GEOLOGICAL SURVEY DEPARTMENT

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SUMMARY REPORT

ON THE

OPERATIONS OF THE GEOLOGICAL SURVEY DEPARTMENT

FOR THE YEAR 1893

BY

THE DIRECTOR

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SUMMARY REPORT

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OPERATIONS OF THE GEOLOGICAL SURVEY DEPARTMENT

FOR THE YEAR 1893.

4th January, 1894.

The Hon. T. Mayne Daly, M.P.,
Minister of the Interior, Ottawa.

Sir,—I have the honour to submit herewith the annual summary report of the executive work, and of the scientific investigations undertaken by the staff of the Geological Department during the year ending 31st of December, 1893. The progress of the work generally has been fairly satisfactory, while in some directions it will, it is hoped, have afforded much valuable, important and interesting information respecting the geography, physical characters and natural resources of two of the most extensive areas of practically unexplored country in the Dominion, viz., the Labrador peninsula; and the western coast of Hudson Bay, or the country which lies between Athabasca Lake, Chesterfield Inlet and Fort Churchill. It may be mentioned that both these explorations were commenced in 1892, and a statement of the result attained that year is given on pp. 12-19 and pp. 32-33 of last year's summary report. It seemed desirable that the work should be continued this year. Instructions were, therefore, given at an early date in 1893, to Mr. J. B. Tyrrell and to Mr. A. P. Low to take whatever steps were necessary to ensure the success of these explorations with, in both cases, the probable contingency provided for, of not being able to return before the summer or fall of 1894. Mr. Tyrrell left Ottawa early in May, and, up to the present date, only one brief communication and a box of fossils collected on his way north have been received from him. The letter is as follows:—

Fond du Lac, 27th June, 1893.

Dear Sir,—In coming from Fort Chippewyan to here we followed the north shore of Lake Athabasca, making as good a survey with the boat log as the time would permit. We were delayed very much by storms, but we managed to make the journey in seven days.

The country presents many interesting features. The sandstone occurs on the north side of the lake in several places, and green Huronian schists were seen about the middle of the west side, and also largely developed at the north end of Black Bay. The point south-east of Black Bay consists of a massive quartz prophyry, and south-east and east of it is a wide belt of white quartzite and conglomerate occupying the shore for about twenty miles. Near the east end of this outcrop of Huronian quartzite is an extensive deposit of limonite and hematite. The point where this deposit was seen was in a hill 125 feet high, the scarped faces of which stand out boldly as high red cliffs. The whole hill is a mixture of quartz and iron ore. The deposit is a very interesting one, and I was very sorry to be obliged to leave it and rush on. However, I have collected a pretty full set of specimens which will give some idea of this ore deposit, and of the shore in general. These specimens I am now sending back from here.*

We are now starting for the Barren Lands, and by the time that this letter reaches you, I hope that we shall have crossed to Hudson Bay.

With kind regards,

Yours sincerely,

(Sgd.) J. B. TYRRELL.

From the foregoing it seems probable that Mr. Tyrrell will pass the winter either at Fort Churchill or at the Hudson Bay Company's post on Reindeer Lake. If the latter, we may expect to receive some communication from him during January.

Since writing the above, on the 2nd January, the following telegram was received from Mr. Tyrrell:—

WEST SELKIRK,

1st January, 1894.

Complete success; crossed barren grounds; explored Chesterfield Inlet and west shore of Hudson Bay.

On the 8th of November, the following interesting letter, dated Rigolet, 5th October, was received from Mr. Low:—

DEAR DR. SELWYN,—I am sending with this a preliminary report of my season's field work. From it you will see that we reached Ungava, 27th August, after a summer of very hard work, in fact, the hardest that I have ever experienced, but as every one was in good health, it was not unpleasant. The most important discoveries made were:

1. The immense deposits of Cambrian rocks along the Ungava River. These closely resemble the rocks along the east coast of Hudson Bay, and I believe they cover a great area of country about and to the

*The specimens referred to have not yet arrived, 20th January, 1894.

westward of Ungava Bay. They are essentially an iron-bearing series, as almost every bed holds that metal, and some of them are pure hematite ore.

2. Evidence that the continental ice cap took its rise in the interior of Labrador, and flowed outwards from a gathering ground in the vicinity of the headwaters of the East Main River.

3. That the interior of Labrador is everywhere well wooded, and that the old opinion that it was a treeless wilderness no longer holds.

On arriving at Fort Chimo, I found the natives there in a most deplorable state, owing to the absence of deer last winter, and to the failure of the Hudson Bay Company's agent to supply their needs, as a consequence between 200 and 300 died last winter, and the small remainder are in a state of abject poverty. Such being the case, I considered it inadvisable to send provisions inland, as they would probably be stolen. The stock of pork at the post was also not sufficient to supply the wants of my party, and as the work can as advantageously be carried on from Hamilton Inlet, I resolved to proceed there on the Hudson Bay Company's steamer.

My provisions have been shipped to North-west River post at the head of the inlet, and I leave here on the 8th inst. for that place.

As regards future operations, I at present propose to immediately send my men up the Hamilton River and the canoes, with instructions to take them as far as the Grand Falls portages if the ice will permit. They will remain there until they can return to North-west River on foot, and will then be employed drawing in provisions on the ice, so that by open water in the spring, next season's outfit will be well inland, thus leaving the summer free for exploration in the interior. I at present propose to return by one of the rivers flowing into the gulf, unless I can find a route from Hamilton River to Michicoon, in which case I might descend the Big River to James' Bay, but this is improbable, as there is a wide interval to cross wholly impassable without a guide, and a guide there, I think, cannot be found, as the people at Nitcheguon had no knowledge of Hamilton Inlet. During the early winter, Eaton and I will be employed writing a report on this season's work and plotting the surveys made. After Christmas, I hope to avail myself of the kind offer of Mr. Wilson, to accompany him on his official visits to Cartwright and Davis Inlet; in so doing I will get a fair knowledge of the rocks along the coast between these places.

Mr. Eaton, in the meanwhile, will accompany the men and carry the survey up the Hamilton River to where we are to commence canoe work in the spring. As the mail arrives here early in April, I will

await its arrival, and will then start inland for the coming season's work.

Mr. Eaton has proved an excellent assistant, and has performed all his duties in a highly creditable manner.

I remain, dear Dr. Selwyn,

Yours sincerely,

A. P. LOW.

It is thus seen that Mr. Low is now wintering at Rigolet, the Hudson Bay post in Hamilton Inlet, on the east coast of Labrador. Whether he will be able in the spring to make his way west by the Big River waters to James' Bay, thus crossing the whole Labrador peninsula about twenty degrees of longitude, or whether he will be obliged to turn south to the St. Lawrence Gulf, is at present uncertain.

Including the parties under Messrs. Tyrrell and Low above mentioned, there have been sixteen separate explorations carried on during the year as follows:—

British Columbia	3
North-west Territories	1
Eastern Manitoba and Keewatin	1
Ontario	4
Quebec	2
East Main River and Labrador	1
New Brunswick	1
Nova Scotia	3

Summary statements of these explorations are presented herewith. The work accomplished is almost entirely in continuation and extension of that of previous seasons in the several districts, and it has considerably advanced the preparation of the geological maps which are being published in uniform sheets, as rapidly as the surveys and investigations required for their completion can be made.

No work has been done during the year in connection with the well at Deloraine, but a sum of $408.72 has been paid the committee since the 1st of July last, on account of the wages and of work due at that date, and a further small balance is still due. The arrangements for placing a pump on the well mentioned, page 6 of last year's report, unfortunately fell through. It was hoped that the Canadian Pacific Railway Company would undertake the work, and it was only on the 18th of October, 1893, that I received intimation that they could not do so. Further effort will, however, be made in the spring to settle this very important question of water supply in Western Manitoba. I was at the well on the 29th of June, and found the water then standing in the six-inch pipe at sixty-one feet from the surface.

What the actual supply might be can, of course, as already stated, only be ascertained by pumping. Tenders for the work might be asked for, and it should be commenced as early as possible in the spring. In view of the heavy cost of fuel, and other expenses incidental to the use of a steam boiler, the pump should, I think, be operated by a wind mill.

The analysis of the water was given on p. 6 of the summary report for 1892, the solid contents being then 447·255 grains per imperial gallon. It is, however, quite likely that this defect will be greatly lessened by continued pumping.

In the summary report for last year, page 8, some particulars were given respecting the annual report, Vol. V., for 1889-90-91. During the entire year much of my attention has been devoted to the work of correcting the proofs, and the details of editing this large volume of 1,567 pages, Rvo. with maps and illustrations. It is now published in two parts, and the first complete copies were received from the printers, Part I. on the 28th of November, and Part II. on the 16th of December.

Since the above was written the following very satisfactory communication has been received from Deloraine:—

DELORAINE, Man., 16th January, 1894.

DEAR SIR,—Replying to your letter of the 13th, received to-night, the engine started pumping at about 10 o'clock on the 10th instant, and worked continuously night and day until Sunday night. I wired Gen. Supt. Whyte to send out an expert, and he came Sunday afternoon. The pump was started again at midnight Sunday to let Mr. A. C. Frith, the expert, off on the Monday morning train. I forwarded a sample of the water to Mr. Whyte on Wednesday, and Mr. Frith took one immediately the pump started Sunday night, another sample two hours later, and another sample at 8 o'clock when the train left. When the pump was first started the sand and mud came for twenty-four hours, and the water became warmer; on Saturday night it was 70°, to-day it is 80°. The pump never stops as we want to test it thoroughly. It smells and tastes to me very much like the Banff hot spring water, this morning especially. I called the attention of a man who went to Banff sick some time ago to the water as it was going into a barrel for some one in the village, and asked him what he thought of it, and he immediately replied, Why, that is Banff water sure.

There does not appear to be the least decrease in the supply. There was a terrible famine for water and sheer necessity made the water man try to use the water with the happy result. It has a slight, salty

taste, but is not as strong as when first used, and every one is drinking it, and although not pleasant at first, get used to it, and it has no bad effect, it is very soft and does splendid in the boiler. All the cisterns in the village were filled up last week, and now we have a length of pipe and run it out on the street between Montgomery's store and the Revere House, and it is flooding the street and makes fine skating for the school children. It does seem good to see this continued stream of hot water running day and night. The farmers come in from the country and take it away in tanks the cattle like it so well. I cannot express to you how pleased I am and everybody else. After so many years' work at it and no result, I never went anywhere without having to stand all kinds of jokes, but it is all right now. I knew it was a white elephant to the department, and I wish now to put you and Mr. Daly especially, in shape to defend the big expenditure, which I always felt was a serious matter as long as no results were obtained, but now every one says the money was well spent, because those in any other part of the country who want to do the same have the knowledge of the Deloraine well, and with it before them a very large amount can be saved by knowing exactly how far they will have to sink, and start from the beginning accordingly. The success of the Deloraine well has been my ambition from the commencement, and I am amply repaid. And your many kindnesses, and also those of Mr. Dewdney and Mr. Daly, who were always willing to help it along, M.P. or Minister, I shall remember and look back upon with the bright side upward. I shall only be too pleased to do anything I can in the way of information, and hope you will not hesitate to give me a chance to do what you may require.

No steps have yet been taken about caring for the water, but there is to be a meeting of the village ratepayers to-morrow afternoon.

Very sincerely yours,

A. P. STUART.

Dr. A. R. C. Selwyn,
Ottawa.

From the above it appears that the improvement I have above referred to is already taking place. A fresh analysis will be made as soon as a sample of the water which has been sent for, is received.

The executive details of the department, matters connected with the Chicago Exhibition, and some special geological examinations which I made in the North-west, entailing visits to Deloraine, Banff, Anthracite, Morley, Calgary and Edmonton, have fully occupied my time and attention during the year now closed. Between December, 1892, and November, 1893, 129 days were spent in Chicago, superintending the

installation of the exhibits, and later on giving information to the numerous inquirers respecting Canada and its mineral resources, and in the duties incidental to the position of one of the judges in the mining department. The exhibit made by the Geological Survey of Canada was highly commended, and eight separate awards were granted it as follows :—

1. Collective exhibit of minerals, rocks and fossils.
2. Placer gold and nuggets.
3. Collective exhibit of coal.
4. Coal, bituminous sand and tar.
5. Marbles and building stones.
6. Maps and sections.
7. Photographs of trees framed in their own woods.
8. Collection of medicinal herbs, barks, &c.

To meet the expenses connected with its preparation in Ottawa, and a large part of those incidental to its installation and its superintendence during the exhibition, from the 1st of May to the 31st of October, a sum of $4,000 was placed at my disposal by the Department of Agriculture. The balance of the expenditure incurred on this account, $2,786, has been paid from the appropriation for Geological Survey purposes, making a total of $6,786.

In this sum none of the salaries of the officers of the department, the whole, or part of whose time during the year was devoted to exhibition work, are included.

The undermentioned members of the staff of the Survey were at Chicago for the periods stated, and I have no doubt that the opportunity thus wisely afforded them of becoming acquainted with the aspect and character of the minerals, their associations and geological relations, in the many and widely separated regions from which they were gathered together at the World's Columbian Exposition, cannot fail to be most instructive and beneficial in connection with the prosecution of the future work of the Survey in Canada, which they may be called on to undertake.

	Days.		Days.
Dr. Selwyn	129	Mr. Lambe	14
Dr. Bell	14	Mr. Chalmers	10
Dr. Ells	16	Mr. Brumell	44
Mr. Tyrrell	7	Mr. White	16
Mr. McConnell	8	Mr. Faribault	11
Mr. Low	17	Mr. McInnes	16
Mr. McEvoy	8	Mr. Giroux	21
Dr. Ami	21	Mr. Willimott	214
Mr. Ingall	16	Mr. Selwyn	245
Mr. Ferrier	19	Mr. Esdale	145
Mr. Dowling	13	Mr. Barlow	18

The following extract from the New York Engineering and Mining Journal, vol. LXVI., No. 26, 24th December, 1893, may be appropriately quoted in the present summary report on the work of the Survey during 1893 :—

THE DOMINION GEOLOGICAL SURVEY.

"A display of minerals covering the resources, geology and physical aspect of the entire Dominion of Canada was made by the Canadian Geological Survey, under the immediate charge of the veteran director, Dr. Selwyn. As may be imagined the exhibit was made with great scientific exactness, and a careful study by the visitor will enable him to gain a good idea of the geology as well as of the minerals of scientific and economic value throughout the length and breadth of the Dominion. We have already passed in view the displays made by the several provinces, but these, as they should, made prominent the metal and mineral upon which each province may depend for commercial advantage. The general exhibit therefore very happily filled out any missing numbers in the series and presented a continuous mineral story from one ocean to the other.

"In a number of flat cases, the style adopted in the museum at Ottawa, appeared suites of specimens neatly trimmed and labelled. The specimens were arranged first geologically and then subdivided with reference to geology; thus under Laurentian were in one row all the gneisses of Nova Scotia; on another those of Ontario, and another those of the North-west Territory. The collection in all comprised 1,500 specimens, and was especially prepared for the exposition by Mr. Walter F. Ferrier, of the Geological Survey. The whole collection will form a part of the cabinet collections in the museum of the Survey at Ottawa. In connection with this a palæontological collection containing many fossils of extreme beauty and rare interest was exhibited. Eozoon Canadense, which has caused so much contention among geologists, was illustrated with great completeness. This fossil was shown not only in connection with the minerals associated with it, but by means of drawings of microscopic observations and by photographs.

"As a rule maps are prepared with so little regard for popular taste that they are passed unheeded. Two charts of the Dominion, however, prepared by the Survey and showing the occurrence of economic and precious minerals, caught the eye of nearly every sightseer. Most prominent on these maps was the great Alberta coal field, in the North-west Territory, which in extent seems to outdo the bituminous fields of Illinois. The gold district of the Fraser in British Columbia, and the valley formed by the St. Lawrence River and Lakes Ontario

and Erie, seemed to have varied and extensive mineral deposits. In both sides of this valley are to be found coal, petroleum, iron, etc., and the belt projects beyond the mouth of the St. Lawrence River over into the districts of New Brunswick and Nova Scotia, where the occurrence of gold and coal has established important mining industries. There was also shown a map geologically coloured, from which was apparent the extent of the great areas of the earlier rocks in Canada, especially the Laurentian and Huronian; sectional maps showed the work of survey expeditions to the Yukon region, the Lake of the Woods and other points. The Survey in all has some thirty men out this year on sixteen expeditions of this kind. Among the most important may be mentioned the party which takes in the Athabasca region of the North-west Territory, and another the British Columbia gold country up to the Alaskan boundary. Special surveys are also being carried on in Manitoba, in Quebec, in Nova Scotia and in New Brunswick. The Ontario survey covers the Algoma, the Sudbury, the Kingston and the Lake Simcoe districts. Some excursions, like that through the North-west Territory to Lake Athabasca, remind one of a Polar Expedition, so far as duration and expense are concerned. The geologists started on this 4000-mile journey from Ottawa in June of this year, and will be absent for a year, with a chance of not returning at all, the country being very wild. The maps exhibited are the result of these surveys. As soon as a party returns to Ottawa its members immediately devote themselves to the presentation of the data secured in the form of charts and maps, and the organization of the specimens into museum collections.

"A special exhibit of the gems and precious stones of Canada was made by a private firm in Montreal. In this the agates were particularly beautiful, and when cut and polished in jewellery form exhibit beautiful surface appearances and markings. Jade, tourmalines, albites, sodalite, quartz-asteria were among the other choice and rare gems native to this rich mineral country.

"In the line of economic minerals, phosphates and building stones headed the list. The specimens showed the many varieties of phosphate mined and a corresponding diversity in colours. The apatites ranged from a deep green to a light pink in colour. A series of pictures above the cases of exhibits illustrated the outcrops of phosphate veins and the methods of mining as practised in Canada. A small trophy of building stones in cubes showed the characteristic limestones and marbles. The most beautiful specimen was one of mottled serpentine and dolomite ranging from pale green to pure white. A cross section of the so-called fossil trees found in Potsdam sand-

stone, near Kingston, was on exhibition. These trees were discovered to be simply concretions in sandstone, although they are perfectly cylindrical in shape, are many feet in diameter, and look like great petrified tree trunks when brought to daylight in the quarry. Canadian plumbago and its uses were illustrated by the commercial exhibit of the Walker Mining Company, which showed both the crude and manufactured articles. Several specimens taken from the quarry show 36 per cent of pure carbon in the shape of disseminated graphite. A number of pictures and photographs arranged along the top of the cabinets gave an idea of the Geological Museum as it appears in the Government building at Ottawa. There were also a number of views of phenomenal geology, such as exposed beds of polished and crumpled gneiss, and pictures of the inspiring mountain and mining scenery of the Dominion.

"This excellent showing of the geology, lithology and mineralogy of the Dominion was undertaken by the Dominion Survey at the request of the Minister of the Interior, Mr. T. Mayne Daly, and in the hands of the veteran geologist, Dr. Selwyn, director of the Survey, possessed, of course, great scientific interest, and presented many new features of Canadian geology. The collections were made up principally of new materials brought in recently from the fields and from duplicates in the Ottawa Museum, and were arranged by Mr. C. W. Willimott, assistant curator, Mr. W. F. Ferrier, lithologist, and Mr. P. H. Selwyn. The fossils were prepared and arranged by Dr. H. M. Ami, palæontologist. The maintenance of the exhibit in Chicago was in charge of Dr. Selwyn and his able assistants, Mr. P. H. Selwyn and Mr. C. W. Willimott."

From the beginning of the present year and until the month of August, Dr. G. M. Dawson was engaged in London and Paris on work connected with the preparation of the British case in the Behring Sea arbitration. This work related chiefly to the geography and natural history of the Behring Sea region, which had already been examined into by Dr. Dawson when acting, in 1891, as one of Her Majesty's Commissioners to Behring Sea. On the 20th of August, Dr. Dawson returned to Ottawa. A portion of his time has since been occupied with official duties during my absence in Chicago, but his attention has been chiefly devoted to dealing with arrears of work connected with the geology of British Columbia and to the preparation of a report on the geology of the Kamloops region, which has been now unavoidably delayed for several years.

While in London, Dr. Dawson read a paper on the mineral wealth of British Columbia, at one of the evening meetings of the Royal

Colonial Institute, which has since been published in the Journal of the Institute, and has already led to a number of inquiries as to the present prospects of mining in that province.

During the early part of 1893, Mr. McEvoy was engaged in plotting and compiling the work done in the previous season in the country embraced by the Shuswap sheet of the southern interior of British Columbia, the position of which is more fully described in the summary report for 1891, p. 17 A. Some time was also spent in selecting suitable specimens to represent the rocks of British Columbia in the stratigraphical collection prepared for the Chicago Exhibition.

In June, Mr. McEvoy was instructed to examine the country in the vicinity of the boundary of the southern part of Alaska.

He reports on the season's work as follows :—

"Leaving Ottawa on the 7th of June, Port Simpson was reached on the 22nd. Here two canoes, sent from Peterborough, were found; for the transport of these I am indebted to the kindness of Mr. King, in charge of the British contingent of the Alaska Boundary Commission.

"Proceeding northward from Port Simpson up Portland Canal (as named on late charts) the shores were found to be composed of mica-schists and gneissic rocks, resembling those of the Shuswap series of the Selkirk Mountains, and possibly Archæan. These rocks continue to the mouth of the Nasse River.

"Above this point along Observatory Inlet the bedding becomes more obscure in the gneisses and at a distance of eight miles up they are replaced by granite.

"The rocks of Observatory Inlet are throughout chiefly granite, except near the head of the Alice Arm and over a considerable area around the junction of the Alice and Hastings Arms, where black, slaty argillites and sandstones are developed. This latter area is probably Cretaceous; but no fossils were found in it.

"The upper parts of the inlet contain some valuable spruce and hemlock timber.

"Portland Canal was next examined. The chief characteristics of this inlet are the general uniformity of its width and the straightness of its shores, which are flanked by uniformly steep mountains. It is well named by the Indians 'Kō-laú,' which signifies 'house.' The predominating rock in this inlet also, is granite; but gneisses and mica schists, with some grayish and greenish schists, appear for some distance on the east side of the upper part.

"The southern portion of the peninsula separating Portland Canal from Observatory Inlet, is composed chiefly of granite-gneiss like those

previously noticed and possibly Archæan. These cross to the mainland on the west, where in places the gneissic structure is rather obscure.

"Returning to Echo Cove, near Nasse Harbour, the Peterborough canoes—being too small to ascend the rough waters of the Nasse River—were left to be returned to Port Simpson, and a suitable Indian canoe was engaged with a crew of Nasse Indians.

"The estuary of the Nasse is wide, to a point about fifteen miles up, with a strong tide; above that point the river narrows and begins to show a fairly strong current, although where the water is low the tide is apparent for twelve miles further up.

"The main channel winds from side to side of the valley, cutting through the flat bottom land of blue clay, with numerous branching sloughs, and making so many islands that the whole river is seldom seen at any one point.

"About thirty-eight miles from the mouth are the Kit-wan-chilt village and cañon. Here the river is confined to a narrow channel which at all times causes a serious obstacle to canoe navigation. When reached this season the water was very high; however, no accident occurred in ascending it, although, owing to an Indian disobeying instructions, we narrowly escaped loss of life and of our whole outfit.

"The Kit-wan-chilt cañon is caused by a recent lava flow on the east side of the river which apparently blocked the river and forced it to cut its present channel along the line of contact between the lava and the black argillites of the hillside on the west. This lava which comes out of the Tseax Valley from the south-east, must have been erupted at least a hundred years ago, but there is no reason to suppose that it is more than a couple of hundred years old. It has long been reported that a recent lava flow occurred in this region, and this report is now found to be correct. No other instance has yet been found within the limits of British Columbia of volcanic eruption later in date than the glacial period.

"Ten miles above the Kit-wan-chilt cañon the river makes an S-shaped bend, above which the foot of the upper cañon is reached. There is no rapid in this cañon but the water is very deep and is narrowly confined, flowing in a successions of eddies. We ascended the cañon for a day and a half, then *caching* the canoe with such articles as were not absolutely necessary each man took a load of 110 to 120 pounds and proceeded on foot up the east side of the river along what is known as the 'Grease trail.'

"The Au-kon River, a tributary from the east, was crossed by an old Indian bridge made entirely of poles and withes, which are now in a rotten and unsafe condition. We followed the Grease trail along the west bank of the Au-kon in a direction parallel to the Nasse, as far as the Fish Houses at the mouth of Gin-mielt-kun Creek. We left the trail at this point turning westward to the Nasse River again, and proceeded in a north-north-west direction following an old indistinct trail.

"It was found that the main branch of the river as shown on Mr. Poudrier's recent map, does not exist, the whole river occupying approximately the position assigned to the north-west branch on the map referred to.

"In the vicinity of latitude 55° 50′ there is a fine valley, with open grassy land, ten miles in length, in part of which the blue joint grass (*Calamagrostis Langsdorffii*) grows to a height of seven feet and would yield four tons of hay to the acre.

"We crossed the river in about latitude 56° where the water of Tam-a-tsi-a'-ten Lake empties by a short tributary stream into the Nasse.

"The ownership of this place has long been a disputed point between the Tahltan and the Kit-wan-cool' peoples, and here many battles and massacres have taken place.

"A few miles above this point the Nasse bends sharply to the east, coming from a narrow gap in the hills, and there is no stream coming into it from the north-west where the so-called north-west branch is shown as continuing, on the map previously referred to.

"Tam-a-tsi-a'-ten is a beautiful lake, eleven miles long, lying within the eastern mountains of the coast ranges. From the head or western end of the lake, a low pass runs westward to Bear River which flows into the head of Portland Canal.

"Travelling northward from the lake, we reached a mountain top which afforded a good view of the surrounding country and found that it would be useless to attempt to reach the Stickine River with the supply of provisions we had with us. We, therefore, returned as far as the 'Grease trail' and having sent the Indians to take back the canoe to Echo Cove, I started for the Skeena River accompanied by Mr. Eaton. On the way we fortunately secured the services of two Indian boys to help carry our loads.

"The trail traverses the wide open valley of the Au-kon, in which there is a large area of good land, though it is uncertain whether late and early frosts might not interfere with agriculture. No definite information could be gained upon this point. The average depth of snow is apparently about three feet.

"Latitude observations taken with a seven-inch-sextant were obtained at various points. During the season 300 miles of track survey was made in canoes, and 230 on foot, necessitating 800 miles of travel."

The cost of the season's work, including salary of assistant, was $1,884.18.

Mr. McEvoy was assisted by Mr. R. B. Eaton. He returned from the field on the 23rd of October, and has since been engaged in plotting and compiling the season's work.

After returning from the field, the 1st of November, 1892, Mr. R. G. McConnell was engaged for three or four months in completing and seeing through the press, his report on a portion of the district of Athabasca (Part D, vol. V., Annual Report, 1889-90-91). The remainder of the winter season was occupied in compiling a geological section through the Rocky Mountains, along the Howse Pass, from the data collected during the preceding summer. A section along the Bow and Kicking Horse Pass has already been published (Part D, vol. II., Annual Report, 1886), and other sections through the more available passes are in contemplation. When these are completed, important progress will have been made towards a proper understanding of the complicated structural geology of these ranges of the Rocky Mountains.

Preparations for taking the field again were begun in April, and on the 4th of May, Mr. McConnell left Ottawa with instructions to make a geological exploration of the Finlay and Omenica Rivers in the northern part of British Columbia. On this work he reports as follows:—

"We arrived at Quesnel on the 24th of May, a few days having been spent at Chicago on the way west, in an examination of the geological and mining and mineral exhibits at the Columbian Exhibition. Owing to difficulties in getting experienced canoemen and transport for our supplies to Fort McLeod, we were delayed for some days at Quesnel, and it was not until the 9th of June that we succeeded in getting away. The party consisted besides myself, of Mr. H. Y. Russell, from the Geological Survey Office, who acted as topographer, and four canoemen, two of whom were Indians. The delay at Quesnel proved most unfortunate, as in the meantime, the Fraser, up which our way led, had risen to its spring level, and the difficulty of ascending it was greatly increased. The men, however, proved both capable and willing, and in ten days' hard work we passed safely through the cañons and worst part of the river and arrived at Fort George. At this point one of the Indians, frightened at the length of the

journey ahead of him, shammed sickness, and I was obliged much against my will to leave him behind, as he had shown himself an excellent canoeman. A Fort George Indian was engaged to take his place, and after a day's delay we proceeded up the Fraser to the Giscome Portage, where we arrived on the 23rd of June. At the Giscome Portage we left the Fraser, crossed over the Arctic Pacific watershed to Summit Lake, the source of one of the branches of Peace River.

"The Giscome Portage to Summit Lake is seven miles and a half across, and we were occupied nearly three days in carrying over our canoes and outfit.

"From Summit Lake we followed a chain of small lakes connected by short, crooked, and at times exceedingly rapid streams, down to McLeod's Lake.

"Fort McLeod, situated on the northern end of the lake, was reached on the 28th of June. We expected to meet the pack train from Quesnel here with our summer supplies, but it had been delayed by the incessant rains, and flooded condition of the rivers, and did not arrive until a week later.*

"While waiting we fitted up a canvas canoe and we also made a couple of short excursions into the neighbouring hills. Our provisions arrived at Fort McLeod on the 5th of July; on the next day we started down the McLeod's Lake River and the Parsnip, and on the 7th reached the Peace.

"The water in the Finlay branch of the Peace being still high, I decided to wait a few days before commencing its ascent, and to spend the time making a hasty examination of the mountains along the Peace River pass through the Rocky Mountains. The range was here found to have the same structure as that which characterizes it further to the south, the mountains are built of westerly dipping beds, mostly limestone, but also including shales, quartzites, and conglomerates, ranging in age from Triassic down to Lower Cambrian. The beds are repeated several times by overthrust faulting; along the eastern edge of the range the Devono-Carboniferous limestones have been thrust up over the Cretaceous sandstones and shales, and in going westward several similar faults are met with. Near the western edge of the range a high overthrust fault cuts through the western slopes of Mt. Selwyn, and has resulted in placing the Lower Cambrian quartzites, conglomerates and shales over Upper Cambrian limestones.

*A sketch map on a scale of five miles to one inch was made by Dr. Selwyn of the whole of this route from Quesnel *via* Fort George and the Giscome Portage to Fort McLeod, in 1875, and thence to Peace River, and is published in the Geological Survey Report for 1875–76.

Other evidence of the tremendous eastward shove to which the range has been subjected, is afforded by the crushed and contorted condition of many of the mountains.

"After returning from the Peace River we moved our supplies up the Finlay to the mouth of the Omenica, *cached* most of them there, and proceeded up the latter stream. In the first thirty-five miles the Omenica has a fall of from 400 to 500 feet, and its current flows with almost torrential rapidity. Two cañons occur in this reach. The lower or Black Cañon is situated about five miles above the mouth. At this point the river is confined for about half a mile between nearly vertical walls of gneiss. Near the upper end a huge rock rises in midstream in the already narrow channel and by partially blocking it causes a wild rapid when the river is in flood. It was at this point that Butler, in 1873, lost his canoe. About twenty miles further up a second cañon, known as the Little Cañon, was met with, but its navigation is comparatively easy.

"A few miles above the Little Cañon the grade suddenly lessens, and thence upward for many miles the Omenica meanders with a gentle current from side to side of a wide, flat bottomed valley.

"We reached Germansen Landing, forty-five miles from the mouth, on the 21st of July; a short trip was made from this point to Germansen Creek and Manson Creek; very little gold is now being obtained from these two creeks, and the mining population, once numbered by thousands, has dwindled to about fifteen. Gold is obtained both from the river bars and from the glacial gravels underlying the boulder clay. The former have been worked out, to a large extent, but only the richer portions of the latter have been touched, and when cheaper communication with the outside world is effected, they promise to become of considerable value.

"We returned to the Omenica on the 23rd of July, and proceeded up to Old Hogem, which we reached on the 26th. The current in this part of the river is easy, until within a few miles of Hogem, where swifter water is met with. The valley ranges from half a mile to a mile in width, and is bounded on both sides by mountains from 3,000 to 4,000 feet in height. From Hogem I made a trip on foot *via* Vital and Tom's creeks to Tatla Lake, a distance of about forty-two miles, while Mr. Russell continued up the river for some distance. Vital Creek was the first paying creek struck in the Omenica district, and the discoverer, Mr. Vital, with a couple of other men, was found still at work on it, although very little gold is now being taken out. Tom's Creek or New Creek was not discovered until 1889, it paid very well for two seasons, but is now also nearly exhausted. From fifteen to twenty men were employed on it during the past summer.

About $100,000 is reported to have been taken out of it since its discovery.

"The rocks exposed along the Omenica consist at the Black Cañon of gneiss, mica schists, quartzites and limestones. Resting on these but apparently confined to the valley of the stream are soft conglomerates, shales and sandstones, holding plant remains either Cretaceous or Tertiary. Further up hard unfossiliferous limestones were met with. These are succeeded by gneisses and mica schists, followed by shales, quartzites and conglomerates, evidently belonging to the Bow River series (Lower Cambrian), and then by limestones again. The latter probably belong to the Castle Mountain group of the Rocky Mountains: above these and exposed all along the river from below Germansen Landing to New Hogem is a great series of green rocks, distinctly foliated in places, but often passing gradually into a massive eruptive looking variety. Interbedded with it are bands of dark shales, limestone, serpentines, and in one place a red magnesite. At New Hogem granites come in and are exposed along the river as far as Old Hogem, and for a couple of miles along the trail to Vital Creek, when they are replaced again by the green and dark schists. The latter are then exposed all along the trail until the valley of Tatla Lake is reached, when Cretaceous conglomerates and sandstones succeed and continue to the lake. The green and dark shales constitute the gold-bearing rocks of the district.

"After finishing the examination of the section through to Tatla Lake, I returned to the Omenica, and Mr. Russell having already arrived, we immediately commenced the descent of the river and reached our *cache* at the mouth, on the 3rd of August. Preparations were then made for the ascent of the Finlay, and on the 5th of August our long journey up it was begun. The water, though still moderately high, had fallen several feet, and some of the bars being exposed, we were enabled, much to the relief of the men, to replace to some extent the pole by the tracking line. The current for some distance above the mouth of the Omenica is moderately easy, and good progress was made. Further up swifter water was met with, and some trouble and danger was experienced in getting round the numerous drift piles lining the banks. On the 8th of August we reached Fort Grahame, a small fur trading post belonging to the Hudson Bay Company.

"We remained there a couple of days for the purpose of climbing the neighbouring mountains, and obtaining all possible information from the Indians about the upper part of the river. Their knowledge of the river as far as the forks was fairly correct, but above that became very vague. On the 12th of August we recommenced our journey and on the 13th came to the In-gin-i-ca River or south branch of

the Finlay, a stream about 125 feet wide; it has not yet been explored. On the 15th we reached the Little Cañon, the Deserter's Cañon of Arrowsmith's map of 1854. A portage of half a mile was made here. From the Little Cañon to the Forks, a distance of about sixty miles, the river continues its north-westerly course following closely the western base of the Rocky Mountains. The Forks or the junction of the Finlay and Qua-da-cha (white waters) was reached on the 21st of August. At this point the Finlay River leaves the great valley which it has followed from its mouth, and which separates the nameless ranges bordering it on the west from the Rocky Mountains, and turns abruptly westward. The valley continues and is occupied by two tributaries of the Finlay, the Qua-da-cha and the To-chi-e-ca. The former soon turns eastward and heads in a great glacier situated near the summit of the Rockies; the latter heads in two small lakes about forty-five miles north of the Finlay.

"A short distance further on in the same valley is another lake from which according to Indian report the waters of the Turnagain or Black River, a tributary of the Liard, issue.

"After leaving the valley just referred to, the Finlay cuts through the range to the west and then again turns north-west. The current becomes much swifter, and about twelve miles above the To-chi-e-ca the valley narrows to a cañon, we continued up the cañon for about four miles and then landed in order to examine a dangerous looking rapid just ahead, a portage proved to be practicable here, but as the cañon seemed to be of great length, I judged it better to camp, and explore it throughout before proceeding further, as the Indians reported it unnavigable. Our most experienced canoeman was sent forward for this purpose and returned with an adverse report. Although I had some doubts as to the accuracy of this report, I deemed it advisable, as the men all showed great unwillingness to proceed further with canoes, to endeavour to explore the remainder of the river on foot. A valley led off to our left in a westerly direction and I hoped by following it up to strike the river again above the great southerly bend, which I had been informed the Finlay made near its head.

"The canoes and outfit were *cached* and on the 25th of August we started over land, and after three days hard tramping over windfalls, through muskegs and ice cold mountain streams, we had the satisfaction of again reaching the river, having cut off by our march through the mountains about half the distance. Two of our men were sent back here, while with the remainder I continued on up the river,—here a long succession of rapids and cañons—and in half a day reached the south end of Lake Tchutade.

"Lake Tchutade (narrow water between mountains) is seldom more than 200 yards wide, and is simply an enlargement of the river. Walking along it proved extremely difficult, owing to the fallen timber and dense underbrush, and after proceeding up it for a few miles, I decided, as the lake followed the strike of the rocks and little geological information could be obtained by going further, to climb the mountains bordering the lake on both sides and then return. Mr. Russell ascended the eastern range, while I crossed the lake on a raft and climbed the range on the opposite side. From the elevation reached the narrow lake could be seen for a distance of about fifteen miles. The valley then divided, one branch turning eastwards, while the other bent to the south-west. I should have liked to have followed up the latter, as it may contain a second lake, but the state of our supplies did not admit of it.

"Lake Tchutade must have been originally much wider, but has been silted up and reduced to river-like proportions by the materials brought down from the glaciers which crown many of the neighbouring mountains. It occupies a rock basin, probably produced by an elevatory crustal movement near its outlet.

"We commenced our return journey on the 30th of August, and reached the canoes late on the following evening. On the 1st of September we descended the Finlay to the mouth of the To-chi-e-ca. The Indian route to Dease River, and the Stikine which follows up this stream was explored by Mr. Russell for some distance, and on the way back a short excursion was made by the writer into the Rocky Mountains. We reached the mouth of the Finlay on the 14th of September.

"The geological section afforded by the Finlay is much inferior to that on the Omenica. For the first 150 miles it follows the strike of the neighbouring mountains, and shows occasional sections of the gneisses and mica schists of which they are built. Numerous sections of conglomerates and plant-bearing shales and sandstones similar to those found on the Omenica above the Black Cañon are also exposed along this part of the river. After bending to the west, the Finlay cuts through green schists, and then in apparently conformable descending section through limestones and calc-schists (Castle Mountain Group), quartzose shales and conglomerates (Bow River series), and gneisses and mica schists probably Archæan. The latter rest on and dip away from coarse grained granite and diorites, the eastern boundary of which follows the western shore of Lake Tchutade. The green schists are probably a continuation of the gold-bearing schists of the Omenica, but if so the band becomes much narrower towards the north.

"Gold was found along the Finlay and on all the streams coming into it from the west, in some places in sufficient quantities to deserve the attention of the prospector. It would be impossible, however, to indicate these places, until a map has been prepared. No gold was obtained from the streams flowing from the Rocky Mountains above the Little Cañon. The section of country drained by the Finlay has never been prospected to any extent, owing to the difficulty and expense of access to it, and the same may be said of the greater part of the Omenica country also. I have little doubt, judging from the gold indications met with in the hurried explorations of the past summer, that if easier and cheaper communication with the outside world was opened up, paying gold districts would be discovered, and this is a matter which well deserves the attention of the provincial authorities.

"We returned from the Finlay by the Parsnip, McLeod Lake and Crooked rivers, reaching the Giscome Portage on the 24th of September. The run down the Fraser was made in three days, and we arrived at Quesnel on the 30th of September, and at Ottawa on the 20th of October.

"Cost of season's exploration, $2,642.60."

Mr. Dowling was occupied during the early part of the year plotting the surveys of the preceding season and compiling a map, on a scale of eight miles to one inch, of the country included in the explorations of Messrs. Tyrrell and Dowling in the Athabasca district during 1892. This is in manuscript form and in the hands of Mr. Barlow, chief draughtsman, to be published with the report of the exploration. It embraces the country included between the 54th and 60th parallels of north latitude, and the meridians of 101° and 112° W. longitude. It is noticed by Mr. Barlow in a subsequent page of the present report. In the latter part of April, Mr. Dowling was requested to prepare for an exploration in the southern part of the district of Keewatin and eastern Manitoba, east of Lake Winnipeg, a hitherto wholly unexplored area included between that part of the Beren's River already explored, on the north, and Winnipeg River, and its northern branch, the English River, on the south. Of the headwaters of the southern branch of Beren's River and Blood Vein River, comparatively little was known, even by report, and the present season's work was directed mainly to exploring the southern and eastern branches of the Beren's River, and locating the headwaters of the eastern branches of the Blood Vein River.

In order to obtain information in regard to the best means of reaching the district and obtaining supplies, Mr. Dowling communicated with the officers of the Hudson Bay Company in charge of trading posts

in that vicinity. Mattawa, a winter trading post on the English River, below Lac Seul, was recommended as being the most accessible and centrally located point from which to begin the explorations northward. Supplies were therefore shipped from Rat Portage to Wabigoon Tank on the Canadian Pacific Railway. Two canoes were also ordered from Peterborough and shipped to the same point.

Of the season's work Mr. Dowling reports as follows: "On the 29th of May I left Ottawa for Winnipeg *via* Chicago, where I remained thirteen days in order to study the very large and varied geological and mineralogical exhibit of the several states and foreign countries in the Mines building. On the 15th of June I reached Winnipeg, where I was joined by Mr. J. C. Gwillim, a student of applied science, McGill University, who had been nominated as my assistant for the season. We proceeded to Rat Portage, where canoemen were hired, and on the 22nd of June, the party started northward from Wabigoon. The distance to the first lake on the canoe route is about nine miles and is now made by wagon. The road passes over two ridges, which rise to about one hundred and eighty feet above the lakes between which they form the watershed. They appear to be principally composed of well-rounded boulders, with pebbles and gravel; their summits are narrow and trend in a north-east and south-west direction. Other ridges of a similar kind were seen north of Shallow Lake. The route to Lac Seul leads through Sandy Lake, Minnietakie Lake, and several others on the upper waters of the English River, previously explored by Drs. Selwyn and Bell in 1872.* The geological features proved interesting as a great part of the route is through an area of Huronian rocks. We arrived at Lac Seul post on the 26th of June, where we hired the only available man who was acquainted with the route from Mattawa to the Beren's River. There seems to be little travel through this country, even by the Indians, and the man we engaged knew but one route.

"Before we reached Shallow Lake we were fortunately overtaken by some Beren's River Indians, and one of these was hired to guide us by their short route. We subsequently returned by the one known to our Lac Seul Indian.

"Our course was briefly as follows:—From the western end of Lac Seul we descended the English River about ten miles to the Mattawa River, up which we turned. Five miles brought us to Shallow Lake, which is about ten or twelve miles long in a northward direction. At its northern end two streams enter, the eastern one from Little Shallow Lake, into which the waters of Trout Lake River flow. The

*Geological Survey Report, 1872-73, pp. 87, 111.

other stream drains Red Lake and other fair sized lakes, Keg Lake and Gull Rock Lake. We ascended Red Lake River, making three short portages to Keg Lake, where the rock is a red slightly foliated granite. On the next lake, Gull Rock Lake, there are inclusions of the darker rocks of possibly Huronian age in the granite, and the western shore is mainly composed of these rocks, which continue to Red Lake. On entering Red Lake we turned north and ascended a small stream, coming in at nearly the extreme north-east corner of the lake. This stream was followed through Little Red Lake and then, much diminished in volume, through several smaller lakes to the height of land. Two portages, with an aggregate length of two miles and a half, with a small intervening lake, brought us to the White River, or rather a lake out of which a small stream, the source of White River, runs. This we followed down, making a number of short portages and turning around innumerable sharp bends until it had increased in volume to a fairly navigable stream with a straighter course. It joins the southern branch of the Beren's River at Pekangeikum or Dirty Water Narrows Lake. Here is an Indian Reserve on which we saw several houses and on a small island near by, a patch of potatoes.

"Our course thus far had been pretty nearly north from Red Lake. We now turned eastward ascending this branch of the Beren's River, passing through Sturgeon Lake which is about seven miles long with an average width of one mile. The river above this lake has several heavy falls at which everything is portaged, while there are other rapids which are not too rough to pull up by line. A series of three lakes is next reached, the first being Goose Lake on which formerly the Hudson Bay Company maintained a small trading establishment. Next is Fairy Lake, and then a second Goose Lake. Shortly above these lakes a small stream coming from near Cat Lake joins the river. We, however, followed up the southern branch till we portaged about a mile, to a long lake called Shaboomene, the waters of which flow eastward to Cat Lake River. From the extreme southern end of Shaboomene Lake we crossed by the Woman portage a mile long, to a series of lakes. The largest, called Woman Lake, draining to Shallow Lake by a stream joining the Trout Lake River.

"From Red Lake north to Beren's River and eastward as far as we went on that river, Laurentian gneiss and granite only were seen. On the first large lake south, previously mentioned as draining to Cat Lake River, dark green schists similar to the Red Lake rocks make their appearance and are continuous southward through a number of lake stretches and through Woman Lake. Woman Lake is the largest in this basin, and is about ten miles long. In the southern part a deposit of magnetite was noticed on a small island. This might be

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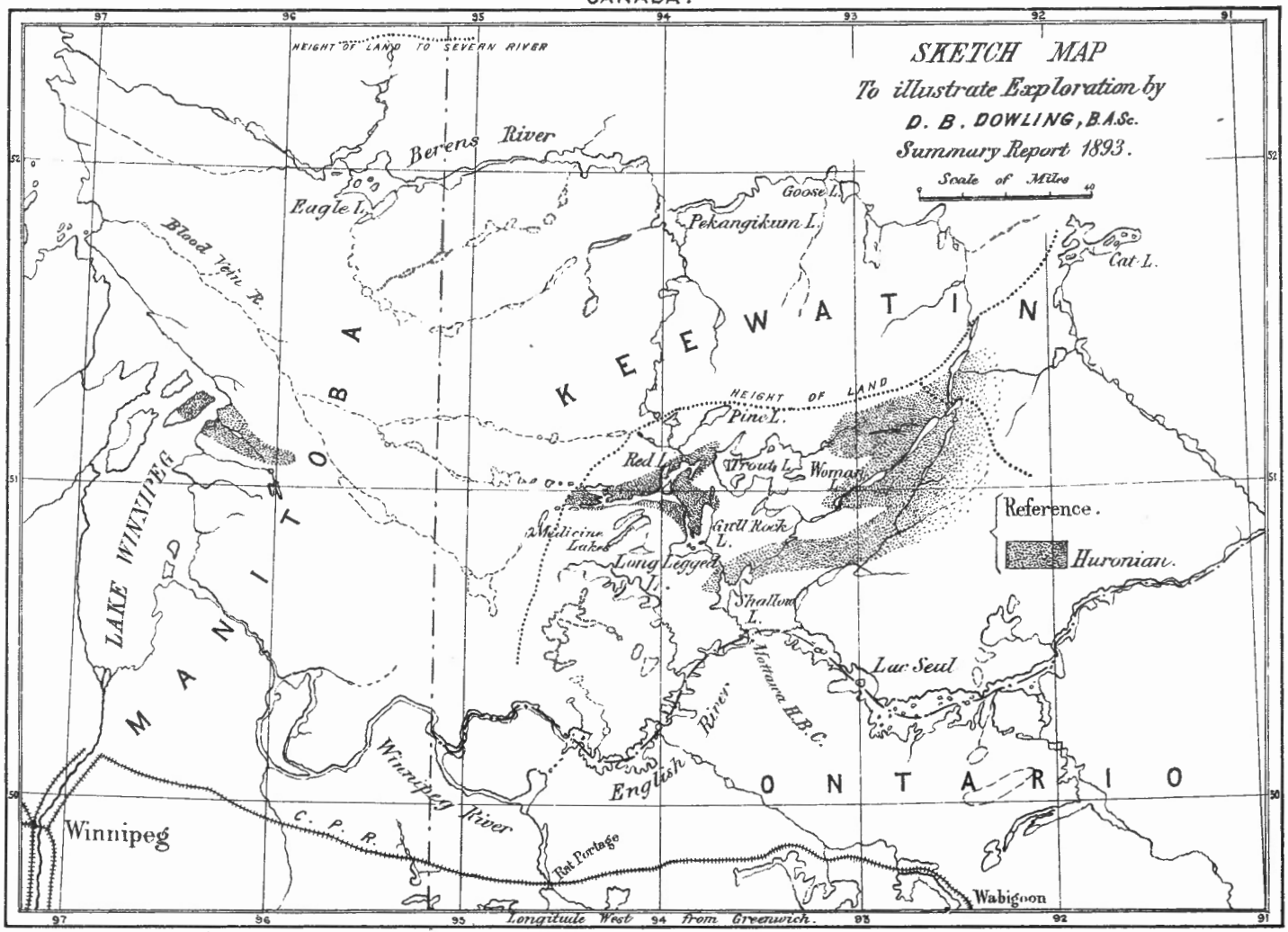

Autographed by C.O. Senécal, C.E.

of some future value except that the quantity appears to be limited by the size of the island which is a mere rock. The stream draining Woman Lake is at first broad and deep with little current to Little Bear Lake where the schists, etc., give place to and are succeeded by granite. The nature of the country then changes somewhat, the hills are rough but of an even outline and lower elevation, a marked difference from those bordering the lakes where the rocks are of a more varied composition. South-westward from Little Bear Lake the stream contracts with several falls and rapids, at which four portages are made. Snake Lake, a small expansion of the river, was next crossed. Below it the river enters a gorge with many rapids and falls, past which we portaged a distance of half a mile. The fall, in that distance, as measured by aneroid, being fifty feet.

"Shortly below this the stream joins Trout Lake River. Our provisions being exhausted, we could not visit Trout Lake. We therefore pushed on to Mattawa, where we expected a supply forwarded by the Hudson Bay Company from Lac Seul. Trout Lake River below this becomes much larger, running in an average south-west direction till it empties into Little Shallow Lake. The rock exposures are very few in this part of the river, owing to a greater accumulation of morainic material. At all but the lowest rapid or fall, however, the rock is exposed and is generally a dark gray and green hornblendic and micaceous schist resembling that on the lower part of Red Lake River and on Shallow Lake, and is probably a highly altered band of the Keewatin rocks. Several large dykes or masses of red granite are found to cut these and are most conspicuous at the rapids. The lowest rapid is caused by an accumulation of boulders in the channels, which are derived from a gravel ridge through which the river has cut its channel at this point. Below this the river is quite straight and apparently deep. It enters Little Shallow Lake at its northern end and leaves it at the north-west corner. On the 1st of July we reached Mattawa, where we found some supplies stored for us. Mr. Gwillim was sent with one canoe and two men to Rat Portage for some other provisions which we needed, that the post on Lac Seul had not been able to supply. I took this opportunity to make a trip to Red Lake to study the rocks of that basin and to make a log-traverse of its shores. Red Lake is of a very irregular shape and may be described as lying about east and west in a trough of Huronian rocks. It has a length of twenty-five miles with an average width of two miles. Dr. Bell makes fuller mention of it in pp. 5-6 of the summary report.* Mr. Gwillim returned on the 31st July, and the whole party proceeded to Trout Lake

*Geological Survey Report, 1882-3-4.

of which I made a log traverse and careful examination of the rocks. The Huronian areas both to the east and west were expected, from their strike, to be found on some parts of this lake, but only fragments of the dark rocks included in gneiss and granite were observed. Trout Lake is the largest sheet of water in this district; it is sixteen miles long and about eight broad. The shores, more particularly of the southern part, are thickly strewn with boulders, and the surrounding hills, except a high ridge running parallel to the south-west shore are not of any great elevation. The top of this ridge is a series of closely joined hills steep on their northern face and more gradually sloping to the south, averaging about two hundred and seventy feet above Trout Lake and 1,575 feet above sea. The material composing them appears to be a mixture of sand and boulders all well rounded. The ridge on its summit is mostly of boulders and is probably of morainic origin. It was observed by us pretty continuously from the first rapid on Trout River, to the west end of Trout Lake, and by Indian report extends northward to Mikiame Falls on the Beren's River, where we made a portage over a high ridge of sand and gravel with a few boulders.

"To the south-west of this ridge, in several places, large areas seem to be covered with stratified beds of sand. On Gull Rock Lake exposures of sand occur showing a thickness of twenty to twenty-five feet. At Mattawa the sand gives place to light clay interstratified with sand, and affords better soil for gardens than further north. On Lac Seul several exposures of sand with thin clay partings are seen in the neighbourhood of the Hudson Bay Company's post, and immediately south across the lake a steep cliff of sand which was not visited, appears to be much higher than the rest, possibly rising to eighty or one hundred feet.

"From Trout Lake I went with light canoes to the eastward, crossing the Woman Lake area, finally portaging to a small stream flowing to the western end of Lac Seul. Following this down we reached Mattawa on the 17th of August. We found the Huronian rocks of the Woman Lake area to extend further to the east, and from their strike they may possibly reach Cat Lake River. The southern limit is crossed on the stream about fourteen miles north of Lac Seul, and is about east and possibly a continuation of the belt which touches the northern and western end of Shallow Lake, making this a much larger area, though not as varied a section as the Red Lake trough. In the meantime, Mr. Gwillim was sent to make a log survey of Little Shallow Lake, and the western shore of Shallow Lake and collect specimens from the several rock exposures; this he successfully accomplished and arrived at Mattawa on the 16th of August.

"Having travelled all the routes known to our guide, I returned to Lac Seul and discharged him, endeavouring to get a man that knew the country further west. The one obtained professed to know the country south and west of Red Lake, and we therefore started westward going down the English River to Maynard's Lake, going up a river at its west side to a series of three lakes joined by short river stretches or narrows. The name Long Legged Lake is given to this group. After making a survey of the whole we tried to find a way across to Red Lake to the north, but missed the road and as we were likely to lose too much time we returned by the English River to Mattawa, thence to Gull Rock Lake, where we tried another route to the west through Stoney Lake to the two Medicine Lakes lying between Long Legged Lake and Red Lake. The portage of Long Legged Lake was found and paced across. Then by a small stream flowing north we reached Red Lake.

"In the meantime, Mr. Gwillim was completing the survey of a lake north of Gull Rock Lake, the position of which we fixed by bearings from the high ridge south of Trout Lake. This would therefore connect the surveys round by the Trout Lake River and Trout Lake with that up Red Lake River. A small lake or extension of the north-eastern part of Red Lake was also examined and surveyed by Mr. Gwillim previous to joining us on Red Lake. A few days were spent examining a route by a chain of lakes to the south-west of the western extremity of Red Lake before completing the work of the season.

"Of the timber seen during the travels little need be said. South of Lac Seul white and red pine was frequently seen in small groves, and on the lake a few patches only. A few trees of red pine were seen on Red Lake, but none further north. Cedar was noticed in small quantity to the height of land, but none further north.

"The country in the vicinity of the headwaters of the southern branch of Beren's River is generally sandy and covered by a thick scrub of jack pine.

"We left for Lac Seul on September the 20th, and arrived at the Hudson Bay Company's post on September the 25th, where our accounts were made up and guide paid off. We arrived at the end of the Portage to Wabigoon Tank on Friday evening, September the 29th, and had our baggage taken across by team on Saturday. The canoes and heavier camp equipments were stored in the warehouse on Sandy Lake, the rest at the store at Wabigoon Tank. Arrangements were made with the officers of the company to ship the smaller canoe to Rat Portage, to be repaired, so as to be of some use for another season. October the 2nd was spent in Rat Portage, paying off the men and making up accounts with the Hudson Bay Company. I

arrived in Ottawa on October the 5th, and have since been engaged plotting the various surveys made during the season.

"Observations for latitude were taken wherever possible, to check surveys, also bearings on the sun near the horizon for variation. About thirty-seven photographs of interesting geological features were taken, and a series of 149 specimens of rocks collected.

"Of the geological results of the present exploration it will be seen from the accompanying sketch map that a very large and long branch of the Beren's River has been found extending much further to the east and south than was previously known or mapped. The eastern limit of the waters flowing westward by the valley of the Beren's River is very nearly 92° W. long., while the southern limit of the basin is in the latitude of 51° 15′ N. This therefore adds to our knowledge of this river, a branch which with its tributaries forms perhaps the largest part of the river, giving a total length of 260 miles from its mouth to its eastern source. The headwaters of the Blood Vein River are also found at a remote distance from its mouth, and show that this river flows in a valley extending south-east to a distance of one hundred and twenty miles from Lake Winnipeg. Of the geological features the most important is the discovery of a large area of Huronian rocks lying to the eastward of Trout Lake. The eastward extension of this area has not yet been defined, and it may cover a large area."

Cost of the season's exploration, $1,511.16.

Mr. McInnes's work during the past year has been entirely devoted to the completion of the surveys and observations made by himself and the late Mr. Smith, in 1892, with the object of perfecting for the engraver and for publication the two sheets, No. 6 and No. 9, of the Ontario series of geological maps on a scale of four miles to one inch. These sheets cover an area of 6,912 square miles west of Thunder Bay between the 48° 30′ and 49° 15′ of north latitude and between the 89° 15′ and 92° 30′ of west longitude.

From January to May, Mr. McInnes was occupied in plotting, reducing and compiling the surveys that had been made during the summer, as well as all available Crown Lands and other surveys, also in studying and working out the notes made by Mr. Smith and himself in reference to the geological structure of the areas that had been examined. In doing this it was found that some further surveys and examinations were needed to complete the work on sheet No. 6, but that as these were not extensive they could be easily taken up during the summer in connection with the work still required for the completion of sheet No. 9.

Mr. McInnes left Ottawa for the summer's work on the 26th of May; sixteen days were spent, en route, at Chicago.

Mr. Wm. Lawson, B.A., of Toronto, was engaged as assistant for the season. He had already spent several seasons in this field and his services were consequently of great value. He commenced work on the 9th of June, and first completed a micrometer and compass survey of the route from Lankoping station on the Canadian Pacific Railway across to Dog River and thence by Dog Lake and the Kaministiquia River to the north line of the township of Ware, a distance of about sixty miles. Between the 22nd and the 29th of June, and while Mr. Lawson was so engaged, the time was spent by Mr. McInnes in an examination of the Matawin River, where considerable prospecting for iron ore has been done. Mr. McInnes found that much work in the way of stripping and sinking test pits, etc., had been done on various locations and that deposits of magnetite of great thickness, but largely interbanded with cherty and jaspery layers, had been discovered.

An interesting conglomerate band occurs at two points on the river. It shows waterworn pebbles of cherty black slate quartzite, etc.

July the 1st to August the 5th was spent in the examination of a route through Windigoostigwan and Crooked Pine lakes, the Aticokan River, Steep Rock Lake and Seine River, returning to the railway at English River, by way of Turtle Lake, etc., a total distance of about 150 miles. The iron bearing range along the Aticokan was examined at a number of points, and although the trenches and test-pits, which had been made, were largely filled by caving in, enough was seen to show that there exist along the eastern half of the range, extensive deposits of remarkably rich and pure magnetite. Towards the western end of the range the ore bodies are banded in character, and the belts of clean ore are not extensive. Veins at Harold Lake, north of the Seine River, hold galena and pyrite, and show free gold in promising quantities. The very interesting rocks about Steep Rock Lake were examined, and the facts noted were found to be in accord with the views as to the age and stratigraphical relations of the series, expressed by the late W. H. C. Smith, in a paper read at the Ottawa Meeting of the Geological Society of America on the 30th December, 1892,* and by H. L. Smyth, in the American Journal of Science, 1891, vol. XLII., pp. 317–331. The series shows evidence of complicated folding at two different times and caused by forces acting from different directions. It includes heavy beds of limestone, beds of sandstone, slate, greenstone, etc., and seems to occupy a position above the

*Bulletin of the Geological Society of America, vol. IV., pp. 333-348.

great mass of the Huronian (Keewatin) rocks of the district. Mr. Lawson made surveys of lakes, etc., along the route which will add to our knowledge of the topography of the region.

August the 10th to September the 6th was occupied in a survey of a series of lakes lying between Konepiminanikok and Windigoostigwan lakes, west of the township of Kars. The whole route was found to lie in gneisses, an extension of those which occur at Pickerel Lake to the west. The route is a difficult one, with long portages, and the total distance traversed in going and returning was about 140 miles.

The last month of the season, or until October the 8th, was utilized to make a micrometer survey from Lac des Isles, by a series of lakes to the north branch of Dog River and down that river to where the old Red River route leaves it and strikes across towards Savanne River, a distance of about sixty miles. This route was found to be occupied everywhere by gneiss, though the presence of boulders of Nipigon rocks in large numbers along the upper stretches of the north branch, indicate that this series is probably in place at no great distance to the north. The north branch of Dog River was found to have its source in a small lake lying in N. latitude 49° 15′. The total distance travelled in the different traverses and surveys during the summer was in the vicinity of 600 miles. Ottawa was reached on the 18th of October, and office work taken up, attention being first given to the plotting and reduction of the surveys made during summer. When the work is finished it will afford all the data required to complete sheets Nos. 6 and 9 for the engraver.

The cost of the season's explorations was $1,752.76.

After the close of the field operations on the 8th of October, 1892, Mr. A. E. Barlow, assisted by Mr. J. F. E. Johnston, was engaged in plotting the instrumental surveys which had been made, copying and reducing township and other plans and in making such rough compilations of the Crown Lands surveys and their own as were necessary for use in the field. The specimens collected had to be permanently labelled and studied in connection with mapping the geological and lithological boundaries. Besides these principal duties some time was taken up in preparing accounts of expenditure in connection with the field work and other matters of minor importance. Before leaving for the field last spring it was thought possible to complete sheet 131 of the Ontario series of geological maps, but a few weeks of next season's work will be required before this map is ready for publication. Mr. Barlow reports as follows:—

"During the whole of the past year I have been assisted by Mr. J. F. E. Johnston of this department, who has had charge of the topogra-

phical portion of the work. He left Ottawa on the 18th of May with instructions to make a survey of the roads in the vicinity of Mattawa, and after its completion to undertake a re-survey of Lake Keepawa. He was joined in the field by Messrs. A. M. Campbell, of Perth, and E. M. Burwash, of Victoria University, Toronto, both of whom by the zealous performance of their duties contributed much to the success of our exploration. The old survey of Lake Keepawa, made many years ago for timber limit purposes, was found very inaccurate in places, while in others the survey did not give sufficient detail.

"The re-survey of this crooked stretch of water necessitated a micrometer line of three hundred and thirty-five miles, which served as a base for further triangulation. This survey, when plotted, will represent very faithfully the tortuous shore-lines and numerous islands of this lake. Mr. Johnston completed this survey on the 26th of July, being delayed by violent wind and rain storms, especially in the earlier part of the season. As usual, a great portion of the time was occupied in making such surveys, as they were very necessary to enable me to delineate the geological details with sufficient accuracy, but the division of the work, Mr. Johnston devoting his whole time and attention to the topography, enabled me to work out the geological structure in greater detail.

"From the 18th of May to the 6th of June, in compliance with your instructions, I was in Chicago, engaged in studying the very instructive exhibits of rocks and minerals at the World's Columbian Exposition.

"Leaving Ottawa for the field on the 19th of June, I reached Sudbury the following day and was joined by Dr. Adams, of McGill University. Together we made a further examination of some of the many points of geological interest presented in this district. Mr. H. N. Topley, photograher to the department, accompanied the party and took some additional views of geological phenomena, besides colouring other views previously taken, to illustrate some of the contacts exposed in the vicinity of the Canadian Pacific Railway.

"Leaving for Mattawa on the 26th of June, a few days were spent examining the rocks of that neighbourhood. The greater part of July was occupied in a detailed examination of the rocks exposed on the shores of the Ottawa River and of Lake Temiscaming from the old Hudson Bay Company's post to Mattawa. During the same time Mr. Topley took some excellent large geological photographs. During August and September the country lying to the south of the Mattabetchouan River and Rabbit Lake was examined, and Mr. Johnston made careful micrometer surveys of all the available routes connecting with the base and township lines of the Ontario Crown Lands Depart-

ment as well as with surveys made by me during the previous summer. The streams in this district are very small, and with the exception of the Mattabetchouan River are only travelled by the Indians in winter or early spring, so that a great deal of time was consumed in chopping out the narrow portage roads necessary for carrying the supplies from lake to lake. The country is all densely wooded and is covered with a second growth of very excellent white and red pine, which although rather small, in many cases, for square timber would make excellent saw-logs. The line of the Nipissing and James' Bay Railway, as located last summer, runs north from North Bay passing to the east of Lake Tilden and Lake Marten and thence crosses Wicksteed Lake by a number of rocky islets. It then continues to the west of Boice, Red Water and Rabbit lakes and reaches Temagami Lake at the north-western extremity of the north-east arm. This is as far as the line has been located, and the engineers consider it an eminently feasible route. Most of the country traversed is comparatively flat, but drops suddenly in the vicinity of Lake Temiscaming and the Ottawa River which seems to occupy a very low depression. Lake Temiscaming, as its name implies, is very deep and the captains of the steamers plying on its waters assert that off the mouths of the Keepawa and Montreal rivers the lead only touched bottom at 1,800 feet. A sketch of the geology has already appeared in last year's summary and it is thought unnecessary to go into further detail pending the publication of the finished report. The main geological boundary on the sheet, the division between the Laurentian and Huronian, was examined in further detail and can now be mapped with great precision. A collection of fossils comprising about 500 specimens was made from an outlier of the Niagara formation exposed on the shores of Burnt Island (Mann Island), besides about twenty specimens from a small outlier of limestone (Trenton?) reposing on the gneiss on the north shore of the Ottawa River about five miles and a half below Mattawa. A boulder of diabase was found on the west side of Bear Island, Lake Temagami, containing porphyritically developed crystals of plagioclase. The crystals are very large and exhibit the twinning lamellæ with great beauty. They may represent the original condition of the altered form of plagioclase, Huronite, found *in situ* in many places near Missinaibi station on the Canadian Pacific Railway, in the vicinity of Lake Huron and elsewhere.

"Some fine specimens of microcline (amazon stone) and perthite were obtained from lot 7, concession B of the township of Cameron. These have been placed in the museum. A good suite of about 700 specimens was collected, representative of the Laurentian and Huronian rocks as exposed in this region. These have all been properly trimmed and

permanently labelled and samples of over a hundred of the more doubtful ones have been sent to Germany to be cut in thin slices for future study under the microscope.

"The measurements made were: by micrometer and compass 504 miles, pacing and compass fifty-three miles, total 557 miles. Finishing the survey we returned to Ottawa on the 12th of October.

"After the close of the season's field work, Mr. Johnston was occupied till the end of the year in plotting the various surveys made. During November, Mr. Barlow's time was taken up in classifying and arranging the numerous rock specimens collected. In December, it was deemed advisable that he should proceed to Montreal, and with the assistance of Dr. Adams, who has been at work for the Survey on areas of similar rocks in southern Ontario, study sections of the more doubtful specimens under the microscope."

The cost of the season's explorations was $2,107.

Dr. Bell reports as follows on his work during the past year :—

"Between the beginning of the year and the commencement of field operations the time was spent in the office as usual, in going over the notes of the previous season's operations, plotting the surveys and explorations which had been made by myself and assistants, and in studying the geological results. A portion of the time was required for correspondence and supplying information asked for, in making preparations for the next season's field-work, etc. A report was partly prepared in reference to sheet 127, but as the geology of sheet 129, which was to be worked out during the summer, is a continuation of the former, it was decided to incorporate the descriptions of these two sheets in one report, as soon as the field work required for the latter should be completed.

"During the season for field operations, I again carried on the working out of the detailed regional geology in the country north of Lake Huron, in continuation of that of the last few years. I was assisted by Messrs. H. G. Skill, W. G. Miller, B.A., R. W. Brock, T. L. Walker, M.A., and W. A. Dent, this having been the fourth season for Mr. Skill, the third for Messrs. Miller and Brock, the second for Mr. Walker, and the first for Mr. Dent. In addition to these gentlemen, canoemen and a cook were employed from time to time as required.

"Our work was principally in sheet 129, which lies within the same latitude as the Sudbury sheet and abuts on it to the west. Sheet 129 may be called, for convenience, the North Shore sheet. But in addition to this we completed the geology of the narrow strip along the lake front with its adjacent islands forming the northern part of the

Manitoulin sheet, No. 126. As the French River sheet, 125, was completed last year, we can now show the geology throughout a solid rectangle consisting of this and the three following sheets : Manitoulin, 126, North Shore, 129 and Sudbury, 130, while the work done in sheet 128, in former years, enables us to carry the geological lines with tolerable accuracy as far as the east end of Lake Superior. Some further geological and geographical details will, however, require to be ascertained in the north-eastern portion of sheet 128, before it will be ready to publish with as much completeness as the sheets between it and the Ottawa River.

"Sheet 129 proved a rather difficult one to work out, owing to the want of good canoe routes and of roads except a few very rough ones used by lumbermen for "toting" supplies to the shanties. As a rule the ground is very much broken and encumbered with boulders and the woods thick and tangled, consisting of a dense growth of coniferous underbrush with larger trees growing up through it. Still by perseverance we managed to work out the geology of the district so as to represent it fairly accurately upon sheet 129. In regard to topographical details, we were much aided by the township maps which have been made by the various lumbering concerns for their own purposes. While the outlines of these townships have been laid down by the Crown Lands Department and posts planted at every six miles to mark their corners, a considerable number of them have been subdivided into sections and quarter sections and the topography sketched in by employees of the lumbering companies. The heads of these firms or their agents kindly allowed us to make tracings of any of their maps, and for assistance of this kind our thanks are due to all the lumbering firms in the district gone over.

"I left Ottawa for the field on the 3rd of July, and on the 5th was joined by all my assistants at Spanish River, which we made our post office address for the season. We devoted ourselves first to working at the geology of the shores and islands to the east and west of Spanish River, and on the 18th of July we left this place in two large wooden canoes for an exploration inland by way of Blind River, the mouth of which was reached the following day. From Mountain Lake on this stream we proceeded through Magog Lake and thence explored the country northward. Returning to the south end of Mountain Lake, we ascended Blind River to Chiblow Lake and the two divisions of Tendenenda Lake, all of which had been surveyed topographically by the late Mr. Alexander Murray, of the Geological Survey, in 1863. Besides revising the geology of the shores of these lakes we made explorations inland from them in various directions. After completing this work we arrived back at Spanish River on the 31st of July.

Messrs. Walker and Dent were next sent for a few days to make detailed examinations and to collect specimens of the rocks about the mouth of Spanish River and thence westward towards Cook's Mills, Mr. Skill to make a sectional traverse of the peninsula between Lake Huron and Spanish River across McBean Mountain, while Messrs. Miller and Brock accompanied me to some of the islands east of Spanish River.

"My personal share in the field-work was now interrupted for a short time in order to undertake a journey, with your approval, to the United States for purposes which I shall explain. There had been disagreements or rather misunderstandings between the Canadian and United States geologists, as well as among the latter themselves, as to the interpretation of many facts concerning the Cambrian and Archæan rocks which are common to both countries in the Lake Huron and Lake Superior region. In order to try to harmonize the work on both sides of the international boundary and to come to an understanding more satisfactorily and effectually than would be possible by the mere written accounts of geologists working altogether independently of one another, it was agreed that a party of those interested in geological investigations in the regions in question should proceed together and inspect certain typical occurrences of these rocks in northern Michigan. With your consent I left Spanish River on the 7th of August and joined this party at Ishpeming on the 9th. After looking at the Huronian rocks at this locality, the party went to Haughton and the Calumet and Hecla mines and viewed the Keweenian or Nipigon formation of that region. From Haughton we proceeded to the Gogebic district and inspected the iron-bearing rocks around Bessemer and Ironwood. These examinations were important as they enable me the better to compare the views and conclusions of the United States geologists with our own.

"With reference to this subject, I may here make a few very brief observations. In addition to the present occasion, I had visited the Ishpeming region in 1860 in company with the late Mr. Alexander Murray, of the Geological Survey of Canada, when the great iron mines were being first opened, and again alone a few years ago. The iron-bearing rocks of this locality appeared to me, as they did to Mr. Murray, to belong to the ordinary varieties of the Huronian series of Lake Superior, and they may be compared with that phase of the System which is developed in the valley of the Mattawa or west branch of the Kaministiquia River.

"The rocks which run through the north-western half of Keewaiwona (now called Keweenaw) Point, and in which the deposits of native copper occur in the vicinity of Houghton, are believed by all

geologists to be the equivalents of our Nipigon series,* in which native copper also occurs on Michipicoten and St. Ignace Islands and Isle Royal. By the United States geologists they have been called by a variety of names, all derived more or less directly from the original name of this point, which is the Ojibwé word for northward. These rocks consist of red and gray sandstones, conglomerates, marls, shales, etc., interstratified with a variety of igneous rocks, especially amygdaloids, tufas and greenstones, all dipping at moderate angles to the north-westward. The southeastern part of Keewaiwona Point consists of red and gray sandstones newer than the copper-bearing series.

"The rocks which we saw in the vicinity of Ironwood consist of a series of silicious schists, quartzites and a flaggy silicious rock containing a considerable percentage of iron carbonate, all dipping at a high angle to the northward and resting upon a gray granite. They were cut at various angles to the horizon by dykes of diorite which are now more or less altered into a soft variety of serpentine. As pointed out by Professor Van Hise, the accumulations or masses of hematite of this locality, which are mostly soft, are formed from the percolation of iron in solution, derived from the iron carbonate, which deposits the oxide upon any nearly impervious floor or receptacle formed either by the inclined dykes or by folds in the underlying rocks. These iron-bearing rocks appear to me to be equivalent to a part of the Animikie series. Their resemblance to the rocks of the Manitounuck group of this series on the East-main coast of Hudson Bay is closer than to those of Thunder Bay, although it appears to be sufficient to identify them with the latter also. In the former region, light gray quartzites, like those of Ironwood, are to be found and a thinly bedded manganiferous carbonate of iron of great purity is largely developed. This series, like the Animikie of Thunder Bay, is clearly unconformable to the Huronian. The two sets of rocks are not only separated in both regions by the most marked unconformity, but the Animikie strata in both instances are unaltered, and have evidence of organic existence, while the Huronian are, as a rule, thoroughly crystalline and belong to the Archæan. In connection with this controverted point in the geology of Lakes Huron and Superior, it is important here to note that last summer we found thinly bedded chert-rocks in every way like those of the Animikie formation of Lake Superior, in an unconformable attitude to the nearest outcrop of Huronian, at about thirty-five miles north of Algoma station on the Canadian Pacific Railway. These thinly bedded cherts, limestones and the light coloured quartzites, forming a small area between Thessalon River

* This series is the upper division of Logan's Upper Copper-bearing rocks, Geology of Canada, 1863, pp. 77-84.

and Lake George, may also belong to this series. They appear to me to rest unconformably upon the rocks of the great Huronian area which surrounds them, and the occurrence of this comparatively small inlier may have given rise to all the confusion in regard to the meaning of the terms Huronian and Animikie, and to the false impression that the Huronian rocks north of Lake Huron dip at low angles, whereas they are almost everywhere nearly vertical. The existence of a little patch of Animikie upon the Huronian of this region, would, by no means, justify the attempt to abolish altogether Logan's well founded name Huronian.

"On the breaking up of the above geological party, and with the approval of the Minister of the Interior and yourself, I paid a short visit to the World's Columbian Exhibition at Chicago, stopping on the way for a few days at Madison, Wisconsin, where the American Association for the Advancement of Science and the Geological Society of America were holding their meetings. Chicago was reached on the 21st of August, and on the 3rd of September I started back by steamer to continue my geological work, and reached Spanish River on the 6th.

"Before leaving on the above journey, I had given detailed instructions to my assistants and provided them with complete outfits for carrying on the field-work in two sections during my absence, and it was gratifying to find that they had done so successfully and returned to Spanish River two or three days in advance of myself.

"Messrs. Miller and Brock made excursions northward from Webbwood, Cook's Mills and Thessalon, the last extending into the township of Morin; while Mr. Skill made a track-survey of Serpent River, and the lakes upon its course, simultaneously with his geological examinations. From one of the lakes near the source of Serpent River he followed a chain of lakes hitherto unexplored, southward to Tendenenda Lake and thence returned to Lake Huron by the Blind River. Messrs. Walker and Dent were sent to explore the region in the neighbourhood of the Sable River. They followed the roads which have been cut by the lumbermen through the thick woods of that region, and reached the northern part of township 124 on the main Sable and the north-western part of township 130 on one of its western branches.

"Mr. Dent started for home on the 11th of September, in order to resume his duties at the University of Toronto; Mr. Walker left on the 19th of the same month, and Mr. Miller went to Kingston on the 24th, in order to take a lectureship in the school of mining, which was just about opening in connection with Queen's University. From the 14th of September to the 13th of November, Mr. Skill made three

trips by canoe and on foot for the purpose of tracing out the subdivisions of the rocks in the central and northern parts of the sheet, at the same time making good track-surveys of the lakes and streams he passed through, and fixing as many points as possible with reference to the posts and lines of the Government land surveyors. He left for home on the 16th of November.

"In township 164, about thirty-five miles north of Algoma, he found thinly bedded black and olive and yellowish-green chert rocks lying almost horizontally, while the nearest outcropping Huronian strata dip at high angles. These rocks appear to be unconformable to the Huronian, and it is probable they may be contemporaneous with the similar beds of the Animikie formation of Thunder Bay.

"From the end of October till the 18th of November, assisted by Mr. Brock, I worked in the eastern part of the sheet, most of the time having been spent in the townships around Massey, where a considerable variety of rocks occur, the boundaries of each of which required to be traced out. Sunday and Monday, the 19th and 20th of November, were spent at Sudbury, where I obtained some information as to the progress of mining in that district, and I reached Ottawa on the morning of the 21st.

"The following is a very brief summary of the leading geological results of the season's operations. Except in the south-west corner, which was worked out by the late Mr. Alexander Murray, the distribution and general character of the rocks within the limits of the North Shore sheet turned out to be quite different from what had been supposed. The central part of the sheet is occupied by the stratified members of the Huronian system, together with some massive greenstones, and this central area is surrounded on all sides by granite, with the exception of a gap towards the west, and a narrower one to the south near the south-west corner. The granite also occurs in the form of a rather narrow belt twenty-eight miles in length from east to west in the centre of the sheet. This granite is like that of the Sudbury sheet, of which it is a continuation. It is nearly always red, of medium texture, and consists of about equal parts of orthoclase and quartz, with a small proportion of hornblende and a little mica. It is still uncertain whether this great area of granite should be classified with the Laurentian or with the Huronian.

"The stratified Huronian rocks appear to extend nearly to the north border of the sheet or twice as far inland as had heretofore been supposed. In the north-east corner of the sheet they reach township 115 or the one next west of Craig and are a continuation of the Straight Lake inlier, which is shown on the Sudbury sheet. In the southern part of the sheet a tongue of the granite, twelve miles wide, extends

from the main body in the neighbourhood of the south-west bend of Spanish River due west to the townships of Long and McGiverin.

"On the south side of this tongue an arm is given off in the township of Victoria which extends due west or parallel to the main body as far as Serpent Point. It is separated from the main tongue by a rather narrow belt of schists, principally micaceous. Much of the granite within the sheet is remarkable for the large quantities of greenstones which are mixed with it. This is also a feature which characterizes the area of gneiss lying between Sault Ste. Marie and Goulais Bay. The extension to the south-eastward of the greenstone area of Tendenenda Lake has been already referred to as well as the existence of several large areas of this rock among the stratified members of the Huronian series about the south-east corner of the sheet. A belt of greenstone extends from this vicinity westward with some interruptions as far as Black Reef in the North Channel of Lake Huron, a distance of about fifty-five miles. Another interesting point was the discovery within the sheet of rocks like those of the Animikie formation already referred to. Besides the above main features, a vast number of new facts as to details were of course noted. The number of photographs was purposely limited to views of geological interest and a few of characteristic scenery, only about twenty in all having been taken.

"Cost of season's field operations extending over nearly five months and including salaries of all assistants, $2,480. Cost of journey with United States geologists and visit to World's Columbian Exhibition, $150."

During 1892, and early in 1893, considerable attention had been attracted to certain mineral discoveries in the townships of Dalton, Digby, Lutterworth, Somerville and Ganway, in Ontario, and as up to the present time not even a preliminary examination of the Archæan rocks had been made by the survey in this part of Ontario, north, east or west of the above townships, it was considered desirable to make some investigations in that district during 1893. Dr. Adams, of McGill College, was requested to undertake this work. He left Montreal on the 17th of June and returned on the 10th of September. His preliminary report is now being printed as Part J, vol. VI. of the Annual Report, 1891-93. Mr. Adams likewise made a preliminary examination with a view to future detailed mapping of the area included in sheet No. 118. It is hoped this will be proceeded with next summer.

Dr. Ells's attention during the past year has been devoted to the work required for the completion of the geological map, sheet No. 121 of the Quebec series, on the scale of four miles to one inch. The eastern limit of this sheet is the western limit of the south-west sheet of the Eastern Townships map, now ready for the engraver and publication, and its western margin is a few miles west of Ottawa city. It covers an area of nearly 4,000 square miles, the south-east corner of which is a part of the province of Ontario.

The winter was devoted by Dr. Ells to the compilation of the many separate and disconnected surveys that had been made by this department and by the Quebec Crown Lands Department, which were required to complete the sheet referred to. Dr. Ells commenced field work early in May, and reports on the season's operations as follows:—

"The surveys and investigations required for sheet No. 121 were for the most part within the counties of Ottawa and Pontiac in the townships bordering the Gatineau River. The examinations were extended northward to the River Desert, about ninety miles from its junction with the Ottawa, and surveys were made of all roads in these townships as well as of those in portions of Lochaber, Buckingham, Templeton, Mulgrave and Ripon.

"Most of the lakes and streams at all accessible for canoes have been explored, and their geological and mineralogical features carefully examined. Further detailed observations in the more immediate vicinity of Ottawa are yet necessary before the somewhat complicated geology of this section can be fully mapped. This can be completed next summer.

" During the season I was assisted by Messrs. W. A. Merkley, an undergraduate of Toronto University, and Christopher Forester, a graduate of the School of Practical Science in that city. Of both these gentlemen I may say they did the work entrusted to them in a satisfactory manner.

"An examination of some of the lakes on the upper waters of the Blanche River in Derry township, was made early in May, but the season being late, the final start for the field was not made until the 29th of that month, when camp was pitched near Wilson's Corners on the line between Hull and Wakefield. From this point a careful examination was made of all the known openings for mica and phosphate in the townships east of the Gatineau, with the view of obtaining and recording all the facts bearing on the mode of occurrence and the geological relations of these minerals, and whether they occupy any

definite horizon in the Laurentian rocks.* This work was subsequently extended to the western side of the Gatineau River, the outcrops of the limestone bands were determined, with their relations to the associated gneisses and quartzites. Several excellent photographs were taken of the mica mines, showing the occurrence of the mica in the pyroxene near the contact with the gneiss ; also of the great pyroxene-diorite dyke, near the Little Rapids mica mine. This dyke cuts almost directly across the strike of the red orthoclase gneiss. Photographs of the limestone conglomerates† in rear of Calumet station on the Canadian Pacific Railway, were also taken later in the season.

"A careful exploration of the several chains of lakes on the Upper Blanche, in Mulgrave, Ripon, Lathbury and Villeneuve townships was made in July, in canoes, and several outcrops of limestone were traced through this area, one of which, on the east side of lakes Gull and Hawke, is slightly serpentinous and has been quarried in the search for chrysotile. A more important serpentinous band occurs, however, in the north-east angle of Big Blanche Lake, and openings have been made on it by a Montreal company. Small veins of chrysotile were found, but the fibre, as is generally the case in these rocks, was too short to be of much economic importance, and the quantity is not sufficient to repay the cost of its extraction. These chrysotile deposits are found at many points, in fact wherever the limestone has been serpentinized, the quantity, of course, varying at different localities ; but in none yet examined does there appear to be sufficient to warrant the investment of capital for its extraction.

"After finishing the examination of the Blanche Lakes, a portage was made to the Lièvre River ; and thence by a chain of lakes through

*A very excellent and exhaustive report on this question, with illustrations, was made by Dr. Bernard J. Harrington in 1877 (see part G, Geological Survey Report, 1877-78), and it may be doubted whether further investigation will result in any better explanation of the facts, as affecting the occurrence and the mining of these deposits, than is given by Dr. Harrington in the report referred to.

The facts in relation to these deposits have again been recently studied in detail by Mr. Ingall over an area of some 150 square miles within the townships of east and west Portland, and in a large part of those of Buckingham and Templeton, including small portions of the contiguous townships. This examination includes all the chief working and worked mines of apatite in Ottawa county besides some opened on deposits of asbestus (chrysotile), mica and plumbago, comprising some eighteen to twenty mines in all.

This work has been reported upon by Mr. Ingall in the Summary reports of this Department for 1889 and 1891, and in the report of the Division of Mineral Statistics and Mines for 1890 (part S, pp. 155-157, vol. V., 1889-91).—A. R. C. SELWYN.

†Having examined specimens collected by Dr. Ells of the supposed pebbles from these "limestone conglomerates," I wish to state that I cannot regard these included gneiss fragments as pebbles in the ordinary acceptation of that term, or that there is any conclusive evidence that the rocks of this series, gneisses, quartzites and limestones, are the result of aqueous abrasion and sedimentation. Some other cause must, I think, be sought to explain the parallelism of the structural layers and their alternating lithological characters. In any case much more detailed and careful investigation is yet required before any decided opinion can be safely expressed on the very obscure and interesting question of the real cause of the parallel structural layers in the Archæan gneisses.—A. R. C. SELWYN.

the Big and Little Whitefish lakes and the creek connecting the latter with the Gatineau, which was reached in the township of Hincks, and thence descended to the Paugan Falls. The portion of the river above the falls is very rough. Side excursions were made to the Plomb Lakes and to the St. Germain chain in Denholm and northern Wakefield. Mica occurs in several places, among which may be mentioned lot 13, range II., Denholm. The deposit has not been developed, but the specimens from the surface are clear and of good colour. At the foot of the Paugan Falls a considerable area of serpentinous limestone occurs, presenting the same concretionary like structure noticed at the Templeton mine, near Perkin's mill. Veins of fine silky chrysotile occur here, and a number of openings have been made at various points, both on the bank of the Gatineau and in the hills a quarter to half a mile to the east. This chrysotile is for the most part in veins of short fibre a sixteenth to half an inch in length, generally under the half inch, and their distribution is usually around cores and concretionary masses of whitish pyroxenite with which the serpentine zones occur. The deposit at this locality and that of Templeton are among the most important yet observed, but the shortness of the fibre generally, and its small percentage as compared with the quantity of rock necessary to be removed for its extraction, renders its successful mining very doubtful. From the Paugan eastward to the township of Portland the rocks are for the most part gneissic; one small band of limestone was seen on the St. Germain Lake, at the south end, the rocks on the other lakes of this chain being gneiss and quartzite. Near the end of the road east from the Paugan Falls, about four miles from the river, a deposit of mica has been recently opened at Wilson's which has yielded some good crystals, and several tons of mica have been extracted.

"From the Paugan Falls we went to the confluence of the Pickanock River, a branch of the Gatineau, sixty miles from its mouth. This stream was ascended to Otter Lake in the township of Leslie, from the head of which a portage road led to Lake Dumont, at the head of the Pickanock. The rocks about the upper portion of this branch and around the lakes where exposed, are mostly reddish and gray gneiss. A thin band of limestone was crossed on the portage road to Lake Dumont, but could not be traced owing to drift. At the east end of this lake, which is north of the township of Clapham and is the largest body of water in this direction, a band of gneiss, mixed with pyroxene, occurs, but no trace of mica or phosphate could be found. Reported outcrops of mica and phosphate at several points were examined, but the quantity seen in every case was insignificant. West of Otter Lake several bands of pyroxene were seen, but these

also appeared to be barren of useful minerals. Returning from Lake Dumont and Otter Lake, the shores of Lakes Landikegama and Kontuagama were examined, but these present no ledges owing to the extensive mantle of sand and gravel which is spread over this area. At the north end of Kontuagama, a band of limestone occurs in the hills to the north, overlying grayish and quartzose gneiss. The limestone is cut by pyroxene dykes carrying a few small mica crystals (phlogopite), but nothing of economic importance was noted. Some dykes of dark hornblende rock at this place have been regarded by the settlers as probably iron ore, but none was observed by us in this vicinity.

"From the north end of Kontuagama Lake a road extends for about fifteen miles to Wright P.O., near the mouth of the Pickanock. This road traverses a gneiss area for eight to ten miles without limestone outcrops, beyond which the calcareous portion of the formation begins and increases in extent as the Gatineau is approached.

"From Wright P.O., an exploration of the lakes lying between this and the Desert River was made. This included the Sturgeon, the Blue Sea, and a chain lying to the east, and the Big and Little Cedar lakes, from the latter of which a canoe route extends by the Bittobee Creek and Lake to the Desert which it meets about a mile west of its junction with the Gatineau, ninety miles from the Ottawa. The prevailing rock in this direction is crystalline limestone with occasional ridges, for the most part showing an anticlinal structure, of reddish and gray gneiss. Large areas are drift covered, and in the river valleys, as well as in much of the country underlaid by the calcareous rocks, soils of good quality occur. A large part of the township of Maniwaki, now an Indian reserve, at the mouth of the Desert and on the south side of the river, is excellently suited for agricultural purposes. The lakes, which will be accessible by the Gatineau Valley railway, abound in trout, pike and bass.

"But few indications of economic minerals were observed. Mica was found near the road along the west side of the Gatineau on lot 36, range I., Bouchette, where several openings have been made in a pyroxene dyke which cuts red and gray gneiss and on lots 14 and 15, range D of Wright, a mass of mica crystals occurs in a dyke of pyroxene with calcite. The quantity of mica crystals is here very great and some of them are of large size and good colour, but are injured by having, in the centre in many cases, small inclusions of calcite. Similar deposits are found on the west side of Bittobee Lake, south of the Gatineau, near the line between Wright and Northfield, though the quantity of crystals is here much less and they are of smaller size.

"In the township of Aylwin another deposit of mica (muscovite) occurs, about half a mile north of Venosta station. It occurs here in a dyke or vein of felspar and quartz, cutting grayish garnetiferous gneiss, and some very excellent crystals were at one time obtained. The mica, however, appeared to terminate in the place where worked, which was near the centre of the dyke, and the mine was in consequence abandoned. It is possible that following the usual mode of occurrence of this mineral in dykes or veins, it would be better to look for it near the contact with the gneiss.

"In the township of Hincks, on lot 22, range II., on land owned by J. Quinn, of Aylwin, mica (phlogopite) occurs in large smooth crystals in a pyroxene dyke cut by a cross dyke of felspar. The mica is dark amber coloured, but the size of the crystals and the freedom from inclusions and flaws enables plates of extra size to be easily obtained.

"The character of the country north of the township of Low differs very greatly from that nearer the Ottawa River. In the vicinity of Kazubazua, and for some miles to the west, great areas of level drift covered land occur, known as the Kazubazua plains, and this character of country extends northward to the Pickanock River. Occasional ridges of reddish and gray gneiss are seen, but much of this district along the Gatineau Valley railway is well adapted for settlement.

"The month of September was devoted to mapping the sedimentary Cambro-Silurian formations, which occupy the level country along the south side of the Ottawa, and to the examination of the mica and graphite deposits of Grenville, Lochaber and other areas in that direction.

"The surveys of the season have enabled us to outline over large areas north of the Ottawa many of the limestone belts which apparently form the upper member of the Laurentian system as we now interpret the structure. Throughout the townships east of the Lièvre, these calcareous rocks generally occur in narrow but well defined bands, the synclinal structure of which is shown as in the areas on the Rouge and Nation rivers. The limestone bands diminish in extent when traced northward towards the height of land, the underlying red and gray gneiss being there the prevailing rock, the strongly marked hill features become less pronounced, and there is, over great areas, a broad mantle of stratified sand and gravel overlying blue gray clay. On the Gatineau, however, after crossing the generally rugged area which extends upwards for twenty to thirty miles, there is a great development of the calcareous formation. On the east of that river it occupies a large part of the country between the river and the Thirty-one Mile Lake, and on the west side it is well developed for several miles along the

lower Pickanock River. It also occupies the greatest part of the country north, to and beyond the Desert River, and is well exposed about the Blue Sea and Cedar lakes.

"The principal minerals found in the area under discussion are apatite, mica, graphite, asbestus and iron ore.

"The present depressed condition of the phosphate market has had the effect of almost entirely closing the mines of this mineral for the time being. Only two are at present operated, viz., the High Rock mine and the Etna mine, both on the Lièvre River. At the former, about thirty to thirty-five men only have been employed during the season. At the latter, a successful application of the diamond drill has been made by Mr. Smith, the manager, to find further deposits of apatite; the drilling was extended horizontally from the bottom of the present shaft, which is about 135 feet from the surface. The drill worked easily in the pyroxene rock, and several large deposits of apatite were found which are now being mined.

"The graphite deposits of Buckingham have not been worked during the past year. At the Walker mine and at Donaldson's Lake they are very extensive and the percentage of graphite high.

"A deposit of columnar graphite of high grade, in a felspathic rock on the south-east corner of Lake Terror has been worked by Messrs. Lewis, of Montreal. Some prospecting has also been done in the township, and the result has shown the existence of some very promising deposits which will doubtless be developed. There are other deposits of graphite in Lochaber, some of which were worked years ago,* but latterly these have been neglected, though the quality appears to be very good.

"New and important discoveries of mica are still being made, the latest being in the township of Hincks already referred to.

"At present mica is the economic mineral of greatest importance in the district; a careful examination of as many as possible of the openings was made with a view to determine its geological relations, its mode of occurrence, and where it may be usefully sought for in unexplored districts.

"Many of the phlogopite and biotite mica deposits, like nearly all those of apatite, occur in association with pyroxene rocks; but unlike the apatite, muscovite or potash mica of commercial value is found in veins or dykes of pegmatite.

"It appears that the occurrence of mica in workable quantity and size may be classed under five heads, as follows:—

"1. Deposits in which the crystals occur in pyroxene rocks near the contact with the red or gray gneiss. In these considerable quan-

*Geology of Canada, 1863, p. 794.

tities of apatite are also often found. In many places the matrix of the mica and apatite is a pink calcite, which forms irregular pockety masses or veins.

"2. Deposits in massive pyroxene, where the mica occurs in irregular bunches apparently along fissures in the pyroxene, as at the Cascade mine.

"3. Deposits in pegmatite veins cutting gneiss, as at the Villeneuve mine, where no apatite occurs, or if at all, merely in small scattered crystals.

"4. Deposits in pyroxene in association with cross dykes of felspar, as in the Quinn mine in Hincks. Apatite occurs in a similar manner at the Etna mine on the Lièvre, where a thick diorite dyke cuts the pyroxene.

"5. Pyroxene and pegmatite veins cutting crystalline limestone in which crystals of mica, for the most part of small size, and seldom workable, are found along the contact, the mica being in these cases generally of a dark bronze colour.

"In regard to the mica, it may be asserted that the 'white' or muscovite mica is always found (or at least in so far as we can ascertain) in pegmatite veins, as at Villeneuve, Venosta and at the new McGee mine at Escoumain, below the Saguenay. In the pyroxene deposits the mica is always of the 'amber' variety, phlogopite or magnesia mica, the lighter coloured occurring in association with the pale greenish-gray pyroxenes, while when the pyroxene is hard and dark, the mica assumes a correspondingly darker tint and a more brittle character.

"During the past season the occurrence of some very large mica crystals has been noted, one of eight feet in diameter being reported from the Cascades mine, while in the Quinn mine, numbers of crystals of three feet in diameter have been found. These last are comparatively smooth and yield plates of large size and good quality.

"The field work extended from the 10th of May to the 27th of October, and in this is included some time spent at Chicago, from the 2nd to the 19th of October, studying the geological and mineral exhibits."

Cost of the season's work was $1,221.54.

Mr. Giroux was requested to complete the geological exploration of that part of the north-west quarter sheet of the Eastern Township map to the west of the St. Maurice River, and on this work he reports as follows:—

"I left Ottawa on the 2nd of June, and proceeded to Joliette, whence I went to Quebec to get copies of certain plans of new surveys,

and on the 17th reached St. Michel des Saints, on the Mattawin River, in the township of Brassard. On the 20th I started down the Mattawin River with a party consisting of four men and two canoes; we pitched camp near the mouth of Rivière de la Bouteille, and from thence went to a small lake on Creek Lacroix which empties into the Mattawin at the head of Rapide Lacroix. On the east shore of this lake which is to the north of the Mattawin River, and 225 feet above it, there are outcrops of impure crystalline limestone, with much broken, rusty weathering whitish quartz in which are small pieces of magnetite. About half a mile further north and on the same side of the above lake is another crystalline limestone. It dips S. 60 W. < 16, and rests on gray garnetiferous gneiss, and a short distance further north a bed nine feet thick of white crystalline limestone rests apparently conformably on quartzose gneiss which dips S. 25 E. < 25 a short distance north of this limestone outcrop. North-east of this place, and as far as the Mattawin River, a distance of about four miles, the rocks consist of highly quartzose grayish gneiss.

"From Rapide Lacroix to Rivière à la Chienne, down the Mattawin, the gneisses are much twisted and associated with granitic rocks holding in places thin veins of pink calcite.

"On the 30th of June, we started up the Rivière à la Chienne. It is very crooked and affords no ledges for about three miles, that is to the head of Lac de la Cache. One mile further up stream are falls ninety feet high over reddish gneiss full of small grains of clear quartz and dipping N. 80 E. < 14. This gneiss varies greatly in composition and texture, being at times coarse and holding hornblende in large quantity, the bedding disappearing as the hornblende increases. From Lac de la Cache we portaged to a small lake on the west, 238 feet higher than the former, and about three quarters of a mile from it. The grayish gneiss around this lake is much twisted and contains black micaceous patches, and is cut by small veins of coarse crystalline felspar as seen in many places throughout this district. The gray hornblendic gneiss at the Falls of Rivière à la Chienne is met with on the next lake at a short distance from the last. The rocks there being much twisted the dip could not be accurately determined. About half a mile further, in a north-east direction, there is a small lake which empties into the main east branch of Rivière à la Chienne. On its north-east shore is a cliff eighty to 100 feet high composed of grayish and pinkish gneisses dipping N. 45 E. < 30 to 35. A characteristic feature of this section of the country is that the mountains are not as regular and rounded as they are to the south of the Mattawin River, but are cut almost perpendicularly in the small valleys and on the shores of lakes, forming cliffs 200 to 300 feet high.

The lakes are also deeper and their water very clear and with a greenish hue in most of them. Up to the head of Lac à la Chienne, or about twelve miles north of the Mattawin River the rocks consist of reddish gneiss, coarse and whitish weathering with a dip of N. 10 E. < 8 to 10 on the east side of the island, at the foot of the above mentioned lake. The inlet of Lac à la Chienne for about eight miles is very crooked and runs in a north-easterly direction through a low, flat country; but at that distance from the lake it takes a sudden turn to the north, and expands into a small lake at the south-west end of which is a cliff about 150 feet high, composed of heavy hornblendic gneiss, with quartzose and felspathic bands, which dips S. 40 W. < 40. From this small lake we went southward to Lac des Aigles and down its outlet for about three miles, where the gneiss is mostly reddish in colour, but holds here and there thin horblendic bands. Having ascended Rivière à la Chienne six miles further, we portaged across to Lac au Sleigh, on the Pabelagnang River, where we experienced a terrible storm, during which a large poplar tree was broken and fell on our canoes which had been carefully placed at the end of the portage. Our bark canoe was broken, and two days had to be spent in repairing it. Lac au Sleigh is narrow and very irregularly shaped; it is about six miles long and surrounded by low hills of brownish gneiss weathering reddish and light gray. The bedding of this rock is generally very obscure, but where discernible it shows a dip of S. 60 W. < 25 to 30. The only large exposure seen around this lake is at the south end, where the bedding is very distinct; the rocks there consist of a brownish gneiss containing more quartz than elsewhere in this locality. Similar gneiss occurs around Lac Dorval, which is situated at a short distance north-east of Lac au Sleigh and between it and Lac à Baude are ledges of hornblendic gneiss. At the northern end of this lake is a mass of quartz and felspar rock with crystals of mica; the gneiss covering this mass is hornblendic and holds at its base layers of reddish quartz and felspar rock like that of the underlying mass. It also contains crystals of hornblende and garnet; it dips S. 80 E. < 35. At the western end of the above mentioned mass is a vein five feet wide of quartz and felspar rock, holding large crystals of biotite, and at the contact of this vein with the gneiss the quartz is almost black.

"Four miles further in a north-east direction is Lac Wakaumekonke. It is about eight miles in circumference and is surrounded by low hills. At its north end there is a cliff of much broken and jointed red gneiss, which is well displayed for a distance of about two miles and a half. It is followed by a very massive hornblendic rock, which shows neither bedding nor foliation. Following a chain of small lakes and portages in a north-eastern course for about three miles, we come to the Wes-

sonneau River at the dam between Lac Soucy and Lake Steam Boat Rock. The rocks on that distance consist generally of red and brown gneiss, intermixed in places with black hornblendic gneiss. We then went down this last lake about two miles and portaged two miles and a half to a small lake on Rivière à la Pluie, which we followed to its confluence with the Wessonneau River, fifteen miles from Lake Steam Boat Rock. We then descended the Wessonneau River, which is very rough and rapid, twenty-two miles to its mouth on the St. Maurice River. All along these last thirty-seven miles there are ledges of reddish and brownish gneiss, holding blackish micaceous bands. The formation is very much twisted and folded, and the dip varies greatly, being at times S. 60 E. < 28, then N. 60 W. < 12 and again S. < 18 to 20.

"Our provisions were now exhausted, so we descended the St. Maurice River as far as La Grande Anse, twelve miles north of the mouth of the Mattawin River. Two men were left there, and with two I proceeded to Grandes Piles and Joliette, where the necessary provisions were obtained. We started up the St. Maurice as soon as these were received at Grandes Piles for La Grande Anse, and on the 22nd of July left there for the Wessonneau River by a nine-mile portage road; along this road small ledges of grayish, brownish gray and blackish gneisses crop out here and there. The timber consists principally of hardwood, such as beech, birch, hard and soft maple, with fir, spruce, tamarack and cedar in the small valleys. We ascended Wessonneau River to almost the head of Lac Wessonneau where we made a four mile portage to Lake Steam Boat Rock. On an island situated near the middle of Lac Wessonneau are ledges of a dark brown micaceous gneiss exhibiting a dip of S. 50 E. < 15. Along the above portage road is a small lake, at the upper end of which are ledges of brown gneiss forming a cliff about 125 feet high. This gneiss is much broken and jointed, reddish-brown on weathered surfaces and partly covered with iron rust. At the outlet of Lake Steam Boat Rock, the gneiss dips N. 75 E. < 25, and can be seen here and there all along to the head of the lake, whence we proceeded in a general south-western direction to a lake about three miles long at the head of Rivière Gros Castor Noir, where I left two men and proceeded down this stream to its mouth on the Mattawin River, which we ascended for about three miles and one-half, and returned to the above lake by a different route, having thus examined the principal lakes of both branches of Rivière Gros Castor Noir. The rocks are much twisted all along these lakes: they consist principally of reddish-brown and brown gneiss, forming high, bare mountains. From Gros Castor Noir lakes we travelled westward by a chain of lakes and portage roads to

the waters of Rivière Pins Rouges, which we descended to its mouth and along which the gneiss is highly felspathic and quartzose and exhibits an occasional low dip to N. 40 W. From the mouth of Rivière Pins Rouges we ascended the Mattawin River to the foot of Rapide des Aigles and from there started through the woods with two men to go to Rivière des Aigles with the intention of ascending it as far as the small lake which we reached before from the sharp bend of Rivière à la Chienne. But unfortunately my guide cut his knee badly with an axe whilst making his way through a very bad swamp near the first lake on Rivière des Aigles, and this necessitated a change in our plans as the poor fellow could not move for several days. As soon as he could walk a little we marched back to Mattawin River, which we descended to the mouth of Rivière des Ours, where the other two men were awaiting us. Near the lake where the above accident happened, the reddish gneiss becomes much more quartzose and holds large veins and numerous patches of almost pure quartz mixed with very little pinkish or reddish felspar. This gneiss dips S. 40 to 45 W., and as far as I could see extends northward to the limit of our exploration and undoubtedly much further. As far as observed it contains less iron and mica than the gneisses to the south of the Mattawin River, although small quantities of magnetite are disseminated through it in many places.

" We ascended la Rivière des Ours by a series of portages and lakes to its upper waters, whence we crossed to Lac des Iles on the Shawenegan River. In all this distance, about fifteen miles, the rocks consist of gneisses varying very much in the relative proportions of quartz, hornblende, felspar and mica in their composition. At times they are highly quartzose and at others micaceous and hornblendic. In places they are much jointed and twisted and are cut in all directions by veins of felspar and bluish quartz. In a few places their dip is very distinct at an angle of about 20° to the south-westward. At the outlet of Lac Pinz Gonke we took a fresh supply of provisions, and went to Lac à la Coureuse, which is about four miles and one-half from Lac Pinz Gonke in a south-western direction. The rocks between these two lakes consist mostly of brownish quartzose gneiss with thin garnetiferous bands and lenticular hornblendic patches. A short distance north of Lac de la Coureuse they form a small anticlinal, south of which the gneiss is much twisted and folded and holds much quartz and garnet. From Lac à la Coureuse we went to Lac à l'Eau Claire all around which the reddish coarse syenite of St. Didace is exposed. This rock was traced all along the outlet of Lac à l'Eau Claire to Rivière du Loup which we descended to St. Alexis, from which place we returned to Joliette, where we arrived on the 16th of August.

Between the 18th of August and the 26th September, the World's Fair at Chicago was visited to examine the geological, mining and mineral exhibits there and thus acquire information which could not fail to be of value in prosecuting my geological work in Canada.

"From the 26th of September to the close of the season I examined the Palæozoic rocks on l'Assomption River and also the country around the village of St. Gabriel de Brandon, St. Félix de Valois and St. Damien, in order to limit certain small areas of a very highly greenish-gray quartzose massive rock, somewhat analogous to that seen on Rivière du Loup, a short distance south of the outlet of Lac à l'Eau Claire and not far from the contact of the St. Didace syenite area. This rock, as far as I could make out, must be a highly metamorphosed portion of the brownish gneiss of the district, this metamorphism being connected with the anorthosite intrusions of St. Damien.

"From the 9th to the 29th of October, I was engaged in examining the most easterly portion of my field from St. Barthélemi in Maskinongé county as far as St. Etienne in St. Maurice county. At St. Barthélemi village there are ledges of dark gray bituminous and fossiliferous Trenton limestone lying nearly flat; but there, as well as on the Chicot River, south of St. Cuthbert village, the extension of such rocks could not be traced on account of the heavy drift deposits. No outcrops of Palæozoic rocks were seen north of St. Justin village nor on the roads north of Ste. Ursule and south of St. Paulin. From Hunterstown to St. Elie and near the former place there are loose pieces of brown weathering crystalline limestone which probably come from the four-foot bed which is interstratified with the gneiss at the falls on Rivière du Loup. About St. Elie the rocks consist of grayish and brownish gneiss much twisted in places and holding quartzose bands in which garnet occurs in small bunches. This gneiss extends about four miles south.

"On Yamachiche River, and about two miles east of St. Barnabé village, ledges of gray bituminous Trenton limestone occur in horizontal beds varying from six inches to two feet in thickness. The banks of Yamachiche River vary in height from thirty to sixty feet, and are mostly composed of clay. On the road from St. Barnabé to Shawenegan or St. Boniface the rocks consist of gneiss which in one place holds impure greenish, gray limestone, full of mica, hornblende, tourmaline, etc.

"The superficial deposits south of the Laurentian hills in this area consist mostly of sand often highly coloured with iron ochre. About seventeen years ago an iron ore deposit was worked on range VII. of Shawenegan, but as the results did not prove to be satisfactory the works were soon abandoned. Iron ore occurs in many places south of

the Mattawin River, in the northern portion of Berthier, Maskinongé and St. Maurice counties, but where seen it is in small quantity and disseminated in small veins and bands of quartz felspar rock.

"Two deposits of infusorial earth occur in that portion of the province I have explored; one in the concession Trompe Souris of the parish of St. Justin, where it occurs in small quantity at a few feet below the surface in a sand bank sixty to seventy feet high near a small ravine. The other deposit which has an area of three to four square acres and a thickness of about eighteen inches is on lot 15, range V. of Chertsey; it occurs at the bottom of a marshy bay of Lac Michel.

"A few years ago in boring artesian wells near the villages of St. Justin and St. Barthélemi natural gas was met with at depths varying from sixty to eighty feet, but nowhere in sufficient quantity to be of any practical value.

"The Canada Iron Furnace Company of Radnor has raised iron ore all summer in several parishes of Joliette county, where excellent deposits are found; and this fall the company will ship about 200 carloads of ore from this locality to their works at Radnor.

"On the 3rd of November I went down to Quebec to get copies of plans of new surveys and returned to Ottawa on the 16th of the same month."

The cost of the season's exploration was $971.13.

The work and investigations in connection with the survey of the superficial deposits was continued in New Brunswick and in part of Nova Scotia and Prince Edward Island by Mr. Chalmers who has ably conducted this investigation for several years.

In relation to this work, its value and uses, I cannot do better than quote the words of Sir Archibald Geikie, the Director General of the British Geological Survey, who says :—

"The survey of the superficial deposits thus combines a wealth of geological interest with a great deal of practical value. The geologist may find in it the solution of some problems and the presentation of many more. While the farmer, the water engineer, the builder, and the sanitary inspector may each in turn gain some practical information from it for their guidance."* As regards Canada, the lumberman may well be added to the list.

On the progress of the work during 1893, Mr. Chalmers furnishes the following interesting report :—

"After my return from the field operations of 1892 in New Brunswick, Mr. Wilson, my assistant, and I spent the winter in the office at

* Paper read before the Federated Institution of Mining Engineers, 2nd June, 1893.

our usual work. This consisted in arranging and compiling the data collected during the previous summer and laying it down on the maps (sheets No. 2 S.E., No. 4 N.W. and No. 5 S.W. of the New Brunswick series), the latter work being done chiefly by Mr. Wilson. A report on the surface geology of the area embraced in these sheets was also partially prepared, but it was found that a number of subjects required further study, especially as some intricate problems were presented for solution. Accordingly, it was thought desirable to continue the work another season before publishing the results, thus enabling us to re-examine some of these doubtful points and also finish the mapping of sheet No. 5 S.W., which includes a portion of Prince Edward Island.

"We left Ottawa on the 16th of May with the object of completing the work just outlined, and continuing the explorations in central New Brunswick on sheets No. 1 N.W. and No. 2 S.W., which had been commenced in the season of 1892.

"Investigations were first undertaken in Prince Edward Island in the area embraced in sheet No. 5 S.W. Here a very careful examination of the glacial phenomena, superficial deposits, agricultural character and forest growth was made, and a cursory survey of other portions of the island attempted with the view of obtaining the main facts relating to the surface geology. All the roads were travelled over and the greater part of the coast explored. The elevation of the country, more especially of the ridges and hills, was measured with aneroids, the readings being based on the level of the Meteorological station at Charlottetown, on the profile heights of the Prince Edward Island railway, and on tide marks along the coast.

"No evidence of Pleistocene ice having moved across the island from north to south was observed; on the contrary, the chief ice movement seemed to have been from west to east, but numerous local and divergent courses of striæ were seen trending in other directions. While thus engaged in studying the surface geology of this island, other places around the great south-western embayment of the Gulf of St. Lawrence were visited for the purpose of collecting all the facts available bearing on the questions under discussion. In the early part of July, a few days were spent at Gaspé and other points in the Baie des Chaleurs and Miramichi districts, while Mr. Wilson was left to prosecute the work in Prince Edward Island. In Gaspé Basin and at Cape Gaspé some important facts relating to the glaciation and Pleistocene changes of level were discovered. No evidence of southward moving ice was, however, found.

"On my return to Prince Edward Island, on the 18th of July, Mr. Wilson and I proceeded to the west coast, where Pleistocene fossils

occur in Leda clay or Saxicava sand. At Miminigash, a few specimens were collected at a height of twenty to twenty-five feet above the sea, and others were obtained from Leda clay or Saxicava sand at Campbellton and Cape Egmont. Sections of these fossiliferous deposits were measured and their elevation above the present sea level carefully noted.

"In the vicinity of Cape Wolf, two remarkably well defined Pleistocene shore lines occur, the heights of which were levelled with our aneroids as carefully as possible. These were traced all around the coast of Prince Edward Island.

"The result of our investigations thus far, regarding shore lines, tends to show that the Pleistocene uplift was less in Prince Edward Island than on the adjacent mainland of New Brunswick and Nova Scotia, but this is, perhaps, after all, only apparent, as the difference may be due, partly at least, to the fact that subsequent subsidence in the recent or prehistoric period was greater there. In the isthmus of Chignecto this subsidence seems to have been about eighty feet.

"On the completion of our work in Prince Edward Island, on the 4th of August, we proceeded to Cumberland county, N.S., to re-examine some doubtful points in the surface geology of the coast district bordering the Straits of Northumberland. This investigation occupied our time a week or more, after which Mr. Wilson went to York county, N.B., to continue the survey and mapping on sheets No. 1 N.W., and No. 2 S.W., which has been in progress during the last two years. On the 14th of August, I took steamer at Pictou, N.S., for the Magdalen Islands, my object being to see how the surface geology there compared with that of Prince Edward Island and the mainland. From the 15th to the 24th of August, I was on these islands and, although the weather was very unfavourable, I nevertheless succeeded in making an examination of the principal features of the Pleistocene on four of the largest of them, viz., Amherst, Entry, Grindstone and Allright. The facts obtained are of great interest and will be given in detail in my forthcoming report. No striation or boulder-clay was observed, and the surface of the solid rocks everywhere, so far as my investigations extended, is covered with rotten rock. Well marked shore lines, somewhat higher than those of Prince Edward Island, were noted. The conical-shaped hills, denuded of forest, which rise above them, seem in strange contrast to those of glaciated countries. There is a remarkable development of dunes of white sand fringing the islands and connecting some of the larger ones.

"On returning to the mainland, an examination of the reported gold-bearing deposits at Memramcook, N.B., was made. The Lower Carboni-

ferous here, in which traces of gold are said to occur, is much disturbed, the strata dipping to the east at a high angle. Bosses of granite, dolerite, etc., protrude through it, and the beds in the vicinity of these are considerably altered and contain seams of quartz, calcite, etc. Upon the upturned edges of the Lower Carboniferous lies the Millstone-grit nearly horizontally. It is in the conglomerates of the latter that a gold mine is now being opened up. A 50-stamp crushing mill has been erected, and operations are in progress. I was informed that each ton of rock yielded from $1.75 to $2 worth of gold.

"In the early part of September some days were spent in photographing striæ, shore lines, boulder clay banks, etc., in different parts of Eastern New Brunswick. The weather being favourable, a number of excellent views were taken, which exhibit new and remarkable phenomena.

"A further exploration of the coal seam in eastern Gloucester, near Caraquette, was made, as it was reported to me that new pits had been opened during the winter of 1892–93. These were, however, found to be partially filled with water and debris at the time of my visit, so that nothing was discovered to further elucidate the question of the thickness or quantity of coal.

"On the 20th of September, Mr. Wilson and I levelled the height of certain wellmarked Pleistocene shore lines in the vicinity of St. John, N.B. The highest of these stands, at present, 225 feet above mean tide level. We also made another examination of the boulder-clay bank on the west side of the harbour of St. John (described in Annual Report Geol. Surv. Can., vol. IV., 1888–89; Bulletin Geol. Soc. of America, vol. IV.), as the heavy storms of August had caused landslips and exposed fresh surfaces. Additional marine shells were collected from the boulder-clay.

"As some questions relating to the surface geology of the western part of the Cobequid Mountains seemed to require further elucidation, I proceeded thither on the 26th of September to re-examine the district. The glacial striæ on both sides of the range were noted, the heights of several shore lines measured, and some time was spent in re-examining the so-called "Boar's Back"—a kame stretching along River Hebert. Several features not hitherto observed in it were studied, and it now appears as if our views regarding this kame will have to be modified to some extent.

"From the 10th till the 28th of October, I was, with the permission of the Minister of the Interior, and yourself, absent attending the Columbian Exposition at Chicago.

"Mr. Wilson was engaged studying the surface geology and mapping the deposits, forest growth, etc., of York county, N.B., under

my supervision, from the 19th of August till the close of field work, except a few days during which he assisted me in levelling shore lines, copying profile heights at the Canadian Pacific Railway office, St. John, N.B., and barometric readings at the meteorological stations at Charlottetown, P.E.I., and Fredericton, N.B. He also spent two days at Halifax in ascertaining the difference between the Intercolonial Railway datum and tide level there.

"Considerable progress has now been made in the survey and mapping in York county (sheet No. 1 N.W.). The surface geology of this area was reported on by me in 1884 (Report of Progress, Geol. Survey Can., 1882-83-84), but little or nothing was done in delineating the deposits on the map. This work has, however, been in progress during the last two seasons.

"After my return from Chicago, I proceeded to Amherst, N.S., to examine the profiles of the Chignecto Marine Railway, at the office of H. G. C. Ketchum, engineer in charge. These profiles afford valuable information respecting the tidal oscillations at the head of the Bay of Fundy and at Baie Verte, in the Straits of Northumberland. To obtain the levels of the Intercolonial Railway in Nova Scotia, the profiles of that line were examined at the railway office, Moncton, through the courtesy of P. S. Archibald, chief engineer, and his assistant, W. B. McKenzie, C.E. Joseph Unsworth, superintendent of the Prince Edward Island Railway, kindly furnished me with the profile heights of the line under his charge. These and other matters occupied our time till the close of field work.

"The agricultural character of the areas explored may be briefly referred to. Prince Edward Island has long been noted for the fertility of its soil. More land fit for cultivation is found there, within a given area, than in any other part of the Maritime Provinces. It yields all kinds of grain and vegetables in profusion, and is especially suited to the production of oats, potatoes, etc. In Cumberland county, N.S., excellent farms were seen along the Straits of Northumberland, and also around the different arms or inlets of the Bay of Fundy. The Maccan River valley may be referred to as an example of a good farming district; and along River Hebert valley there are also some fertile areas.

"The agricultural capabilities of that part of York county, N.B., explored during the past two seasons was described in my report on the surface geology of Western New Brunswick already referred to.

"The forest growth of Prince Edward Island is for the most part, original, especially in Prince county, in the north-west, but the timber trees have been largely cut away. Queen's county in the central part is almost entirely denuded of forest covering and whatever remains

is of mixed growth. The lumbering business has consequently declined on the island.

"The minerals and materials of economic importance observed during the season may be briefly mentioned.

"Peat bogs are extensively developed in the north-eastern part of Prince county, Prince Edward Island, in the vicinity of Richmond and Cascumpeque Bays. They are described in Dawson and Harrington's report, printed under the authority of the Prince Edward Island Government in 1871.

"Brick-yards with kilns in operation were seen at Bloomfield station, also near Indian Point on the south side of Bedeque Bay, and a third small one near Cape Egmont.

"At Marysville, York county, N.B., an extensive brick-yard has been operated by Alex. Gibson for a number of years.

"The large deposits of bog iron ore at Maugerville, N.B., were described in my report already cited (Report of Progress, Geol. Sur. Can., 1882-83-84).

"The field investigations and mapping of the surface geology and forest growth of the three sheets 2 N.E., 4 N.W. and 5 S.W., of Eastern New Brunswick, North-western Nova Scotia and a portion of Prince Edward Island have now been brought to a close, and the preparation of these maps for the engraver will be completed at as early a date as possible. A detailed report to accompany them, which is already partly written, will now be finished.

"Mr. Wilson returned to Ottawa on the 17th of November and I on the 18th."

The cost of the season's explorations was $1,193.93.

During the past year Mr. Faribault continued and extended the work of previous seasons connected with the detailed examination and mapping of the structural geology of the gold-bearing and associated rocks of the Atlantic coast of Nova Scotia. On this work he furnishes the following summary report:—

"According to your instructions, all the time at my disposal was devoted to the further careful study of the Cambrian rocks of the Atlantic coast of Nova Scotia and to the gold-bearing quartz veins which cut them.

"After the close of the field operations of 1892, the winter months, from the 1st of January until the 25th of May, were chiefly occupied compiling the map of the area examined. This work included the plotting of the instrumental surveys made during the summer, the revising of plotting done by the assistants, the reduction of plans from the Admiralty charts, the Crown Lands Department and other sources;

the compiling and adjustment of these various surveys on the projection prepared by Mr. Scott Barlow on the scale of one mile to one inch, the laying down of the geological boundaries and other data gathered in the field, and finally, the study of the geology of the region which had been examined during the summer and the working out of the structure and relations of the numerous folds in these gold-bearing rocks.

"A great deal of time was also taken up preparing the manuscript maps of the county of Guysborough for the engravers, and correcting proofs of sheets Nos. 25, 26, 27 and 28 of the eastern part of the same county.

"Besides the principal work of the winter months above mentioned, a certain amount of time was taken up preparing a summary report, making a statement of expenditure in connection with field work, answering inquiries for information and preparing field maps, etc., for the following season's operations.

"From the 25th of May till the 9th of June, fifteen days, were spent, with your permission, at the Columbian Exhibition, to study the mining, mineral and geological exhibits gathered there from all nations.

"I left Ottawa on the 9th of June, for Nova Scotia to commence the season's field work. This was for the most part of a purely geological character. The first month and a half, however, was spent making a topographical survey of the country, lying west of that surveyed in 1890, and south of that surveyed in 1891. This extends from the west side of Bedford Basin and Halifax Harbour to Margaret's Bay and Hammond's Plains, comprising an area of some 200 square miles.

"The southern, and greater part of this area is occupied by a mass of granite. On its northern boundary it comes in contact with the Lower Cambrian auriferous rocks, along a line lying half way between the Margaret's Bay post road and the Hammond's Plains road; it extends eastward to Halifax Harbour, southward to the Atlantic and westward to Margaret's Bay. Apart from the granite quarries in the vicinity of Halifax Harbour, this area of granite is not of economic importance, and it was but hastily examined. In order to complete the Halifax sheet, however, a detailed topographical survey was made and the line of contact between the granite and the Lower Cambrian rocks was carefully traced.

"These latter lying north and east of the granite and extending northward to Hammond's Plains and a few miles east of Bedford Basin, were minutely surveyed and the plications of the strata carefully studied. The only anticlinal fold of importance is that passing through

the middle of Birch Cove, where its broad dome dipping westerly at an angle of 25°, is well exhibited along the shore of Bedford Basin. The auriferous quartz veins, partially prospected a few years ago, at Prince's Lodge, are situated on the north slope of this fold, and the many quartz veins met with about Birch Cove and westward along the anticline, as far as the granite mass, are certainly worth prospecting. About one mile inland on the eastern shore of Bedford Basin, along the prolongation of this anticline passing the north end of Navy Island, some mineralized barrel-quartz veins of good appearance were met with.

"The latter part of the season was devoted to the work of re-examining the gold-bearing rocks of the eastern part of the province, comprised between the rivers of St. Mary's, Musquodoboit and Stewiacke and the Atlantic coast, an area of some 300 square miles in the county of Guysborough, 900 square miles in the county of Halifax and 75 square miles in the county of Colchester. This was done in order to complete up to date the geological maps of that part of the province now in course of publication, and to study and locate with more accuracy and detail the nine or ten anticlinals into which the strata have been folded. The gold-mining districts of Cochrane Hill, Wine Harbour, Goldenville, Gegogan Harbour, Ecum Secum, Moosehead, Harrigan Cove, Salmon River, Ragged Falls, Fifteen Mile Stream, Killeag, Beaver Dam, Caribou, Moose River, Gold Lace, Mooseland, Tangier and South Branch of Stewiacke, are all situated along the anticlines. These were all visited and the new developments made since my last examination were noted. The anticlinal folds were followed along their course and the structure of each one carefully studied wherever possible, in order to locate any elevation of the axis forming a dome having the characteristic structure of a gold district. Several such domes were located, and their eastern or western dip will indicate the probable dip of the pay-streak of gold in the quartz veins.

"Numerous faults of more or less magnitude affecting the structure of these rocks were also located.

"Photographs of a few gold mines and of a number of auriferous quartz veins, some of them showing well the barrel-shape of the quartz, were taken.

"Field work closed on the 11th of December, and Ottawa was reached on the 14th of December.

"I was ably assisted for five months, as in previous years, by Messrs. Archibald Cameron and J. McG. Cruickshank.

"The expenditure on the season's explorations, including the salaries of two assistants and wages of one labourer and one cook, was about $1,597.92."

Part of the winter, after his return to Ottawa in January, 1893, was spent by Mr. Fletcher, assisted by Mr. D. J. V. Eaton, in plotting and revising plottings by Messrs. McLeod and McLean of the surveys described in the Summary Report for 1892, page 40, and in correcting proofs of Part P., published in May, 1893, of Annual Report, vol. V., 1889-90-91, but the greater part in reducing and compiling these surveys, as far west as Parrsboro', to a scale of one inch to a mile in extension of the sheets mentioned on page 61 of the Summary Report for 1892. Between the 25th of May and the 8th of June he was studying the exhibits at the World's Fair in Chicago.

The district examined by Mr. Fletcher in Nova Scotia in 1893 comprises the eastern portion of Hants county, bounded on the south by the gold-bearing rocks, on the east by the Shubenacadie River, on the north by Minas Basin, and on the west by the Avon River. It covers an area of about 600 square miles.

Some parts of the district are well cultivated, producing apples, wheat and other grains, hay and root crops for feeding stock and dairy cattle. Ship-building has been long the chief industry of the little villages along the shores and rivers, and lumbering is carried on to some extent in the woods. Large tracts are, however, barren and useless except for the strips of hay land along the sluggish streams, some of them formed by beaver dams, the remains of which are still to be seen, although the beaver is now extinct in Nova Scotia. Moss and peat cover the treeless bogs at the head of the Tomcod River and elsewhere.

Several largely worked quarries of gypsum, the manganese mines of Tennycape, Walton, Pembroke and Cheverie, and the iron mines of Selma and Goshen are situated within this district. At Five-mile River and at Walton there are beds of red manganiferous limestone, susceptible of a fine polish, which might be used for ornamental marble; and at several places beds of good building and grindstones have been quarried.

The geological formations include (Summary Report for 1890, page 40), Triassic, Carboniferous limestones and Devonian, also small areas of igneous rocks and a tongue of the Lower Cambrian or gold-bearing slates, veined with quartz, which extends from the district of Rawdon and the Gore to the Barr and Indian Road settlements, as already pointed out by Mr. Faribault. In many places the underlying rocks are concealed by deep accumulations of drift, sand and gravel. At the Gore courthouse, Cambrian slates show glacial striæ with a direction N. 43° E., a few N. 81° E. and others S. 67° E. A short distance to the eastward, the slates are rounded and channelled in the direction N. 68° E.; while further east, near the Barr settlement, the course is S. 79°

E., and on a road also in this neighbourhood S. 52° E. Boulders of syenite and altered rocks, resembling those from the Cobequid Hills, are very abundant in the valley of the Shubenacadie River and along the Kennetcook.

A large proportion of the Triassic, as at Economy, consists of very coarse conglomerate with a calcareous cement, "vuggs" of reddish compact calcite and veins of calcite and dogtoothspar sometimes four inches thick, interstratified with brick-red sandstone and lenticular beds of limestone, nearly horizontal or with a very low dip into Minas Basin along which they form a narrow fringe. At many points Devonian rocks project through the latter, and their jagged outline makes a fine contrast with the massive or roughly flaggy Triassic beds, which are rounded and carved into pretty caves and basins by the tides. At Tennycape River, the mouth of Cambridge Creek and on the west side of Conley's Brook, the ores of iron and manganese are found at these contacts of the Triassic and Devonian, but nowhere in workable quantity.

The Carboniferous limestone formation was greatly denuded before the deposition of the Triassic and is scarcely met with on the coast; but inland it occupies several important belts and outliers, the dip being generally low, and extensive outcrops of gypsum and limestone alternate with red and green or gray marls and sandstones. Along the Five-mile River, the contact of the lowest beds with the Devonian is well seen, the former being exposed in cliffs more than 100 feet high, with a northerly dip in the main river, while reddish and gray Devonian sandstones and shales are seen in the tributaries from the south. The lowest band, a red and gray concretionary limestone, is overlaid by a great thickness of gypsum in which, on the farm of Mr. Andrew Hayes, there is a celebrated cave, seventy-five feet wide and fifteen feet high near its mouth, which is somewhat obstructed by fallen blocks of gypsum; but at 350 feet in, the cave narrows considerably. The floor is rough with blocks of gypsum and several small ponds hold the water that drips from the roof. Among numerous smaller caves, those near Miller's Creek, Kempt Shore and Cheverie may be referred to as well as the pinnacles, natural bridges, pits and ponds with underground outlets so characteristic of the plaster-land. Strong saline springs issue from these rocks at Walton, Noel Road, Pembroke, the Barkmill road and other places. North of Cheverie Creek a cliff of gypseous marl comes against the Devonian without the intervention of the limestone, indicating apparently a fault, and is succeeded immediately by the gypsum of one of the quarries, among the fissures of which a small quantity of petroleum is found, which has been described by Professor Hind in a report on the district. South of the creek the first

rocks seen on the shore are Devonian, but on this side limestone is in place and has been worked for manganese ore. The gypsum in the neighbourhood of Enoch Rhines' seems to occupy a narrow basin in the Kennetcook River and the limestone and gypsum of Selma to be in broken patches among the Devonian. One of the most persistent belts is that which is mentioned above and which extends eastward along the Five-mile River for a great distance from its mouth westward. Next to the gypsum the most interesting member of this formation is the red basal limestone, along which the manganese ores are found. It is of considerable thickness, concretionary, brecciated, and associated in places with red conglomerate and grit.

Much of the district examined is occupied by plant-bearing Devonian rocks, similar to those of Union and Riversdale, Clifton (Old Barns), and Economy, with, however, a larger proportion of grit and coarse sandstone. They are well exposed at South Maitland on the Shubenacadie River, on Minas Basin, in the branches of Five-mile River from the south, in Sterling Brook, Mungo Brook, Tennycape River and other streams. They extend north from Noel Lake to the shore road and perhaps occupy a great part of the road from this lake to Kennetcook Corner. The boulders of pyrolusite, one of which is said to have weighed 400 pounds, found one mile north of the Corner, perhaps indicate a contact with the Carboniferous limestone now concealed by drift. In the upper branches of Glen Brook, a narrow belt of hard conglomerate, sandstone and shale separates the gold-bearing slates from the gypsum; gray and red sandstone occur in Robinson Brook east of Kennetcook Corner and in the little brooks west of the Gore court-house: these perhaps represent the Devonian rocks of Union and Tennycape, but require further examination. Rocks of the Riversdale series are met with at Indian Road and the Barr settlement, and near the head of one of the branches of Nine-mile River contain thin seams of coal or coaly shale. In Rocky Brook, near Maitland, an adit was driven into the bank and several shafts sunk, one of them forty feet, in these rocks, supposed because of their dark colour and the presence of fossil plants to yield coal. A shaft was also sunk, to a depth, it is said, of sixty-five or seventy feet, between two branches of Sterling Brook, in the hope of finding silver. The explorations for coal on the small seams found in proximity to gypsum and limestone along Kennetcook River are described in the Summary Report for 1889, page 30.

On the shore immediately north of Cheverie, massive, compact and fine grained igneous rocks, of limited extent, but great variety of colour and texture, cut red and dark gray Devonian slates and extend halfway to Split Rock. In a compact variety there are veins of white

crystalline quartz with an amethystine tint. Beneath the Carboniferous limestone of the hills of Kempt shore, large blocks of gray diorite are found which perhaps indicate this rock *in situ*. The south side of Minas Basin differs from the north in no respect more strikingly than in the absence of the large masses of syenite and diorite which compose the Cobequid Hills.

At Peter Stevens', on the shore road east of Noel River, a shaft, worked to a depth of thirty feet by a horse-whim, is said to have yielded a ton of crystalline pyrolusite from a crack or vein in whitish flinty, quartzose, Devonian sandstone. The manganese ore of Minasville (Moose Brook) and Bear Brook also belongs to that class of deposits which are not in the immediate vicinity of limestone, the ore being all in red Devonian quartzite and shales or from joints, veins and blotches, varying from a quarter of an inch to five inches in thickness and holding also crystals of calcite. Nearly all the other worked deposits of manganese, however, occur in or near the limestone described above, as lying at the base of the Carboniferous formation, the ore being near the top at Cheverie, at the bottom at Walton, and in thirty-seven feet near the bottom at Tennycape mines. These are the most largely operated mines in the district, and have produced, since 1861, about 3,000 tons of "the purest and most beautifully crystallized pyrolusite found in America." It has been sold at prices varying from $40 to $140 per ton, chiefly in the United States, for use in decolourizing glass and in chemical processes for which only the purest ore can be employed. A number of shafts and open cuts, the deepest about 170 feet, have been sunk and a tunnel driven to drain the mine to the lowest ground. The rock, a twisted, reddish, shaly or brecciated, dolomite, is sometimes separated by two to four inches of hard red clay from the Devonian sandstone or quartzite which forms the foot-wall or floor of the mine. The ore occurs in veins, strings, nodules and masses. One of the latter is said to have yielded a thousand tons, associated with calcite, selenite, barite and limonite, but in some places almost entirely free from foreign matter. It occupies the lines of jointing and bedding, breaks apart the fragments of the breccia and replaces the shale and limestone. The latter dips S. 20° E. at a variable angle beneath a mass of gypsum; it has been worked for about 200 yards on the strike and the whole distance tested is probably less than 500 yards. It has been again found, however, on the east side of Tennycape River and traced across the Faulkner and Hill lots upon which several shafts have been sunk in a reddish, gray and blackish, calc-veined, bituminous, more or less concretionary limestone, overlaid by gypsum and in contact with Devonian rocks, which contain a quantity of pyrolusite in veins, blotches and threads.

North of Tennycape mine is the Parker mine, from which in 1881 Mr. William Stephens took about thirty tons of excellent pyrolusite. It is at present leased by Mr. Gould Northup, who late in 1893 put up a small engine for pumping, and before the fall rains stopped the work, had taken about half a ton of ore from prospecting trenches in a disturbed limestone, which apparently forms a small outlier among Devonian rocks.

At the Shaw and Churchill mine on the west bank of Walton River, immediately above the bridge on the shore road, a large quantity of pyrolusite has been found in a small outlier of red and gray limestone, like that of Tennycape. This fills a hollow in red Devonian quartzite and shale, which projects around the opening in all directions. Large masses of ore of great beauty and purity have been taken out, and a magnificent display of it is made in the storehouse at the old plaster-mill.

Bearing apparently the same relation to the last-named deposit as the Tennycape mine does to the Parker mine, is the limestone from which the ore on lots owned by the Provincial Manganese Mining Company and by Messrs. Stephens and Davis was obtained. It continues from the workings on these lots to the bank of Walton River, south of the Shaw and Churchill mine, crosses the river to "Miner" Brown's tunnel and is seen in several later excavations among small veins of pyrolusite, it then passes eastward beneath the plaster of the Walton quarries and is perhaps continuous to Hibernia, where a quantity of ore was found in reddish calcareous grit, interstratified with concretionary limestone.

Openings have also been made on another outlier of limestone in the valley of Whale Creek, between the shore and the telephone road, upon the land of Mr. Willie Weir and Mrs. Timothy Parker.

About two miles west of Walton, at the Sturgis mine, now worked by the Provincial Manganese Mining Company, ore occurs in considerable quantity as strings, veins or films, or impregnating and staining large masses both of the limestone and of the underlying flinty sandstone, in both of which shafts have been sunk and tunnels driven. The dip of the limestone is variable and high.

To the westward, at the Tomlinson mine, the limestone has not been much prospected, but openings made in the reddish, greenish and gray quartzite immediately underlying have developed a large quantity of pyrolusite and hematite, sometimes mixed, sometimes in distinct masses.

At the Lantz mine several shallow pits have cut limestone dipping about S. 32° E., from which fine specimens of pyrolusite have been obtained.

Goshen iron mine is situated at the contact of this limestone with the Devonian, just as are those of Clifton, Selma, Brookfield and the East River of Pictou. Here a mixture of limonite, hematite, barite and calcite is found in a dark gray limestone dipping S. 12° E. < 15°. A tunnel was driven 530 feet, by Mr. Browne, from the low land south of the road, but only halfway to the ore cut by the deepest shaft.

Underlying the gypsum of the Cheverie quarries is a reddish and gray concretionary limestone, from which 200 or 300 tons of pyrolusite and manganite are said to have been shipped. The ores occur in plates and veins associated with calcite.

Bog manganese occurs near Goshen, south of Cheverie, at the head of Bass Creek and at other places.

Gypsum was at one time quarried at Pitch Brook, Green Oak, South Maitland and Selma. It is still largely exported from Walton, Cheverie and the widespread deposits of Newport township, the principal quarries being those of Wentworth.

An analysis of a sample from the quarry of Mr. William Stephens, of Tennycape, was made by Professor Kennedy, of King's College, Windsor, with the following result :—

Water	20·60
Oxide of iron, Fe_2O_3 } Alumina, Al_2O_3 }	·37
Sulphuric Acid, SO_3	46·51
Lime, CaO	32·52
	100·00
Insoluble matter	·44

This is excellent for farming purposes and for making cement, though it is not as white as the gypsum from Wentworth and Ellershouse.

An analysis of soft plaster from Cheverie is given by the same authority as follows :—

Water and oil	20·78
Carbonate of lime and magnesia	0·72
Sulphate of lime	78·50
	100·00

Cheverie hard plaster or anhydrite is much cheaper than gypsum; it cannot be manufactured into plaster of paris, and yields even for farming purposes slower results than the soft plaster, because less soluble in water.

Limestone quarries to supply local demand have been opened at Northfield, Glencoe, Whale Creek, Maitland, and other places.

Barite occurs in considerable quantity in veins in limestone at Walton and Pembroke.

Whetstones used for sharpening saws are reported from the quarries of gray sandstone at Scotch Village.

Brine springs and "Spa" springs are found near Hibernia, at Walton and on the west branch of Tennycape River, the last depositing a quantity of yellow ochre. A strong spring in Robinson Brook comes probably from the outlet underground of Long Lake which is in greatly broken plaster-land.

Mr. Fletcher was assisted during the summer by Messrs. M. H. McLeod, T. S. McLean and W. B. Almon.

The expenditure on the season's surveys and explorations, including the salaries of all assistants, was about $1,442.

Dr. Bailey, of Fredericton, assisted by Mr. W. H. Prest, has continued the explorations and surveys in south-western Nova Scotia. He reports as follows on the progress of this work :

"My attention was first directed to the completion of the investigations carried on in previous years in the counties of Queen's and Shelburne. This work included: 1, the more exact delimitation of the main granitic belt inclosing the Cambrian strata on the northern side, with the several smaller areas of granite which protrude through these strata at various points; and 2, the determination of the position, extent and structure of the various domes or anticlinal axes, so intimately connected with the question of gold mining, which mark the distribution of the Cambrian rocks. With this object in view, the entire coast region between Port Medway Harbour and Barrington was carefully examined by myself, as well as numerous islands which had not previously been visited; while at the same time an exploration of the interior was undertaken by Mr. Prest. This latter, owing to the nature of the country, and unusual drought, was a work of a peculiarly arduous character, but was successfully accomplished, including not only the accurate determination of the outline of the granite and the nature of the adjoining rocks, but also the location of the position, outlines and relations of the numerous lakes and streams found about the sources of the Port Medway, Liverpool, Roseway and Clyde rivers, with far more correctness than has ever previously been effected. In the same connection careful observations were made on the nature of the soils in the region explored, and upon the distribution of the forest trees. Finally, a detailed and measured section was made along the course of the Port Medway River from the granite

hills of Annapolis county to the Molega gold district, including a study of the structure of the latter, and of its relations to the adjoining gold districts of Pleasant River, North Brookfield and Whitebourne.

"The results of the above explorations have already been incorporated with those of previous years, in a report upon the geology of the counties named. The delineation of the geological boundaries only awaits the completion of a more accurate topographical map of south-western Nova Scotia.

"From Shelburne county our explorations were extended into that of Yarmouth, and the data needed for the completion of a report and map of the latter have also been obtained. Contrary to expectation only Cambrian and granite rocks were found, the former, though presenting some peculiar features as the result of local metamorphism, present a sequence in every respect like that of the same system in Queen's county.

"In Digby county also the prevailing rocks are either granitic or Cambrian and their relations were pretty fully worked out through the whole distance between Cape St. Mary and the vicinity of Annapolis. Here, however, there is, in addition to the groups referred to, a belt of fossiliferous rocks, such as those which have been long known at Nictaux, Clementsport and Bear River. It was thought probable that this belt might extend westward beyond Bear River to near Cape St. Mary, and it was actually traced nearly to the great bend of the Sissiboo River, south of Weymouth, but partly owing to increasing metamorphism, and partly to the depth of the drift covering, we were not able to determine its existence beyond this point.

"In connection with the exploration of Digby county some time was spent in the examination of the volcanic rocks and associated Triassic strata; collections were made, and sent to the museum, of various quartzose and zeolitic minerals as well as of iron ores from the trappean rocks which mainly constitute the peninsula of Digby neck and Long and Briar islands."

Chemistry and Mineralogy.

Reporting on the work of this division, Mr. Hoffmann says:—

"The work carried out in the chemical laboratory during the past year has, conformably with the practice of preceding years, been almost exclusively confined to the examination and analysis of such minerals, etc., etc., as were deemed likely to prove of more or less economic value and importance. Briefly summarized it embraced,—

"1. The examination of certain fuels, to wit, peat, lignites and coals.

"2. The analysis of natural waters—with the object of ascertaining their suitability for domestic or manufacturing purposes or probable value as a remedial agent—from respectively, the town of Joliette, Joliette county, Quebec; the township of McNab, Renfrew county, and township of Huntley, Carleton county, in Ontario; Moose Jaw in the district of Alberta, and Kamloops, in the province of British Columbia.

"3. The analysis, in regard to nickel contents, of ores from the townships of Eardley, in Ottawa county, Quebec; Hyman, in the district of Algoma; Dalhousie, in Lanark county; Somerville, in Victoria county, and Galway, in Peterborough county; also from the English River, in the district of Rainy River, and Jack-fish Lake, in the district of Thunder Bay, in the province of Ontario.

"4. The assay, for gold and silver, of ores from the provinces of Nova Scotia, Quebec, Ontario and British Columbia, and some localities in the North-west Territories.

"5. Analysis of iron ores from Annapolis and Cape Breton counties, Nova Scotia; the townships of Lutterworth, Minden and Snowdon, in Haliburton county; of Galway, in Peterborough county; and of Digby, in Victoria county; also from the district of Thunder Bay, in Ontario.

"6. The analysis of a series of marls—with special reference to their employment in the manufacture of hydraulic cement—from important deposits of this material occurring, respectively, at Marl Lake, island of Anticosti, Quebec; and in the townships of Lavant, in Lanark county; Sheffield, in Addington county; Reach, in Ontario county; and Rockwood, in Wellington county, in Ontario.

"7. The examination, and in some instances complete analysis, of several minerals not heretofore identified as occurring in Canada, certain of which constitute valuable and important metalliferous ores.

"8. Miscellaneous examinations. These include the examination, testing or analysis of brick and pottery clays, of limestones, silts and tufa, supposed to possess hydraulic properties, of some samples of bog manganese and disseminated graphite, and of other material not included under the above headings.

"The number of specimens received for identification or for the purpose of eliciting information in regard to their economic value, amounted to four hundred and sixty-three. Of these the greater number were brought by visitors, to whom the desired information was communicated at the time of their calling, or failing that—owing to a more than mere cursory examination being necessary, or when a partial or even complete analysis was considered desirable—was subsequently communicated by letter. The correspondence, chiefly in this

connection, called for the writing of two hundred and fifty letters, many of which constituted lengthy reports. The number of letters received amounted to one hundred and two.

"Mr. R. A. A. Johnston has assiduously, and in all respects most satisfactorily, carried out the work intrusted to him. Apart from a lengthy series of gold and silver assays, he has made complete analyses of many important and interesting minerals, and in addition conducted a great variety of miscellaneous work. Mr. F. G. Wait has been engaged in carrying out complete analyses of a series of marls, also in the partial or complete analysis of several natural waters, and has also made many miscellaneous examinations.

"In the work connected with the mineralogical section of the museum, I have been very ably assisted by Mr. R. L. Broadbent. He has readjusted the systematic collection of minerals, so as to allow of the introduction of species not previously represented, and also re-adjusted, in accordance with the arrangement adopted in the catalogue, the contents of certain of the cases containing the collection of economic minerals. He was further engaged in continuing the work of permanently labelling specimens already on exhibit, and in labelling and cataloguing recent additions to the collections. Further, he rendered valuable aid in assisting in the correction of proofs, at the time the catalogue of the mineralogical section of the museum was passing through the press.

"This catalogue, an octavo volume of two hundred and fifty-six pages, which was issued at the close of August last, will, it may be anticipated, prove serviceable not only to visitors to the museum, but also to those at a distance, conveying as it does a good general idea of the mineral resources of the Dominion. A revision of the "Annotated list of minerals occurring in Canada," has been entered upon and is in a fairly advanced state. This work has been rendered desirable on account of the many and important additions that can now be made to the former list.

"The additions to the mineralogical section of the museum consisted of:—

(*A*) The following specimens collected by members of the staff, and by Dr. F. D. Adams and Mr. Prest who were engaged in field-work in connection with the Survey:

1. Adams, F. D.:—

   Magnetite from the townships of Minden, Lutterworth and Snowdon, Haliburton county, and Digby, Victoria county, Ontario

2. Barlow, A. E. :—
   (*a*) Gersdorffite from lot 12, range III. of Denison, district of Algoma, Ontario.
   (*b*) Nickeliferous pyrrhotite from the Murray mine, lot 11, range V. of McKim, district of Nipissing, Ontario.
   (*c*) Pentlandite from the Worthington mine, lot 2, range II. of Drury, district of Algoma, Ontario.
   (*d*) Six specimens of perthite and ten specimens of amazon stone from lot 7, range B. of Cameron, district of Nipissing, Ontario.
3. Broadbent, R. L. :—
   (*a*) Shell marl from Hemlock (McKay's) Lake, near Beechwood cemetery, Gloucester, Carleton county, Ontario.
   (*b*) Eighteen specimens of argentiferous galena from lot 11, range IV. of Calumet, Pontiac county, Quebec.
   (*c*) Sixteen specimens of sphalerite from lot 10, range IV. of Calumet, Pontiac county, Quebec.
4. Giroux, N. J. :—
   (*a*) Beryl from De Maisonneuve, Berthier county, Quebec.
   (*b*) Iron-ochre from Rivière du Milieu, Maskinongé county, Quebec.
   (*c*) Infusorial earth from about two miles north of Chertsey village, Montcalm county, Quebec.
5. Prest, W. H. :—
   (*a*) Four specimens of selenite from near Elmsdale station, I. C. R., Hants county, Nova Scotia.
   (*b*) Twenty-nine specimens of Thomsonite, one of jaspar and one of apophyllite, all from Margaretsville, Annapolis county, Nova Scotia.
6. Selwyn, Dr. A. R. C. :—
   Bituminous sand rock from the south side of Egg Lake, south-west quarter of section 30, range XXV., township 56, west of the 4th initial meridian, district of Alberta, N.W.T.

(*B*) And the undermentioned presentations:

1. Barlow, Scott (Survey) :—
   Marl from concession IV., Rideau front, township of Gloucester, Carleton county, Ontario.
2. Brophy, G. P., Ottawa, Ont. :—
   Slab of limestone showing footprint, from Hull, Ottawa county, Quebec.
3. Caldwell, W. C., M.P.P., Lanark, Ont. :—
   Marl from lot 13, range IV., Lavant, Lanark county, Ontario.

4. Christie, P., Manchester, Ont. :—
   Marl from Chalk Lake, township of Reach, Ontario county, Ontario.
5. De Wolf, G., Vancouver, B.C. :—
   China-stone from Spatsum, district of Yale, British Columbia.
6. Garrioch, W. H. G., Hull, Que. :—
   Concretionary nodule from Front Street drain, Hull, Ottawa county, Quebec.
7. Hammersley, A. S., Vancouver, B.C. :—
   Roofing slate from the Jervis Inlet slate quarry, Jervis Inlet, British Columbia.
8. Haycock, E., Ottawa, Ont., per Dr. R. W. Ells (Survey) :—
   Phlogopite with pyroxene from lot 13, range XI. of Hull, Ottawa county, Quebec.
9. Hayes, F. B., Ottawa, Ont. :—
   Muscovite from Pied des Monts, Charlevoix county, Quebec.
10. Lewis, Wm., Holland's Mills, Que. :—
    Graphite from lots 11 and 12, range III. of Portland West, Ottawa county, Quebec.
11. Mather, J., Ottawa, Ont., per Dr. G. M. Dawson (Survey) :—
    Auriferous quartz from near portage from Wabigoon to Manitou Waters, district of Rainy River, Ontario.
12. Moffatt, James, Wakefield, Que. :—
    Tourmaline from Wakefield, Ottawa county, Quebec.
13. McWilliams, J. B., Peterborough, Ont. :—
    Pyrite and chalcopyrite from lot 30, range X. of Dummer, Peterborough county, Ontario.
14. Poole, H. S., Stellarton, N.S., per H. Fletcher (Survey) :—
    Stalagmitic mass from the Acadia Coal Mines, Pictou county, Nova Scotia.
15. Röminger, Dr. Charles, Ann Arbour, Mich., U.S. :—
    (*a*) Ten specimens of galena (crystals).
    (*b*) Galena inclosed in limestone of secondary origin subsequent to the shattering of the Sub-carboniferous flint ledges.
    (*c*) Three specimens of galena with blende.
    (*d*) Three specimens of ore-bearing breccia.
    (*e*) Ore-bearing breccia inclosing pieces of coal.
    (*f*) Blende with galena in a calcareous cement mass, ordinary mode of occurrence of the ore.
    (*g*) Three specimens of blende (crystals).
    (*h*) Ruby blende.

(*i*) Ruby blende with galena.
(*j*) Carbonate of zinc.
(*k*) Silicate of zinc.
(*l*) Two specimens of calcite (crystals).
(*m*) Porous silicious cement mass from which part of the inclosed blende crystals have been lixiviated by percolating fluids.
(*n*) Dolomite with blende and asphaltum.

Above are all from the Joplin mines, Missouri, U.S.

(*o*) Ore-bearing breccia, from Belleville, Missouri, U.S.
(*p*) Calcite with blende, from Webb City, Missouri, U.S.
(*q*) Two specimens of silicate of zinc, from Mosely mines, Newton county, Missouri, U.S.
(*r*) Ore-bearing breccia, from Mosely mines, Newton county, Missouri, U.S.
(*s*) Blende crystals imbedded in a soft calcareous mud, from the Spring City mines, Missouri, U.S.
(*t*) Carbonate of zinc, pseudomorph after calcite, from Aurora, Missouri, U.S.
(*u*) Silicate of zinc, from Aurora, Missouri, U.S.
(*v*) Blende, from Linden, Wisconsin, U.S.
(*w*) Two specimens of anglesite on galena, from Highland, Wisconsin, U.S.
(*x*) Blende, from Highland, Wisconsin, U.S.
(*y*) Blende with galena, from Mifflin, Wisconsin, U.S.
(*z*) Carbonate of zinc, from Mifflin, Wisconsin, U.S.
(*aa*) Carbonate of zinc, pseudomorph after calcite, from Benton, Wisconsin, U.S.
(*bb*) Carbonate of zinc, from Pigeon Creek, Wisconsin, U.S.
(*cc*) Carbonate of zinc, in fissures of Sub-carboniferous chert, from Cave Creek, Arkansas, U.S.
(*dd*) Carbonate of zinc, from Rush Creek mines, Arkansas, U.S.
(*ee*) Carbonate of zinc, in fissures of lower magnesian limestone from Rush Creek mine, Arkansas, U.S.
(*ff*) Carbonate of zinc, from Dubuque, Iowa, U.S.

16. Rutledge, J., Ottawa, Ont. :—
Muscovite from lot 16, range II. of Calvin, district of Nipissing, Ontario.

17. Selwyn, Admiral J. H., London, Eng. :—
Gilsonite from Utah, U.S.

18. Shaughnessy, F. G., Montreal, Que. :—
Polished cube of black limestone from the Château Frontenac, Quebec City, Quebec.

"Mr. C. W. Willimott was engaged in the early part of the year in arranging, cataloguing and packing the collection of minerals intended for exhibit at the World's Columbian Exposition. On the completion of this work he proceeded to Chicago to attend to the unpacking and assist in the instalment of the same. The duties assigned him called for his presence during the whole period that the exhibition was open. At the closing of the same he assisted in the repacking of the collection in question and further, by permission of the Commissioners for Ontario, British Columbia and Quebec, in selecting from the exhibits of these provinces such specimens as were considered desirable for the forthcoming Antwerp Exhibition. The packing of the whole of this material, which constituted over 300 cases, boxes and barrels, and the making out in duplicate of the necessary invoices and clearance papers for the United States customs, was attended to by Mr. Percy H. Selwyn, who having completed this work left Chicago on the 8th of December and arrived in Ottawa on the following day.

"Mr. Willimott returned from Chicago on the 25th of December.

Mr. W. F. Ferrier, lithologist, reports on the work of the past year as follows:—

"At the beginning of the year I was still engaged, assisted by Mr. Percy Selwyn, in the preparation of a preliminary list of the rock specimens in the drawers under the museum cases, but on the 18th of January, having received instructions to prepare a stratigraphical collection of Canadian rocks for exhibition at the Chicago World's Fair, work on this list was, for the time being, discontinued, and the Chicago collection at once commenced.

"My time was fully occupied until the 3rd of April in this work, and I was ably and energetically assisted by Mr. Percy Selwyn in preparing a manuscript catalogue of the specimens. The preparation of this collection involved the selection, trimming, labelling, naming, arranging and cataloguing of 1,500 specimens of rocks, illustrating all the geological formations known to occur in the Dominion of Canada, from the Laurentian to the Pleistocene.

"After the collection had been shipped to Chicago it was decided to print the manuscript catalogue which accompanied it, and the greater portion of my time for about a month was occupied in the necessary rearrangement of manuscript and in proof-reading. It was published under the title:—'Catalogue of a Stratigraphical Collection of Canadian Rocks prepared for the World's Columbian Exposition, Chicago, 1893.' It forms a royal octavo pamphlet of 150 pages. Three thousand copies were printed and many were distributed at Chicago to those interested. Copies were also sent to all institutions and individuals on

this department's list of exchanges, and the remaining copies will be available for use here, as it is intended to place the collection in the Museum, now that it has been returned from Chicago.

"My acknowledgments to my colleagues on the Geological Survey for their hearty co-operation and assistance have already been expressed in the preface to the above mentioned catalogue, and I take this opportunity of repeating them. Owing to the short time at my disposal, much work after office hours was necessitated, and these gentlemen did everything in their power to aid me, several of them kindly volunteering to work in the evenings at the museum.

"Several letters have been received from well-known scientists abroad, and handed to you, referring to the information they had derived regarding the rocks of Canada from a study of the collection, and in two cases asking that samples and drawings of the labels, cases, and other museum appliances used by this Survey, be supplied them, as they had decided to adopt the same in the institutions which they represented.

"Although so much of my time has been taken up this past year by the work above referred to; good progress has been made in the microscopical study of the Archæan rocks collected by Messrs. A. E. Barlow, E. D. Ingall and J. B. Tyrrell, and it is hoped to have the reports on these completed at an early date.

"Some fifteen thin sections of rocks have been examined for Dr. Dawson and reported on, and microscopic examinations of a large number of British Columbia rocks have from time to time been made for him. The total number of thin sections of rocks prepared and received during the year was twenty-seven, but in addition to these, 102 specimens were sent to Germany, and nine to the United States to have thin sections prepared from them. These have not yet been received.

"Two thin sections and a hand specimen of an interesting olivine-pyroxene rock, Harzburgite, were purchased in Germany for comparison with a similar rock, collected by Dr. Dawson in British Columbia. Of the specimens in the Chicago collection, ten were polished and four were slit to reduce their size or to show peculiarities of structure.

"Early in January, a collection of 115 thin sections of crystals of the more important rock-forming minerals, purchased from Messrs. Voigt & Hochgesang of Göttingen, Germany, was received, and has proved to be a most valuable addition to the equipment of the lithological laboratory.

"A large series of rocks collected by myself in 1891, from the Eastern Townships of Quebec, was carefully gone over, packed, and placed in store. As usual, a considerable amount of work of a miscellaneous

character has been done, including blowpipe determinations of various specimens submitted to me.

"On the 16th of September, in accordance with instructions received, I left for Chicago, remaining there until the 4th of October, during that period assisting and giving information to those who wished to study the mineralogical and lithological collections exhibited by this department, and also examining the foreign exhibits bearing on my own work. Since my return until the close of the year, my time has been mainly occupied in microscopical work. The specimens in the upright cases containing the stratigraphical collection of rocks were removed and packed carefully in boxes, this being rendered necessary by the extensive repairs which the museum is undergoing. Thirty official letters were received during the year and thirty-six written.

"Expenditure during the year, $130.25."

Mining and Mineral Statistics.

Of the work of the division of Mineral Statistics and Mines, Mr. E. D. Ingall, the officer in charge, gives the following particulars :

"From the date of the last summary (31st December, 1892), the office work of the division has been carried out as usual. The time of the staff was occupied in collecting and compiling statistics of the mineral production, and general information regarding the mineral resources of the country, as well as of mining operations and discovery, and in answering inquiries for such information and in office routine.

"In January, 1893, sickness necessitated my absence from duty. Thus the work necessarily fell greatly behind. On my return from sick leave in February, special and urgent work in connection with the preparation of the exhibits of views and maps for the World's Fair at Chicago, called for the co-operation of the whole staff of the division. Four large maps of the Dominion showing the distribution of the deposits of economic minerals were prepared. The localities were largely taken from the Directory of Mineral Occurrences, on which the staff of the division has been at work from time to time as other work allowed.

"These were represented on the map by means of a systematic series of conventional signs prepared by myself with your approval. The collections of rocks made by the various officers of the division were unpacked and gone over in order to select a representative series for addition to the systematic collection prepared for Chicago.

"This work having been disposed of, attention was directed to the annual report of the division for 1891, which would have been attended

to several months previously, but for the combination of circumstances above detailed.

"On the 13th of April, the Preliminary Summary of the Mineral Production of Canada, was completed, sent to press and distributed shortly afterwards.

"During the early part of the summer season, my whole time was taken up in putting the before-mentioned report through press, in proof-reading, etc., and in office routine work.

"From the 21st of June to the 3rd of July, I was in the Sudbury and Sault Ste. Marie districts, accompanied by Mr. H. N. Topley, directing the taking of photographs of the mines for our series of mining photographs and obtaining general information as to mining and mineral development in the district. Steps were taken which it is hoped will obviate the difficulties which have been experienced in the past in getting returns from some of these mines.

"The three chief operators in the Sudbury district, viz., the Canadian Copper Co., the Dominion Copper Co., and Messrs. H. H. Vivian & Co., were still, as in previous years, mining ore and shipping matte. The Travers mine was visited, but no underground work had been done there since the 1st of February, 1893, all the efforts being directed to completing and improving the surface works.

"Besides the nickel mines above named, two companies were operating on the gold-bearing veins of the district, viz., at the Creighton mine near Larchwood, west of Sudbury, on the Canadian Pacific Railway, and the Ophir mine near the Bruce mines, on the Algoma branch of the same railway. At both these mines underground exploratory work was in progress and mills were being erected for the extraction of the gold.

"On my return to the office, the proof-reading of the Report for 1891 was completed, the last forms having been signed for press on the 14th of August. I was then occupied at Chicago in connection with the 'World's Fair,' from the 24th of August to the 12th of September, whilst from the 18th of September to the 2nd of October my time was occupied in the field in connection with working out the distribution of the rocks of the area included in the lower or south sheet of the map illustrating the investigation of the River du Lièvre and Templeton phosphate districts, begun by myself, assisted by Mr. White. This work had to be done piecemeal as intervals occurred in the other work.

"Up to 1893 Mr. White had only assisted by carrying out the topographical surveys necessary to construct a map of the district whereon the results of the mining-geological investigations might be shown and in compiling the map in the office. In view, however, of his increasing interest and experience in geological work, I instructed him to move his

party to Ottawa county and endeavour to finish the tracing out of the distribution of the various lithological subdivisions constituting the Laurentian, of the district under investigation. Our work this season thus brings to a conclusion the field work for this investigation, but the office work necessary to work out and report upon the results of these observations yet remains to be completed.

'My time being very fully occupied with the work proper of the mining division, I had planned to work at the above during the evenings of last winter. The complete reversal of all my plans by sickness and family trouble last winter prevented this, and the arrears of the division work will have to take precedence. I still hope, however, that I shall find intervals which may be utilized in completing this work.

"The series of microscopic sections made from rock specimens collected are in the hands of Mr. Ferrier, the lithologist, for detailed examination. I found a little time in the spring to work with him at the sections, but since then the matter remains in abeyance.

"Mr. Brumell reports on his summer's work as follows:—

"'I left Ottawa on the 18th of June, going direct to Windsor, where inquiries were made regarding the boring operations going on in search of natural gas in Essex county. After visiting various points in the county I went to Ridgetown, where natural gas has been in use for some time. Here it was found that the whole town was being supplied from shallow wells in the vicinity, which afford large quantities of practically odourless surface gas, some wells affording as much as 5,000,000 cubic feet per day. There have been about 150 wells sunk, many of which are of course valueless, while about thirty of them produce largely. Those of greatest capacity are nearly all in the vicinity of the town and on the southern side, those to the northward affording the least flows. The record of one of the McMaster Bro's. wells is as follows, and may be taken as a fair index of most of those in the vicinity of the town:—

Surface soil	6 feet.
Gravel with water	23 do
Clay	57 do
Hard-pan	2 do
Fine white sand and gravel, with gas	

"'The hard-pan ranges from two to fourteen feet thick, beneath which is found the white sand and gravel to a depth of from six inches to thirteen feet and from which the gas is obtained. The wells are all "drive wells" of three and one-half inch pipe, and have an initial pressure as high as fourteen and a half pounds. About eight miles

of one, two and three inch mains with regulators, are laid throughout the town, and the gas is being used in all factories, and in many private residences, shops and hotels. This gas-bearing sand covers a large area, extending from Ridgetown to the south-west as far and perhaps further than Rondeau on Lake Erie. At Blenheim, a few miles west of Ridgetown, an effort was made to find deep-seated gas, and a well was sunk to the depth of 1,300 feet without success.

"'From Ridgetown I went to St. Thomas, where Mr. John Campbell had started a deep well in search of gas and had just succeeded in finding bed-rock (Hamilton shale) at 285 feet without encountering gas.

"'From St. Thomas I went to Petrolea, where I obtained considerable information regarding borings in different parts of the province as well as records of several wells sunk in past years. Thence I proceeded to London, Buffalo, Port Colborne and Hamilton, obtaining in all these places records of borings and general information regarding wells in the vicinity, as well as correcting the directory lists of mineral producers throughout the province.

"'On the 22nd of July I left my work to attend the World's Fair in Chicago, where I remained until the 1st of September, the length of my visit being necessitated through the absence of Mr. Willimott on urgent personal business.

"'I returned to Ottawa on the 5th of September, leaving again on the 11th in company with Mr. H. N. Topley, with whom I visited all the more important abandoned and operating mines in Hastings county, Mr. Topley making photographs of a number of them while I made such notes of their history and of general interest as were to be obtained. In this way we visited the Sexsmith, Richardson and Wallbridge mines in Madoc township, the Consolidated, Fiegle, Gladstone and Twenty acres mines in Marmora, the Carscallen and Ledyard gold mines, the Belmont, Bessemer Ore Company's mine and the Blairton mine in Belmont, as well as the lithographic stone quarry in Marmora township, the Emily mine in Tudor and the Coe Hill and Jenkins mines in Wollaston. Of these the only ones in operation were the Twenty acres, Carscallen and Ledyard gold mines and the lithographic stone quarry in Belmont and Marmora.

"'At the Twenty acres, lot 8, range VIII., Marmora, there are two inclined shafts sinking on the vein which is about two feet wide, dipping to the south-west at an angle of about 38° gradually flattening to about 22°. The vein has been followed to a depth of seventy-five feet in No. 1 shaft, showing good ore between clean walls the entire distance. The ore is composed of pyrite and mispickel in a gangue of quartz.

"'The Carscallen mine on lot 20, range I. of Belmont, owned and operated by the Moira Gold Mining Co., of New York, owing to an accident to the mill, was temporarily closed, at the time of our visit. It was expected, however, that operations would shortly be resumed. The works here consist of three shafts and two open cuts, one (the main shaft) being 132 feet deep and the Strickland shaft, the most easterly, thirty feet, while the O'Neil on a cross vein to the south of the Strickland, is about thirty-five feet. The main vein at the main shaft is about two feet wide, striking N. 80° W. with a slight dip to the south while at the Strickland the vein has widened to eight feet, dipping to the south at an angle of 68°. The vein at the O'Neil shaft is ill defined and from twenty to twenty-five feet wide, striking N.N.W., and dipping approximately vertically and affords about thirty per cent of good mill ore, well mineralized and rusty in appearance. The ore on this property appears to be but slightly arsenical. It consists almost entirely of pyrites carrying gold in a quartz gangue. The machinery in connection consists of one Blake's crusher and feed, two Crawford mills and plates, engine and boiler.

"'At the Ledyard gold mine on the east half of lot 19, range I., Belmont, exploratory work was being carried on, and consisted of an open cut about forty feet long in the end of which a shaft had been sunk thirty-five feet on the vein, which measured six feet in width at the surface, striking N. 65° E., and dipping to the south at an angle of 60°. The ore is quartz carrying pyrites, with a small proportion of mispickel and free gold. The free gold occurs more abundantly in the rotten honey-combed quartz and "gossan" on the surface. The work was being prosecuted by six men, and of the ore mined, thirty-seven tons had been hand-picked, barrelled and shipped.

"'The Ledyard Iron mine on the west half of the aforementioned lot is owned by the Belmont Bessemer Ore Co., and was at the time of our visit idle, the cuts and workings being full of water. The ore, of which about 500 tons were on the dump, consists of magnetite about fifty per cent of which is somewhat sulphurous. An assay of a lot of 100 tons sent to the Cambria Iron Co., showed the ore to contain :—

Iron, metallic	61·75 per cent.
Phosphorus	·023
Sulphur	Not given.
Silica	7·48

"'An assay of the above made by the producers showed sulphur to the extent of ·497 per cent.

"'A large boarding-house, stables and engine-house were erected at the mines and a roadway built to Marmora at a cost of $30,000, though no rails were laid.

"'A visit was made to the lithographic stone quarry, owned and operated by the North American Lithographic Stone and Asbestus Co., of New York, on lots 7 and 8 in range III., and 7 in range II. of Marmora. The quarry is situated on the south side of Crow Lake near the water's edge and covers an area of forty-five by 100 feet. In the development of the quarry five or six beds of good stone have been found, a few blocks of which have been planed and shipped, and the intention of the company is to ship all sizes from twelve by twenty to thirty-six by fifty-two inches.

"'The Crescent Gold Mining Co. own and, until quite recently, operated the Gladstone and Fiegle properties, consisting respectively of lots 17 and 16, range XI., Marmora. The operations consist of several open cuts and strippings and two shafts ninety and sixty feet each, cutting diagonally across the several stringers and leaders which go to make up the mass of vein-matter constituting the main ore body. The various veins opened up are said to have afforded some very rich stuff, more especially in the rotten and weathered portions over the surface. The mill and plant in connection with the mine are in first-class condition, and include one Blake crusher, ten stamps, two automatic feeds, two amalgamated plates and one improved Frue vanner, engine and boiler.

"'In Marmora village the Hastings Mining and Reduction Co., of Toronto, have erected and are now running a small custom mill, and state that very good results are being obtained. The mill is run by water-power and contains one Blake crusher, one Griffin mill, one Walker and Carter roaster, one amalgamator, three collecting pans, one settling pan, two arsenic condensers and drying floor. The company claims to have proved beyond doubt that the arsenical ores of the district can be successfully and profitably milled and if so the success achieved by this company should lead to the reopening of many of the promising gold veins of this district.

"'At Millbridge we obtained considerable historical information regarding the many lead and iron properties at one time operated in Tudor and Lake townships.

"'From Bancroft we took several short trips into Wollaston, Monteagle, Faraday and Herschel townships, visiting several deposits of phosphate and mica. Nothing has as yet been done beyond locating the various properties, on none of which, however, are the deposits of very great commercial value. The mica deposits visited were at L'Amable in Dungannon township and north of Bird Creek in Monteagle.

"'On the 29th of September Mr. Topley returned to Ottawa, while I went on to Toronto, where on the 4th of October I was joined by

Mr. L. L. Brophy of our staff, in company with whom I went to Essex county. We were engaged there in levelling and reducing to common datum most of the many wells sunk in search of natural gas, as well as in collecting all the information we could procure regarding boring operations. From this county we went *via* Ridgetown and St. Thomas to Welland county. We there obtained the levels of all wells in Bertie and Humberstone townships, as well as information regarding the distribution and occurrence of natural gas and petroleum in the Welland field. On the 14th of November, Mr. Brophy returned to Ottawa, while I continued my observations visiting Hamilton, St. Thomas, London, Windsor and Toronto.

"'At Hamilton the local company had struck small flows of gas in their second well at the depths of 400 and 500 feet, they were, however, but short lived. The first well was sunk to a depth of 1,950 feet at which point granite was struck; in the Trenton limestone at a depth of 1,830 feet a little flow of gas was noted.

"'At St. Thomas the boring had been carried to a depth of 1,640 feet, at which point the drill was in the Medina formation where a very small flow of gas was found. Work was suspended, but it was expected would very shortly be resumed and the boring carried to the Trenton formation.

"'I returned to Ottawa on the 24th of November, when I resumed my office duties.'

"Mr. White reports of his summer's work, as follows:—

"'I left Ottawa on the 28th of May for Chicago to study the mining and geological exhibits at the World's Fair, returning on the 15th of June. Mr. J. H. Featherston, B.Ap.Sc., had been instructed to commence the chaining required to correct the inaccurate surveys of some of the townships included in the area under examination. A compass and chain survey was carried northward from the village of Portland in Leeds county through Lanark to the village of Calabogie, in the southern part of Renfrew county, and another from Flower station in Lavant township, southward through part of Lanark and Frontenac counties, to Sharbot Lake junction. Mr. Featherston was engaged in this work from the 1st to the 22nd of June, when he joined Mr. White at Harrowsmith.

"'Mr. White then commenced a transit and chain survey to connect Sharbot Lake junction with the city of Kingston, as the latitude and longitude of the latter have been accurately determined. On the completion of this work, as it was deemed advisable to make a reconnaissance of the southern part of the district, the party was transferred to Perth, on the 1st of July, and a geological examination made of the

lakes and connecting streams of the Rideau Canal to the edge of the Cambro-Silurian rocks in the vicinity of Kingston. Side traverses were also made to some of the larger lakes in the vicinity of the Rideau waters.

"'Returning to Westport on the 21st of July, the chain of lakes extending from there to the Kingston and Pembroke Railway, viz., Sand, West Rideau, Bobbs, Eagle, Long and Sharbot Lakes were examined geologically. Four large granite masses and several smaller ones were found, notably one near the Chaffey and Matthew's iron mines in the townships of North and South Crosby, another between Eagle and Long Lakes in the townships of Hinchinbrook and Olden, and others in North Burgess and the central part of Storrington townships. The latter was observed by Mr. Alex. Murray in 1851, and supposed, by him, to occupy only a small area in and near the village of Battersea, where it is capped by the sandstones and limestones of the Cambrian and Cambro-Silurian formations. The investigations of last summer, however, showed that, emerging from under the fossiliferous formation, it extends about four miles to the north-eastward, occupying the country between Loughborough and Dog lakes.

"'The Eagle Lake mass of syenite was not fully delineated, but appears to occupy a large area in the western part of Hinchinbrook township, and it may possibly join the mass of the 'Red Mountains' in the adjoining township of Sheffield. Further exploration, however, will be required to decide this. The close proximity, usually from 100 to 200 yards, of iron deposits to these igneous masses has been well shown on Mr. Coste's map of the Madoc and Marmora mining district, hence the importance of delineating them, and thus giving the clue to further discoveries.

"'Numerous bands of crystalline limestone were traced, notably the great Dalhousie-Lanark band which was traced from its western termination in lot 22, con. XI. of Olden township, through Oso, Bathurst and Dalhousie to the Dalhousie-Lanark town line. From this point it extends in a north-easterly direction through the townships of Lanark and Ramsay, in the former of which it attains its maximum width of eight miles.'

"On the 18th of August it was decided to move to the Ottawa county, Quebec phosphate district, to complete the work on the south sheet of the map of that district. This was accordingly done and the work carried to completion.

"Mr. White returned to Ottawa on the 6th of October.

"During the greater part of the season he was ably assisted by Mr. J. H. Featherston, B.Ap.Sc., Mr. H. W. Mussen also acted as assistant from June the 22nd to Sept. the 13th.

"Since the return of the various members of the staff from the field their time has been occupied with the usual office work."

The expenditure on the field work of the division amounted to $2,401.11.

Palæontology and Zoology.

Mr. Whiteaves reports on the work in this branch as follows:

In the early part of the year he was engaged in a study of the gasteropoda of the Trenton limestone of Manitoba. The results of this study are embodied in a paper published in the 'Canadian Record of Science' for April last, in which fifteen species are identified and enumerated and one described and figured as new.

On the 23rd of May last it became his duty to deliver the presidential address before that section (Section IV.) of the Royal Society of Canada, which is devoted to the Geological and Biological Sciences. The topic selected for consideration on this occasion was 'The Cretaceous System in Canada.' The address consisted, first, of an exhaustive summary of the work that had been done by other labourers in this field of inquiry previous to the confederation of the provinces in 1867, and secondly, of a succinct epitome of the subsequent investigations, by members of the staff of the Survey and others, up to the present time, into the geographical distribution, stratigraphical relations, palæontology, and economic products of the Cretaceous rocks of Manitoba, the North-west Territories, the Rocky Mountain region, British Columbia, and the Yukon district. It makes a paper of seventeen pages quarto, which has since been published in the eleventh volume of Transactions of the Society, and separate copies have been widely distributed on this continent and in Europe.

On the 14th of July last, Mr. Weston was so fortunate as to discover two unusually large remarkable Unio-like shells in the productive Coal-measures at the South Joggins Coal field. A paper descriptive of these specimens, which are believed to represent a new and extinct genus of Unionidæ, for which the name *Asthenodonta* is proposed, was prepared and has since been published, with illustrations, in the eleventh volume of Transactions of the Royal Society of Canada.

The members of the Natural History Society of British Columbia have kindly forwarded, for examination and comparison, the whole of their collections of the fossils of the Cretaceous rocks of Vancouver and the Queen Charlotte Islands, and Dr. C. F. Newcombe has obligingly supplemented these by some additional specimens from rocks of the same age, collected by himself, in 1892, on the Comox River, V.I. Among the former are two new species of Ammonites from the Queen

Charlotte Islands. These Mr. Whiteaves has since described with an illustration in the October number of the 'Canadian Record of Science,' published in Montreal; and among the latter is a specimen of a new cycadaceous fruit which has recently been described by Sir J. W. Dawson. The types of the two new species of Ammonites, and four other fossils which gave some additional information about species that had previously been described, have now been presented to the museum of the Survey by the members of the Natural History Society of B.C., in return for a named series of other fossils from that province, and the remainder of their collection has been named and returned. The type of the new cycad fruit and a set of the most interesting fossils from the Comox River, have been presented to the museum of the Survey by Dr. Newcombe.

A paper entitled "Notes on some marine invertebrata from the coast of British Columbia" has been written for the 'Ottawa Naturalist,' and published in the December number of that periodical. The fourteen species referred to therein were collected by Dr. G. M. Dawson and Professor Macoun.

The second part of the third volume of the "Palæozoic Fossils" of Canada is intended to consist of a descriptive and illustrated report upon the fossils of the Guelph formation of Ontario. A considerable portion of the letter-press of this report has been written, and it is hoped that the whole of it will be ready for publication early in the spring of 1894. With a view to making the list of species as complete as possible, the writer spent a few days in the early part of September in collecting the fossils of the Guelph formation at Belwood and Elora, and succeeded in obtaining several specimens of unusual scientific interest at these localities.

In Zoology, one hundred birds and two mammals have been skilfully mounted by Mr. S. Herring, who has also performed the usual annual cleaning of the whole series of stuffed mammals and birds. Important and extensive collections of the recent vertebrata and marine invertebrata of the coast of British Columbia have recently been made by Professor Macoun, but these will be referred to in more detail in his report. Apart from these, the most interesting specimens added to the museum during the past year are a nearly complete skeleton of the Great Auk *(Plautus impennis)*, from Funk Island, presented by the Smithsonian Institute: a skeleton of an adult male fur seal *(Otaria ursina, Callorhinus ursinus)*, from Behring Island, presented by Mons. N. Grebnitzky in 1891; a mounted adult female of the same species, from the North Pacific; and a series of Alaskan birds, most of which were collected by Mr. J. M. Macoun. Among the latter are fine examples of the Aleutian and Prybiloff Sandpipers *(Tringa Couesii*

and T. ptilocnemis), the Emperor Goose *(Philacte canagica)*, Steller's Eider *(Eniconetta Stelleri)*, the Parroquet, Crested and Least Auk *(Cyclorhynchus psittaculus, Simorhynchus cristatellus,* and *S. pusillus)*. The bones of two or more individuals of Stellers Sea Cow *(Rhytina gigas)* from Behring Island, presented by Mons. Grebnitzky, in 1891, and referred to in a previous report, have recently been unpacked and are now on exhibition in the museum. They consist of one imperfect skull, six cervical and sixteen dorsal vertebræ, two scapulæ, two humeri, one ulna, two radii, one sternum and five ribs.

During part of the time that the director was absent from Ottawa, at the World's Fair, or on field work, the duties of acting director were performed by me, and, in addition to the correspondence entailed thereby; about 250 official letters have been received and about 164 written.

Mr. T. C. Weston reports that he spent most of the first three months of the year in preparing the following collections for exhibition at the World's Fair, at Chicago. 1. Two cases of specimens of *Eozoon Canadense*, from the Laurentian rocks of the Dominion. These consist of decalcified and other specimens, microscopic sections, microphotographs and drawings, all of which required much care in preparing. 2. One case illustrating the methods employed by the Survey in labelling and exhibiting geological specimens in the museum. 3. One case containing a series of specimens, neatly re-labelled and re-arranged, of native gold, or of models of gold nuggets from the Chaudière, etc. 4. A series of 150 hand specimens of the fossiliferous rocks of the Dominion, which were incorporated with the large stratigraphical collection.

Part of July and August was spent in field work in the provinces of Nova Scotia and Quebec. A large and interesting series of fossils, including the two large Uniolike shells already mentioned by Mr. Whiteaves, was obtained from the Carboniferous rocks of the South Joggins coast, and an important series of graptolites from the Cambro-Silurian shales at Point Lévis.

The remainder of his time, up to date, has been spent in museum work in the palæontological and ethnological branches, in preparing and labelling new specimens for exhibition in the cases, in making microscopical sections of rocks and fossils, and in developing and preparing specimens for study or exhibition.

Dr. Henry M. Ami reports that during the earlier months of the year he was engaged in selecting from among the Survey duplicates, naming and arranging a systematic collection of Canadian fossil remains

for the World's Columbian Exposition. This collection formed an attractive and instructive feature of the Canadian geological exhibit in the Mines and Mining building, and was without exception the largest and most comprehensive palæontological collection in that building, consisting, as it did, of 2,448 specimens of 597 species. In this work Dr. Ami was efficiently assisted by Mr. Harold B. Cushing, B.A. In connection with the collection of rocks Mr. Ami named 373 fossiliferous rock specimens, as is stated on page xiii of the catalogue mentioned, page 48 of the present report.

Classified and systematic lists of fossils from the following localities were prepared as follows:—

Bord à Plouffe, Que.; Grande Ligne Quarry; St. Martin's Junction, Que.; Ross's Quarry, Little Rideau, six miles east of Hawkesbury, Ont.; Murrays' Quarry, Ont.; Butler's Quarry, four miles west of L'Orignal, Ont.; Stone Fence (loose), a mile and a half west of L'Orignal, Ont.; Clarence Creek, near Rockland mills, county of Russell, Ont., collected by Drs. Ells and Deeks in 1891 and 1893.

Three collections of fossils, of Trenton and Chazy age, made by Mr. Lambe, 1891, at two quarries near L'Orignal and Hawkesbury, Ont.

Dudswell and Famine River collected by various officers of the Survey from 1860 to 1886. These indicate clearly and conclusively the occurrence of Devonian rocks along the Famine River, Que., as previously determined by Mr. Billings; *vide* page 428, Geology of Canada, 1863.

Seventy specimens from the Bear River beds, Nova Scotia, near great bend of the Sissibou River; from Mistake Settlement, county Digby, N.S.; and from the Nictaux iron ore beds, N.S., collected by Prof. Bailey in 1893 and by T. C. Weston in 1872.

Graptolites from Point Lévis, Que., collected by Mr. Weston in 1892.

For Sir Wm. Dawson:—Specimens from the Utica and Chazy formation—sent from the Peter Redpath Museum for identification. These include fossils from the Island of Montreal, Lake Memphremagog and Little Métis, Que.

Fossils from the Yamaska River, one mile and a half below mouth of Salvailles River, near St. Hyacinthe, Que., collected by Mr. Giroux in 1890, and from Rougemont and Rivière des Hurons, P.Q., collected by T. Curry in 1872.

Miscellaneous. Collections of fossils from Les Islets and Pte. aux Trembles, Que.; from Cobourg, Russell county, Ont., Lot 16, Con. II. made by J. Richardson, in 1853; from the Ottawa district in collections made by Dr. Ami at Hog's Back, Rockland, Hull, Ottawa and Gloucester, and a preliminary examination of fossils collected at various

localities in the counties of Hastings and Frontenac, Ont., by Mr. James White, C.E.

Two collections of coal plants from the Lower Carboniferous of Pictou county, N.S., and from the "conglomerates at the base of the Millstone Grit" of Middle River, both sent by Mr. H. S. Poole, F.G.S.

Fossils from the Albion Mines, Back Pits, Deep Coal Seam, Pictou, N.S., ironstone balls or nodules collected by Hugh Fletcher, 1892, also, fossil remains from West Advocate, Cumberland county, N.S., Hugh Fletcher, 1892.

Graptolites from near Hamilton, Ont., collected by Col. C. C. Grant, Hamilton, Ont.

Systematic lists of fossil remains for labelling specimens in the Museum from the Trenton of Manitoba, the Sillery of Little Metis, the Leda Clay of Green's Creek, etc., were prepared at various times.

Besides the World's Fair collection of fossils already mentioned, Dr. Ami selected and forwarded collections to the following institutions during the year.

Toronto University :—302 specimens comprising seventy-five species of Devonian fossils illustrating Mr. Whiteaves' memoir—"Contributions to Canadian Palæontology," vol. I., part 4.

Redpath Museum, Montreal :—Devonian fossils from Manitoba, to illustrate the same report.

Provincial Museum, Victoria, British Columbia :—Upwards of one hundred specimens of fossils, chiefly Cambrian and Cretaceous, from the province of British Columbia.

"Muséum Royal d'Histoire Naturelle de Belgique," Brussels, Belgium :—In exchange for two volumes of De Konick's illustrated folio monographs of the Carboniferous fossils of Belgium, 219 specimens of Devonian fossils, including 438 species.

Musée Rémy, Marceuil-le-Port (Marne), France :—Sixty-eight specimens of twenty-three species of Canadian fossils sent to the Rev. Dr. D'Orban, late of Montreal, Que.

A small series of Tertiary and Cretaceous ostracoda from Manitoba and the North-west Territories was sent to Professor T. Rupert Jones, who is the best living authority on these minute and obscure organisms, for examination and description.

A small collection of middle Cambrian fossils from the Rocky Mountain Park has been selected for Mr. J. Townsend, of Toronto, in exchange for Guelph fossils. A few type specimens were loaned to Mr. G. F. Matthew, of St. John, N.B. These have been returned, and in acknowledgment he has kindly presented to the Museum a series of Cambrian fossils from St. John City, New Brunswick.

Dr. Ami has prepared a scheme for cataloguing the Palæontological division of the Museum. He has also determined and classified, during the summer months, most of the Cambrian material from Mount Stephen and the Rocky Mountain region—besides a few fossils from the middle Cambrian of the Selkirk Range, near Donald, B.C. Of these, the best specimens have been placed in the Museum cases.

Mr. Lambe reports that copies of his first paper, on "Sponges from the Pacific Coast of Canada and Behring Sea," illustrated by four full sized plates, were distributed in the early part of February; this paper was published in the tenth volume of the 'Transactions' of the Royal Society of Canada, 1892, and was descriptive of the dried specimens in Dr. G. M. Dawson's (1885) collection.

During the first part of the year, until the middle of April, he was engaged in the preparation of a second paper, on a number of siliceous and calcareous sponges, collected by Dr. G. M. Dawson, in 1885, from the waters surrounding Vancouver Island and the Queen Charlotte Islands. The sponges that form the subject of this paper, entitled, "Sponges from the Pacific Coast of Canada," constitute the remaining portion of Dr. G. M. Dawson's, 1885, collection, and are for the most part preserved in alcohol. This paper, illustrated by three full sized plates, was read before the Royal Society in May last, and has since been published in the current volume of its 'Transactions'; copies of it were distributed during December, 1893.

During part of April and in May, June, July, and from the 23rd of October until nearly the close of the year, he had in course of preparation, and has now completed a paper on Atlantic recent marine sponges, illustrated by three plates, which he proposes to read before the Royal Society in May next. This paper is an attempt to make as complete a catalogue as possible of the marine sponges of the Atlantic coast of Canada and of the River and Gulf of St. Lawrence, with descriptions of such as appear to be new. With few exceptions the specimens were collected by Sir William Dawson at various dates since 1845, and by Mr. J. F. Whiteaves in 1867, 1869 and 1871-73. About thirty-two species in all are represented, of which four are calcareous, and the remainder are siliceous.

In July a very large collection of sponges, made by Dr. W. H. Dall in Behring Sea and adjacent waters, was received from the Smithsonian Institution, Washington, D. C. These specimens, preserved in alcohol and contained in about one hundred and twenty-five jars, bottles and vials, were kindly sent to Mr. Lambe, for purposes of study in connection with the sponges already in the possession of this department from the Pacific coast and Behring Sea. It is his intention to

make a careful study of this collection, and to report on it with as little delay as possible, describing and illustrating such forms as may appear to be new.

During part of August and in September and October, he devoted himself to a preliminary microscopic examination of it.

On the 3rd of December, the collection was supplemented by one hundred and seventy-nine dried specimens of sponges and a number preserved in alcohol, in fortyfive bottles, jars and vials; this includes not only the remainder of Mr. Dall's collection, but all the Alaskan sponges in the possession of the United States National Museum.

Mr. Lambe is greatly indebted to Professor Richard Rathbun, to Dr. Dall, and to the authorities of the United States National Museum at Washington for the opportunity thus afforded him of studying such an important collection of recent marine sponges.

During parts of March and July, he was engaged in assisting Mr. Whiteaves in ascertaining the septation of two ammonites from the Cretaceous rocks of the Queen Charlotte Islands, the characters of some fossils from the Guelph formation of Western Ontario, and of a large unio-like shell from the coal measures at the South Joggins, N.S. Drawings were prepared of these fossils illustrating papers by Mr. Whiteaves, mentioned in his report.

Between the 24th of August and the 29th of September, Mr. Lambe visited the World's Fair at Chicago, for the purpose of studying the exhibits bearing on his official work.

The number of official letters received by him during the past year was fifty-three, and the number written was thirty-four.

The following is a list of specimens collected by officers of the Survey during the past year :—

Dr. A. R. C. Selwyn :—

Nine specimens of fossiliferous shale holding ostracoda, from the boring at Calgary.

Fourteen specimens of Cretaceous (Pierre) fossils from the shore of Buffalo Lake, eighteen miles north of Moose Jaw, Section 17, Tp. 19, R. 26, Assiniboia.

Dr. G. M. Dawson :—

Mass of boulder clay, containing foraminifera and fragments of shells, collected at Middleton Island, Alaska, in 1892.

J. F. Whiteaves :—

About fifty specimens of fossils from the Guelph formation of Elora and Belwood, Ont.

Prof. Macoun :—

Large collection of the marine vertebrata and invertebrata of the coast of Vancouver Island, B. C.

About four hundred skins of birds and small mammals from Vancouver Island, B.C.

Dr. R. W. Ells :—

One hundred and fifty specimens of Trenton fossils from Clarence Creek, near Rockland Mills, county of Russell, Ont.

One hundred and thirty specimens of Post-Tertiary plants, marine fish and shells, from shore of Ottawa River, near Besserer's Grove and Green's Creek, Ontario.

J. B. Tyrrell :—

One hundred and seventy-eight fossils from Middle Rapids, and from two miles above Crooked Rapids, Athabasca River.

R. G. McConnell :—

About fifty specimens of fossil-plants from the Ominica and Finlay rivers, British Columbia.

Dr. H. M. Ami :—

About fifty specimens of Post-Tertiary fossils from Graham's clay-pits and brickyard, Ottawa East.

About fifty specimens of Trenton fossils from the new Rockland Quarries, in the county of Russell, Ont., and twenty from the Chazy and Potsdam formations of the same place.

A. E. Barlow :—

Between five hundred and six hundred specimens of Silurian fossils, from the Isle of Man, Lake Temiscaming, Que.

T. C. Weston :—

Fifty Carboniferous fossils from South Joggins, Nova Scotia.

Seventy-five specimens of graptolites in shales, Point Lévis, Que.

D. B. Dowling :—

Skin of three-year old Moose from Long-legged Lake, 1st of September, 1893, Keewatin.

J. McEvoy :—

Six specimens of obsidian arrow heads and one spear head, from the Shuswap District, B. C. ; also fifteen agate chippings from Indian graves, opposite Lytton, B.C.

R. Chalmers and W. J. Wilson :—

About fifty specimens of Leda Clay fossils from Prince Edward Island (north shore); Cape Egmont; Campbellton, and Miminegash, and from Lancaster shore, St. John, N.B.

Twenty specimens of boulder clay fossils from a bank on the west side of St. John Harbour.

W. J. Wilson :—

Twelve fossils from the Permo-Carboniferous or Triassic rocks of Miminegash, P.E.I.

The additions to the palæontological, zoological and ethnological collections during the year, are as follows :—

By presentation:

The Smithsonian Institution :—

Nearly complete skeleton of the Great Auk *(Plautus impennis)* from Funk Island.

Miss A. Mowat, Regina, Assa. :—

Two fine specimens of *Scaphites nodosus* and three of *Baculites compressus*, from the Cretaceous of the Dirt Hills, south of Regina.

Rev. J. I. Keen, Masset, Q.C.I. :—

Specimen of a toad, from Masset.

A. J. Kingston, Ottawa :—

Four eggs of the Rose-breasted grosbeak *(Habia Ludoviciana)* from near Farrelton, P.Q.

Alexander McInnes, Springhill, N.S. :—

Forty-five fine slabs of fossil plants from the Coal Measures at Springhill, N.S.

Dr. C. F. Newcombe, Victoria, V.I. :—

Twenty-one specimens of Cretaceous fossils from the Comox River, V.I. ; twenty specimens of Post-Tertiary fossils from V.I., and some rare recent shells from the coast of British Columbia.

James Fletcher, Ottawa :—

Five marine sponges from Prince Edward Island, and one from Meach's Lake, P.Q.

Rev. G. W. Taylor, Victoria, V.I. :—

Thirteen specimens of two species of marine sponges from Victoria.

The Redpath Museum (per Sir William Dawson) :—

Specimen of the large spider crab *(Chinocœtes opilio)* from the Gulf of St. Lawrence.

J. Townsend, Toronto, Ont. :—

Forty specimens of rare fossils from the Guelph formation at Belwood, Elora and Durham.

Colonel C. C. Grant, Hamilton, Ont. :—

Twenty-six specimens of fossils from the Niagara group near Hamilton.

By exchange :

From the Natural History Society of British Columbia :—

Four rare species of fossils from the Lower Cretaceous rocks of the Queen Charlotte Islands, and one from the Upper Cretaceous of Vancouver Island.

By purchase :

One skin each of the Parroquet, Crested and Least Auk, from the North Pacific, and one skin of Mandt's Guillemot, from the North Atlantic.

Eggs of the Red-headed Woodpecker, Blue Jay, Kill Deer Plover, and Wilson's Thrush, from Western Ontario.

Natural History.

On the work of the botanical branch during the year Professor Macoun reports as follows :—

"After the date of my last summary report, the continued absence of my assistant, Mr. Jas. M. Macoun, made it necessary that much of my time should be occupied with the ordinary routine work of the botanical branch which last winter included the preparation of certain exhibits for the Columbian Exhibition at Chicago. When time permitted progress was made with the preparation of the 'Catalogue of Canadian Birds' on which I have been working for several years whenever other duties allowed. In the course of the work it became apparent that our knowledge of the birds frequenting Vancouver Island and the neighbouring coast of the mainland was very incomplete, and it was decided to make a further examination of that region. Mr. William Spreadborough, who had been my field assistant for four years, was accordingly again engaged and directed to proceed to Vancouver Island and commence collecting and making observations on the birds and mammals of that island and its vicinity. This work was commenced by Mr. Spreadborough early in April, and on the 3rd of May Mr. Frank Wallbridge, of Belleville, and I, arrived in Victoria and at once commenced to collect.

"It may be stated here that in view of the increased museum space which it is hoped will become available some time in the near future, we have been for the past ten years steadily collecting material in all lines of natural history, so that when a locality is visited for the purpose of collecting botanical specimens we gather mammals, birds, reptiles, fish, shells, insects, etc., as well. In this way we now have in the museum quite a large and varied collection of material, and although much of it remains unclassified, it will be available when the proper time comes.

"The work on Vancouver Island this year was chiefly for the purpose of extending our knowledge of the birds breeding there, but besides this, large numbers of land plants and sea-weeds, in all over 1,400 species, were collected. About 150 species of birds were noted, and nearly 400 skins of birds and small mammals procured. Owing to the peculiarly wet and cold spring and early summer, the snow remained in the mountain woods so late that I decided to waste no time in the interior, but turned my attention to the sea which was always open.

"While at Comox, about 150 miles north of Victoria, during the month of June, rain fell steadily every day, and the prospects for a successful summer were very poor. A series of low tides occurred about this time, and although the rain did not cease we turned to the sea and made very large and valuable collections of marine invertebrates shells, and many species of crabs and other articulates, some of which were cleaned and dried and some preserved in alcohol. In July we visited Nanaimo in the hope that the snow in the mountain woods had disappeared, but on ascending Mount Benson, which is only 3,040 feet high, it was found that on July the 10th at 1,800 feet above the sea, violets that were abundant at Victoria, at the beginning of May were only then in flower. This same mountain had been ascended on the 8th of June, 1887, and all the snow at that time had melted and flowers were blooming on the summit. In the same year I ascended Mount Arrowsmith, and on the 17th of July, the mountain woods at an altitude of 5,400 feet were full of the same violet (*Viola sarmentosa*).

"During four days collecting at Nanaimo, 167 species of marine shells were secured, besides a large series of other marine animals. Similiar collections were made later at Victoria and Sooke. During the whole season I was ably assisted by Mr. William Spreadborough to whose indefatigable zeal, the large collections made are in great part due. He not only shot and skinned all the birds brought home, but under my instructions collected in all other branches of natural history, including botany. In August, after the work of the season was closed, he and Dr. Newcombe of Victoria, who is an adept in shells, made a trip to Clayoquot Sound, on the west coast of Vancouver Island, and around Stubbs Island collected and dredged 134 species of shells, many of which were of great interest and some peculiarly so.

"A few facts of economic importance were noted. Amongst these may be mentioned the presence of *Mya arenaria*, the common clam. Seven years ago this species was unknown on the coast of Vancouver Island, but had some years before this been planted on the California coast. Now it is extremely abundant on both sides of Vancouver

Island, and is quite common at Comox, 150 miles north of Victoria. The edible oyster was planted in Victoria Arm some years since, and Mr. Frank Wallbridge, while collecting at the mouth of Colquitz River, picked up a fine one, nearly four inches long.

"After leaving Vancouver Island in August, the adjacent mainland was visited, and for ten days collections were made in the vicinity of New Westminster and Burrard Inlet, similar to those that had been made on Vancouver Island.

"Since my return to Ottawa, on the 19th of September, I have been principally engaged in arranging and naming the cryptogams collected during the past season, while my assistant, Mr. James M. Macoun, is, when his other duties permit, prosecuting similar work in connection with the flowering plants collected by myself and others not only during this season but in 1892 as well. This work he will continue under my instructions, though the routine work of the branch occupies so much of his time that at the present rate of progress this work will be far from completion next spring.

In previous years I have been able to report large collections of plants having been received for our herbarium in exchange for those sent out, but during the past year owing to the absence of my assistant, who was engaged on work connected with the Behring Sea arbitration until the 15th of July, no specimens worth mentioning have been sent out, though several fine collections have been received from various public institutions, notably from Harvard University, from the California Academy of Science and from the Government botanist of Natal. For these as well as for many thousand others received during the past three years, exchange is still due from us. The accumulation of office work has been so great that until further assistance is given nothing more can be done in this line.

"During the year I have, as usual, examined and determined many collections of plants from all parts of Canada. The most important of these were from Miss Taylor, who made a large collection in the valley of the Mackenzie River; from Rev. A. Waghorne, who spent the past summer on the coast of Labrador; from Thomas Bean, who collected in the Rocky Mountains, and from Mr. W. Scott, who submitted to me for examination and determination nearly 1,000 species of plants collected along the line of the Canadian Pacific Railway between Winnipeg and the coast and on Vancouver Island. Mr. James M. Macoun brought with him from Behring Sea many specimens to add to those collected by him in 1891.

"Since the date of my last Summary Report, 346 letters of sufficient importance to copy were written in connection with the work of this branch and about the same number were received."

MAPS.

Maps in course of preparation and maps published during 1893:

	Sq. Miles.
North-west Territory, Athabasca and part of British Columbia (3 sheets) 20 x 30 in., to illustrate work of Mr. McConnell, 1889–90, and reaching from longitude 110° to 120°, and latitude 54° to 60°, ready for engraver, scale 8 miles = 1 inch.	
Index Map of the above, published 1893, scale 48 miles = 1 inch.	
North-west Territory, country lying between Athabasca River and Lake, and Reindeer Lake, reaching from west longitude 101° to 112°, and latitude 54° to 60°, in progress (Messrs. Tyrrell and Dowling), scale 8 miles = 1 inch. British Columbia, Kamloops sheet (Dr. Dawson), in progress, scale 4 miles = 1 inch.	6,400
British Columbia, Shuswap sheet (Dr. Dawson), in progress, scale 4 miles = 1 inch	6,400
Mr. Bowman. British Columbia, Placer Mines of Cunningham Creek, scale about 27¼ chains = 1 inch.	34
Mr. Bowman. British Columbia, Quartz Veins and Placer Diggings, Grouse Creek, scale about 25 chains = 1 inch.	14
Mr. Bowman. British Columbia, Placer Mines of Antler Creek, scale about 26 chains = 1 inch	38
Mr. Bowman. British Columbia, Lightning Creek, scale 400 feet = 1 inch	17
Mr. Bowman. British Columbia, Williams Creek, scale 10 chains = 1 inch	12
The above five mining plans were published in 1893.	
Rocky Mountains, region lying between Howse Pass and Athabasca Pass, Mr. McConnell, 1892–93, in progress, scale 8 miles = 1 inch	48,600
North-eastern Manitoba, Lake Winnipeg, in progress, Mr. Dowling, scale 8 miles = 1 inch	20,000
Northern Ontario north of Hunter's Island, sheet No. 6 (Messrs. Smith and McInnes, in progress, scale 4 miles = 1 inch	3,456
Northern Ontario, sheet No. 9, Mr. McInnes, nearly ready for engraver, scale 4 miles = 1 inch	3,456
Ontario, sheet No. 115, ready for draughtsman, scale 4 miles = 1 inch	3,456
Ontario, sheet No. 118, Latitude 44° 50′ to 45° 30′, and longitude 77° 25′ to 78° 54′ (Mr. Adams), in progress, scale 4 miles = 1 inch	3,456
Ontario, mining sketch map of the Kingston and Pembroke district, Mr. Ingall, in progress, scale 4 miles = 1 inch, area about	1,700
Ontario, sheet No. 125, south of Sudbury sheet, Dr. Bell, in draughtsman's hands, scale 4 miles = 1 inch	1,800
Ontario, sheet No. 129, west of Sudbury sheet, Dr. Bell, in progress, scale 4 miles = 1 inch	3,456
Ontario, sheet No. 131, east of Sudbury sheet, Mr. A. E. Barlow, in progress scale 4 miles = 1 inch	3,456

	Sq. Miles.
Ontario and Quebec, sheet No. 121, west of Eastern Townships Map, Dr. Ells, in progress, scale 4 miles = 1 inch	3,456
N. E. Territory and Northern Quebec, exploratory survey by Mr. A. P. Low, from Lake Mistassini to the mouth of East Main River, in progress, scale 8 miles = 1 inch.	
Quebec, S. W. ¼ sheet, Eastern Townships Map, ready for engraver, scale 4 miles = 1 inch	4,500
Quebec, N. W. ¼ sheet, Eastern Townships Map, in draughtman's hands, scale 4 miles = 1 inch	4,500
Quebec and Lake St. John district, 2¼ sheets, in progress, Mr. Low, scale 4 miles = 1 inch	6,912
Quebec, ¼ sheet 18, S.E., Messrs. Bailey and McInnes, published in 1893, scale 4 miles = 1 inch	3,456
Quebec, ¼ sheet 18, N. E., Messrs. Bailey and McInnes, in progress, scale 4 miles = 1 inch	500
Quebec, Lièvre River and Templeton phosphate region, Ottawa county, 2 sheets, Mr. Ingall, with engraver, scale 40 chains = 1 inch	220
Mr. Chalmers. New Brunswick, Surface Geology, ¼ sheet, 1 N. W., in progress, scale 4 miles = 1 inch	3,456
Mr. Chalmers. New Brunswick, Surface Geology, ¼ sheet, 2 S. W., in progress, scale 4 miles = 1 inch	3,456
Mr. Chalmers. New Brunswick, Surface Geology, ¼ sheet, S. E., ready for engraver, scale 4 miles = 1 inch	3,456
Mr. Chalmers. New Brunswick and Prince Edward Island, Surface Geology, ¼ sheet, 5 S.W. ready for engraver, scale 4 miles = 1 inch	1,500
Mr. Chalmers. New Brunswick and Nova Scotia, Surface Geology, ¼ sheet, 4 N. W., ready for engraver, scale 4 miles = 1 inch	3,456
Nova Scotia, 16 sheets 18 x 12 inches (Messrs. Fletcher and Faribault), with engraver, scale 1 mile = 1 inch (sheets Nos. 25 to 40 inclusive), area about	3,000

Sheets, Nos. 25, 26, 27 and 28, of the above 16 sheets are ready for publication.

Sheets 41 to 51, are nearly ready for engraver.

Library.

Dr. Thorburn, the Librarian, reports that during the past year ended December 31st, 1893, there were sent out by him 12,891 copies of publications of the Survey, comprising reports, special reports and maps. Of these 8,253 were distributed in Canada, the remainder, 4,566, were sent to other countries for the use of the various leading scientific and literary institutions, and to persons engaged in scientific pursuits. In exchange for these the Survey received 2,393 publications, including reports, memoirs, proceedings, pamphlets, maps, &c.

There were 135 publications of various kinds purchased during the year for the Survey, and 39 periodicals were subscribed for.

Sales of publications by the Librarian during the year amounted to $220.20.

There were 233 books bound during the year.

The number of letters and acknowledgments sent from the library was respectively 587 and 716. The number of letters received, including acknowledgments, was 617 and 1,869.

There are now in the library about 10,000 volumes and over 4,000 pamphlets, all being more or less of a technical character, and relating generally to geological, palæontological, mineralogical, zoological and botanical subjects.

The library is open to the public for reference during office hours, but books are not allowed to be removed.

VISITORS.

The number of visitors to the Museum during 1893, has exceeded that of any previous year, namely, 21,000, and would probably have been some hundreds more had the Museum not been closed while the necessary repairs lately made, were in progress. In my last Summary Report I made some remarks on the desirability of opening the Museum on Sunday afternoons, and the educational advantages the doing so would confer on a large class of the community. In this connection I would now quote the following extract from the "News of the Week," Cardiff, Wales:—

"MUSEUM SUNDAY IN WALES.

"Next Sunday is to be Museum Sunday, and promises to be an even more successful one than last year, when it was first instituted by the Sunday Society. Upwards of forty of the clergymen of the Church of England and ministers of nonconformist bodies have promised to preach this year in support of the one object of the society, viz., the opening of museums, art galleries, libraries and gardens on Sundays. The Duke of Westminster, Lord Brassey and other friends will open their art galleries to members of the society during the afternoon."

The progress this movement is now evidently making in Britain, as shown by the above extract, is very encouraging to those who have for a number of years advocated the same movement in Canada.

STAFF, APPROPRIATION, EXPENDITURE AND CORRESPONDENCE.

The strength of the staff at present employed is 58, viz., professional, 37; ordinary, 21.

No changes have taken place in the permanent staff during the year 1893.

The funds available for the work of the department during the fiscal year ending 30th June, 1893, were :—

——	Grant.	Expenditure.
	$ cts.	$ cts.
Civil list appropriation	49,502 50	
Geological Survey and Museum appropriation	60,000 00	
Civil list, salaries		48,477 50
Exploration and survey		29,365 07
Wages of temporary employees		18,429 85
Boring operations, Deloraine		2,690 72
Printing and lithography		7,601 48
Purchase of specimens		39 68
Purchase of books and instruments		1,321 03
Purchase of chemicals and laboratory apparatus		246 35
Stationery, mapping materials and Queen's Printer		1,320 99
Columbian Exhibition		360 30
Incidentals and other expenses		1,986 59
		111,839 56
Unpaid 30th June, 1893		330 58
		111,508 98
LESS—Paid in 1892		7,107 73
		104,401 25
ADD—Advances to explorers for 1893–94		4,075 00
		108,476 25
Unexpended balance, civil list appropriation		1,025 00
do Geological Survey appropriation		1 25
	109,502 50	109,502 50

The correspondence of the department has, of late years, very largely increased; in 1889 it is recorded as 7,100 letters sent and 5,860 received. This year, 1893, the numbers are 10,812 sent and 8,529 received, a total of 19,341.

I have the honour to be, sir,
Your obedient servant,

ALFRED R. C. SELWYN,
Deputy Head and Director.