I shall just add a few closing remarks as to the cost of raising, shipping and marketing our coal, etc. Once the preliminary operations of erecting the necessary plant, making connections, and establishing a coal depot at some suitable locality for shipping were completed, I cannot see why this coal could not be mined and put on board ship just as cheaply as the product of the Cape Breton mines is to-day.

Let us take for example the Juke's seam in Bay St. George. This seam is so situated that it can be stripped of its cover, which is comparatively light, and for a long time it could be mined by quarrying or open cast, as it is termed. Much of it lies above the level of the Barachois River, and all the coal it contains down to that level, can be easily won. So far as I am aware there is no mineral product in the Island which could be more easily or cheaply mined, nor is there any that would give a greater yield for the same amount of labour. Two men could certainly with ordinary tools, mine 3 or 4 tons per day with the greatest ease. At the ordinary rate of miners' wages of $2.00 a day each, we have the cost of mining just $1.00 per ton, 20 cents more should be ample to remove it to the surface and dump it on board cars, at the mouth of the drifts or tunnels.

According as sufficient working space were made, more and more miners could be put on; fifty men could, without difficulty, mine 100 tons per day. Of course as soon as regular coal cutting machinery were substituted for manual labour, the output could be greatly increased.

Were a short connecting railway of about 8 miles constructed to tap the Reid system near Salt Springs, the coal would then be brought within 60 miles of Port aux Basques, where a depot might be established, which would be acessible all the year round. At the present railway rate of 7/6 of a cent per ton, per mile, the carriage thence would amount to 42 cents freight, or a total cost per ton at Port aux Basques, of $1.62. Allowing 38 cents more for handling and putting aboard ship, the coal should stand, when leaving the shipping point, not more than $2.00. The cost of freight from thence to our east coast markets, and the handling, storage or other expenses connected therewith, should be about the same as from Sydney, whatever they may amount to, certainly not more.

Assuming that the water borne freight was $2.00 per ton, and the handling, storage, etc., 50 cents, the coal should cost, landed here in St. John's somewhere in the vicinity of $4.50 per ton, at the outside. As there would be no duty levied on local coal, surely ours could compete favourably with any imported, even though the cost to the consumer were a dollar less than we are now paying, and that, too, for such a poor quality of fuel. Of course, in the above figures, I am only taking into account the cost of actual mining, transportation and shipping of the coal to our local markets, after a mine was fully established and all necessary connections and facilities for transportation, etc., were provided.

I fully recognize that a large sum of money would have to be expended to provide these facilities. I might say the whole question of utilizing our coal hinges on this latter point.

Having first established the fact that the coal is there in sufficient quantity, and of good quality, the question as to whether our present consumption, and the cost of mining and shipping would warrant going to the great expense entailed by the other requisites, is the one to be considered, and as to whether the profits on the coal would afford sufficient interest on the outlay or not. These are all questions for business men to determine. I do not profess to be sufficiently well posted on such matters myself. My humble opinion is, however, that when in full swing one year's profits would cover all the other expenses.

I append a few extracts from independent sources of qualified experts re our coal, to further bear out my statements, also analyses of the coals made some years ago by undoubted authorities of high repute.

Mr. Hugh Fletcher, Sr., Mining Engineer, visited and inspected the Cleary Coal areas in Bay St. George in 1874.

Speaking of the Jukes' seam Mr. Fletcher says: "The coal in this seam is bituminous, free from Sulphur, and of the very best quality."

"The smaller 2 foot (or Cleary Seam) showed coal of the same quality as the larger (Jukes') seam, but with a few traces of sulphur."

He also speaks of a small seam of "two or three inches of pure Cannel," which I did not see.

Mr. A. D. Turnbull, M.E., who inspected the Cleary Coal areas in 1910 says of the Jukes' seam: "The seam has been exposed for a length of 102 feet and averages about 4 feet in thickness. The coal is excellent."

Again, "the Murray seam also a fine seam, etc." He adds, "there are several small outcrops on the Middle Barachoix River along the S. W. boundary of your claims. In fact there are indications of coal all over the property."

Of the Howley seam on Robinson's River, he says: "The average thickness of this seam is about 4 feet with a tendency to thicken. Some 80 feet of the seam have been exposed, and there is a fine solid block of coal in view."

In 1890 a Mr. Geddes, coal expert, Edinburgh, Scotland, examined several specimens of our coal I sent him at the instance of the late James Murray, M.H.A. and this is what Mr. G. remarks:

"From the general character of the coal, I do not think in the meantime an analysis of any of the specimens will be required, as there can be no doubt that the whole consists of coal of good quality, suited, I would say, for both household and for manufacturing purposes—the specimens showing seams very similar in character to what we have to deal with in Scotland. The characteristics of No. 1 are very much those of a seam of coal of the Midlothian coal field, which has not been worked for many years, but which was highly prized and commanded the best price in the Edinburgh market.

"None of the specimens are of the character of the coals in the North of England, known as manufacturing coals, by which term there coking coals are meant; but so far as the manufacture of iron is concerned, there are specimens among those you send me which answer this purpose admirably I think."

	From Coal Brook.		From Kelvin Brook.
	No. 3.	No. 4.	No. 1.
Moisture	9.93	5.02	8.44
Volatile Matter	24.01	31.25	28.54
Fixed Carbon..	49.15	54.03	50.07
Ash..........................	16.14	8.66	11.53
Sulphur....	.77	1.04	1.42
	100.000	100.000	100.000
Coke in closed vessel	66.06	63.73	63.92

FROM BAY ST. GEORGE.

	Cleary Seam	Jukes Seam	Howley Seam	Shears Seam
Moisture	3.548	3·036	2·784	4·90
Volatile matter	30.897	30·344	29·784	33·12
Fixed Carbon	55·229	60·142	54·468	not given
Sulphur	3·946	1·963	3·047	0·44
Ash	6·380	4·515	10·430	3·16
	100·000	100·000	100·000	Coke 61·371*

* The evaporative power of this coal expressed in pounds of water evaporated by one lb. of coal at 212 F. was 12.371, which considerably exceeds that of North Sydney, or the best Scotch, Welsh or English coals.

*FROM ALDERY BROOK, GRAND LAKE.

	No 2.	No. 6.	No. 7.	No. 9.	No. 15.	No. 16.	No. 17.	No. 20.
Moisture	10·22	5·80	10·77	13·71	15·78	5·82	4·32	7·41
Volatile Matter.......	24·39	31·44	16·55	26·83	30·30	33·62	16·84	30 73
Fixed Carbon.........	48·51	57·86	33 89	51·06	45 29	55 28	72 66	52·49
Ash	15·72	4·08	37·86	7·56	8 08	4·49	5·53	7·71
Sulphur...........	1·16	·82	·93	·84	·55	·79	·85	·66
	100·000	100·000	100·000	100 000	100·000	100·000	100·000	100·000
Coke in closed vessel	65·39	62·76	72 68	59·56	33·92	60·56	78·84	61·86

* These latter assays were made for the Government, by Wm. H. Fitton, F.G.S., F.S.Sc., M.E., England, in 1892