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SUMMARY REPORTS
OF THE
OPERATIONS OF THE GEOLOGICAL SURVEY
FOR THE YEAR 1889.

DEPARTMENT OF THE INTERIOR,
GEOLOGICAL AND NATURAL HISTORY SURVEY AND MUSEUM BRANCH,
OTTAWA, 31st December, 1889.

The Hon. EDGAR DEWDNEY, M. P.,
Minister of the Interior,
Ottawa.

SIR,—I have the honor to submit herewith the customary summary report of the work of the Geological and Natural History Survey corps during the past calendar year.

From January to May was occupied in the preparation of the reports and maps that have since been published, forming a volume, in two parts, of about 1,400 pages, with numerous maps and illustrations. It contains thirteen separate reports, relating to the geology, the mineral resources and the natural history of various portions of the Dominion, from British Columbia and the North-West to Hudson's Bay and Nova Scotia.

The following publications have also been prepared and published during the year:—

1. Vol. I., Part 2, Contributions to Canadian Palæontology.
2. Description of eight new species of fossils from the Cambro-silurian rocks of Manitoba, with six plates.
3. Contributions to the Micro-Palæontology of the Cambro-silurian rocks of Canada: by Ulrich.
4. List of publications of the Geological and Natural History Survey of Canada from 1843 to 1889, with prices, and a brief description of the contents and the arrangement of the Museum and Library. 36 pp., R. 8vo.

There are also in preparation and in part ready for press :

1. Enumeration of Canadian Liverworts, with Notes.
2. Part V. of the Catalogue of Canadian Plants.
3. Catalogue of Canadian Birds, with their Habits and Range ;
also list of species now represented in the Museum.
4. The Vertebrate fossil fauna of the Tertiary rocks of the North-West, with plates : by Prof. E. Cope.

Early in April, 16 parties were organized for field exploration, and were distributed as follows :—British Columbia, 3 ; North-West Territory, 2 ; Manitoba, 1 ; Ontario, 2 ; Quebec, 4 ; New Brunswick, 2 ; Nova Scotia, 2. A brief summary of these explorations is given in the following pages ; as well as of the work that has been performed in connection with the Museum, the Chemical Laboratory and the Library.

Up to the end of June my own time was fully and constantly occupied in attending to executive details, in answering enquiries verbally and by letter, and in work connected with editing the Annual Report and maps above referred to. On the 5th June I left Ottawa, for the purpose of making some observations at various points along the north shore of the lower St. Lawrence and in the Strait of Belle Ile. This was effected by securing a passage on board the Lighthouse Service steamer "Napoleon," but afforded opportunities for examination only at widely separated points, mostly at or in the vicinity of the lighthouses, along the great stretch over 500 miles of coast line, extending from Point de Monts to Belle Ile. Some interesting facts were, however, ascertained, and I have acquired such a general knowledge of the character of the country as will enable me better to direct any future explorations that may be undertaken in this region with a view of ascertaining what its mineral resources are. In this connection it may be stated that Belle Ile itself, hitherto supposed to be composed of Laurentian gneiss, was found to consist largely, if not wholly, of various crystalline and sub-crystalline strata, like those of the Huronian mineral-bearing belts of the country north and west of Lakes Huron and Superior, and it is not improbable that considerable areas of these rocks may yet be found on the main land of Labrador ; and, if so, they may expect to be accompanied by deposits of valuable economic minerals, like those which characterize them in all the areas where they have yet been recognized and explored.

Hasty examinations were made, and specimens collected, at the following places :—Point de Monts, Egg Island, Pentecoste, Sheldrake, Seven Islands, Perroquette Island, Esquimax Island, West, South-west and South points of Anticosti, Greenly Island, Point Amour, Chateau Bay and Belle Ile ; and in Newfoundland at Cape Bauld and Quirbon

Harbor, and at Capes Norman and Rich. The geological formations of the northern peninsula of Newfoundland have been described in the *Geology of Canada*, 1863, and are there all referred to one or other of the divisions—Levis, Lauzon and Sillery—of the Quebec group. From what I have seen this summer I am led to believe that the true order of succession of the strata has been misinterpreted, as it was in the Eastern Townships, and that much of the so-called Sillery and Lauzon is probably Huronian, but certainly not more recent than Lower Cambrian. Diorites and serpentines appear to be somewhat largely developed, and it seems quite likely that valuable deposits of asbestos may accompany them, as they do in the Eastern Townships of Quebec.

In this connection it may be interesting to quote some passages from a Memoir by A. S. Packard, Jr., read before the Boston Society of Natural History, October, 1865, and published in Vol. I of its Memoirs.

On page 216, under the heading "Huronian Group," he says: "A system of quartzite and trap rocks which lie in a depression of the Laurentian rocks, about 125 miles long and probably 25 miles broad, stretching along the coast between Domino Harbor and Cape Webuc, I refer with some hesitancy to the Huronian series of Sir Wm. Logan, and consider as probably equivalent to the Quartzose division of the primitive slate formation of Newman and Keilhau. It agrees in part with the Domino gneiss of Mr. Lieber." The author then gives further interesting details of these strata, and in conclusion, page 218, says: "Should further search prove the existence, in connection with this quartzite, of beds of a true conglomerate, which we should look for in the interior, and of the presence of copper ore in connection with quartz veins near the trap rock, the identity of this formation with the Huronian rocks of Canada and of similar rocks in Sweden would seem satisfactory; and, if proven, will be interesting, not only to the geologist, but be of practical value in the search for ores on this coast."

Mr. Packard also describes the remarkable columnar basaltic, trap rocks of Castle and Henley Islands, in Chateau Bay, but I think erroneously assigns them to the Laurentian. From their attitude and appearance, they are, I think, more probably of Cambrian age and equivalent to the Animikie of Thunder Bay, Lake Superior, Lake Nipigon, and the islands on the eastern shores of Hudson's Bay. No such rocks are, so far as I am aware, associated anywhere with the Laurentian system. If this proves to be correct, we may expect to find areas in East Main and Labrador of both the Archæan (Huronian)

and the Cambrian (Animikie) metaliferous-bearing zones of Lake Superior. The white quartzites of Marble Island, described by Dr. Bell* as Huronian, seem to correspond closely with those described by Mr. Packard at Domino Harbor and Cape Webuc, while the columnar basalts of Castle and Henley Islands, Chateau Bay, are almost identical with those of Castle Peninsula, Richmond Gulf, † the Outer and Inner Barns of Lake Nipigon and the better known trap formation of Thunder Cape, Pie Island and McKay's Mountain, on Lake Superior.

At Sheldrake near the eastern end of the Seignoiry of Mingan, and both east and west of the settlement, the coast is occupied by massive Labradorite rocks. On shore, where tidal action has polished these rocks, some fine examples of the beautiful opalescent anorthosite or labrador spar were observed, but specimens could not be easily obtained without appliances for blasting the rock. Inland for a considerable distance, where the vegetation has been burnt, the weathered surfaces of these rocks are perfectly white, making the country look as if there had been a heavy fall of snow. The extent of the area of these rocks in this region is entirely unknown. It is not impossible that it is continuous with that described by Prof. Hind, on the Moisie River and its branches, ‡ and that this again extends continuously south-eastward to Pentecoste River, where similar rocks occur as described by Richardson.§ We should then have in this region the largest known area in Canada of these Norian rocks, and here doubtless it would not be difficult to determine their true relations to the red and grey granitoid orthoclase gneisses, which they have been supposed to unconformably overlie. There can, however, be little doubt that they are intrusive igneous rocks. On the 29th July I returned to Quebec, where Prof. C. Walcott, of the United States Geological Survey, met me by appointment, for the purpose of examining some of the typical sections around Quebec, on the correct interpretation of which so much has of late years been said and written by the geologists of the United States and Canada.

From the 14th to the 23rd August I was occupied, in company with Prof. Walcott, in studying the relations of the Cambrian and Cambro-silurian formations on either side of the boundary between Vermont and Canada, with a view to uniformity of mapping by the respective surveys, and which, it is hoped, will now be secured.

After attending the meeting of the American Association for the Advancement of Science, in Toronto, from the 28th of August to the

* Report Geological Survey of Canada, 1882-83-84 P. 35 D.D.,

† Bell—Geological Survey of Canada, Report 1877-78, p. 14c.

‡ Explorations in the interior of the Labrador Peninsula, 1863.

§ Geological Survey of Canada, Report 66-69, p. 307.

2nd of September, a few days were spent—with a similar object in view to that above referred to, but in connection with the work now in progress along the Minnesota boundary, in company with Professor N. H. Winchell, of the United States Survey, and Dr. Lawson—studying the Huronian rocks around Sudbury and Algoma, and in an endeavour to show that the metaliferous Huronian strata of the Sudbury-Algoma region do not differ in any important particular from the similarly metaliferous schists, etc., which occur in the country between Lake Superior and Lake Winnipeg, including the Lake of the Woods, and Rainy Lake and River. In connection with this matter, and the importance of the work of tracing out and mapping these bands or belts of Huronian rocks, I may here quote what I wrote respecting it in 1873: * *

“Apart from the geological interest which attaches to the determination of the distribution of these rocks and their precise relations to the underlying Laurentian gneiss, the foregoing facts show that it is economically important that the extent of these bands be defined; and that their mineral characters should be closely investigated is equally so, inasmuch as the gold, the copper and the iron of the region, as far as known, are associated with similar strata, and thus not only the best land, but likewise valuable mineral deposits are to be looked for within the limits which they occupy.” * *

Since the above was written, nearly all the discoveries and developments of mines and minerals in the Huronian areas that have been indicated by the Survey have been made. That these facts are somewhat of the nature of cause and effect may, I think, reasonably be surmised; and whether they prove the truth or otherwise of the reiterated and apparently somewhat popular statements that of recent years the Survey has paid no attention to and takes no interest in the development of the mineral resources of the country, may perhaps be left to the decision of the public and to the testimony of the sixteen volumes of reports, maps and other documents that have been published by the Survey since 1870.

In the enormous area which stretches from the Georgian Bay north-west to the Mackenzie River, and from the same point north-east to the Straits of Belle Ile and Cape Chulleigh, there are probably many such areas to be investigated and located; and a map on which they are even roughly indicated will always be a valuable guide to the mineral prospector.

The rest of the season, from the 9th of September to the 10th of October, the date of my return to Ottawa, was devoted to investiga-

tions and enquiries bearing on water supply in the North-West. The artesian wells of the James River valley and Devil's Lake, in Dakota, were visited, and also the boring now in progress at Deloraine. The quality of the water in the Dakota wells varies considerably. Most of the wells give a copious supply of excellent water. At Devil's Lake, however, though a copious supply was obtained at about 1,750 feet, the water, though good for stock, contains too much saline matter for ordinary domestic uses. There seems every probability, when a sufficient depth has been reached at Deloraine, of a good supply of artesian water being obtained. What the quality will be there is no evidence to show, but this is not now important, because even if as saline as is much of the surface and the artesian water of the Red River valley, it can, by a simple and inexpensive process of filtration, be made sufficiently pure for all domestic uses. This has recently been proved by experiments made at my suggestion on some of the most saline water of the Red River valley south of Winnipeg. It consists in simple filtration through from 50 to 60 feet of sandy gravel. Further experiments will perhaps suggest additions to the material used that would render the process still more perfect. Even as it is, the importance and value of this discovery to the whole of Manitoba and the North-West in such seasons as that of 1889 can scarcely be estimated.

The history of the discovery and development of natural gas in Ontario, to which I briefly referred in my last summary report, is interesting; but as it is somewhat of a personal character, I shall not now refer to it. The results attained during the past year are stated under the head of mineral statistics. They are highly satisfactory; but it would be well to bear in mind that the supply is not inexhaustible, and that wells that are now sending out their millions of cubic feet a day will gradually decline and become extinct. The greater the number of wells bored in a district the sooner will this inevitable event occur. Unlike water, neither gas, nor oil, nor coal, are constantly replenished, and must therefore sooner or later be exhausted. I called attention to this in my summary report for 1887, pages 24-25; and on page 30 of my summary report for 1888, in commenting on Mr. Coste's report on investigations I had directed him to make the spring of that year. I said: "There seems no reason why further trials, especially in that part of Ontario between Lake St. Clair on the south-west and Lake Simcoe on the north-east, should not prove more successful and yield as abundant a supply of gas or petroleum as do some of the Ohio wells." Since that expression of opinion, all the large gas wells now referred to have been bored.

Dr. G. M. Dawson was, during the past season, again occupied in continuing the geological exploration of the southern part of the province of British Columbia. In consequence of the recent important mineral discoveries in the West Kootanie district, it was considered desirable that he should visit that district in the first instance, and should afterwards give as much time as possible to the completion of the more systematic work on which he had previously been engaged in the Kamloops region. Dr. Dawson, who was assisted by Mr. McEvoy, B., Ap. Sc., and by Mr. P. Edgar, furnishes the following summary account of the explorations carried out:—

“About a month, in the earlier part of the summer, was devoted to the examination of the more important localities in the West Kootanie district, which have lately been proved to afford valuable ores. While I was occupied in this work, accompanied by Mr. Edgar, Mr. McEvoy was independently engaged in examining a stretch of country between the North Thompson and Bonaparte Rivers, along the northern edge of the geological map-sheet now in course of completion. Work during the remainder of the season was practically confined to the area of the sheet just referred to.

“It should be explained that, in conformity with the suggestion made in last year's Summary Report, the area covered by the original reconnaissance map of the Southern Interior portion of British Columbia was divided into four equal parts, each forming a square of eighty miles side, and including a superficies of 6,400 square miles. The scale was at the same time increased from that of eight miles to that of four miles to the inch, and a preliminary compilation on that scale was made by Mr. McEvoy before field work commenced. The sheet to which the field work of last summer related extends in longitude from the vicinity of the North Thompson to that of Lillooet (long. $120^{\circ} 10'$ to 122°), in latitude from $50^{\circ} 10'$ to $51^{\circ} 20'$. The exploratory work required for this sheet may now be considered as completed, with the exception of a belt of mountainous country to the west of the Fraser between Lillooet and Lytton. The enlargement of the scale of the map will enable greater justice to be done to the somewhat complicated geological and topographical features of the country.

“The Kootanie district, to the south of the line of the Canadian Pacific Railway, is naturally separated by the high, rugged, axial portions of the Selkirk and Purcell ranges, into eastern and western sub-districts. The first of these may be reached by ascending the Columbia from Golden, the second from Revelstoke, by way of the Columbia River and Arrow Lakes. Much prospecting has been going on in both East and West Kootanie for the past two or three years, and

a large number of promising discoveries—chiefly of silver-bearing ore—have been made. The West Kootanie sub-district was that visited by me last summer, and in it no previous observations by officers of the Survey had been made, with the exception of a traverse of the Columbia and Arrow Lakes by Mr. Bowman in 1884.

“Attention was first permanently drawn to the mineral wealth of the West Kootanie region when the discovery of rich ore by the Hall Brothers on a mountain which has since been known as Toad Mountain became known in 1887. Many prospectors soon flocked to the vicinity and a large number of claims have since been taken up, not only on and near Toad Mountain, but also at Hot Springs or Ainsworth, on the west side of Kootanie Lake, at Hendryx on the opposite side, and at many outlying localities. At Nelson and Ainsworth town sites have been laid out, and the first steps toward the establishment of permanent mining centres have been taken.

“Speaking generally of the district, I may say that the result of my examination has been to convince me that the importance of the mineral discoveries made has not been exaggerated, while their number and the area over which they are distributed is such as to guarantee a large and continuous output of good ore so soon as adequate means are provided for the transport of the product to market. As a number of details respecting the various deposits (chiefly obtained through the kindness of Messrs. G. B. Wright and G. M. Sproat) have already been given in my report on ‘The Mineral Wealth of British Columbia,’ recently printed, it will not be necessary in the present summary to speak of the individual claims and deposits visited by me. These particulars I hope to embody in a more comprehensive report shortly to be published. It may be noted, however, that in nearly every instance the result of my personal examination has been to verify the accuracy of the statements made in the publication just alluded to.

“The majority of the ores met with are to be classed as silver ores, and in the vicinity of Hot Springs and Hendryx these are for the most part argentiferous galenas, which, in a number of instances near Hot Springs, are decomposed to a considerable depth, forming so-called ‘carbonate ores.’ These possess a special value owing to the ease with which they are worked and their importance in the process of smelting the unaltered galenas. The aggregate quantity of such ‘carbonate ores’ to be found in the deposits already proved must be great, but all will no doubt pass in depth into sulphide ores.

“At Hot Springs or Ainsworth a truly remarkable number of metalliferous veins has already been brought to light within a very limited area, and additional discoveries are still being made from time

to time even within this area. Near the lake-shore, the country-rock is a coarse mica-schist which is overlain further back by green and grey schists, and these in turn are followed by limestones and black argillaceous schists, a mass of granite bounding the whole at a distance of two to three miles inland. In evident relation to this change in the country-rock is the circumstance that the ores improve almost uniformly in respect to content of silver in crossing the series of veins in a westward direction from the lake and rising higher above the lake-level. Some of the deposits associated with the limestones hold more or less native silver in a filiform condition, and very high assays are frequently obtained from these. It is not yet possible to quote assays of the ores of this vicinity made from specimens collected by myself, but it is safe to say that from several of the claims considerable quantities of ore can already be obtained by ordinary hand picking, which yield from 50 to over 100 ounces of silver to the ton, in addition to a high percentage of lead.

“At Hendryx, the only considerable developments made are those of the New Haven Mining and Smelting Company. The principal feature at this place is a lode of very great size, consisting largely of galena, but classing in respect to silver as a low-grade ore. So soon as efficient means are provided for handling and smelting this ore and shipping the product, a very large output may be counted on.

The Toad Mountain ores differ from the foregoing in containing a large amount of copper and less galena. The Hall Brothers' property, known as the 'Silver King Mine,' from the name of the claim on which most work has been done, is so far the leading one here, and has turned out a considerable quantity of ore, which has approached or surpassed \$300 to the ton in total value as sold at the smelter. Other claims are, however, being opened out, some of which present a very favourable appearance.

“At the east end of Toad Mountain, a whole belt of rusty schistose rocks, containing more or less quartz and much iron pyrites, has been discovered. The superficial portions of this belt have been completely oxidised and afford free-milling gold. This property has been acquired by an English company, known as the Cottonwood Company, and a Huntingdon mill has been erected for the purpose of treating, in the first place, the decomposed surface material, of which there is, in the aggregate, a great quantity in sight. The results of trials so far carried out have not been made public. Should it prove, however, that the deeper pyritous portion of the deposit contains sufficient gold to pay for concentration, roasting and chlorination, the quantity of the ore appears to be almost unlimited. Another gold-bearing deposit, in the

form of a well-defined vein traversing a granite rock, is situated on Eagle Creek, toward the west end of Toad Mountain. Work is being carried on here and a stamp mill is in process of erection.

"Beyond the neighborhood of the better known centres, a great number of discoveries, chiefly of silver ores, are reported throughout the district. Most of these isolated localities time did not permit me to visit. Mention may be made, however, of an extensive deposit of copper-pyrites, on the north side of Kootanie River, nearly opposite Forty-nine Creek, and of a peculiar and apparently important occurrence of magnetic iron-ore on the same side of the river below the lower fall.

"No large quantity of ore has yet been shipped from the deposits of the vicinity of Kootanie Lake and Toad Mountain, but small shipments of hand-picked rich ores have been made from time to time during the two past summers, representing a total value of over \$75,000. The ore has been carried down to the lake-shore on horses or mules, taken by steamer to Bonner's Ferry in Northern Idaho, thence over thirty miles by waggon to the nearest point on the Northern Pacific Railway, and then, as a rule, to Montana, where it has been sold and smelted. The cost per ton of transporting the ores to smelter by this route has not been less than \$30, and when to this is added the cost of mining and clobbering the ore, it is evident that very high-grade ore alone can thus be utilized, while even in the case of deposits capable of yielding a considerable proportion of such high-grade material, the greater part of the ore extracted, embracing the lower grades and requiring concentration, must at present be put to one side.

"It may thus be said that the West Kootanie district is at present waiting merely for some satisfactory outlet for its ores, and the developments already made, though for the most part merely of a preliminary character, are such as in my opinion to justify the expenditure necessary to provide such an outlet at once. It might be added that capital for the proper development of the various discoveries is also required; but this will naturally follow as soon as the district is rendered more accessible, and can only be prevented from doing so, for a longer or shorter time, by the exaggerated ideas of the value of undeveloped properties too apt to prevail among the holders of claims in such new districts.

"The construction of a railway twenty-four miles in length along the unnavigable portion of the Kootanie River, between Nelson on the West Arm of Kootanie Lake and Sproat's Landing on the Columbia, would connect the navigable waters of this lake with those of the Columbia and Arrow Lakes, and would enable ores to reach the Cana-

dian Pacific Railway at Revelstoke. A still more efficient and permanently satisfactory route would, however, be afforded by a direct line of railway from the north end of Kootanie Lake to Revelstoke, a distance of about eighty-six miles by the route which would have to be followed. Of this length of line, however, only that part between Kootanie Lake and the North-east Arm of Upper Arrow Lake need be constructed in the first instance, with a length of about forty-eight miles; the remaining portion of the distance being for a time served by steamer on the Columbia. Still another alternative outlet may also eventually be supplied by a branch line from the Northern Pacific Railway; but it is of importance to the prosperity of the district that it should have a means of communication independent of the rulings of the United States Customs as to the introduction of silver-lead ores, &c., into that country. The metals likely to be produced in quantity in the district are silver, lead and copper, all of which may be sold to advantage at first hand in the markets to which the same metals are exported by the United States.

“For the purpose of treating the ores from the East and West Kootanie districts, a large and well appointed smelter has just been completed at Revelstoke, while arrangements for the erection of a second are in progress at Golden.

“In the above summary, particular prominence has been given to the main features which appear to be of immediate economic importance in the West Kootanie district. It is of course impossible to give here any general review relating to the province as a whole. It may, however, be stated that during the past summer a considerable amount of substantial progress has been made in the exploration of mineral deposits already known, while a number of new discoveries of promise have occurred. The output of ore, which has already in a small way been fairly initiated, will now doubtless increase from year to year, till British Columbia attains the prominence from a mining point of view which her great mineral resources guarantee. The rate at which this development may proceed must depend for the most part on the degree of energy which those primarily interested exhibit.

“I have reason to believe that the publication giving a synoptical account of the minerals of the province, printed last spring under the title of “Mineral Wealth of British Columbia,” has already served a useful purpose, in directing the attention of capital to the province. I may also take this opportunity of stating that gypsum, one of the minerals enumerated in the above mentioned publication among those unknown in British Columbia, has since been discovered, and, according to the accounts received, in large quantity. The locality is stated to

be on the Salmon River, about twenty miles distant from the railway. From the excellent quality of the specimens which I have seen this discovery may prove to be of importance."

Mr. Amos Bowman was occupied during a portion of the summer in continuing the examination of the country on the Lower Fraser River, with special reference to the question of the occurrence of beds of coal or lignite-coal of economic importance. This work was briefly referred to in my last summary report, and the facts then ascertained were given. No report of the past season's work has yet been received from Mr. Bowman.

Mr. R. G. McConnell left Ottawa on the 30th of April, with instructions to explore the almost unknown country north of Lesser Slave Lake, bounded by the Peace and Athabasca Rivers. On this work he reports as follows: "I reached the Athabasca landing on the 19th of May, and descended the Athabasca to near the mouth of the Pelican River. From this point a portage of three miles brought us to the Pelican, some miles above its mouth, and above most of the bad rapids. We then followed the Pelican—a small, winding stream—to its source in Pelican Lake, and crossing the latter, followed up Beaver Creek for a short distance, and then made a portage of a couple of miles across the height of land to Sandy Lake, which drains northward to the Peace. Following the outlet of Sandy Lake, we soon reached the Wabiscaw Lakes, and crossing these, entered the Wabiscaw River, which we descended to its junction with the Loon, and then continued our way down the latter until it emptied into the Peace.

"Loon River, with its continuation, the Wabiscaw, has a length of about 350 miles, and drains an area of over 25,000 square miles. It might be navigated with strong, light-draught steamers, and by using the line in some places, up to the Grand Rapids, a distance of about 150 miles. Its principal tributaries are Bear River, Pine Creek, Panny Creek, Trout River and Wooden-house River—all fair-sized streams, but reported to be very swift and filled with rapids.

"From the mouth of the Loon we ascended the Peace to Fort Vermilion for supplies, and, then returning, explored little Red River for a distance of 200 miles. I ascended this river with the expectation of finding exposures of the bitumen-bearing sands which outcrop along the Athabasca, but failed in this, as the river in its upper part does not cut down below the boulder clay, and for long distances is destitute of any valley whatever. The geological data it affords are in consequence very slight.

“Returning from Red River to Fort Vermilion, a trip with pack-horses was made into the Buffalo-head Hills, after which we continued our way up the Peace to the Peace River landing, making on the way exploratory excursions eastwards into the wooded country which borders the river.

“From the Peace River landing we crossed over to Lesser Slave Lake, and engaging there a small pack-train, started north along an execrable trail for Trout Lake, where we left the horses and pushed on, partly on foot and partly with canoes, until we reached the Wabiscaw and made connection with the previous traverse down that stream. On this trip I sketched in the outlines of White-fish Lake, Loon Lake, Bear Lake, Trout Lake and a host of smaller ones, and crossed and followed for some distance a score of streams, but obtained little geological information, as the country is everywhere so deeply mantled with drift that none of the streams which I examined have succeeded in cutting through it and so exposing the rocks beneath.

“After returning to Lesser Slave Lake I coasted around it, examining on the way the tertiary plateau south of the lake, and Martin Mountain at the north-east corner, and then continued our way down Lesser Slave River to the Athabasca, and down the latter to the Athabasca landing, making side trips on the way to Moose Lake and Baptiste Lake. We arrived at the landing on the 1st October and started at once for Ottawa, arriving there on the 13th October.

“The whole country between the Peace and the Athabasca north of the Loon—an area of about 25,000 square miles—is generally forested, mainly with spruce and poplar, and is everywhere characterized by an abundance of lakes and of muskegs and marshes. Narrow strips of excellent land are usually found along the main rivers and surrounding many of the lakes, and in the interior many areas often equal in size to an eastern county, might be selected which are well adapted for cultivation, but the wide morasses which separate these detract greatly from their value. Numerous streams, mostly draining northwards, everywhere intersect the surface. Few of these have large valleys, and they usually flow in a sluggish manner, often dilating into lakes in the flat districts, but break over the steeper slopes of the country in a series of strong rapids. With the exception of Loon River and Red River, none of the streams are navigable.

“Two ranges of hills cross the district in question. One of these, the Buffalo-head Hills, commences abruptly about fifty miles above the mouth of the Loon, with an elevation of 1,000 feet, and running in a south-south-westerly direction, with a gradually diminishing height, dies away opposite the mouth of Battle River, while the other com-

mences north of the east end of Lesser Slave Lake and extends in an easterly direction towards the Athabasca.

"Excellent sections of the rocks of the country are found along the Peace and Athabasca and the lower parts of the Loon, but the geological information obtained in regard to the interior of the district is small, owing to the almost complete absence of deep valleys or scarped banks showing exposures. The exploration has, however, added largely to our geographical knowledge of this little known region.

"Lignite was found in several places along the Peace River, but in some too small to be workable. It was also found in the Laramie plateau, south of Lesser Slave Lake. Here four seams were found ranging in thickness from one to four feet, besides a number of smaller ones, scattered through about 1,000 feet of shales and sandstone. This lignite is apparently of fair quality, but has not yet been analyzed. Drift lignite was also found in Martin River near the base of Martin Mountain, but was not traced to its source.

"Clay iron stone is of universal occurrence in the Cretaceous shales exposed along the Peace Valley, and, in many places between Battle River and the mouth of the Smoky forms thick accumulations at the foot of the cliffs lining the valley, some of which may prove to be of economic value.

"Gold was found in many of the bars along Peace River and in several places in sufficient quantities to deserve attention. Four miles above the mouth of Battle River is a large bar, nearly a mile long, from which we obtained fifteen or twenty *colours* of fine gold by washing a few handfulls of the mixed gravel and sand in an ordinary frying pan. We tried the bar at several points, and always with the same result. A small stream descends from the plateau on the opposite side of the river, and by leading its waters across the river, which is here 1,000 feet wide, the bar might be easily and inexpensively worked on a large scale. A few miles further up the river another bar was examined, which yielded from twenty to forty *colours* when washed in the way just mentioned.

"A couple of *colours* of gold were washed out in one place on Loon River. This is of some interest, as the Loon heads in a south-easterly direction, and has no connection whatever with the mountains.

"Inspissated petroleum, lining cracks in calcareous nodules, was found along Peace River for some sixty miles below the Peace River landing. At Tar Islands, about thirty miles below the mouth of Smoky River, there is a saline spring which is kept in a constant state

of ebullition by the escape of natural gas. Small quantities of tar line the sides of the spring and float on the surface of the water. This spring and a couple of others which are reported near by, are situated near the axis of a broad, flat anticlinal, one of the essential conditions of a successful oil field. Gas and oil in paying quantities are most frequently found in these great natural domes, and the only element of uncertainty in this district is the presence or absence of some porous formation to act as a reservoir. It is possible that the loose sands found along the Athabasca extend this far, or that some equivalent formation occupies their place, but as natural sections are wanting this can only be proved by artificial sections obtained by boring.

"Bituminous nodules were also observed along the north side of Lesser Slave Lake, and a tar spring is reported on this lake near the mouth of Martin River, but its situation is kept a secret by the Indian who professes to have discovered it.

"The Athabasca River was not examined during the past season, but it is proposed to devote next summer to it and its tributaries.

Cost of season's exploration, \$2,183.63."

Mr. J. B. Tyrrell, assisted by Mr. D. B. Dowling, was engaged during the past season in making a thorough geological examination and completing the surveys of the shores and islands of Lake Winnipegosis. Red Deer, Swan, Dauphin and Waterhen Lakes were also surveyed and examined. The Red Deer River was explored up to the mouth of the Etoimami, and several excursions were made into the Porcupine Mountains. The expedition was eminently successful in obtaining a continuous section from the Cambro-silurian to the Devonian rocks, and in determining the exact contact of the latter with the over-lying Cretaceous beds.

Mr. Tyrrell reports as follows:—

"On 11th May I left Ottawa and proceeded to Winnipeg, where supplies were obtained sufficient to last for the summer, after which I descended the Red River to West Selkirk.

"A small fishing smack had been purchased from Wm. Watts & Son, of Collingwood, and shipped by Canadian Pacific Railway to West Selkirk, whither Mr. Dowling had preceded me by a few days, in order to have the boat launched and properly rigged. Into this the cargo of supplies and general camp equipage, &c., was stowed, and on the afternoon of 23rd May we left West Selkirk and sailed down the river and thence northward across Lake Winnipeg to the mouth of the Little Saskatchewan River.

"In descending the Red River from Winnipeg the banks first seen consist entirely of grey stratified alluvial clay. This deposit gradually decreases in thickness, and at the first rapid the river is found to have cut through these bedded clays into unstratified till containing boulders. From this point downwards the banks constantly show little cliffs of boulder clay containing many boulders of white or cream coloured limestone, mixed with some of gneiss, &c., and from those cliffs are falling the boulders that are afterwards carried into the channel, and there cause the rapids which form such serious impediments to the navigation of the river.

"At Lower Fort Garry the Cambro-silurian limestone makes its appearance for a short distance, and thence to the mouth of the river the banks are generally low and wooded, and the channel is wide and deep, so that boats have no difficulty in ascending the stream after the bar at the south end of the lake is crossed.

"Leaving Red River, a straight course was taken across the lake to the north end of Big Island and thence to Black Island.

"The object we had in view in visiting this latter locality was to examine the deposit of iron ore known to occur on its south shore, owned by the International Smelting and Mining Company, of Winnipeg.

"The island itself lies at the north end of the southern expansion of Lake Winnipeg, fifty-four miles from the mouth of Red River, in a large bay or depression in the east shore of the lake, with deep channels both to the east and west of it; that to the west separates it from Big Island, on which there is now a flourishing Icelandic settlement. It has a total length of twelve miles and three-quarters in a direction N. 56° E, and a general width of four miles and three-eighths, and an area of 40.4 square miles.

"The southern portion of the island is overlain by horizontally stratified sandstone and limestone of Cambro-silurian age, the latter being somewhat similar to that quarried at East Selkirk and used so extensively in Winnipeg as a building stone. The surface of the island is thickly wooded with poplar, birch and spruce.

"Five miles and a-half along the south-east shore from its south-west point, altered and highly inclined rocks are for the first time met with. They consist of light green cericitic schists and quartzites, probably of Huronian age, which are often externally reddened by oxide of iron. When first met with they strike N. 15° E. and S. 15° W., and dip at angles varying from 60° to 75°. These schists outcrop along the shore for a distance of 450 paces, forming generally a rough, irregular beach which slopes gradually into the water.

"Towards the north-east end of the exposure, however, a low rugged cliff rises above and behind the sloping beach, and on examination this cliff is found to consist in the centre of a mass of hematite, which extends along the shore for a distance of a hundred paces and rises to the height of seven feet above the water. As shown in sections running back from the shore, it dips away from the lake at an angle of 30° , and in the vicinity of the mass of ore the bedding of the schist is almost entirely obliterated.

"The ore is a more or less pure hematite, not very compact on any of the exposed surfaces, and with numerous little seams and particles of crystalline calcite scattered throughout the mass, along with which are also a number of small lenticules and crystals of quartz. In some places, especially near the outside of the mass, the hematite assumes quite a pisolitic or botryoidal structure, the spherules being often arranged in very well defined rows, the interspaces of which are filled with calcite.

"Towards the outside of the mass in places the ore has been converted for from a few inches to a foot into a hydrated oxide of iron or limonite.

"No analyses have yet been made of the typical specimens collected during the past summer, but a number of analyses have been made of specimens previously sent in from Black Island, both in the laboratory of the Geological Survey of Canada and by Messrs. Gilchrist, Riley and Miller, in London, England.

"These show an amount of metallic iron ranging from 53.99 per cent. downwards. None were found to contain more than a trace of phosphorus. One specimen gave on analysis 2.026 per cent. of sulphur, the sulphur being present in the ore as finely disseminated iron pyrites, while three other specimens show respectively 0.07, 0.12 and 0.032 per cent. of this impurity. In the other five analyses the sulphur was not determined. No iron pyrites was seen in the general run of the ore, but indications of decayed nodules could be traced in a very few places as yellow incrustations on the surface of the rock, and two or three small nodules were seen lying loose at the bottom of the cliff.

"As stated above, the deposit extends for about 300 feet along the shore, which has here a direction of $N. 70^\circ E.$, rises to a height of seven feet in the centre of the exposure, and dips back from the shore at an angle of 30° . The direction of its strike differs very materially from that obtained for the schists at the south-west end of the exposure, but in the immediate vicinity of the ore itself the bedding was entirely or almost entirely obliterated, so that it was impossible to determine

in the short time at my disposal whether it was a true bedded deposit, or a lenticular inclusion in the schists.

“The hematite is underlain at the water's edge by a green quartzitic schist, and is overlain by a greenish white argillaceous breccia from one to two feet in thickness. Overlying this is a mixture of quartzite (or infiltrated quartz) and rather hard green schist, containing a considerable quantity of hematite. This quartzose band is again overlain by light green argillaceous or cericitic schists, very much crumpled, but generally dipping at an angle of 60° and striking on the west side of the ore N. 50° E. and S. 50° W. Beyond this is twelve feet of light green soft cericitic schist, and this then runs into the harder and more quartzitic schists, which comprise the rest of the whole exposure of Huronian rocks along this part of the shore.

“On our way north from Black Island we stopped for a short time at the north end of Big Island, at Big Grindstone Point and at Deer Island. The cliffs at these places present some very interesting geological features, being capped by compact impure Trenton limestone, below which are white, more or less soft, sandstones, interstratified with bands of light blue clay shale. These sandstone beds have been referred by Mr. Billings to the horizon of the Chazy of Eastern Canada, on the evidence of a few obscure fossils. These rocks require a much more extended examination, but some fossils were this year obtained from them, which, it is hoped, may determine more accurately their taxonomic position.

“At Deer Island we were delayed several days by heavy north-west winds, so that it became advisable to secure the services of a little steamer that was passing, and obtain a tow to Swampy Island. While waiting at this island for the wind to moderate I secured a fine collection of fossils from a cliff of Trenton limestone, a mile west of the Fishing station. These were immediately packed and, along with the fossils and rock specimens from Black, Big and Deer Islands, and Grindstone Point, were shipped directly to Ottawa, where some of them have since been examined, and are described by Mr. Whiteaves in the Transactions of the Royal Society of Canada, Volume VII.

“From Swampy Island we sailed to the mouth of the Little Saskatchewan River, where the services of several Indians were secured, and the next four days were spent in tracking and poling the boat and canoes with their loads of provisions up to St. Martin's Lake, after which the greater part of a day was occupied in ascending the Partridge Crop River to Lake Manitoba. It was late in the evening of Saturday, the 10th of June, when we arrived at Manitoba House, where we were hospitably received by Mr. and Mrs. Armit.

"The Little Saskatchewan River, from Lake St. Martin to Lake Winnipeg, is for much of the way a swift stream 250 feet wide, and with a depth varying according to the seasons from one to five or six feet. It has a total length of 31.2 miles and a fall in this distance of eighty-five feet, the larger part of which is accumulated into the lowest seven miles of its course.

"Following the river upwards from its mouth for 1.1 mile, the banks are generally low and consist of stratified alluvial clay without pebbles or boulders. The water is moderately deep and flows with an easy current. At this point, however, a light brown calcareous sandstone makes its appearance at the bottom of the bank. This sandstone is in general horizontally bedded, though sometimes slightly undulating, and a few obscure fossils found in it show it to be of the age of the Hudson River formation. It is exposed in low outcrops along the bank for 1.75 mile, when it finally disappears. Throughout the distance it is overlain by stratified blue clay, five or six feet in thickness.

"Above the last outcrop of bedded rock the banks rise rapidly to a height of twenty feet above the bed of the stream, and are here seen to be composed of light grey unstratified boulder clay or till, containing pebbles and boulders, chiefly of white limestone, though some are of gneiss; above which the banks again fall, relatively to the stream, till at the distance of 7.5 miles from the mouth they are only four feet above the water. At this latter point there is another low exposure of rock, consisting of a soft, light, buff-colored, semi-crystalline, horizontally stratified dolomitic limestone, in which are very few traces of organic remains.

"The river between the highest and lowest rock exposures here mentioned is one succession of heavy rapids, the bed of the stream being covered with gravel and boulders. Very few of these latter are of any great size, and it is rather their number than their magnitude that gives rise to the rapids. The channel is very clearly defined; there is no valley, other than the channel itself, and there is no bottom-land, though an occasional slide from some of the higher banks has sometimes the appearance of a kind of grassy terrace. The banks were once very generally timbered with poplar and spruce, but much of this has lately been burnt, and there is now little else to be seen but a succession of dead tree-trunks.

"This long rapid is, as will be seen, a very serious obstruction to the general navigation of the river, but on the other hand it will furnish a water-power that will be of the greatest value to Northern Manitoba in years to come. Above this rapid, which, on account of

our heavy load, cost us two days of incessant labor to surmount, the river up to the Elbow, a distance of 8.36 miles, is, on the whole, remarkably beautiful. It consists of stretches a mile or more in length of quiet water, severed by six short, though often swift rapids or shoals, where considerable care must be exercised in navigating the boat, though it was rarely necessary to lighten it. The grassy banks, not more than two or three feet in height, descend in a graceful curve to the edge of the water, or break down in little scarps covered with sliding clay and pebbles. Open park-like woods of aspen poplar fill in the centre of the picture, and it is only now and then that occasional glimpses can be had of the coniferous forest in the distance,

“Above the Elbow to Lake St. Martin the river has a length of 15.28 miles, in which distance there are three short rapids and three other short stretches of river where the current is very swift. For the rest it is generally wide and sluggish, with low, flat meadow banks, evidently often flooded, stretching back to a forest of poplar and spruce. Lake St. Martin is a shallow, evaporating basin or expansion at the head of the Little Saskatchewan. It has an elevation of eighty-five feet above Lake Winnipeg, or 795 feet above the sea, a shore line of eighty-five miles, an area of $118\frac{1}{2}$ square miles, and a greatest depth, as far as at present ascertained, of fifteen feet. In it are situated a number of islands, with a total area of $3\frac{1}{4}$ square miles, some of which, however, are chiefly interesting from the fact that they, along with several hills in the vicinity, are composed of trap and gneiss which rise as bosses above the surface of the surrounding bedded Silurian limestone, though these limestones abut sharply against the gneiss, &c., and are quite undisturbed by it. The islands and hills are thus shown to be original inequalities in the paleozoic ocean floor on which the limestones were laid down, and as these are probably unusually high points on this floor, so there may be unusually deep depressions holding rocks much lower than any now known in Manitoba, the existence of which, however, will in all probability be determined only by close and long continued investigation.

“The total distance through St. Martin Lake from the head of the Little Saskatchewan to the mouth of the Fairford River is twenty-two miles and a half.

“The Fairford River flows from Lake Manitoba into Lake St. Martin, expanding in the middle of its course into a shallow, marshy lake, known as Partridge Crop Lake. The river has a total length of ten miles and a total fall in this distance of about fifteen feet. Most of this fall occurs in two rapids, one a short distance below Partridge Crop Lake and the other a mile and a-third in length, between the Fairford

Mission and Lake Manitoba. This latter is caused by a bed of compact white limestone, which crosses the river at the head of this rapid, while most of the other rapids, both in this and the Little Saskatchewan River owe their origin to banks of hard boulder clay and the great numbers of boulders that fall from them and dam back the water.

"The total distance by water from Lake Winnipeg to Lake Manitoba is sixty-three miles and three-quarters, and the time occupied in the journey was a little more than five days.

"After the week of severe and incessant labor, the Sunday at Manitoba House was thoroughly enjoyed as a day of rest.

"Monday was spent in obtaining two experienced canoe men, and on Tuesday morning we set sail for the north end of Lake Manitoba and the mouth of Waterhen River. The wind proved to be contrary, and we were obliged to beat up to Garden Island, where a day was spent running tie lines in the north-west portion of the lake, to correct some errors that had crept into its topography.

"From Garden Island we crossed to the mouth of the Waterhen River, and with a fair wind sailed up the river to the Hudson's Bay Company's post, near the south end of Waterhen Lake. From Waterhen Lake we ascended the upper portion of Waterhen River, in which there are no rapids, and skirted along the low lying, gravelly shore on the west side of the long point of land that separates Lake Manitoba from Lake Winnipegosis, till the Meadow or Plain Portage was reached, and of which a careful examination was made. This portage has been already pretty thoroughly reported on by engineers sent out at the time the old location of the Canadian Pacific Railway was being surveyed. It is about two miles in length, and runs over a low, flat ridge, the top of which is either marshy or wooded with small oak and poplar, the water in the marshes being dammed back by a ridge of sand and gravel running along the summit of the eastern slope. The top of this gravel ridge is the highest point on the portage, rising from ten to twelve feet above Lake Winnipegosis. This whole point may possibly be underlain by limestone, though none was seen, or it may be a compact ridge of till, with the exception of some of the higher, narrow ridges of sand and gravel above mentioned. A little further to the south I was informed that in seasons of high water the Indians can pass from one lake to the other in their birch canoes without making any portage at all. From the Meadow Portage we coasted along the south shore of Lake Winnipegosis to the mouth of Mossy River, calling at Snake, Spruce and other islands on the way. Numerous exposures of fossiliferous Devonian limestone were examined. The islands, both here and throughout the rest of the lake, were surveyed with a

Massey's patent floating log. A micrometer and compass survey was made by Mr. Dowling, of the Mossy River, and the shores of Lake Dauphin were run in with the floating log. Descending the Mossy River, we coasted northward along the west shore of the lake, past the old Salt Springs—where salt used to be boiled down for the supply of the Red River settlement, and from which water was collected for analysis in the laboratory of the Survey—to the mouth of Pine Creek, where there is another large saline area, from which brine was collected. From the Hudson's Bay Company's store at Pine Creek the specimens of brine and the fossils collected up to that date were shipped to Ottawa in order to avoid possible delay on my return in the autumn.

“North from Pine Creek the shore and adjacent islands were carefully examined, both in connection with any outcrops of the underlying rocks, and to gain all the other information possible about the structure of the islands, the mode of formation of beaches, &c. Many of the islands were found to be rounded or lenticular hills of boulder clay (Drumlins), lying with their longer axis parallel to the glacial striæ and rising a few feet above the surface of the water.

“A number of soundings were taken, sufficient to show the general depth of the lake in different places, and a record was also kept of any timbered areas seen, although most of the forest has been destroyed by fires that have ravaged this country in late years. We reached the mouth of Shoal River on the 30th of July, but before ascending the river I considered it advisable to examine the islands in Dawson Bay, on many of which cliffs of bedded rock were known to occur. These islands were accordingly visited, and the scientific results obtained from them quite exceeded our most sanguine expectations. They were found to consist chiefly of thick-bedded dolomites very rich in fossils of lower and middle Devonian age, rising in vertical cliffs out of from twenty to thirty feet of water. The high point on the west shore of the bay, known as Point Wilkins, was also found to be particularly interesting, as it showed the lowest sandstones of the Cretaceous rocks in this area resting unconformably on horizontally stratified Devonian limestones. Leaving these interesting cliffs for a time, we took two canoes and ascended Shoal River to Swan Lake. This was a task of considerable difficulty, as the water during the past season was very low, and in periods of high north winds the bar at the head of the river was almost dry. Swan Lake was thoroughly examined, and a survey made of the islands dotted through it. These were found to present exposures of fossiliferous Devonian limestone similar to that seen in Dawson Bay.

“At the south end of Swan Lake a small brine spring is flowing out

on the shallow, muddy beach, while a short distance back in the woods a hill rises to a height of between 200 and 300 feet. Its sides are beautifully terraced, showing successive stages in the recession of the water of the general lake under which this country was submerged down to the conditions at present existing. On some of these terraces many traces are to be seen of a thick deposit of the white sandstone of the Dakota group. These Dakota sandstones have not previously been definitely recognized in Manitoba, though for a number of years they have been known to occur in the states, immediately to the south, and it has been thought that the bitumen-bearing sands on the Athabasca River are also of the same age. This discovery will form an important link in the chain connecting the typical sections in the United States with those in the far North-West of Canada. The sandstones are here found not to be bituminiferous, however, and no bitumen is seen in the underlying limestones, as there is said to be in the limestones on the Athabasca. Their position, immediately overlying the horizontal Devonian limestones, also for this district practically settles in the negative the question of the existence or non-existence of intermediate Carboniferous rocks.

“From the west side of Swan Lake an excursion was undertaken along the foot of the Porcupine Mountain to Wild Turnip River, a branch of the South Woody River, where a good section of Cretaceous beds was seen, and meanwhile Mr. Dowling crossed to Bell River, and ascended it to the summit of the mountain, also obtaining an excellent section of the Cretaceous shale and the overlying drift. North of Porcupine Mountain the Red Deer River was ascended in canoes to Red Deer Lake. There horses were obtained from a small band of Indians living at the west end of this lake, and with two men I struck back to the foot of the mountain and obtained a good section of the Niobrara-Benton rocks on the North Woody River. From this stream two gravel track ridges were followed alternately to near the mouth of the North Etoimami River, where they merge into an extensive sandy delta plain. An old trail was then followed down the north side of Red Deer River back to the lake. The valley in all its upper portion was found to be thickly filled with till or alluvial deposits. On approaching the lake, however, the river cuts a deep gorge, in which the Dakota sandstones are well shown. The whole of the wide plain or valley lying between the Porcupine and Pasquia Mountains would appear to be underlain by rich alluvial soil, and will doubtless in the near future be the home of a thriving population. Portions of it are now thickly wooded with large spruce, which if protected from destruction by forest fires will furnish Manitoba with an abundant supply of timber.

“From the mouth of Red Deer River we coasted round the north shore of Lake Winnipegosis to the two Mossy Portages, which are respectively the winter and summer highways to Cedar Lake. The western Mossy Portage was examined and surveyed by Mr. Dowling, who found it to be between four and five miles in length, running for the greater part of the distance through a deep mossy swamp, thinly wooded with small spruce and tamarac. The eastern portage runs along the summit of a gravel ridge for all but the northern half mile of its course, the land descending on either side into a mossy spruce and tamarac swamp. About the middle of the portage some small cedars were first noticed, and from here north to Cedar Lake they may be seen at intervals. An old corduroy road is still in existence at the northern end of the portage, made by the Hudson's Bay Company to facilitate the transport of their goods in carts from one lake to the other.

“From Mossy Portage we descended the east side of the lake, where, on account of the extreme low stage of the water, the underlying limestone, here found to be of Silurian or of Cambro-silurian age, was in many places visible. When the water is at its mean elevation this rock would be entirely covered.

“From the Hudson's Bay Company's post at Pine Creek I despatched Mr. Dowling with the boats to Manitoba House, where he arrived safely on the 20th of October. On the way he again examined some rock exposures in the south-eastern portion of Lake Winnipegosis, and made a survey, with the floating log, of Waterhen Lake. Meanwhile, I took horses and carts and made an odometer survey of a new cart trail back to one of the upper gravel ridges near the foot of the Duck Mountain, here connecting with my survey of 1887. I also ascended one of the forks of Pine Creek to the summit of Duck Mountain, determining the existence of the Pierre shales in this vicinity. I then drove southward and then eastward through the flourishing settlement on the Lake Dauphin plain to Manitoba House, where I arrived on the 21st of October. We then sailed southward to Westbourne, where the men were paid off, and the boats laid up for the winter.

“Returning to Winnipeg, I made a hasty trip to Deloraine, in south-western Manitoba, where a deep well is being sunk through Cretaceous shales in the hope of finding water. An excellent set of specimens from this well was obtained. The gentlemen engaged in sinking this well have shown the most commendable enterprise in their endeavor to supply a very pressing want in this beautiful section of country; and also, as soon as asked to do so, in collecting specimens from every five or ten feet bored through, in order to make the well of

thorough scientific and practical value to the surrounding country. It is sincerely to be hoped that a large supply of water will be obtained as soon as the permeable Dakota sandstone is struck.

"I returned to Ottawa on the 10th of November, having been absent exactly six months.

"During the year a very large and interesting collection of Cambro-silurian, Silurian and Devonian fossils was gathered, and typical rock specimens were obtained from all the exposures of older rocks, and also from many places where the sands, clays and gravels were examined. Having a small schooner, we were able to transport them to the railway, whereas, if we had been entirely dependent on canoes, it would have been very difficult or perhaps impossible to have got them out of the country. Specimens of brine from all the principal springs in Swan and Winnipegosis Lakes and Red Deer River were also secured, and are now in the Museum of the Survey.

"One hundred and ten photographs were taken, illustrating points of geological and historical interest, and showing the general character of the country and the peculiarity of its native inhabitants. Most of these photographs were developed by Mr. Dowling in the field.

"It affords me much pleasure to acknowledge the efficient assistance that I have received from Mr. Dowling throughout the season, not only in carrying on the surveys connected with the exploration, but in carefully collecting fossils and rock specimens from any exposures visited.

"Cost of season's exploration, \$2,176.73."

Dr. A. C. Lawson, assisted by Messrs. W. H. Smith and William Lawson, was engaged during the season in prosecuting geological and topographical surveys in the country north-west of Lake Superior, in continuation of the work of which he has had charge for some years past. He reports as follows:—

"The usual preliminary work of purchasing supplies and hiring men for the season was begun at Port Arthur on 31st May, and a few days later the party proceeded to Savanne, where the survey work proper began. It was deemed expedient to divide into two parties, Dr. Lawson, as usual, devoting his time to the study of the geology of the region; while Mr. Smith, accompanied by Mr. W. Lawson, with a somewhat larger outfit of canoes and men, was engaged throughout the season in making surveys between Savanne and Pine Portage, and thence throughout the country south of the Seine River as far as Sturgeon Falls.

The nature and extent of these surveys may be briefly summarized as follows:—

1. A transit and micrometer line down the old Dawson Route from Savanne to Pine Portage, and thence to the north end of Hunter's Island, connecting there with previous surveys.

2. A transit and micrometer line from a point on the above line, running down the Atic-okan River, and thence from the Seine River to Sturgeon Falls, where connection was made with previous surveys in the Rainy Lake region. These two lines aggregate about 160 miles in length, and afford an excellent base line, to which can be tied the various more rapid compass and micrometer, or compass and log surveys, of the numerous lakes which are distributed over the region.

3. The survey of all the known lakes south of the Seine River, with prismatic compass and log or micrometer.

4. The survey of a chain of lakes in Hunter's Island which it had been found impossible to finish the previous season.

The measurements of these various lake surveys aggregate about 450 miles, and the distances so measured served as the bases for compass triangulation whereby other distances were determined. The area under survey comprised about 1,400 square miles.

Throughout this survey work Mr. Smith took careful notes of the geological features of the country through which he passed, and these, together with an excellent suite of rock specimens which he collected, will be of much service in the mapping of the region, and in giving direction to future geological examination by Dr. Lawson. Mr. Smith also visited the new iron locations on the Seine River route, which are attracting attention, and procured specimens of the ores. His topographical survey completes all the field-work necessary for the construction of the south half of the Seine River sheet. It is estimated that another season's work will be required for the completion of the northern half.

While Messrs. Smith and W. Lawson were carrying out these surveys Dr. Lawson proceeded with the geological examination of a portion of the country where topographical surveys had already been made, supplementing these by his own sketches when necessary. From Savanne he proceeded across Lac des Milles Lacs to the portage leading to Kashabowie Lake, and thence across Kashabowie Portage to Shebandowan Lake. From the west end of this lake a route leading by several long portages and small lakes was followed to Round Lake, and thence the Kahwawigamak River was followed to Hunter's Island. Hunter's Island was the principal field of study, and this route to it was followed chiefly because it passed through a new country, which had

not been before examined. The greater part of two months was spent by Dr. Lawson in circumnavigating Hunter's Island and in traversing it in various directions by the numerous chains of lakes which lie within it. The work done, together with that of a former year, supplemented by the notes and specimens secured by Mr. Smith in 1888, while making a topographical survey of the island, supplies us with all the data necessary for the compilation of a geological map of the region, the drafting of which is now under way. This sheet, which is known as the Hunter's Island sheet, will, it is expected, be ready for the engraver in the course of a month.

Hunter's Island is interesting economically, chiefly for the iron ores associated with jaspery beds which occur on its south-east side, and which are entirely analagous, geologically, to the famous iron ores of Vermilion Lake at Tower, Minnesota. Some patches of good pine at the west end of the island also are of considerable value. Having thus completed all the work that was deemed necessary for the Hunter's Island sheet, Dr. Lawson proceeded to Port Arthur for the purpose of inaugurating some preliminary enquiries into the ancient beaches and terraces of Lake Superior. In various parts of the continent the ancient shore lines of lakes which were once necessarily perfectly horizontal are found at the present day to be tilted at a considerable slope, the measurement of which affords us important data for determining the extent of the local elevation or depression of the crust of the earth in quite recent geological times.

It becomes, therefore, desirable to ascertain whether the old beaches of the north shore of Lake Superior will throw any light on this important problem. With this object in view, Dr. Lawson walked along the Canadian Pacific Railway track from Port Arthur to Terrace Bay, north of the Slate Islands. Numerous old beaches were observed and many interesting notes on the geology of the sections along the railway and the coast were obtained. It was seen that there is a regular succession of beaches and terraces which range between the present level of the lake and an altitude of probably 350 feet. It would seem from the observations made that the beaches run to higher altitudes towards the east, and it was concluded that very interesting results would be obtained by a systematic levelling of the beaches from Sault Ste. Marie to Pigeon Point. This trip along the railway occupied the latter half of August, and at its conclusion Dr. Lawson proceeded to Toronto to attend the meeting of the American Association for the Advancement of Science, in the geological section of which he read two papers on subjects pertaining to Canadian geology. On the way back some days were spent on the Huronian rocks between Sudbury and

Sault Ste. Marie for the purpose of comparing them with the analogous formations north-west of Lake Superior. On the return to Port Arthur the remainder of the season was occupied in levelling up instrumentally the old lake beaches between that town and Pigeon Point; in visiting and examining the Badger silver mine, one of the newest and most successful of the mining enterprises of the region, and in investigating certain reported finds of native copper in the townships of Blake and Crooks.

The season's work was brought to a close at Port Arthur on 17th October, when Dr. Lawson and party left for Ottawa.

Cost of season's operations for both parties \$2,300.

Mr. E. D. Ingall, Mining Geologist to the Survey, has been engaged during the summer in continuing the investigation into the nature and lithological surroundings of the deposits of apatite of the River du Lièvres district in Ottawa county, P.Q.

He says: "In prosecuting this work during the past summer, the main lines upon which it had been started the previous season were adhered to, and efforts were made to further elucidate and understand the nature and origin of the pyroxenite belts, with which the apatite deposits are mostly associated, and the relationships of the same to the rocks forming the general mass of the district, as well as to add to our knowledge of the nature and habits of the apatite deposits themselves.

"In connection with the latter, as many deposits were visited and studied as the time necessarily expended upon the other branch of the work would allow of, whilst the principal mining developments of the district were visited from time to time, so as to watch for and note any new features that might be brought to light during their progress, plans being made of some of the chief of these.

"In pursuance of the first object mentioned, the main source of information on these points would naturally be found in a close study of the contacts of the pyroxenites with the surrounding gneissic and granitoid rocks, so that the investigation thus naturally confined itself to a detailed examination of these points along some of the more thoroughly worked belts, where, in the course of considerable mining developments, the ground had been sufficiently cleared of bush, &c., to give a reasonable chance of seeing sufficient rock exposures to acquire the evidences sought.

"Thus the geological work was found to concentrate itself chiefly on the broad and extended belt upon which are the considerable excavations of the Crown Hill, High Rock and Star Hill mines, time being also found to similarly investigate for some distance the belt on which

are the openings of the North Star mine and adjacent properties, at which latter point, the belt being narrow and the bush and surface cover having been more thoroughly removed by clearance and bush fires, better facilities were afforded than elsewhere for acquiring the necessary data.

“With a view to illustrating some of the results thus attained, and as a necessary prelude to the purely geological part of the work, the limited areas thus dealt with were mapped accurately and in detail, where small the plane table alone was used, whilst where of greater extent that instrument was used to fill in the detail in connection with skeleton transit and chain surveys.

“In this way it is hoped to obtain a few thoroughly worked-out examples which may serve as illustrations of the numerous similar belts in the surrounding country and of their nature, associations and habits, thus possibly adding something to our stock of knowledge of the pyroxene belts and the associated apatite deposits. Such systematized knowledge, systematically applied, must necessarily be the basis of all intelligent mining ventures.

Mr. Jas. White continued attached to the party as topographical assistant, and besides laying out the transit and chain skeletons for the more detailed mining plans and some underground surveys, was mostly engaged completing the necessary surveys throughout the surrounding district for the compilation of an accurate topographical map of the area comprehending the chief mines, with a view to showing their position, means of communication and other such information pertaining to the phosphate district in general.

The topographical work was commenced under Mr. Jas. White's direction on 10th June and finished 16th September, whilst Mr. Ingall followed, and was occupied in the geological investigation from the 10th of July to the 28th of September.

The total expenditure on this work was \$1,399.56.

Mr. Ingall having been recently appointed to the vacant position of Mining Engineer to the Geological Survey, in charge of the collection of the statistical and other information for the compilation of the annual report on the mining and mineral production of the Dominion, his time will be necessarily considerably encroached upon by these new duties, but it is hoped, notwithstanding, during the winter, to prepare for publication the results of the above-mentioned work in the Lièvre phosphate belt.

During the season of 1889 Dr. Bell has continued the geological survey of the district around Sudbury, on which he was engaged the

previous year, and he has now completed this work over an area measuring 72 miles from east to west by 48 miles from north to south, which will be represented on sheet No. 130 of the regular series of maps on the scale of four miles to one inch. A part of this area has been surveyed into townships by the Crown Lands Department of Ontario. Some of the lakes and rivers within it had been traversed by the late Alexander Murray, of the Geological Survey, in 1856. These surveys, and also those of the Canadian Pacific Railway lines, were utilized by Dr. Bell in laying down his work, but it was found necessary to do a good deal of topographical surveying before the natural features within the limits of this sheet could be correctly mapped. In this work Dr. Bell was again assisted by Mr. A. E. Barlow, who left Ottawa for the field on the 10th of June and returned on the 18th of September, while Dr. Bell started on the 5th of July and returned on the 26th of October.

In addition to the geological investigation work of the season, Dr. Bell made a micrometer survey of Pogamasing Lake and the Spanish River, from near Spanish Forks to the township of Hyman, a distance of about seventy miles, below which the river is laid down on the maps of the Ontario Crown Lands Department and those of the late Mr. Murray. He also made a careful track-survey of Onaping Lake, which was found to be about thirty miles in length, and of a smaller lake lying parallel to it on the west side, and a similar survey of the Onaping River throughout its entire course. Mr. Barlow's time was mostly occupied in surveying the following lakes and rivers by means of the micrometer, at the same time making notes on the rocks which came under his observation: Panache Lake (which had been outlined by Mr. Murray in 1856), two small lakes which he named Wavy and Gabodin Lakes, lying to the north-east of the east end of Panache Lake, a canoe-route from Round Lake to Rat Lake, the southern branch of Veuve River, Aiginawassing, Elbow and Red Deer Lakes, the western bay of Lake Nipissing, parts of two western branches of Wahnapiæ River, and the Vermilion River from the intersection of the main line of the Canadian Pacific Railway to a point east of the township of Lumsden.

In the district covered by the above-mentioned sheet there are a few settlements, chiefly along the line of the Canadian Pacific Railway, but the district may be described in a general way as still in a state of nature. Scarcely any common roads exist, and it was therefore necessary to carry on operations principally from the railway and from the lakes and rivers as bases from which the minor explorations were made. The surveyor's lines were often useful, not only for

locating geographical positions, but in facilitating journeys in the woods. Still, there were some tracts in which there were neither the advantage of such lines nor of canoe routes, and in those it became necessary to make the best traverse possible through the primeval forest.

The following are some of the most notable geological features within the limits of the above sheet: The western and north-western part of the ground is occupied principally by a great area of reddish quartz-syenite, which extends beyond the limits of the sheet in these directions. It appears to belong to the Huronian rather than the Laurentian system. The position of the boundary between these two systems was traced north-eastward across the sheet,—the Laurentian consisting almost entirely of gneiss, occupying its south-eastern corner. There is also a considerable area of these rocks in the middle of the northern part of the sheet.

The great Huronian belt of Lake Huron runs diagonally across the whole sheet, from south-west to north-east, and embraces a considerable variety of rocks, including crystalline schists, quartzites, breccias, conglomerates, argillites, greywackés, diorites, diabases and syenites. These rocks seldom appear to run far as distinct bands with parallel boundaries, but have rather the form of elongated masses, which pinch out in both directions or give place to other rocks. The Huronian region, including the syenite areas, is traversed by diabase dykes, newer than any other rocks of the district, which are remarkable for their persistence in length. Their commonest direction is about west north-west.

Ores of copper and nickel are the most important of the economic minerals which have yet been discovered in the above district. Five mines are in operation at present. Three of them are worked by the Canadian Copper Company, namely: the Stobie, three miles and a-half north north-east of Sudbury Junction, the Copper Cliff, three miles and a-half south-west of the same point, and the Evans, one mile further south. The Dominion Mineral Company is working a mine, situated about a mile north-east of the Stobie, and the Messrs. Vivian, of Swansea, are opening the Murray Mine, on the main line of the Canadian Pacific Railway, three miles and a-half north-west of Sudbury Junction. Similar deposits of these ores have been found in various localities within the district examined, and these will be described in the fuller report to follow.

The general character of the mixed ore and its mode of occurrence are nearly the same in all three localities. It consists of pyrrhotite in which some of the iron is replaced by nickel mixed with more or less

chalcopyrite. These sulphides are mingled with fragments of all sizes of quartz-diorite in some cases, and of a kind of greywacké in others, so that the ore has often the appearance of a conglomerate. The ore-bearing masses are of all sizes, and they take the form of lenses or pod-shaped bulges, conforming with the large scale lamination of the strata. Around the richer ore bodies the country rock is filled with coarse and fine impregnations of the sulphides. These deposits may be described as "stockwerks" in which the vein structure is very obscure. The strata of the whole district generally stand at high angles, approaching the perpendicular, so that the underlie of the ore-masses is usually very steep. The rocks immediately associated with them are not always the same, but it most frequently happens that the ore itself occurs in some form of diorite, more particularly in diorite breccia, with quartz syenite or gneiss on one side. The diabase dykes above referred to were seen near the ore deposits in several instances and further search may show their presence in all cases. It would not be surprising if they should prove to have had some connection with the concentration of the ore in these masses, which may be locally enriched portions of certain ore-bearing belts.

Two smelting furnaces, capable of reducing 300 tons of ore a day, are in operation at the Copper Cliff mine. One of them has been running without interruption for nearly a year. The other went into blast on the 4th September. Both the Dominion Mining Company and the Vivians are erecting similar blast furnaces.

The rock specimens collected in the above district during the season number 285, but 665 had been obtained in the same district the previous year, making a total of 950 specimens.

The cost of the season's field work was about \$1,800.

Mr. Low was employed during the past summer in completing the geological investigation of the N. E. sheet of the Eastern Townships map on the north side of the St. Lawrence River, comprising the southern portion of the counties of Quebec and Portneuf—the work extending from Ste. Anne de la Parade on the west to the Montmorency River on the east.

He left Ottawa 23rd May and was engaged until 17th June making a micrometer survey of the Ste. Anne River and its north branch from the northern limit of the sheet to the St. Lawrence.

Odometer surveys of the roads to the west of the Jacques Cartier River occupied the time to 31st July, when a geological examination of that river was made, which lasted until 5th August.

The road survey to the eastward was then continued up to 1st October, with four days spent in making a section along the north shore of the St. Lawrence, from Deschambault to Cap Rouge.

In all eight hundred miles of surveys were completed, comprising six hundred and four miles of odometer, seventy-five miles of micrometer, seventy-one miles of pace, and fifty miles of track surveys. By these surveys the contact of the Laurentian gneisses with the Cambro-silurian limestones and shales was traced out and the boundaries of the latter formation established.

The rocks of the Laurentian area were carefully examined for economic minerals. Magnetic iron ore in small disseminated masses was found to be common in many localities, but never in sufficient quantities to be practically worked, but showing that such masses may exist.

The prevalent rock being a mica gneiss without pyroxene or limestone, no phosphate areas were found, and are not likely to be discovered in this vicinity. The areas covered with drift and superficial deposits were noted, and will be mapped on the sheet, as they are of considerable economic importance, from the deposits of bog iron ore which occur associated with all, or nearly all, of the stratified sands of the region.

The work of Dr. Ells during the past season was, for the most part, confined to the south-west quarter sheet map of the Eastern Townships, and to that portion lying south of the Grand Trunk Railway, between Acton and Richmond, to the Vermont boundary.

In addition, however, accurate chain and micrometer surveys were made of the Black Lake and Thetford asbestos areas, in order to complete the proposed map of that district. The area examined during the season contains nearly all the outcrops of serpentine in the southwestern section. A careful study of these was made to determine the presence of asbestos-bearing belts. The character of the serpentine in this section appears to present several points of difference as compared with that from Thetford and Coleraine, and in so far as examined asbestos in workable quantity has not yet been found in it.

The results obtained during the past season are not yet in shape for publication, more particularly as regards the determination of the exact age and the relative position of several of the slate formations. The Sutton mountain range of Pre-Cambrian schists and associated rocks was carefully traced to the River St. Francis, and the position of the black slates series, as intermediate between these, and the overlying red and green slates and sandstones of the Sillery, verified; but further

careful examinations of these belts will be necessary during the coming season in order to determine from the evidence of fossils, if possible, or in some other way, the exact horizon of the rocks which extend across into Vermont, and in which surveys are now being carried on by the United States geologists, more especially by Prof. Walcott.

But little work is being done in this section at present in the way of mining. The new mine of the Memphremagog Mining Company, lot 28, range ix, Potton, was examined. It shows a body of ore, mostly iron and copper pyrite, about sixteen feet thick, and extending for several hundred yards. This is capped by a considerable body of bog iron ore, which should be valuable if facilities for shipping and smelting were afforded. But little work other than exploratory has yet been done at this place.

Some efforts have been made to develop asbestos areas on the east side of Brompton Lake, on lot 26, range x, Brompton Gore, but at present this locality is accessible with difficulty, and the indications are not equal to those presented at Thetford and Coleraine. On lot 7, range xv, Cleveland, the slate quarry, formerly Stubs', has been re-opened by Mr. Bedard and others and some very good slate extracted. At the time of my visit, however, this work was not sufficiently advanced to warrant an opinion as to its ultimate success. On lot 18, range x, Brompton Gore, a new quarry, in red rock slate, has been started.

Quarries of excellent granite are in operation on the east side of Lake Memphremagog, in the area which extends across the Vermont boundary.

During the past season Dr. Ells was assisted by Mr. Giroux. The surveys of lakes, roads and streams aggregate 750 miles, of which 17 were by chain, 87 by micrometer, 105 by pacing and 547 by odometer. A large collection of graptolites in a very fine state of preservation was obtained from the black slates on the west side of Memphremagog Lake.

The cost of the season's operations was \$1,100, and occupied from the 27th May to the 18th October inclusive.

Mr. F. Adams left Ottawa on 10th July, 1889, and spent about three weeks in continuing the examination of that portion of the St. Maurice district which is included in the N. W. sheet of the Eastern Townships map. On this work he reports as follows:

"I proceeded first to St. Michel des Saints, a village situated in the township of Brassard, in the county of Berthier, and having secured a

canoe and two men, made an examination of the Rivière du Poste (or Rivière au Lac Clair, as it is called on our map), as well as of the lakes out of which it flows. I then examined the country about the Red Canoe River and descended the Matawin to Birch Rapids, about fifteen miles from its junction with the River St. Maurice. I then returned to Montreal by way of Shawenegan, reaching that city on 2nd August. The country examined is all underlain by Laurentian gneiss, that along the Matawin, east of Ile de France, dipping at very low angles, and in many places lying flat. Thin bands of crystalline limestone were found at several places on the eastern arms of Lac Croche (Lac Long), as well as on the discharge of Lac Clair, and at three points along the course of the River Matawin, viz.: (1) in woods about four miles north of Rapids Lacroix, (2) just above Rivière à l' Aigle, and (3) two miles and a half below this river. In the last mentioned locality the limestone band is about ten feet thick. These limestones hold little grains of serpentine, mica, apatite, &c., and in character are identical with the Laurentian limestones elsewhere. Bands of quartzite, and occasionally thin bands of pyroxenite, are also found associated with these gneisses; their presence, taken in connection with that of the crystalline limestones, shows that the series cannot be considered as belonging to the lower or fundamental gneiss, as had previously been stated. The only anorthosite which was observed, with the exception of that in the township of Shawenegan, which was mentioned several years ago by Mr. McConnell, was a small band which crosses Ile de France, situated in the River Matawin, a short distance below the mouth of the Rivière du Poste, and which was again met with about five miles north of the Matawin, between Red Canoe Lake and the Rivière du Poste."

Cost of season's exploration, \$158.10.

The Rev. Abbé Laflamme has made some further interesting observations in working out the geology in the Saguenay region and in determining the position and approximate extent of certain areas of Cambro-silurian limestones which lie there in depressions in the Laurentian gneiss, but are often largely covered by superficial deposits. Such areas are of considerable economic importance as future sources of lime. Further details of the work in this district will be given in the Annual Report.

Cost of season's work, \$400.00.

On the work in northern New Brunswick and Quebec, Professor Bailey reports as follows:

"The work of the summer of 1888 having been devoted chiefly to

the study of the Silurian system in its extension northward to Lake Temiscouata, as well as east and west of the latter, and to the preparation of the map sheet (No. 17 N.E.) illustrating the same, that of 1889 has had for its main object the study of the Cambrian and Cambro-silurian rocks, making up a portion of the so-called Quebec group which lies between the lake referred to and the shores of the St. Lawrence, being the area to be included in the next succeeding sheet (No. 18 S.E.) of the series of maps of New Brunswick and Quebec.

As connected with this work, and with a view to a better understanding of the Cambrian strata of the succession, a few days were devoted, in company with Mr. G. F. Matthew, at the commencement of the season, to a revision of those which occur in the valley of the St. John River, in King's county, N.B., and which were referred to in the report of 1873. This revision led to the recognition, in the district mentioned, of most of the sub-divisions of the Cambrian system, as distinguished in the St. John basin, including the red rocks of the series (Series A), bands *a*, *b* and *c* of Division 1 (Series B), and an imperfect representation of Division 2; while Division 3, containing the Dolgelly and Arenig faunas, appeared to be wholly wanting.

In Division 1, Band *b*, of Caton's Island, examples were collected of *Obolus pulcher*; Matthew, a fine species resembling *Lingula* (?) *favosa*, Linnarson, of the Eophyton sandstone of Sweden, but larger, and (at Belyea's Landing) specimens of *Volbrothella tenuis*, a species of the blue clay of Russia, thus, according to Mr. Matthew, extending the vertical range of this species in New Brunswick from near the base of the Cambrian deposits upwards nearly to the *Paradoxides* beds. The fossils referred to have been forwarded to the office of the Survey.

After the examinations last described I proceeded northward to the Temiscouata region, devoting a few days, on the way, to search for fossils in the supposed Cambro-silurian rocks of Carleton county, but without adding anything to the information previously had upon the subject.

Upon reaching my proper field of work my first efforts were given, in accordance with your instructions, to the examination of the region about the head waters of St. John River and adjacent to the Quebec boundary, with a view to determine, if possible, the limits of the Silurian basin in that direction, and the distinction between the latter and the resembling rocks of the Eastern Townships, which, formerly regarded as Upper Silurian, have recently been referred by Dr. Ellis, upon palæontological and stratigraphical grounds, to an earlier horizon. For this purpose a traverse was made across the country from L'Islet, on the St. Lawrence, to Big Black River, and down the latter to the

St. John, this being followed by the ascent of the last-named stream to one of its principal sources in Baker Lake, and a return traverse, by way of the north-west branch of the St. John and its tributary, the Daaquam, to St. Magloire and St. Valier. These traverses afforded good opportunities for observing some of the varying aspects of the so-called Quebec group, the members of which are generally well exposed, but as regards the rocks in the country lying to the south of the latter, the age of which was one of the chief questions sought to be determined, the results were much less satisfactory, owing chiefly to the almost entire absence of any exposures from which conclusions could be drawn. As far as could be seen no appreciable change in the character of the slate occupying the valley of the St. John was discovered, nor any reason for regarding the strata about its head as other than an extension of those of Silurian age found around the lower half of Lake Temiscouata, and over large areas in northern New Brunswick, Quebec and Maine. At one point only (the falls of the North-West Branch) were they found to be fossiliferous; but the remains, in the form of branching and corrugated stems of plants, were too imperfectly preserved to be of any value in the determination of the age of the strata. With the view, if possible, of obtaining further information upon the subject, a few days were subsequently spent, in company with Dr. Ells, in the vicinity of Sherbrooke, where a similar doubt had arisen as to the age of certain slates which hitherto had been regarded as Silurian, but which Dr. Ells now considers as belonging to the Cambrosilurian. The close resemblance of portions of them to the slates of the Upper St. John valley is certainly quite marked, but without more extended information than we have as yet been able to obtain upon the subject we do not feel justified in concluding that the two are of the same age.

Examinations were also made of portions of the country adjacent to the Temiscouata portage road and in the vicinity of Rivière du Loup, St. Paschal, Kamouraska, Cacouna and L'Islet, partly alone and partly in company with Mr. McInnes. Having taken the field on the 1st of July, my work was continued, with the interruption of a few days only, until the 1st of October."

Mr. McInnes left Ottawa on the 10th of August and arrived at Rivière du Loup on the 12th. The first part of the season was spent in pacing a section along the coast from the long wharf at Rivière du Loup eastward as far as St. Luce. But few fossils were found in the pre-Silurian rocks during the season. Fucoidal marking, or trails, occur in the greenish-grey slates which underlie the limestone conglomerates, and were noticed at various points along the coast.

Numerous fragments of trilobites were found in a pebble in the limestone conglomerate near Trois Pistoles, and obscure brachiopods and a fragment of a trilobite in bands of fine limestone conglomerate, enclosed in soft shale, at the portage road above Rivière du Loup.

A few days were spent on the Rimouski River, in an examination of the high ridge south of Lac Ferri. This was found to be made up of undoubted Silurian strata, highly contorted slates, with bands of limestone. A collection of fossils was made from the Silurian shales at Tuladi Falls, on the Rimouski River. These have not yet been examined.

The remainder of the season, after the 20th of September, was devoted to a survey, by prismatic compass and odometer, of the roads of the district. Two hundred and sixty-two miles were surveyed in this way, and about one hundred miles by pacing. The field work was closed on the 23rd of October:

“In the study of the region referred to we have necessarily had constantly in view the work of previous laborers in this field, and more particularly the recent investigations made by Dr. Ells and his associates in the Gaspé peninsula, and by the same gentleman, as well as by Dr. Selwyn and others in the Eastern Townships and around Quebec. As the results of these investigations, in common with our own, differ in important particulars from those of earlier investigators, and tend to place the age and succession of the so-called Quebec group in a very different position from that which it first occupied, we had hoped that the report of Dr. Ells, embodying these results, would have been in hand during the progress of our own field work and have been available for purposes of comparison. As this, however, has not been the case, we are at present unable to judge how far our conclusions are concordant with or likely to be modified by those obtained by more extended examinations. In view of this fact and the desirability of the avoidance of any conflict of opinion, it is suggested that a more lengthened report upon the work here reviewed be postponed until such time as will allow of a further study of the important questions involved.”

Mr. Chalmers left Ottawa on the 2nd of May, with instructions to continue the exploration and mapping of the superficial deposits of southern New Brunswick, on which he had been engaged during the two previous seasons (1887 and 1888). Mr. E. W. Swinyard accompanied him as volunteer assistant. The area on which Mr. Chalmers has now spent three seasons is that delineated on the three $\frac{1}{4}$ sheets—1 S.W., 1 S.E. and 1 N.E.—in which lie the counties of Charlotte, St. John,

King's, the chief part of Queen's, and portions of Albert, Westmoreland and Sunbury. The survey of the surface geology of this area is now completed, at least as far as the nature of the country will admit of such being done in detail. Considerable portions are still unsettled and in a wilderness state, and in these, of course, the study and mapping of the surface deposits could only be done in a very general way. The data on hand seem sufficient now, however, to enable the surface geology to be exhibited on the three sheets referred to with a considerable degree of detail, and to prepare a report thereon. This will be done during the coming winter.

The main portion of the past season's work was on the surface geology of sheet No. 1 N.E., that is in the counties of King's, Queen's, Albert and Westmoreland; but unfinished portions of the districts examined during the two previous seasons were also studied. Much difficulty was experienced in determining the mode of glaciation and the distribution of the superficial deposits in the hilly country lying to the south of the great Carboniferous overlap. In the cleared and settled parts, however, careful investigations have been made in regard to striæ, boulder-clay, stratified deposits, alluviums, agricultural character of the soil, forest covering, &c., and the results obtained will, it is hoped, serve to elucidate, in some degree, the problems which perplex students of surface geology.

On the 2nd of July Mr. Chalmers engaged Mr. W. J. Wilson, of St. John, to examine and map, under his direction, the southern part of Queen's County, included in sheet No. 1 N.E. Mr. Wilson continued this work till the 9th of August, and showed himself competent to perform the duty assigned him in a satisfactory manner. Mr. Chalmers further reports as follows: "The glaciation of the eastern part of the area embraced in $\frac{1}{4}$ -sheet 1 N.E., in which lies the north-eastern extension of the ridge or plateau bordering the Bay of Fundy, was investigated with some care, and facts of much interest discovered. This ridge forms a prominent feature in the landscape, being higher than any part of the country, except the north-western highlands or the Gaspé peninsula. Here, therefore, we might naturally expect to find traces of a continental glacier, if any such ever swept over the eastern part of New Brunswick. None were observed, however; on the contrary, great masses of decayed rock *in situ* encumber its northern and north-western flanks, while along the valleys of rivers descending from it northwardly into the Petitcodiac striæ were found clearly indicating northerly ice movements. Along the Petitcodiac valley, however, which lies below the 200 feet contour line, striæ were seen to follow its course, showing ice movements in an easterly direction. It

is evident that local glaciers and icebergs were amply sufficient to produce all these phenomena.

On the summit of the Bay of Fundy ridge or plateau referred to, local areas which served as gathering grounds for glaciers sent some of these off towards the Bay of Fundy. A large number of facts relating to the glaciation of the district will be given in the detailed report.

Excellent opportunities for studying boulder distribution are afforded in eastern and southern New Brunswick. One fact worth noting here is that while boulders from the Bay of Fundy pre-Cambrian ridge are found to have been transported northwardly over the low Carboniferous area, none from the latter rocks were found upon the ridge itself. The older ridges of crystalline rocks have, it would seem, been the centres of boulder distribution, and have sent off waste material in all directions around them. Along coasts and areas submerged during the Post-Tertiary period various distributing agencies seem to have been in active operation, rendering boulder distribution on these lower levels a somewhat complex problem.

Till or boulder-clay is found wherever there are traces of glacier or iceberg action, and in some places where there are none. My study of the boulder-clays in New Brunswick has led me to the conclusion that they have formed in two or three different ways, viz.:—(1) by land ice or icebergs, these two producing similar deposits; and (2) by the kneading and compacting of ordinary decayed rock material *in situ* by ice passing over it, or simply by the weight of ice and snow acting upon it, while saturated with water; and, in some cases, in their beds, by a mechanical assorting of the clays, gravels, &c., somewhat in the manner that hardpan is produced. The first two usually contain transported and glaciated materials; the last do not, except on the surface. Another kind of deposit which resembles boulder-clay, but which occurs in limited quantities, is that of landslips. These landslips may sometimes have produced striae. It is found along the base of cliffs and of mountains, &c., and is without glacial boulders.

The above classification may render some slight change in the definition of the terms till or boulder-clay necessary. Full details respecting them will be given in my forthcoming report.

The examination and study of the other superficial deposits in the area under consideration have revealed no new facts. I shall now, therefore, briefly refer to the materials of economic importance observed in connection with the work during the past season.

Peat bogs are numerous and well developed near the Bay of Fundy coast and in many places inland. Those near Musquash, Popelogan

and Digdeguash Rivers are quite extensive. Lying just east of Musquash Harbor is a bog covering an area of 450 acres and 20 feet in depth, which is now about to be utilized in the preparation of "moss litter." This is an article used in stables as bedding for horses. Owners of studs in the United States have for some time been looking for a material for this purpose sufficiently light and porous to be an absorbant of the liquids, moisture and ammonia which collect in stables, and which could afterwards be used as a fertilizer in gardens, &c. A few capitalists from St. John, St. Stephen and other places have formed what is known as the Musquash Moss Litter Company, and having purchased this bog, are now erecting buildings and machinery there for the preparation of this article, which, it is claimed, is well adapted for the object intended, and as good as the imported European moss litter. The kind of peat used is not the upper or living peat, nor the deep-lying, decayed material, but that between the two, in which the mosses and rootlets are only partially decomposed, and which has the fibres nearly whole. The chief process in its preparation is depriving it of the water, of which it contains 90 to 95 per cent. This is done by a plunger, by pressing it between rollers and by evaporation. When thoroughly dried it is packed in bales for shipment, and is worth \$15 to \$17 per ton in the principal United States cities. This new enterprise promises to be successful.

Brine springs are found at Sussex, at Salina, on Salt Springs Creek, and at Bennett's Brook, near Peticodiac. Five or six hundred bushels of salt per annum are manufactured at Sussex. This is all consumed locally, and used chiefly for table and dairy purposes. Several springs occur near the site of these salt works. A boring 125 feet deep was recently sunk at one of these springs—13 feet of it through surface deposits and 112 feet in rock. The object was to find the salt rock, but nothing of the kind was met with. The strength of the brine, I was informed, increased slightly till the solid rock was reached; beyond that it did not perceptibly change. At Salina an attempt was made some years ago to manufacture salt from the brine of the surface springs there, but was discontinued. Possibly a series of borings might result in improving the quality of the brine, but none have yet been made. At Bennett's Brook nothing has been done to utilize the springs there, to my knowledge. In all these places the brine contains a considerable percentage of sulphate of lime or gypsum. There appears to be less, however, in that of the Sussex Springs than at Salina or Bennett's Brook. The salt manufactured at the Sussex works is said to be of a superior quality.

Medicinal springs are met with at Apohaqui and at Havelock

Corner, King's county. The one at the former place, which is situated about a mile from Apohaqui station, Intercolonial Railway, has attained quite a reputation for its therapeutic properties. It is an alkaline water, and is said by chemists to resemble the famous Vichy water, and also to be a natural emulsifier. Favorable mention has been made of it in the *Canada Medical and Surgical Journal*, and it has been used in the General Public Hospitals of Montreal and St. John, N. B.

The Havelock mineral water has, for some years, had a local reputation as a remedy for certain diseases; and as an extensive deposit of mud surrounds the spring, it might be utilized for the establishment of "mud baths," which are said to be beneficial in the treatment of some diseases.

Infusorial earth has been reported as occurring at Fitzgerald Lake, St. John county, and at Pollett River and Pleasant Lakes, King's county. The deposits at the two first mentioned places are quite large. Mr. Wm. Murdock, C. E., of St. John, who owns the one at Fitzgerald Lake, is endeavoring to introduce this material into use in some ways. Clays and sands suitable for brick-making, &c., occur in many parts of the district. Near Sussex, and at St. John and Fairville, there are large brick-making establishments.

On the 21st of October Mr. Swinyard left for Ottawa. Afterwards I visited the ship railway now under construction across the Isthmus of Chignecto. In an excavation which is being made for docks in the salt marsh at its western end, the following series of deposits is disclosed:— (1) Marsh mud, 5 to 10 feet; (2) fine-grained, stratified blue clay, holding numerous shells of *Mya arenaria* and *Macoma fusca*—thickness, from a few inches at one end to five to eight feet at the other; (3) peat or humus, six to fifteen inches thick, containing roots and stumps of small trees, chiefly *hacmatac*, and in some places portions of the stems. This peat or forest bed evidently grew on a sloping bank at the border of a lagoon or quiet inlet. The lowest part of it is now twenty feet or upwards below the level of high tides in the Bay of Fundy.

At Aulac station, Intercolonial Railway, which is on the great Tantramar salt marsh, a boring 305 feet deep was put down under the direction of P. S. Archibald, chief engineer, Intercolonial Railway. This boring shows likewise (1) marsh mud, eighty feet; (2) "turf and bog;" (3) red clay, &c. These facts clearly establish the conclusion that a subsidence has taken place here since the growth of the peat beds, and confirms the observations made previously by Sir J. W. Dawson, (*Acadian Geology*, 3rd ed., p. 13).

Later on a cursory examination of the surface geology of the northern and western parts of Nova Scotia was made. In Pictou county striae and transported boulders, showing northerly ice-movements, were observed. In Annapolis valley boulders derived from the South Mountain were also found strewn about in profusion. Numerous facts having a close relation to the surface geology of southern New Brunswick were noted.

Field work was continued until the 14th of December.

Cost of season's explorations, \$997.75.

The district examined by Mr. Fletcher in Nova Scotia in 1889 comprises a portion of Pictou and Colchester counties, lying between the Gulf of St. Lawrence west of Pictou harbor, and Cobequid Basin, including the valleys of Toney, John, Waugh and French Rivers, on the north side of the Cobequid Hills, and of the Salmon, North, Chiganoise and Debert Rivers on the south side of these hills. The northern part of the district is being opened up by the short line of railway from Oxford to Pictou, now nearly completed, which will pass near the celebrated red freestone quarries of River John, Tatamagouche and Toney Rivers.

Along the north side of the hills, as far west as Waugh River, runs a belt of red conglomerate, described as Permian in previous reports, of the same geological age as that of New Glasgow, interstratified with red grit, sandstone and marl, and overlaid by grey sandstones, like those of Pictou and the West River. These are succeeded in turn by brownish and red sandstones and marls, with one or two thin layers of limestone. They form the rich agricultural country which borders the Gulf shore. All are affected by important east and west faults. Associated with the conglomerates, and also occasionally with the grey sandstones are veins of albertite and of baryte. The veins of albertite are not, however, confined to these rocks. Hitherto no veins of greater thickness than four inches have been found, and these are lenticular and irregular. Barytes was quarried to some extent in the grey sandstone of Hodson, near River John, some years ago, but at present none of the known deposits are being worked, none of them perhaps warranting a large expenditure for exploitation. Small seams of bituminous coal have been discovered in the grey sandstone, but none seem to be persistent.

Reference has often been made to the grey sulphide and carbonate of copper found associated with carbonized plants in calcareous, concretionary beds among the grey sandstones of this formation, or as

nodules in red and green marls. In many places, but particularly on Waugh River and French River, these ores have been largely but not profitably worked.

The rocks of the eastern slope of the hills, from Salmon River to Great Village River, near the Londonderry iron mines, consist for the most part of the brick-red crumbly sandstone and conglomerate, called Triassic by Sir J. W. Dawson, underlaid here and there by Carboniferous and probably also by Permian rocks, in some of which unimportant seams of coal have been discovered.

The structure of the Cobequid Hill is much more varied and interesting. No evidence of the age of the trap, felsite, syenite, diorite and schistose rocks was found on the north side of the hills, where they are immediately overlaid by Permian strata evidently newer; but on the south side and towards Earltown, similar rocks cut Silurian and Devonian in such a manner as to make it appear probable that they are igneous and younger than these sedimentary strata. The Silurian is confined to small areas at and near Earltown, in Waugh River, and at Wentworth railway station, the principal sedimentary rocks being an extension of the Devonian slates of Mount Tom and of Waters' Hill, and McCulloch Brook, at the north-western corner of the Pictou coal field, similar to a group containing iron ores in Guysboro', Antigonish and Pictou counties, including the iron ore belt of the Londonderry mines, in the slate of which, on the I. C. R., and many of the brooks of the neighborhood, many well preserved remains of plants have been discovered.

The small coal seams of West River, Riversdale and Kempton, with their associated slaty shales and quartzites, have been traced in the North, Chiganoise and Debert Rivers, where much money has been spent in attempts to find them in workable shape. In every case in which the including strata have been followed to contact with the syenite and diorite of the hills, they have been found greatly altered.

Towards the close of the season, several weeks were spent in a further examination of the Pictou coal field, in which recent mining operations, borings made by Mr. R. P. Fraser, of Pictou, with the diamond drill for certain mining companies, and geological explorations made by the late Mr. Jesse Hoyt, and Mr. H. S. Poole for the Acadia Coal Mining Company, have added many facts necessary for understanding the complicated structure of the field. A visit was also made to Kennetcook Orner, where coal has been reported to occur; but the seams are all apparently too small to be workable, and the basin in which they lie, between lower Carboniferous limestone and gypsum, is very narrow.

During the past summer two companies began to work the iron ores of the East River at Pictou. One of these, under the management of Mr. H. V. Leslie, of New York, has begun the construction of a railway from Sunnybrae to New Glasgow, which is projected to extend to the harbor of Liscomb, on the Atlantic coast. The second company, under the management of Mr. Graham Fraser, of New Glasgow, has also surveyed a line of railway from the iron mines to the I. C. R., near the fork of the East River, and vigorously pushed the development of the mining areas. The mining has been done on a large vein of excellent limonite, which follows the contact of Silurian and Cambro-silurian rocks with Carboniferous limestone in the valley of East River. The same company is also mining a vein of excellent red hematite at Newton Mills, Stewiacke, and another near Maitland. Other discoveries of red hematite have lately been made in the hills at the head of French and Sutherland Rivers, in Pictou county. Mr. Fletcher was assisted during the summer by Mr. M. H. McLeod, and for nearly three months by Mr. Archibald Cameron. Field-work was begun about the end of May and continued to the middle of December. Mr. Faribault continued his explorations on the gold-bearing series of rocks in Colchester and Halifax counties, and reports as follows:—

“The district surveyed lies westward of that surveyed in 1884 and northward of that surveyed in 1887 and 1888. It comprises, in Halifax county, the whole of the basin watered by the Musquodoboit River and the head waters of the West Sheet Harbor, Tangier, Ship Harbor and Gay’s River; and, in Colchester county, the south branch and the south-eastern tributaries of the Stewiacke River and the St. Andrew’s River.

Narrow basins of lower Carboniferous rocks extend along the Musquodoboit, Gay’s, Stewiacke and St. Andrew’s Rivers, containing large deposits of gypsum and limestone, and lie uncomformably upon the sharply folded auriferous rocks of the lower Cambrian. The folding of these latter rocks, and more especially the anticlinal folds, were carefully examined and traced out, on account of their close relation to the richest auriferous belts. The Caribou and Moose River gold mining districts are situated in the region examined. They are now extensively worked, with steady, good returns. Auriferous quartz veins have also been opened up on Fish River, Gay’s River and the south branch of the Stewiacke River, but none of them have so far been worked to any extent.”

Mr. Faribault was assisted, as in the previous year, by Messrs. A. Cameron, J. McG. Cruikshank and P. A. Faribault.

An area of some 350 square miles has been surveyed. The season's work extended from the 16th of May to the 1st of October.

Cost of season's work by Messrs. Fletcher and Faribault, about \$2,000.

MINING AND MINERAL STATISTICS.

Mr. Brumell was occupied during the winter and spring in preparing the report on the Mining and Mineral Statistics of Canada for 1888. About 3,000 circulars were sent out, and were followed by about two thousand five hundred letters asking for the returns. Fifteen hundred were received.

The work was under the supervision of Mr. E. Coste, M. E., till March, when he obtained leave and eventually resigned his position. A summary statement of the totals of the mineral production for 1888 was published in March, and the detailed report, completed by Mr. Brumell, was published and issued in October, and forms Part S, Vol. IV., of the Annual Report of the Survey.

Of the past summer's work Mr. Brumell reports as follows :

"I left Ottawa on 27th August last to visit the various places in southern Ontario, where boring operations were in progress. The counties visited were Welland, Lambton and Essex, in all of which drilling is being actively carried on.

In Welland county a company has been in operation since the month of June last, and had, at the time of my visit, completed one well, which attained a depth of 846 feet, and had begun a second. From the first well a flow of gas of 1,000,000 cubic feet had been obtained, though subsequent to my visit this well was shot, and the flow increased to about 1,750,000 cubic feet.

An accurate log and specimens were obtained of this well and also of others in the Niagara Peninsula. In August last eight wells had been completed in the Peninsula. Of these three are at Port Colborne, two at Niagara Falls South, and one each at Thorold, and at St. Catharines and in the Township of Bertie. A very small flow of gas was obtained in the well at St. Catharines and at Thorold, while from the wells of Port Colborne there is a total production of about 50,000 cubic feet per diem. It is understood that the burning spring at Niagara Falls is being supplied with gas from one of the wells recently sunk at that place.

At Bertie and Port Colborne the gas was obtained from the upper beds of the Medina formation, which is reached at these places at a depth of 735 and 730 feet respectively. At Niagara Falls the gas

comes from a depth of 201 feet, at which depth the bore is in the lower beds of the Niagara shales, while at Thorold and St. Catharines the flow is obtained from the lower part of the Trenton series, in the former place at a depth of 2,394 feet, or 489 feet in the Trenton limestone, and at the latter in a sandstone at a depth of 2,185 feet, or 13 feet below the limestones of the Trenton series.

Two more wells have been drilled in the townships of Bertie and Humberstone, to a depth of 851 and 836 feet respectively, having a flow of gas of about 500,000 cubic feet per diem each, the flow in both cases being from the Medina sandstone.

In Lambton county the oil fields of Enniskillen township are still being extensively drilled upon. A number of drillers living in Petrolia and Oil Springs were interviewed, and logs and information regarding wells throughout the province were obtained from them.

In Essex county exploration for gas is being continued. It has, however, been obtained in quantity, but in one well, namely, "Coste No. 1," which has a daily flow of 10,000,000 cubic feet. This well, drilled to a depth of 1,031 feet, is situated in the township of Gosfield, lot 1, concession 3, eastern division. Wells had recently been completed at and near Kingsville and at Comber, and drilling was, in September, being carried on at Amherstburgh, Essex Centre, Marshfield, Kingsville, Leamington and Blytheswood. The well at Marshfield, being sunk for Messrs. Walker & Sons, of Walkerville, will be watched with considerable interest, as it is the intention of the firm to carry this drilling down as far as the Trenton limestone.

Logs and specimens of drillings were obtained of most of the wells in the county. In order to further work out the underground geology of the province in connection with the boring operations, elevations were obtained of many of the wells, their relative levels to the nearest railway station being generally obtained. Accurate instrumental measurements were made when necessary.

About 150 logs or records are now on file in this office, which number is constantly being supplemented as operations continue.

Mr. Brumell returned to Ottawa on 3rd October, after having, in addition to the counties named, visited and obtained information in regard to borings at London, Brantford, Hamilton, Toronto and Whitby. Since his return he has been preparing the circulars for the Mining and Mineral Statistics for 1889, and in constructing from the data he obtained during the summer, and from all other available sources, maps and sections on which it is proposed to show the location of the numerous borings that have been made, or are now in progress in Ontario; also the depth of each boring, and the nature of the strata

passed through, and the strata in which gas, oil or water was obtained.

Mr. E. D. Ingall, M.E., Associate of the Royal School of Mines, has now been appointed to succeed Mr. Coste, and will henceforth be in charge of the Mineral Statistics Division, and be assisted by Mr. Brumell.

CHEMISTRY AND MINERALOGY.

The report handed me by Mr. Hoffmann on the work carried on in the Chemical Laboratory also embraces that in connection with the Mineralogical Section of the Museum, to the arrangement of which he has devoted much time and care.

Mr. Hoffman reports as follows:—

“The work carried out in the Chemical Laboratory during the past year was of an almost exclusively economic character, and embraced—

1. Analyses of coals, lignites and other fossil fuels.
2. Analyses of iron and copper ores.
3. Analyses of limestones and dolomites.
4. Analyses of mineral and other waters.
5. Gold and silver assays.
6. Miscellaneous examinations.

The number of mineral specimens received for examination amounted to 472. A large number of these were brought in by visitors desirous of having them identified and obtaining information in regard to their economic value, and this information was communicated either at the time of their calling or, where a more than cursory examination was called for, subsequently by letter. The number of letters written, most of which partook of the nature of reports, amounted to 205.

Mr. E. D. Adams, in the capacity of Assistant Chemist, rendered good service up to the time of his leaving for field work in July.

Mr. R. A. A. Johnston has, as Junior Assistant Chemist, diligently applied himself to the work entrusted to him. In addition to the gold and silver assays, he has, as opportunity afforded, made further analyses of limestones and dolomites, besides carrying out a great many minor examinations.

In the Mineralogical Section of the Museum a large amount of work has been carried out in the way of labelling and re-adjusting specimens. The manuscript catalogue of the scientifically arranged collection of minerals is, as stated in my last report, completed, and that of the economical collection of rocks and minerals is now almost so. Apart

from the replacement of numerous specimens, already represented, by more typical ones, the collection has been augmented by the addition of some 140 others, including the following presentations:—

Allan, W. A., Ottawa, O.:—

Hematite, from the west half of lot 28, range 5, of the township of Oso, Addington county, O.

Allison, J. F., per Dr. G. M. Dawson:—

Chalcopyrite, from the British Columbia Copper Company's mine, South Similtamen River, B. C.

Bedard, —, per Dr. Ells:—

Roofing slate, from Bedard's quarry, lot 5, range XV., of the township of Cleveland, Richmond county, Q.

Boulanger, Horace, J. P. for Keewatin and Chief Factor in charge at Norway House, per Mr. J. B. Tyrrell:—

Serpentine, from the extreme north end of Reindeer Lake, N. W. T.

Brock, S. R., Alwyn, Ottawa county, Q.:—

Phlogopite, from the township of Alwyn, Ottawa county, Q.

Brown, John R., St. Alice Hotel, Harrison Hot Springs, B. C.:—

Iron ochre, from Silver Creek, Harrison Lake, twenty miles north of Harrison Hot Springs, B. C.

Breels, Joseph, East Templeton, Ottawa county, Q.:—

Fluorite, from lot 15, range 1, of West Templeton, Ottawa county, Q.

Chambers, R. E., Truro, N. S.:—

Limonite, three miles from Brookfield station, Colchester county, N. S.

Chapman, C., Prescott, O.:—

Huronian quartzite, three polished slabs of; from the north shore of St. Joseph Island, Lake Huron, O.

Dickson, W. H., Ottawa, O.:—

Apatite and graphite, from lot 28, range VI., of the township of Buckingham, Ottawa county, Q.

Furlonge, W. H., Port Arthur, O.:—

Native silver, from Silver Mountain mine, township of Lybster, district of Thunder Bay, O.

Argentite, from the Beaver mine, Rabbit Mountain, district of Thunder Bay, O.

- Marion, Rev. Father, Douglas, Renfrew county, O. :—
Magnetite, from lot 24, range II, of the township of Stafford,
Renfrew county, O.
- McKay, J. W., Kamloops, B. C. :—
Molybdenite, from near the head waters of the South Fork of
Spuzzum Creek, Fraser River, B. C.
- Poole, H. S., Stellarton, N. S. :—
Altered bitumen, from the falls measures, immediately over-
lying the Acadia seam at Westville, Pictou county, N. S.
- Russell, A. L., Port Arthur, O. :—
Native silver (two specimens) from Silver Mountain vein,
mineral location, range 56, township of Lybster, district
of Thunder Bay, O.
Native silver with sphalerite from Silver Hill, near Silver
Mountain, district of Thunder Bay, O.
Argentite, from Silver Mountain vein, mineral location range
56, township of Lybster, district of Thunder Bay, O.
Argentite, from Rabbit Mountain mine, township of Gillies,
district of Thunder Bay, O.
- Saunders, Wm., Ottawa, O. :—
Altered bitumen, from Queen Charlotte Island, B. C.
- Stewart, G., West River, Sheet Harbor, N. S. :—
Native gold in quartz, from the Killog mine, Sheet Harbor,
Halifax county, N. S.
- Trethewy, T. H., Port Arthur, O. :—
Native silver (two specimens) from Silver Mountain, district
of Thunder Bay, O.
- Wertheim, Ed., Desjardins, P. O., Q. :—
Asbestos (chrysotile), from south half of lots 27 and 28, range
XII., of the township of Coleraine, Megantic county, Q.
Samples of mill-board, steam-packing, &c., manufactured from
the asbestos of this locality.
- Wilson, —, per Dr. G. M. Dawson :—
Magnetite, Rivers Inlet, B. C.

Mr. R. L. Broadbent has rendered most efficient service in the mineralogical section of the Museum. Indeed, but for the interest and assiduity he has displayed in the work, the progress achieved could

hardly have been hoped for. In the early part of the year, Mr. C. W. Willimott was occupied in making up collections of minerals and rocks for various institutions. Of such collections, the following have been sent out in the course of the year :—

	Specimens.
To W. G. Kidd, Public School Inspector, Kingston	13
Public School, Upper Sumas, B. C.....	87
Bishop's College, Lennoxville, Q. (Supplementary)...	32
Manitoba College, Winnipeg (Supplementary)	35
Town Council, Sault Ste. Marie, O.....	112
Bourget College, Rigaud, Q. (Supplementary).	40
High School, New Westminster, B. C.....	112
Iberville Convent, Iberville, Q.....	112
Mrs. A. Frechette, Ottawa, O., (fragments).....	70
Rev. D. Borthwick.....	25

During the summer he visited the townships of Leeds, Garthby, South Ham, Grenville, and several of the townships in Ottawa county, in the province of Quebec. A large quantity of material was obtained for the purpose of making up collections for educational purposes, as also numerous interesting specimens for the Museum.

PALÆONTOLOGY AND ZOOLOGY.

Of these divisions of the Survey's field of operations Mr. Whiteaves reports as follows :—

Advance sheets of the letter press of pages 151-184 of the second part of "Contributions to Canadian Palæontology" were printed and distributed in July, 1889. A similar edition of pages 185-196 of the same publication was printed and distributed in August. The manuscript of the pages last mentioned, which consists of a descriptive report on the fossils of the Niobrara-Benton formation of the Duck and Riding Mountain district in Manitoba, for the most part collected by Mr. J. B. Tyrrell, in 1887, was all written during the present year. The entire part, which consists of 107 pages large octavo, illustrated by fifteen full-page lithographic plates, was issued in August, 1889. About one-half of the letter press of the third part of the "Contributions to Canadian Palæontology" has been written. This part is intended to contain a descriptive report on the fossils collected by Mr. McConnell in 1888 and 1889, from the Devonian rocks at several localities in the Mackenzie River basin. A paper entitled "Descriptions of Eight new Species of Fossils from the Cambro-silurian rocks

of Manitoba," has been written for the transactions of the Royal Society of Canada for 1889. Three hundred advance copies of this paper, which consists of nine pages quarto of letter press, illustrated by six full-page plates, were printed and distributed in November. A preliminary examination has been made of a rather large series of fossils collected by Mr. J. R. Tyrrell, during the summer of 1889, from the Cambro-silurian rocks at Swampy, Big and Deer Islands, in Lake Winnipeg, at Grindstone Point, on the west side of the lake, and at the mouth of the Little Saskatchewan; also of a number of fossils recently obtained by Mr. R. G. McConnell, from the Cretaceous rocks of the Peace River and its tributaries, Lesser Slave Lake and the Athabasca River. A short visit was made to Thetford, Ont., in September, and some fossils of interest were collected from the Devonian shales and limestones of that neighborhood.

In the upper flat of the Museum a new upright glass case, seven feet five inches high, six feet five inches long, and two feet nine inches broad, has been constructed for the reception of the fine collection of Dinosaurian and Mammalian remains recently made by Mr. Weston, from the Laramie and Tertiary formations at various localities in the North-West Territory, and all the specimens in this case have been provisionally labelled. In the same flat a small glass case has been made, in which has been exhibited a named series of the fossil plants collected by Mr. McConnell in 1888, from the Tertiary rocks of the Mackenzie River, 20 miles above Bear River, recently described by Sir William Dawson.

In the Department of Zoology a large collection of the mammalia birds, reptiles, &c., of British Columbia, has been received from Professor Macoun. Seventy-seven additional specimens of fifty-nine species of Canadian birds, and nineteen specimens of sixteen species of Canadian mammals, most of which were collected by Professor Macoun, have been skilfully mounted by Mr. T. Herring during the year. These have been carefully labelled and arranged in their proper places in the zoological cases. Two large upright glass cases (each 7 feet high, 6 feet 5 inches long, and 3 feet 6 inches broad, with plate glass shelves) have also been constructed for this flat of the Museum. One of these is now filled with a collection of the mammalia of Hudson's Bay and Strait (including a pure albino wolf from that district, which has recently been mounted), and the other with a choice series of seals from the Atlantic and Pacific coasts of Canada, and with a fine head of the walrus. The specimens in each of these cases have been re-labelled re-arranged.

The number of official letters received during the year is 330, and and the number written 283.

From the 1st of January to the end of June, Mr. T. C. Weston's time has been employed in museum work, in the sections devoted to palæontology and ethnology. Many new specimens have been added to some of the fossil cases, and a large number of labels written. Numerous additional specimens, also, have been placed on exhibition in the room devoted to ethnology, among which are about seventy implements or other objects of Indian manufacture, recently collected for the survey by Dr. Franz Boas, in British Columbia. On the 1st of June Mr. Weston left Ottawa for the Red River, N.W.T. From the Laramie sandstones near Calgary, some fine specimens of fossil plants were obtained, which have since been identified by Sir William Dawson, and are now labelled and exhibited in their proper place in the Museum. The Red Deer River, eight miles below the crossing of the Calgary and Edmonton road, was reached on the 13th of June. Four days were spent preparing boats for the journey down the river, and in collecting fossil plants from the Laramie sandstones and argillities of the Blind Man River. On the 17th of June the journey down the Red Deer was commenced, and in a short time the great coal seams in range 24, township 28, were reached. The confluence of the Red Deer with the South Saskatchewan was reached on the 14th of July. Between this point and Tail Creek, a distance of about 250 miles, the rocks were examined in a number of places, and a fine series of vertebrate remains was obtained from the Laramie and Belly River deposits. Among these are the right and left side of the jaw of a Deinosaur (probably *Loelaps*) vertebræ, limb bones, teeth and claw cores. The Battleford and Swift Current crossing was reached on the 19th of July. Ten miles below this, at the mouth of Swift Current, there is a large exposure of the Pierre, from which a small but interesting collection of fossil shells and reptilian remains was obtained. After this the White River beds of the Cypress Hills were re-visited and a few fine fossil bones were collected, among which is a large portion of the right ramus of the lower jaw, apparently of an *Elotherium*. On the return journey to Ottawa, a few days were spent searching for fossils among the Animikie rocks of Port Arthur and Rossport, but none were found. Ottawa was reached on the 21st of August. From 2nd September to the 16th several fossiliferous localities in the Eastern Townships of the province of Quebec were examined, various specimens of interest (including examples of *Salterella* from two new localities) were obtained for the Museum. The remainder of the year has been occupied by Mr. Weston in preparing, labelling and arranging for exhibition in the Museum the collections received during the summer.

With the exception of two months spent in Europe, on leave of ab-

sence, a considerable portion of Mr. H. M. Ami's time has been occupied in the examination of numerous collections of fossils recently made by members of the staff at various localities in the provinces of Quebec and New Brunswick. Separate lists of the species from each locality in the province of Quebec, have been prepared by Mr. Ami, which have been incorporated into Dr. R. W. Ells' second report on the geology of a portion of that province, and a systematic list of the whole, by Mr. Ami, has been printed as a supplement to that report. Similar lists of fossils collected at various places in northern New Brunswick and adjacent areas in Quebec and Maine, have also been made by Mr. Ami, which have since been published in Prof. L. W. Bailey and Mr. McInnes' report on the geology of that region. A paper "On a Species of *Goniograptus* from the Levis Formation, at Levis, P.Q.," written by Mr. Ami, has been published in the seventh number of the third volume of the "Canadian Record of Science," and another paper, consisting of additional notes on the same species has been published in the eighth number of that volume. These papers are illustrated by an octavo plate, skilfully executed by Mr. L. M. Lambe. Some progress has been made in the manuscript of a report on the fossils contained in the Cambro-silurian exposures and outliers in Central Ontario along the line of contact with the Laurentian area to the north. Labels for the species of fossils enumerated or described in recent palæontological publications by Mr. Whiteaves, Prof. T. Rupert Jones, Dr. G. J. Hinde and Mr. E. O. Ulrich, and for other specimens mostly of recent addition to the Museum, have been prepared for the printer by Mr. Ami. By permission of the Director, and on special application, the types of a few Canadian species and some other specimens have been sent for examination to Professors James Hall, T. Rupert Jones and H. A. Nicholson, to Dr. G. J. Hinde and Mr. C. D. Walcott, but all of these specimens have since been returned. Named sets of duplicate fossils are being made up by Mr. Ami for distribution to educational and other public institutions in Canada. One of these sets has been despatched to the Historical and Scientific Society of Manitoba, at Winnipeg, and it is hoped that six similar ones will be distributed at an early date.

In the Palæontological work of the office Mr. L. M. Lambe, the artist to the Survey, has also rendered most efficient service. All the drawings required for the illustration of the palæontological publications issued by the Survey during the year have been made by him, and he has either effected or superintended their reproduction in a most satisfactory way. He has also made a number of drawings of fossils, which are as yet unpublished, and all the figures which have

been used to illustrate Sir William Dawson's paper on the fossil plants collected by Mr. McConnell in the Mackenzie River basin, published in the transactions of the "Royal Society of Canada" for 1889, are from his skilful pencil. In addition to this Mr. Lambe has materially helped in the elucidation of the characters and specific relations of many of the fossils which have been entrusted to him to draw.

The following collections have been received during the year from members of the staff:—

Dr. Selwyn:—

Fifteen specimens of fossils from the Cambrian and Cambro-silurian rocks of the Strait of Belle Isle and Newfoundland.

Dr. G. M. Dawson:—

About forty fossils from the southern part of the interior of British Columbia.

Also a few skins of small mammals and birds.

J. F. Whiteaves:—

About 100 specimens of fossils from the Hamilton shales at and near Thetford, Ont.

Prof. Macoun:—

Skins of 358 birds and seventy-three mammals from British Columbia; also a collection of reptiles, butterflies, shells, &c., from the same province.

Dr. R. W. Ells:—

About 100 slabs, containing graptolites, from the Cambro-silurian rocks near Lake Memphremagog, P.Q.

Prof. L. W. Bailey:—

Fifteen specimens of *Obolus pulcher*, Matthew, from the lower Cambrian rocks at Caton's Island, N.B.

J. B. Tyrrell:—

About 5,000 fossils from the Cambro-silurian and Devonian rocks at various localities on Lakes Winnipeg and Winnipegosis.

R. G. McConnell:—

Forty specimens of fossils from the Devonian rocks of the Peace River and 200 from the Cretaceous rocks of the Peace and Athabasca Rivers.

T. C. Weston :—

Fifty specimens of fossils from the Quebec group of the province of Quebec. Thirty specimens of vertebrate and 300 of invertebrate fossils from the Cretaceous rocks of the South Saskatchewan. 200 specimens of invertebrate and the same number of vertebrate fossils, including a fine series of Dinosaurian remains, from the Laramie of the Red Deer River, N.W.T. Seventy specimens of fossil plants from the Blind Man River, N.W.T.

W. McInnes :—

About 100 fossils from Tuladi Falls, Rimouski River, and a few from Notre Dame du Portage, P.Q.

H. M. Ami :—

A number of fossils from the Trenton and other formations near Ottawa; also arrow heads and fragments of pottery from near Casselman, Ont.

The additions to the palæontological, zoological and ethnological departments of the Museum, by presentation, exchange or purchase, are as under :—

By presentation :

G. R. White, Ottawa :—

Skin of a female Ruddy Duck (*Erismatura rubida*) from the Ottawa River.

Rev. G. W. Taylor, Stewarton, Ont. :—

Eggs of twenty-four species of Canadian birds, mostly from British Columbia. One specimen of a crab (*Echidnocerus cibarius*) from Vancouver Island.

James Fletcher, Ottawa :—

Eggs of thirty-two species of Canadian birds, and photograph of egg of the Great Auk (*Alca impennis*).

W. A. D. Lees, Ottawa :—

Eggs of nineteen species of Canadian birds. Specimen, in the flesh, of the Mole Shrew (*Blarina brevicauda*), from near Ottawa.

F. E. Trudeau, Ottawa :—

Mounted specimen of the American Raven (*Corvus corax sinuatus*) shot at Lake Edward, P.Q.

James Davidson, West Templeton, P.Q. :—

Specimen, in the flesh, of an Ermine (*Putorius ermineus*.)

Philip Cox, Newcastle, N.B. :—

Pair of the Hudsonian Chickadee (*Parus Hudsonicus*), from the Miramichi River, N.B.

• Joseph Edwards, Ottawa :—

Specimen, in the flesh, of the Northern Hairy Woodpecker (*Dryobates villosus leucomelas*), from Blue Point, Lake St. John. Specimen of the Hoary Bat (*Atalapha cinerea*), from the Rideau River, in the flesh. A Brown Creeper (*Certhia familiaris Americana*.) A male House Wren (*Troglodytes ædon*), both in the flesh; also two eggs of the Horned Lark (*Otocoris alpestris*), and two of the Flicker (*Colaptes auratus*), all from near Ottawa.

The U. S. Geological Survey (per C. D. Walcott) :—

Fourteen species of fossils from the Lower Cambrian rocks of Newfoundland, &c.

J. Heron, Billing's Bridge :—

A female Woodchuck (*Arctomys monax*), in the flesh.

J. H. Bartlett, Ottawa :—

Female Jumping Mouse (*Zapus Hudsonius*), from Billing's Bridge, in the flesh.

W. C. Bedingfield, Ottawa :—

Nest of the Ruby Throated Hummingbird (*Trochilus colubris*), from Kemptville.

H. M. Ami, Ottawa :—

One Brown Bat (*Scotophilus fuscus*), in the flesh.

D. Herring, Toronto :—

Skin, since mounted, of a female Buffle Head (*Charitonetta albeola*); do of a female Green-winged Teal (*Anas carolinensis*); do of a female Blue-winged Teal (*Anas discors*), and do of a female Black-throated Green Warbler (*Dendroica virens*); all from near Toronto.

S. Herring, Ottawa :—

Pair of the Whip-poor Will (*Antrostomus vociferus*), from near Toronto.

- W. McRae, Twin Glen, Carleton Co., Ont.:—
Rattle of a large Rattle Snake from Arkansas.
- Dr. C. A. White, Washington, D.C.:—
Three specimens of *Astarte Packardii*, White, from the Sauranodon beds ("Jurassic") at Aurora, Wyoming.
- Alex. Jacques, Ottawa:—
Piece of oak of the "Royal Savage," a culverin and musketoon ball, each of which were taken out of a beam on the church at Plattsburgh, and pieces of Indian pottery found near that city.
Piece of sound wood found 116 feet below the surface of the ground at Polk Co., Indiana.
- W. J. Baylay, Ottawa:—
Female Sharp-shinned Hawk (*Accipiter velox*) shot at Aylmer, P.Q., in the flesh.
- E. G. White, Ottawa:—
Specimen of the American Crow (*Corvus Americanus*), in the flesh.
- R. A. A. Johnston, Ottawa:—
Albino Chipmunk (*Tamias striatus*) from Uxbridge, Ont.,—mounted.
- Sir William Dawson, Montreal:—
Sixteen specimens of ten new species of fossil sponges, one example of *Butotrephis pergracilis*, Dawson, and nine of *Linnarssonina pretiosa*, from Métis, P.Q.
- Prof. R. J. Hill, Austin, Texas:—
Thirty-one specimens of *Terebratula Wacoensis*, Roemer, from the Washita limestone west of Austin, Texas.
- Rev. Hector Currie, Thetford, Ont.:—
Twelve specimens of fossils from the Hamilton shales near Thetford.
- Rev. W. H. Barris, Davenport, Iowa:—
One specimen each of three rare species of fossils from the Hamilton formation near Alpena, Michigan.

R. R. Rowley, Curryville, Pike Co., Missouri:—

One hundred and three specimens of twenty-four species of fossils from the Burlington and Kinderhook formations at Pike Co., Miss.

By Exchange.

From the Manitoba Historical and Scientific Society, Winnipeg, per C. W. Bell (President).

Four fossils from the Cambro-silurian rocks of East Selkirk and Stony Mountain, and two from the Cretaceous rocks of the N. W. T.

From Prof. T. F. Calvin, Iowa City:—

Thirty-two species of fossils from the Devonian rocks of Iowa and Missouri, one from the Niagara limestone of Iowa, two from the Hamilton shales of Ontario, and six from the Cretaceous of Montana

By Purchase.

Semi-albino Red-tailed Hawk (*Buteo borealis*); semi-albino Song Sparrow (*Melospiza fasciata*); male Grasshopper Sparrow (*Ammodramus savannarum passerinus*); female Wilson's Warbler (*Sylvania pusilla*); and albino or nearly albino variety of the Red Squirrel (*Sciurus Hudsonius*); all from Hyde Park Corners, Ont.

Albino American Crow (*Corvus Americanus*), shot near Whitby, Ont.

Remarkable colour variety of the American Robin (*Merula migratoria*), shot near Ottawa.

Male Murre (*Uria troile*), shot near Wakefield, P.Q.

Male Coot (*Fulica Americana*), shot near Toronto.

Sixty-four specimens of fossils from the Silurian and Devonian rocks of western Ontario.

Skeleton of a large Snapping Turtle (*Chelydra serpentina*), obtained at Markham, Ont., and prepared by M. Jules Bailly, Montreal.

In the section of entomology, Mr. Fletcher reports that the collections have been regularly examined since they have been in his charge, and are now in a good state of preservation, no instance of injury by insects, mould or accident having occurred.

Mr. Fletcher further reports as follows:—

The collections have been considerably augmented by donations, and by the labours of different members of the staff of the survey, who have brought from distant localities a number of insects of rarity and interest, many of which were previously unrepresented in the cabinets.

Since Mr. Fletcher had charge of the collection, (1887) the following additions, made by members of the staff, have been examined, identified and prepared for the cabinets.

1. By Professor Macoun, at Nipigon, in the Rocky Mountains, in Vancouver Island, in Prince Edward Island and on the mainland of British Columbia.

2. By Dr. G. M. Dawson, in the Yukon District, and in the interior of British Columbia.

3. By Messrs. McConnell and Ogilvie, in the Mackenzie River district.

4. By Mr. Frederick Bell, at Fort Simpson, Mackenzie River, and presented for the museum to Mr. McConnell.

5. By Mr. J. B. Tyrrell, in Manitoba.

6. By Mr. A. P. Low and Mr. J. M. Macoun, at Hudson Bay.

7. By Mr. J. S. Cotter, at Moose Factory, Hudson Bay, and presented to Mr. Low for the museum.

8. By Mr. T. C. Weston, in the North-West Territory.

Of these collections by far the most important were those made by Professor Macoun, Dr. Dawson and his assistant Mr. McEvoy.

It is true that most of the above mentioned collections consisted largely of specimens in a poor state of preservation; but they included many rare insects, amongst the more important of these are the following:—*Oeneis Macouni* and *Nemeophila Selwyni*, both new species discovered by Professor Macoun, at Nipegon, *Papilio Machaon* var. *Alaska*, collected by Dr. Dawson, on the Laird River, and by Mr. Ogilvie, on the Mackenzie River, *Erebia discoidalis*, collected at Fort Simpson, Mackenzie River, by Mr. Frederick Bell, *Colias Nastes*, brought from Hudson Bay by Mr. Low, *Colias Interior*, from Nipegon and Prince Edward Island, collected by Professor Macoun. A fine series of *Lyccenia Couperi* was brought from British Columbia by Dr. Dawson. The specimens in the best preservation were those collected by Mr. James McEvoy and by Messrs. James and William Macoun.

In addition to the above, fine collections of insects belonging to various orders have been presented to the museum by Mr. T. E. Bean, of Laggan, North-West Territory.

All the specimens bear dates and localities of their capture, which materially enhance their scientific value.

During the past year several students have examined the collections.

Mr. Fletcher is at present engaged in the preparation of a small collection representing the insects of Canada only, which is for exhibition in open cases in the hall of the museum, and which it is believed will be of interest to visitors.

BOTANY, ETC.

During the greater part of the winter Professor Macoun was confined to the house by sickness, but with the aid of his assistant, Mr. J. M. Macoun, the office work was carried on and the specimens that had been collected during the summer were named and mounted. He was also able, before leaving for the field, to make good progress with the catalogue of Canadian birds, referred to in the summary report for 1888.

On the work of the past summer, Professor Macoun reports as follows:—

“On the 30th of March last, accompanied by my assistant, I started for British Columbia, and reached Vancouver, 4th April. Next day we commenced work, and between that date and 12th August, with the aid of one man, we collected birds, mammals, reptiles and insects, and also made a complete collection of the flora from the coast to the Eagle Pass in the Gold Range, a distance of nearly 400 miles on the Canadian Pacific Railway. This being the first season of my duties of naturalist, we devoted much more time to general natural history than to botany. Our season's work ended at Griffin Lake, on Eagle River, after we had lived at an altitude of 7,000 feet for ten days, and collected as much of the mountain flora and fauna as time and means would permit.

The total cost of the exploration was \$1,377.21.

“Since our return to Ottawa we have been engaged in sorting, naming and arranging the collections of the season. Satisfactory progress has been made up to 31st December; forty species of plants new to science have been examined and named, and others are still to be determined.

Mr. Pearson's paper on Canadian Liverworts is now passing through the press, and will be followed by Part V. of the Catalogue of Canadian Plants, and by the Catalogue of Canadian Birds already mentioned.

These papers were placed in the hands of the printer last spring, so that they might be in type before my return.

During the past three years I have spent much time in collecting and working up the mosses of the Dominion, and with the aid of European specialists, hope during 1890 to complete the work and publish a full list of them, forming Part VI of the Catalogue of Canadian plants.

Many hundred species of plants have been received from Newfoundland, and from every province in the Dominion, for identification, the largest number being from Newfoundland, Quebec and New Brunswick.

While in British Columbia we collected over 1,400 species of plants, in which were included more than 15,000 specimens; 431 skins of birds and mammals, representing 141 species were secured. Nearly 100 reptiles were collected and preserved in alcohol, and several hundred insects, which are now being determined by specialists.

All work in connection with the herbarium and the distribution of specimens has been done by Mr. Jas. M. Macoun. During the past year there were mounted and placed in the herbarium 4,406 sheets of specimens. Of these 3,592 sheets were of flowering plants and 814 of cryptogams. Of the flowering plants 1,987 sheets were Canadian, 1,079 from the United States, 340 from Australia and 186 from Europe. The cryptogams mounted were, with few exceptions, Canadian; 5,960 sheets of specimens were sent to public institutions and to private individuals in exchange for desiderata; 3,593 of flowering plants and 2,167 of cryptogams. These included 400 sheets to the University of Copenhagen, in exchange for which plants from Greenland were sent; 432 sheets to Columbia College; 445 sheets to the British Museum; 293 to the National Museum at Washington; 200 to Miss R. Marson, Lausanne, Switzerland; 200 to J. B. Ellis, Newfield, N.Y.; 100 to Prof. L. M. Underwood, Syracuse, N.Y. For all of these, specimens have been sent us in exchange, but besides these several hundred specimens were sent to McGill University, the Department of Public Instruction, Quebec, Harvard University, the California Academy of Sciences, the University of Nebraska, and a set of Canadian grasses to Prof. Scribner, of Knoxville, Tenn., U. S.

Since my last report 448 letters of sufficient importance to copy were written in connection with our work and about the same number were received."

While the collections of Natural History specimens are rapidly growing larger and increasing in value, no greater space is being given for their disposal, and while the danger from fire is constantly increas-

ing the absence of any fire-proof room or building renders it impossible to take any precautions to insure their safety. The room now occupied by Professor Macoun is so crowded with inflammable material that a spark, or the dropping of a match, would in a few moments cause the destruction of specimens of inestimable value, which could never be replaced, and such a fire would endanger the whole building.

MAPS.

Maps in course of preparation and lately published, December, 1890.

	Area in square miles.
Yukon district, North-West Territory, and adjacent northern part of British Columbia (3 sheets), published 1890, scale eight miles to one inch.....	
Index Map of above, published 1889. Report B. 1887-88.....	
Big River, Great Whale River, &c., E. coast Hudson's Bay (unpublished), scale eight miles to one inch.....	
British Columbia, part of Southern Interior (Dr. Dawson), in draughtsman's hands, scale four miles to one inch.....	6,400
Kootenay district, British Columbia (Dr. Dawson), in draughtsman's hands, scale eight miles to one inch.....	11,000
North-Western Manitoba Preliminary Map, published. Report E, 1887-88, Mr. Tyrrell, scale eight miles to one inch.....	12,000
Northern Manitoba, in draughtsman's hands (Mr. Tyrrell), scale two miles to one inch.....	5,000
Northern Manitoba, in draughtsman's hands (Mr. Tyrrell) scale eight miles to one inch.....	20,000
Western Ontario, lake of the Woods (5 sheets), No. 2, ready for engraver shortly, scale two miles to one inch.....	2,000
Western Ontario, Rainy Lake Map (No. 3), published Report F, 1887-88, scale four miles to one inch.....	3,456
Western Ontario, Hunter's Island Map (No. 7), in hands of draughtsman, scale four miles to one inch.....	1,450
Ontario, Sheet 130 (Sudbury Mining District), Dr. Bell, in hands of draughtsman, scale four miles to one inch.....	3,456
Ontario, Sheet 115, ready for draughtsman, scale four miles to one inch.	3,456
Ontario, General Map (in progress), scale four miles to one inch.....	
Quebec, N.E., $\frac{1}{4}$ sheet (E. Township map), in hands of draughtsman, scale four miles to one inch.....	4,500
Quebec, S.W., $\frac{1}{4}$ sheet (E. Township map), in hands of draughtsman, scale four miles to one inch.....	4,500
Quebec, N.W., $\frac{1}{4}$ sheet (E. Township map), partly in hands of draughtsman, scale four miles to one inch.....	4,500
Quebec, Lièvre River and Templeton phosphate region (Ottawa county), scale forty chains to one inch, Mr. Ingall, ready for engraver in about two months.....	260

	Area in square miles.
Quebec, New Brunswick, $\frac{1}{4}$ sheet 17 N.E., published 1887-88, and $\frac{1}{4}$ sheet 18 S.E., in hands of draughtsman.....	
Nova Scotia, $\frac{1}{4}$ sheet 11 N.W., and S.W., in engraver's hand, scale four miles to one inch.....	
Nova Scotia, $\frac{1}{4}$ sheet 4 N.E. and S.E. (Mr. Fletcher), drawn on scale of one inch to one mile.....	
North-West Territory, Mr. McConnell's traverses on the Liard, Mac-Kenzie and Porcupine Rivers, in the draughtsman's hands, scale eight miles to one inch.....	

LIBRARY.

The Librarian, Dr. Thorburn, reports that from 2nd January to 31st December, 1889, the number of copies of the Geological and Natural History Survey publications, comprising annual reports, parts of same, special reports and maps distributed was 9,199. Of these 8,032 were distributed in Canada; the remainder, 1,167, were sent to foreign countries as exchanges to scientific and literary institutions and to individuals engaged in scientific pursuits.

Every year the list of our exchanges is increasing, so that, as a consequence of this the operations of the Survey are being more widely known and its publications more sought after.

There have been received during the year 2,367 publications, including books, transactions, memoirs, periodicals, pamphlets and maps. In addition to these 51 books were purchased and 38 periodicals were subscribed for, on geological, mineralogical and natural history subjects. For a considerable time past the space allotted to the Library has been found to be altogether insufficient, and, consequently, many of the books, which are frequently required for reference, have had to be stored away in other parts of the building, to the great inconvenience of those wishing to consult them.

The number of books bound during the year has been 162.

There were sent out during 1889, by the Librarian, 1,511 letters, and 1,256 were received by him, thus showing the large and increasing interest taken in the work of the Survey.

The number of volumes in the Library is now about 8,000, and of pamphlets 3,000.

The sales of the Survey publications during the year to 31st December, have amounted to \$2,909.57.

VISITORS.

The number of visitors to the Museum during the year from 1st January to the 31st December, was 18,300, being an increase of 886, as compared with the previous year.

STAFF, APPROPRIATION, EXPENDITURE AND CORRESPONDENCE.

The strength of the staff at present employed is 47, viz., professional 32, ordinary 15.

During the calendar year the following changes in the permanent staff have taken place:—

Mr. Eugene Coste, Mining Engineer, resigned.
 Mr. Jno. McMillan, Field Explorer, “
 Mr. F. D. Adams, Assistant Chemist, “
 Mr. M. O'Farrell, Caretaker, superannuated.
 Mr. E. D. Ingall, appointed Mining Engineer.
 Mr. Thos. Burke “ Caretaker.
 Mr. Allan McKinnon “ Messenger.
 Mr. R. G. McConnell, promoted from 2nd to the 1st class.
 Mr. E. R. Faribault, “ 3rd to the 2nd class.

The amount available for the fiscal year ended the 30th June, 1889, was:—

	\$	cts.	\$	cts.
Civil list appropriation.....			45,900	00
General purpose appropriation.....			60,055	91
The expenditure may be summarized under the divisions named as follows:—				
Civil list salaries.....	43,319	56		
Wages of temporary employes.....	15,396	17		
Exploration and survey.....	24,095	11		
Printing and lithography.....	12,585	13		
Purchase of specimens.....		67	75	
Purchase and binding of books and purchase of instruments.....	1,437	69		
Laboratory apparatus and chemicals.....	514	47		
Stationery and mapping materials, and Queen's Printer....	1,087	33		
Incidental and other expenses.....	2,104	75		
	100,607	96		
Less—Paid in 1888.....	3,259	42		
	97,348	54		
Add—Advances to field explorers.....	6,026	93		
	103,375	47		
Unexpended balance, Civil list appropriation.....	2,580	44		
	105,955	91	105,955	91

The correspondence of the branch shows a total of 7,100 letters sent and 5,860 received.

In my summary report for 1887, page 14, a report to be prepared

by Mr. Warren Upham, of the United States Geological Survey, on the Glacial Lake Agassiz, was mentioned.

The report and accompanying maps were received only on the 19th of December, too late to be incorporated in the last Annual Report. I am now in correspondence with Mr. Upham respecting it, and I hope it will soon be ready for the printer.

I have the honor to be, Sir,

Your obedient servant,

ALFRED R. C. SELWYN,

Director.