SUMMARY REPORT

OF THE

OPERATIONS OF THE GEOLOGICAL SURVEY

FOR THE YEAR 1892.

1st January, 1893.

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

Sir,—I have the honour, in compliance with Section 6 of the Act 53 Victoria, Chap. XI., to submit a summary report of the proceedings and work of the Geological corps during the year now closed.

The work during 1892 has been for the most part a continuation and extension of that recorded in the preceding years 1890 and 1891. The progress made in working out the structural details, and mapping the districts in part examined in those years has been satisfactory, while some extensive and hitherto wholly unknown areas south of Lake Athabasca, and east of James' Bay have been examined with interesting results, while important additions have also been made to our knowledge of the geologic and geographic features of these regions.

The working field parties, during the past year, numbered fifteen, distributed as follows :—

British Columbia	1
North-western Alberta and Columbia Valley	1
Between Lake Athabasca and Reindeer Lake	1
Ontario	4
Quebec	3
East Main	1
New Brunswick	1
Nova Scotia	3

As in previous years, Messrs. Macoun, Ami, Weston and Willimott have made investigations and collections in botany, palæontology and mineralogy, the particulars of which are given under the divisions named. Dr. G. M. Dawson's time and attention has been occupied, as in 1891, almost entirely with work in connection with the Behring Sea Commission, and he has, therefore, been unable to do any geological

field work. The exploration in British Columbia has, however, been ably carried on by his assistant, Mr. McEvoy, who has also completed the drawing on stone of the orographical features of the Kamloops sheet.

In the Summary Report for 1891 it was stated (p. 8 A), that the boring at Deloraine had reached a depth of 1,808 feet, and that the total expenditure to the 31st of December, 1891, had been $15,494.80. Many unfortunate and unexpected accidents and delays have arisen in the prosecution of the work. On the 11th of July, I reached Deloraine and found that the water-bearing sands under the impervious clay shales had been reached that morning, and that a weak stream of somewhat saline water was flowing from the pipe; since then this flow was shut off by lowering the casing, and the boring was continued in the hope of securing a more copious supply. On the 22nd of September, when I again visited Deloraine, a total depth of 1,943 feet had been reached, or 121 feet into the Dakota formation, consisting of layers of coarse and fine white quartz sand, with hard streaks of sand-rock, holding occasionally concretionary nodules of pyrites. After the casing was lowered as above mentioned, the water no longer flowed over, except when the boring rods were being inserted, and then not till from six to nine lengths of about thirty feet each, had been put down, indicating the water to stand permanently at about 100 feet below the surface.

Though too saline for drinking, as shown by the quantitative analysis below, it is clear and soft, and unlike the water of the shallow wells of the district, lathers readily with soap, and would, therefore, be a useful and wholesome water for domestic purposes. Deloraine is 1,630 feet above sea-level, and thus it seems almost certain that at any height not exceeding 1,500 feet above tide, strong flowing artesian water might be obtained from the Dakota sands. The eastern outcrop of these sands was observed in 1889, by Mr. J. B. Tyrrell (Geol. Survey of Canada, Ann. Rep. vol. iv., p. 23 A), on some terraces at the south end of Swan Lake, near the foot of the Manitoba escarpment in the Riding Mountains, about 120 miles north of Deloraine, and about 1,000 feet above the sea. This outcrop is evidently here the eastern rim of the great water-bearing basin, of the Dakota formation of Western Manitoba, which has now been struck at Deloraine, 215 feet below sea-level, and 1,205 feet below its eastern rim in the Manitoba escarpment.

Further south the Cretaceous escarpment which forms this rim sinks below the level of the country, and both it and the underlying Palæozoic and Archæan rocks are deeply covered and entirely concealed by the deposits of Glacial Lake Agassiz. It appears that the

flow of the water in the well at Deloraine is much impeded by the loose nature of the sand causing it to run in and block the pipe; a similar difficulty occurred at the Devil's Lake well in Dakota and in many other cases, but it has been found that by continued pumping, or natural flowing, the sand after a time ceases to run, and the available supply, as well as the quality, of the water, improves. Arrangements have, therefore, now been made to place a pump in the Deloraine well in order to satisfactorily test this matter. Supposing, as we do, that the main supply of water is derived from much higher levels to the westward, it seems probable that the natural pressure to be expected in the well at Deloraine may be so much relieved by outflow along the above described eastern rim of the basin, as to prevent any overflow at elevations greatly exceeding the level of that rim, which is as stated, about 1,000 feet above the sea level. Further south the edge of the basin, or outcrop of the water-bearing Dakota sands must be considerably lower, but is completely sealed by the overlying clay deposits of Lake Agassiz, and hence, perhaps, the greatly increasing pressure to the south, as manifested by the wells of the James' River valley in Dakota, and also the swampy character of the country, below the rim of the basin to the north. The result of pumping the Deloraine well will be most interesting, whether viewed from an economic or from a purely scientific stand-point.

A sample of the water analysed in the chemical laboratory of the Survey gave the following result:—

	Grains.
Chloride of potassium	1·562
Chloride of sodium	309·502
Sulphate of soda	28·196
Bi-carbonate of soda	94·409
Bi-carbonate of lime	3·961
Bi-carbonate of magnesia	3·581
Carbonic acid, free	5·044
Organic matter	none
	447·255

grains per imperial gallon.

Specific gravity at 60 F., 1004·99.

Boiling produced a slight precipitate consisting of carbonate of lime with a little carbonate of magnesia.

The water of the artesian well at Jamestown, Dakota, contains 129·2496 grains per gallon. I have not been able to find an analysis of the water from the Devil's Lake well. It would, however, be between that of Jamestown and Deloraine in saline contents.

On pages 71 A and 86 A of the Summary Report for 1891, it was stated that geological and botanical collections had been made and were being prepared for the proposed museum in the Rocky Mountain park at Banff. In July I visited Banff to inspect the building, then unfinished, and to ascertain what was required to complete it and adapt it for the purpose contemplated: also to ascertain the dimensions and the kind of cases that would be most suitable for the specimens. This was carried out, a plan of the rooms was made, some alterations suggested, and the position and kind of cases, fifteen in number, determined on. These are now being made in Ottawa, and will be ready to be placed early in the ensuing spring. They will afford about 1,444 square feet of glass frontage, upright and flat. A fair collection of animals, fossils, minerals, and rocks will be ready to be placed on exhibition, as soon as the cases are completed, as well as maps and photographs. A herbarium also, containing named species of all the plants growing in the Park and vicinity, has been prepared by Professor Macoun.

On the 20th of July I visited section 11, township 2, range 23, on the flank of the Turtle Mountains, south of Deloraine. On the north-west quarter of this section, the owner, Mr. Duncan McArthur, has sunk several shallow pits, and a shaft 23 feet deep, in which he states three seams of lignite coal were found with intervening clay strata.

1st seam at seventeen feet.....	2′ 6″
2nd seam at (?)	2′ 6″
3rd seam at twenty-three feet thickness not ascertained.	

All the workings were full of water at the date of my visit.

From the specimens of the lignite shown me by Mr. McArthur, it appears to be of similar quality to that now being mined at Estevan, and would certainly be a valuable fuel for local use if mined and sold at a reasonable figure.

These are doubtless the same seams as those described in the Geological Survey Summary Report for 1890, page 10, as having been opened in range 24, township 1. It was then stated the seam would probably be found from range 19 to range 34, in township 1. It is now proved that they extend in places at least a mile into township 3, or thirteen miles north of the international boundary.

On the 7th of August I left Ottawa for Quebec, where in company with Mr. Weston, some examinations were made with a view to determine the hitherto doubtful question of the relation of the black graptolitic bitumino-calcareous shales of the Citadel Hill, to the Trenton. In this we were completely successful, and the evidence

obtained leaves no room to doubt that these shales are above, and not beneath the Trenton limestone, or in other words, that they occupy the position and represent, in a much disturbed and sharply folded attitude, the Utica Hudson terrane, the whole mass being squeezed in, and compressed between two great dislocations. The evidence of these dislocations abounds from the Falls of Montmorency and the Island of Orleans to Lake Champlain. That some beds older than Trenton are involved in these folds is quite likely, but these strata are certainly all newer than Levis.

On the 13th of August I left Quebec for Nova Scotia, where a few days were spent with Mr. Hugh Fletcher, examining and consulting on some doubtful points of structure in the Chignecto promontory and the Cobequid Hills, on the line of the Intercolonial, and the Spring Hill and Parrsboro' railways.

In the conclusions arrived at by Mr. Fletcher, I fully agree, and there can, I think, be no question that the crystalline rocks of the Cobequid Mountains are not Archæan but contemporaneous igneous ejections, and of Devono-carboniferous age. Full details will be given in Mr. Fletcher's map and report on the district.

On the 29th of August I again reached Ottawa.

On the 22nd of September I was again at Deloraine, when it was concluded to stop the boring and to make arrangements to place a pump in the well, as already stated. On the 25th of September a trip was made to Estevan and the Souris River coal fields, which I had examined and reported on in 1880.*

At the Hassard mine, fourteen miles from Estevan, a very fine seam of lignite has been opened, and above it at the same point, there are three seams as under:

1—4 feet.....	12 feet	below	prairie level.
2—2 feet.....	40	do	do
3—1 feet.....	50	do	do
4—8 feet.....	80	do	do

This eight-feet seam is only a few feet above the level of the Souris River, and being covered by debris and superficial deposits, was not seen either by Dr. Dawson, in 1874, or by myself in 1880. The Hassard mine is on the left bank of the Souris River, section 4, township 2, range 6, west of second meridian. The seam presents a solid tough lignite eight feet thick and of excellent quality. It is somewhat difficult to correlate the above section with that at the Estevan mine, but it seems quite unlikely that the eight-feet seam at Hassard's is, though thought to be so, the same seam as that now being worked at Estevan, and, as the latter is only 28 to 30 feet below the

*Geol. Survey of Can. Rep. of Progress, 1879-80, pp. A 2-26, ss.

prairie level, it seems much more probable that it is the same seam as the six feet seam shown in the figure, page 7 A, of the report 1880, above cited, and also as the seam in the old Sutherland mine, page 5 A of same report, in which case the Hassard seam would be below the bed of Long Creek at Estevan. In any case, there is an enormous quantity of available fuel in this field. In estimating the quantity in 1880 it was stated :—

"It may be assumed that there are in this region above the level of the Souris River at least eight feet of available lignite coal, over an area of not less than 120 square miles. This estimate would give 7,136,864 tons to the square mile, calculating the cubic foot at only 64 lbs." *

On page 6 A of the Summary Report for 1891 it was stated that vol. V. of the Annual Report would probably be issued before the close of 1892. This has not been found possible, but four Parts have been issued, and the printing of six other Parts is now well advanced, while two more are ready to put in the printer's hands. Most of them are also translated, and it is hoped that the interval between the issue of the English and the French edition will be considerably less than heretofore.

The Annual Report, vol. V., will contain the following Parts, with maps, illustrations and sections :—

A—Summary Reports for 1890 and for 1891.

D—Peace and Athabasca Rivers, with index map and sections—McConnell.

E—North-western Manitoba, &c., with map and illustrations—Tyrrell.

F—Sudbury Mining District—Bell.

G—Geology of Hunters Island—Smith.

L—Geology and Economic Minerals of Portneuf, Quebec and Montmorency Counties, P.Q.—Low.

M—Report on a portion of the Province of Quebec and adjoining areas in New Brunswick and Maine, &c.—Bailey and McInnes.

P—Surveys and Explorations, Pictou and Colchester Counties, Nova Scotia—Fletcher.

Q—On Natural Gas and Petroleum in Ontario—Brumell.

R—Chemical Contributions—Hoffmann.

S—Mineral Statistics and Mines—Ingall.

On the 28th of December and following days, the Geological Society of America, on the joint invitation of the Royal Society of Canada and The Logan Club held its winter meeting in Ottawa. The proceedings were opened by an address of welcome to the visiting members of the society from His Excellency the Governor-General.

Instructive and interesting papers or communications were read and discussed, several of which were contributed by members of the Geological corps of Canada. The social features of the meeting were of a most agreeable nature, and even from a scientific aspect by no means unimportant. At the close of the meeting the following resolution "adopted cordially and unanimously" was transmitted to the Logan Club by the secretary of the society, Professor LeRoy Fairchild:

"Resolved—That the thanks of the Geological Society of America "be heartily tendered to the Logan Club for its invitation to the "Society to meet in Ottawa, and for its generous hospitality; and "especially to its committee, consisting of Dr. A. R. C. Selwyn, Dr. "Robert W. Ells, Mr. Joseph B. Tyrrell, and Mr. W. H. Smith, "whose untiring efforts have so largely contributed to the success of "the meeting."

Mr. McEvoy left Ottawa on the 8th of June with instructions to continue the examination of that part of the southern interior of British Columbia, embraced by the Shuswap sheet, the situation of which was described in the Summary Report for 1891, p. 17 A. He was joined at Kamloops by his assistant, Mr. C. J. Bowell, and continued work in the mountains till the end of September. On the 8th of October he again reached Ottawa.

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

"Nearly all the roads and trails in the country having been previously examined and surveyed, the work of this season was necessarily difficult, as it involved travel on foot through trackless forests and over steep and lofty mountains.

"The first trip was made from Shuswap station, up Chase Creek and through a low pass to Tappen siding. A few days were spent exploring in the vicinity of White Lake. This lake has heretofore been known only from Indian report. It proved, however, to be only two miles long, and apparently very shallow. The name, a translation of the Indian one, is derived from the appearance of the water due to the white silt bottom.

"On the hills west of Armstrong, on the Shuswap and Okanagan Railway, near Davidson Creek, black chiastolite schist, like that of granite in Nova Scotia and elsewhere around were found. The conditions here are apparently similar to those in the east; the argillites or argillaceous schists become altered on approaching the granite, imperfect crystals of garnet appear, and still nearer the contact the typical chiastolite schist is found.

"About three weeks were spent in the country north of Shuswap Lake, around the headwaters of Scotch Creek. The mountains here are smooth-topped, about 6,800 feet high, and heavily glaciated over the summits. They are composed for the most part of gneisses and mica-schists of the Shuswap series, probably Archæan. On Scotch Creek, however, the overlying black argillaceous schists of the Nisconlith series are well developed. The return was made along the route followed by the old Seymour trail, all signs of which are now completely obliterated. Considerable difficulty was experienced in getting the pack-horses across the mouth of Adams River, owing to the extreme high water.

"The season was fully a month later than usual at an altitude of less than 6,000 feet. On the 1st of August about one-half the ground was still snow-covered, and even on the sunny exposures the horses could find scarcely any grass.

"From a point opposite the first island on Adams Lake, four miles from the outlet, a low pass, extends westward to Louis Creek, the summit of which is only about 3,000 feet above sea level. Throughout this valley there is a good deal of rich land which, unless some exceptional climatic conditions exist, would be very suitable for cultivation.

"From Cīn'-max, a point on the stream flowing into Adams Lake at Skwa-am Bay, a traverse was made due north to the east fork of Barrière River. An isolated area of basalt, at a low elevation, was found on this route. On the east fork of the Barrière a lake not shown on any existing map was discovered. Its Indian name is Hum-ham-ilt and it proved to be seven miles long, with a low pass from its head running to Adams Lake.

"While in the neighbourhood an opportunity was afforded of visiting the coal mine on the North Thompson Indian Reserve. A tunnel running northward from the creek bed showed the following section:—

Coal	6 inches.
Sandstone	2 feet (variable.)
Coal	9 inches.
Sandstone	6 "
Coal	18 "

Besides these an underlying seam of coal is reported.

"About a week was spent in tracing the complicated outline of the Granite and Tertiary areas which are found interrupting and overlying the limestones and schists around the heads of Reservation and Edward creeks.

"It was found impracticable to take horses into the mountains of the Gold Range, so three or four weeks of the latter part of the season

were spent in those mountains on foot. The climbing was steep and difficult. Four main points were occupied for topographical sketches, besides several secondary ones. The rocks are gneisses and mica-schists, (probably Archæan) the latter holding garnets in many places.

"A careful examination was made of all exposures on the line of the Canadian Pacific Railway from Revelstoke to Salmon Arm for the purpose of getting a good section.

"A visit was paid to the Coal Hill mine, three miles south of Kamloops. An incline was being sunk along the dip of the seams, and in it the following section was seen:—

Coal	3 inches.
Shale	5 "
Coal	12 "
Clay	4 "
Coal	2 "
Shale	6 "
Coal	3 "
Shale and clay	5 "
Coal	5 "
Shale and sandstone	12 "
Coal	2½ "
Sandstone	8 "
Coal	3 "

The quantity of clay is variable and some of the shale partings are not continuous.

"Before returning the Glen iron mine on Kamloops Lake was visited. The ore is magnetite throughout, with a slight mixture of calcite and felspar in a few places, which, however, does not injure the ore for smelting. The following items were noted:—

"1. An opening a few feet from the railway, filling an irregular angular fissure from two to six feet in width.

"2. Three hundred feet south of last a deposit of four feet of good ore, with five feet mixed ore and country rock.

"3. Five hundred feet southward from last a large deposit of fourteen feet good ore, with ten feet of mixed.

"4. Thirty feet north-west of last, twelve feet ore.

"5. West of last a vein three feet thick.

"6. South-west of last numerous croppings of good ore undeveloped. At a low estimate ten per cent of the mass here is ore.

"7. North-east of No. 3 a vein four to ten feet thick. This is the principal source of output at present and is connected with the railway by an aerial tramway.

"All the veins run in an easterly and westerly direction, and are nearly vertical or dipping northward at high angles."

The cost of the season's work, including salary of assistant, was $1,335.69. Since Mr. McEvoy's return from the field he has been occupied in completing the plotting, &c.

Mr. McConnell left Ottawa on the 27th of May with instructions to make an exploration in the Rocky Mountains to the North-west of Calgary, crossing either by way of the Howse or the Athabasca Pass to the Columbia to ascertain and define approximately the eastern limit, in that region of the northern extension of the great East and West Kootenay mineral bearing belt of crystalline rocks, which I had myself met with in 1871, at the head of Canoe Creek and in the vicinity of Tête Jaune Cache on the Fraser, at the western entrance to the Yellow Head Pass.*

On this work Mr. McConnell reports as follows:—"The party left Morley on the 9th of June, with six pack-horses carrying instruments, baggage and supplies for five weeks, but in addition to this, some Indians were engaged to pack 400 lbs. provisions as far as the Saskatchewan, so as to enable us to complete the survey through the Howse Pass without wasting part of the summer returning to the C. P. R. for fresh supplies. From Morley we travelled through the foot-hills to the Red Deer River which we crossed near the 'Gap,' and then entering the Rockies continued northwards by the longitudinal passes inside the first ranges. We reached the Saskatchewan at the Kootanie Plain on the 17th of June. From there we descended the Saskatchewan to the 'Gap,' and then worked westward to the summit. Mr. Russell making a paced survey up the valley, and a compass triangulation of the bordering mountains, supplemented by sketches from the various peaks climbed, while I collected data for a geological map and section.

"Before crossing the summit to the Blaeberry River a few days were spent round Glacier Lake, the source of one of the four branches which unite to form the Saskatchewan. Glacier Lake occupies the bottom of a deep valley bounded by high precipitous limestone mountains, and is about three miles long by a mile wide. A few miles above the head of the lake the valley is filled by the Great Saskatchewan Glacier, and two miles further on is terminated by a line of cliffs out of which the ice from the great river of the central range of the Rockies precipitates itself in ice cascades and avalanches. The glacier was

*Geol. Surv. of Canada, Progress Report, 1871–72.

ascended and such measurements of its size, rate of motion, &c., as time permitted were made.

"Leaving Glacier Lake we crossed the summit of the Howse Pass to the Blaeberry River and descended the latter to the Columbia, which we reached on the 1st of August. The Howse Pass has not been used for some years owing to the well-nigh impassable state of the trail caused by fallen timber, and much time was lost in cutting a passage through.

"The section through the Rocky Mountains cut by the Saskatchewan and Blaeberry rivers bears a general resemblance to that previously described along the Bow and Kicking Horse rivers,* but necessarily differs greatly in detail. In the eastern part of the range three great thrust faults due to pressure from the west were detected. The first of these occurs along the eastern boundary of the range, the second cuts through the Kootanie Plain, while the third and greatest, is situated immediately west of the continuation of the Saw-back range and has resulted in placing rocks of Middle Cambrian age over the Carboniferous. A notable feature of the Saskatchewan section is the almost complete absence of Cretaceous beds. Two bands of red sandstone which may possibly be of this age cross the valley, but the dark coal bearing shales which enter so largely into the composition of the ranges further to the south were not observed west of the 'Gap.' In the western part of the range the beds except in places have not been so violently disturbed as along the Kicking Horse. The Bow River series is nowhere brought to the surface and the mountains are composed of Castle Mountain, and more recent limestones and calc-schists often lying in great synclines and anticlines.

"After completing the traverse of the Howse Pass, we refitted at Donald, B.C., and then descended the Columbia valley to Kinbasket Lake. The packtrain was left some miles above the lake and the latter part of the journey made by water, as the old Moberly trail which we were following, owing to its long disuse had become so completely blocked with fallen trees that we were unable even with all hands chopping to clear more than a few hundred yards a day. The original intention was to descend the Columbia to Canoe River and then to recross the mountains by the Athabasca Pass, but this plan had to be abandoned owing to the length of time and heavy expenditure required to cut a trail down the valley.

"The geology of the Columbia valley proved to be extremely complicated and will only be briefly referred to here. On the south-west or

* Geol. Surv. Can., Ann. Rept., vol. II., part D, 1886.

Selkirk side of the valley, the rocks consist of mica schists and gneisses, probably to the Shuswap River of Dawson and Selkirk sections (Brit. Geol. Soc. Ann. vol. 2, p. 165). East of these but separated from them by a deep fault running parallel with the valley is a great thickness of quartzites, crushed conglomerates and argillites, representing the Bow River series. The latter are succeeded by the limestones of the Castle Mountain Group, the beds of which form the mountains bounding the valley on the north-east or Rocky Mountain side. Behind the first range of the Rockies the argillites and associated beds of the Bow River series are again arched by an anticlinal and extend north-westward in a gradually widening band from below Bush River to the Athabasca Pass and beyond.

"Coarse gold has been found in the beds of several of the streams heading in the band of Bow River rocks, and it is highly probable that paying placer deposits will eventually be discovered in this part of the range. The impassable state of the trails has hitherto prevented much prospecting being done. The schists of the Shuswap rivers on the Selkirk side of the valley are also metalliferous. A lode of galena was discovered during the present exploration, west of Kinbasket Lake, a specimen of which has been analysed in the Survey laboratory and is reported by Mr. Hoffmann to contain 26·25 ounces of silver to the ton.

"Work was discontinued on the 20th of September, somewhat earlier than usual, owing to a heavy snow-storm in the mountains rendering further climbing impossible. The outfit was brought back to Golden on the 23rd and shipped by the Canadian Pacific Railway to Morley, where it was stored for the winter. The horses were left at the same place, in charge of R. McFarlane. Cost of season's exploration, including purchase of pack-train, $2,443.62."

In the beginning of April, Mr. Tyrrell was requested to prepare for an exploration in the country lying north of the Churchill River, and south of Athabasca Lake and Bear River. The region explored (an area of about 40,000 square miles) is remote from all ordinary routes, no reports or descriptions of it have been published, and the greater portion of it has never been travelled over by white men, not even by officers of the Hudson's Bay Company. Mr. Dowling accompanied Mr. Tyrrell, in the capacity of assistant, but worked to a great extent independently, and on different routes. Mr. Tyrrell summarizes the season's work as follows:—

"It was impossible to decide with any degree of certainty on the most advantageous starting point for the exploration, but

after a careful examination of the maps of the surrounding country, and Mr. Cochrane's unpublished traverse, made in 1882, of Reindeer and Athabasca lakes and Black River it was decided, with your approval, to send Mr. Dowling northward from Edmonton down the Athabasca River with the boat that had been used on Lake Winnipeg for the last two years, while I should proceed from Prince Albert by Green Lake to Isle à la Crosse, and push northward in canoes from there through the unknown country. The experience of the summer proved that this arrangement was the best that could have been made.

"We left Ottawa on the 6th of June and proceeded to Winnipeg, where C. C. Chipman, Esq., Commissioner of the Hudson's Bay Company, kindly gave us letters to the officers at all the northern trading posts, instructing them to furnish us with all necessary supplies. On June 13th we left Winnipeg by the train for the west, Mr. Dowling being instructed to go by rail to Edmonton, thence to drive north to Athabasca Landing, where he would find James Collins, whom I had sent from Selkirk with the boat, to descend the Athabasca River and survey the south shore of Athabasca, and the streams flowing into it, as far east as Fort Fond du Lac, where he was to meet me not later than the 1st of August, bringing with him supplies for the remainder of the season. I went west as far as Regina and thence northward on the Qu'Appelle, Long Lake and Saskatchewan Railway to Prince Albert.

"At Prince Albert a light wagon was hired, and on the 17th of June, with one man (Herbert Porter) and a teamster, we crossed the Saskatchewan, and entered a ridge of sand hills wooded with Banksian pine. The trail winds over and among these hills to beyond the crossing of Shell River, where it enters an almost level or very gently rolling country, with rich dark soil, wooded with groves of poplar varied with prairie glades. On account of almost constant rains the travel through these rich poplar woods was very heavy, and it was with much pleasure that we again reached Shell River, at a distance of about thirty miles from Prince Albert, where it winds in a narrow channel through the bottom land of a wide, sloping valley like that of the Saskatchewan. Beautiful gravel plains and terraces extend along the sides of this valley, and these are followed by the trail for the next forty or fifty miles, making one of the most beautiful roads in the North-west Territories.

"The valley is at first occupied by Shell River, or a branch of it called Snake Creek, while further north it is occupied by Sandy Lake, Devil's Lake and Whitefish Lake, and is crossed by Big River and also by a branch of Shell River. It was not traced to its northern

extremity, but it appeared to originate in a conspicuous ridge of boulder-covered, morainic hills which forms the main watershed between the waters flowing into the Saskatchewan and those flowing into the Churchill.

"Shortly before reaching these hills the trail leaves the valley, where its sides are 150 feet high, and enters the morainic hills, which are wooded with large white spruce. Crossing the hills, the trail descends to a gravel plain, and, again turning westward, it plunges into the deep valley of the upper part of Big River. The sides of this valley, through the bottom of which winds a small stream, appear to be composed of dark Cretaceous shales, and are bordered by several beautiful terraces, on which the trail has been located. This valley gradually decreases in depth as it is ascended till it appears to terminate in an extensive tamarack swamp. Here the trail leaves it and crosses an extensive plain underlaid by a sandy clay with boulders. On crossing this plain we entered another wide stretch of sand hills, beyond which is a level clay country, wooded with poplar, extending to Green Lake.

"At the south end of Green Lake the Hudson's Bay Company have a storehouse. On reaching here, on the 21st of June, we found that Mr. Gwillim had arrived with our two Peterborough canoes several days before. We also here found Mr. Moberly, the Hudson's Bay Company's officer in charge at Isle à la Crosse. He had come thus far southward to superintend the distribution of their freight. Having made the necessary arrangements with him we launched our canoes and started northward on Green Lake.

"This lake is a long, narrow body of water occupying the bottom of an ancient valley cut in the face of an easy slope.

"A survey of Green Lake was made with a compass and boat log, and then an estimated track survey of Beaver River down to its mouth in Isle à la Crosse Lake. In its upper portion the banks are stratified post-glacial deposits, while at the rapids the stream has cut into the underlying till, which contains many striated boulders. No rock in place was seen on Beaver River until the foot of the rapids was reached, just above the mouth of Doré River, where high banks of soft stratified sand are cut out of the Dakota formation.

"At Isle à la Crosse, Pierre Girard, a half-breed, and Ithingo and Heddery, two Chipewyan Indians were engaged.

"On the 29th of June we descended Churchill River to the mouth of Mudjatick or Cariboo River. This latter stream was found to be at its extreme high water stage, but we turned into it, and began to stem its rapid current. The banks were overhung with willows into which the

water had spread from the swollen stream, so that it was impossible to track the canoes with a line and the depth of the water and the bottom of soft quicksand prevented the use of poles, so that we were obliged to ascend entirely with the paddle.

"The river winds from side to side of a wide sandy plain in the bottom of a sloping valley, the sides of which are composed of ridges of well banded red gneiss. The stream very rarely reaches the bases of these ridges and no rocky barriers obstruct its course, the few heavy rapids met with being caused by accumulations of boulders in the channel. The source of the river is in a series of small lakes lying in depressions in a sandy plain, on the height of land and not among rocky hills as might have been expected. Crossing this sandy height of land by several portages, a small lake is reached which discharges its crystal waters northward by a winding stream that flows at first through the above mentioned sandy tract, and then through an area of gneiss hills into the southern end of Cree Lake.

"This large lake, about fifty miles in length, lies a short distance north of and but little below the height of land. The southern end is surrounded by rocky hills of Archæan gneiss, while further north the islands and the west shore, which were the only parts visited, were found to be underlaid by horizontally stratified white or light red Palæozoic sandstone of the same age as that south of Lake Athabasca. Thus this lake adds one more to the number of the great lakes in Canada that lie along the line of contact of the Palæozoic and Archæan. Both Athabasca and Wollaston lakes occupy similar positions.

"In the central portion of Cree Lake are a great number of oval islands, composed of till and boulders, all lying with their long axes parallel to the direction of glacial striation. These islands in some cases rise to a height of 175 feet, while the water near them was found to be about seventy-five feet deep. They are of the character of those hills known to glacialists as drumlins.

"Cree River flows out of a bay at the north end of Cree Lake. It is a wild, impetuous stream, with only a shallow channel and no distinctive valley. It flows generally over a bed of angular masses of coarse whitish sandstone, which everywhere forms the country rock. The rock itself is but seldom seen, and the many dangerous rapids are caused by the presence of these broken angular masses of sandstone, as well as by sudden contractions and expansions of the channel. The river has every appearance of being very new, and the whole country shows abundant evidence of having been only slightly modified by meteoric or fluviatile agencies.

"The descent of Cree River was accomplished in three days, Wapata Lake, into which it flows, being entered in the evening of the third day. A survey was made of this lake, and of the shores of Black Lake as far north as its discharge into Black River.

"In order to obtain supplies for the remainder of the season I was obliged to proceed hence westward to Fond du Lac, on the north shore of Lake Athabasca.

"One canoe with two men, and all the supplies on hand were accordingly left here, and with a light canoe and three men I started westward across the portage, about three miles and a half in length, which it is necessary to make in order to pass a series of heavy rapids and falls on Cree River. After crossing a small lake another portage two miles and a half in length had to be crossed before the easy water of the lower portion of Black River was reached. The total descent of the river in rapids and falls avoided by these two portages is about 300 feet, or at least this may be taken as the altitude of Black Lake above Lake Athabasca. From the lower end of the latter portage we descended Black River and followed the long straight narrow arm of Lake Athabasca westward to the Hundson's Bay Company's Post of Fond du Lac. Both the river and lake occupy the bottom of a great valley which extends along the line of contact of the altered Archæan rocks and the overlying unaltered sandstones. To the south stands the high and almost unbroken sandstone escarpment, while to the north rise high rounded hills of reddish grey gneiss, or lofty crags and precipices of dark green trap.

"This trap is found most largely developed along the north side of Black River, and all along the north-west side of Black Lake, where it appears to be running off into the country towards the north-east. It is very similar in character to many of the green Huronian rocks at Sudbury, Lake of the Woods, &c., and future investigation may show it to contain minerals of economic value. On the west side of Black Lake, and perhaps associated with this trap, is a low exposure of green chloritic schists apparently of clastic origin.

"We arrived at Fond du Lac on the evening of the 27th of July, where we were welcomed by Joseph Mercredi, a venerable old half-breed who had been in charge of the Hudson's Bay Company's post at this point for the past forty-seven years. He informed me that part of my supplies, and an old canoe previously used by Mr. McConnell, had already arrived.

"On the following day Mr. Dowling arrived from Fort Chipewyan having completed the survey of the south shore of Lake Athabasca. He brought word that the Athabasca River steamer would leave

on her last trip up the river about the 7th of August, and as the specimens already collected could not be carried with us during the remainder of our journey it was necessary, if they were to reach Ottawa this year, to send them at once to Chipewyan. A canoe and two men were therefore employed and sent off at once with the collections made up to that time.

"Afterwards we set to work to stow all our goods in our two canoes and leaving the boat to be sent back to Fort Chipewyan, we again started eastward on the morning of July 30. Mr. Dowling continuing the log survey of the south side of this arm of the lake, while I made a similar survey of the north shore, to the mouth of Black River. From this point to Wollaston Lake Mr. Dowling, as stated in his report, made a survey with compass and micrometer of all the rivers and smaller lakes, while the larger lakes were surveyed with a Massey boat log.

"A band of Indians had been induced to wait for us at the long portages, and a few miles before reaching them, Ithingo, one of our Indians from Isle à la Crosse, was sent by land to apprise them of our approach. With their assistance the two canoes and their heavy loads were carried across both portages in a day, and early in the evening we camped on the shore of Black Lake near the head of the western portage, where the two men had been left ten days before. Here the three canoes were loaded and bidding good-bye to our Indian friends we continued eastward, Mr. Dowling taking the south shore, while Mr. Tyrrell followed the north side of the lake, which was at first found to consist of high cliffs of dark green trap, and then of low lying rounded bosses of red granite.

"This granite extends up Black River above the lake to near the mouth of Porcupine River, where it runs off to the north-east, and the horizontal sandstone again makes its appearance. The river continues in this sandstone until near Little Hatchet Lake, its course being generally governed by the directions of the great drumlins or hills of unstratified sand and boulders, which rise on every side. Both the north and south shores of Little Hatchet Lake were surveyed, and on the 18th of August we entered Wollaston Lake, after a very laborious journey up a stream obstructed by heavy rapids, in which the men had constantly to wade in the water up to their waists, surrounded by ever-present swarms of noxious black flies.

"The west shore of Wollaston Lake was surveyed down to the mouth of Drifting River, near which we met a little band of Indians, from whom we fortunately obtained a small additional supply of tea and ammunition. We had hoped to have also obtained from them some

information about the country to the south-west, but they knew nothing of it, except that formerly there was a canoe route up Geikie River, and across the height of land to Churchill. This route had not been travelled for a long time, and the portages would probably be all blocked with fallen timber if they could be found at all. Besides this our stock of provisions would last for very little more than a week longer. However, it was important that a survey should be made across this portion of the country if possible, and the three men from Isle à la Crosse were willing to try to get through it with me.

"The party was accordingly divided, Mr. Dowling was sent with two canoes and four men with instructions to survey the south shore of Wollaston Lake, thence to proceed by either the southern or northern route, as would be found advisable, to Reindeer Lake, to continue his instrumental survey through that lake, down Reindeer River and up Churchill River to Stanley Mission, connecting with Mr. Fawcett's survey of the Churchill River at Frog Portage. From Stanley he was to turn southward through streams and lakes to Montreal Lake, whence he was to proceed overland to Prince Albert. If possible an instrumental survey was to be made throughout, the streams being measured with a micrometer, and the lakes with Massey's patent log.

"The writer took one canoe and three men, and on the 25th August began the ascent of Geikie River. The country through which this river flows consists of evenly banded red granite gneiss, with a regular and very persistent strike in a south-westerly direction, arranged in long ridges, parallel to the strike, which are separated by more or less wide intervening valleys. The lower portion was easy of ascent, as it consisted of a series of narrow lakes connected by rapid, but not impassable, stretches of river, but in its upper part the difficulties became much greater, for the stream breaks up into a number of small branches in which there was hardly enough water to float the canoes. Ascending one of these branches to its source we crossed from one lake to another over old and obscure portages, which we were obliged to cut out anew, till we came to Little Whitefish Lake and thence descended an irregular stream to a large lake known as Whitefish Lake, where we arrived on the 9th of September. Our provisions would have been long since exhausted had not a moose and four bears been added to our stock on the way. Wild fowl of any kind were very scarce.

"My Indian canoemen recognized Whitefish Lake as a place which they had previously visited, and, as they had descended Whitefish River from the lake to Churchill River, uncertainty as to our route was now at an end, and though the river ahead of us was broken by many dangerous rapids, the proper channel and all the portages were

known, and we hailed with delight the finding of a route which we could follow with the assurance of finally reaching our desired destination. The survey was continued across Whitefish Lake and down Whitefish River to Churchill River, where it was connected with Mr. Fawcett's micrometer survey of the latter stream. All the way from Wollaston Lake a very careful survey had been kept. The bearings were taken with a prismatic compass, checked daily by readings on the sun near its rising or setting. As there was no sign of local attraction, these may be considered as being fairly accurate. The lakes and quiet reaches were measured with a patent log, while the lengths of the stretches of flowing water were estimated. Observations for latitude were taken as often as possible, sometimes twice daily, and thus the positions of most of the natural features observed were obtained within a comparatively small limit of error. Similar observations for latitude were taken at many other points during the course of the summer.

"From the mouth of Whitefish River we followed the Churchill River upwards, examining the various rock exposures, and living on what ducks we could shoot from time to time, for our stock of provisions had been exhausted some time before. On the evening of September 20th we arrived at Isle à la Crosse, just as a heavy equinoxial storm began to set in.

"Here the men were paid off and my canoe was left for the winter, and while the storm raged without, two days were spent very pleasantly with Mr. H. J. Moberly, the Hudson's Bay Company's officer in charge of that district. Arrangements were then made with Mr. Moberly for a passage out to Prince Albert, and leaving the pleasant friends at Isle à la Crosse on the 24th of September, I was taken up Beaver River to Green Lake in three days, and pushing onward, Prince Albert was reached on the evening of the 2nd of October.

"As Mr. Dowling, and the men with him had not yet arrived from Montreal Lake, I determined to spend a few days in this vicinity. The underlying rock here was found to be a soft dark gray clay shale similar to the Pierre shale of Manitoba and the Upper Saskatchewan, but no fossils were discovered in it, so that its exact age could not be certainly determined.

"A short distance below the town a high steep cut bank runs along the north side of the river, and near its west end a slide has carried down a large section of the bank. The cliff is composed above of about twenty feet of stratified sand, through which chalybeate springs are issuing here and there, after cementing the sand in their vicinity into a hard red sandstone. The bottom of the cliff is a soft gray non-calcareous Cretaceous shale.

"On digging into the slide above mentioned, and after passing through a mass of loosely arranged slidden sand, we reached some beautifully stratified sand standing at a high angle. It looked like an old bar or point beside the river, on top of which the bank has slidden, but the false-bedding (if such it be) is very steep, and it is just possible that it may be a portion of the bank, slidden and tilted, but not otherwise disturbed. This sand is composed of grains of quartz in layers, interbedded with layers of fragments of black lignite, the latter occasionally in well rounded pebbles an inch or more in diameter. There is a great quantity of this lignite, the bed of sand, whose thickness could not then be determined, being often composed largely of it.

"These rounded grains and pebbles of lignite have clearly been washed some distance by the water, and deposited alternately with the heavier quartz grains as the current varied in strength, but the quantity present would seem to be too great to permit of its having been washed from any of the known coal seams on the river, the lowest of which is near the mouth of Egg Creek, 400 miles higher up the stream. It is much more likely that these fragments of lignite have been washed from a deposit, not at any great distance, which is now covered.

"In order to determine whether such a deposit of coal exists in the vicinity or not, also whether the Dakota sandstone is here tar-bearing or not, as well as to ascertain the exact nature of the Cretaceous section in this district, where the surface appears to be almost everywhere covered with drift, it would be of the greatest service to make a boring down to the underlying Palæozoic rocks. If either coal or oil were met with the value of the country would be enhanced to many times the cost of the boring. A careful log, with specimens of the drillings from every five feet, should be kept, so that even if nothing of immediate importance were struck, the scientific information obtained would be of great interest. This part of the country has not yet been thoroughly examined, and it is therefore impossible to say whether a complete geological section of the underlying rocks can be obtained from natural exposures, but the overlying glacial and post-glacial deposits appear to be so continuous that it is highly improbable that such a section can be obtained without boring.

"Following the river downwards below Prince Albert, it is found to flow in a gradually deepening valley until in section 36, township 48 range 24, near the head of the rapids, the sides are sloping and composed of dark gray clay, like that weathered from the Pierre shales. The country to the south of here is undulating, with a soil of a gray slightly sandy clay without boulders.

"The bank of the channel is a soft dark gray clay with now and then a few boulders on the points. Occasionally there is an appearance of dark gray shale which may be a true outcrop of the Pierre formation. Half a mile lower down, the river cuts into the south side of the valley, and expose partially bare cliffs of dark gray unstratified clay or till with pebbles and a few boulders, overlaid by irregularly stratified clay. About half of the boulders and a third of the pebbles both here and on the points are of reddish and light yellow Palæozoic limestone, a very few are of Niagara shale, the rest being fine and coarse granite, &c. Almost all the boulders, and a great number of the pebbles are beautifully polished and striated.

"Proceeding eastward, on the south side of the valley, the trail crosses a ridge of sandy hills wooded with pine and poplar, representing the sand dunes on an old shore line, and then strikes out on a wide level plain, through which both branches of the Saskatchewan flow in deep channels with high scarped banks.

"Two miles above the Forks the sides of the valley of the North Branch are about 160 feet high, and show at the top two feet of rounded gravel, below which is about thirty feet of hard unstratified till, with pebbles and a few boulders. Below this the banks, where seen, are covered with slides, but as springs are issuing from beneath the till, it is probable that porous, stratified, inter- or pre-glacial deposits are there present. The boulders are of gneiss, red and yellow Palæozoic limestone, Cretaceous sandstones, etc., and many are beautifully striated.

"At the Forks, the high banks, as far as could be seen, are covered with slides of loose sand.

"Up the South Branch the trail from the Forks crosses the thinly wooded plain for about three miles, ascends a low ridge of sand hills, representing sand spits and dunes on an old shore line, runs over a moderately level country, and for about five miles over a more prominent ridge of sand hills wooded with pine, etc., and across an undulating country to Prince Albert.

"I left Prince Albert on the 7th of October, and remaining one day in Winnipeg to settle accounts with the Hudson's Bay Company, arrived in Ottawa on the 15th of October.

"A large number of specimens were collected, typical of the different classes of rocks met with.

"Between two and three hundred photographs were taken of different features of interest, but unfortunately, many of them, having been taken on defective negative films, were not good."

Mr. Dowling left Ottawa on the 8th of June, and reached Edmonton on the evening of the sixteenth. Here a boatman familiar with the rapids of the Athabasca was engaged. A sailor engaged at Selkirk, had been sent on in advance, with a small sailboat used by Mr. Tyrrell, on Lake Winnipeg, in 1891, and had arrived at Edmonton. The journey to Athabasca Landing was made by wagon, and on the 24th of June the party commenced the descent of the Athabasca. At Fort McMurray, 260 miles below, a canoe was secured, with which to ascend and examine the smaller streams flowing into the Athabasca River and Lake from the east and south. Mr. Dowling further reports on the work as follows:—

"The first river ascended was the Firebag, a small stream rising in a range of hills to the east of Fort McMurray, and joining the Athabasca about eighty miles below. This river in its lowest course cuts a deep valley through the lacustral deposits which form a wide belt bordering the southern shore of Lake Athabasca. Several exposures of the underlying rocks are seen; the first few are of the light coloured Devonian limestone, similar to that exposed on the Athabasca. Further up at the forks of the stream the limestone is followed by the black sandstone holding tar, but this is here represented by beds only a few feet thick, so that it probably does not extend much further to the east.

"The section of the later deposits consists of about ninety feet of stratified sand overlying beds of fine dark clay fifty feet thick. The bedding of the sand is accentuated by a liberal staining of occasional beds by tar. The surface of the country is generally undulating, the soil is principally sand with very little loam, so that it supports only a scanty growth of pines. This sandy country, or sandy plain, was found to stretch all along the south side of the lake and past the Beaver River.

"After calling at Fort Chipeweyan, the southern shore of the lake was followed to the east end, and a survey of it was made with compass and boat log.

"The streams examined were the Old Fort River and the William River. The former was found to be perhaps the larger, though the William River has a larger channel, and evidently in the spring is a fair sized river. Both cut through the sand beds to the underlying rock, which was in both cases of a hard reddish or brownish sandstone. The low water in the William River compelled us to leave the canoe and travel across country in order to examine the part of the river above the rapids. About fifteen miles of bare sand plains were crossed before we came into the scrub pine country again. The

country here is more undulating, and the river is said to rise far to the south in the Muskeg Mountains.

"The general character of the southern shore of the lake is monotonous, mostly sand beach, varied occasionally by boulder points. Ledges of sandstone appear in two or three places, but the shore is generally backed by cliffs of sand. Behind, the country rises rapidly, and is covered with a light growth of small Banksian pines. There are a few spruce and birch in the valleys of the small streams and on a narrow strip along the lake shore.

"The turbid waters of the Athabasca, entering the western part of the lake, colour the lake water to the eastward. On the 20th of July this extended fifty miles eastward from the mouth of the river. Beyond this the lake water was clear, blue and cold, the surface temperature being 47° F. On July the 28th we reached Fond du Lac (Hudson Bay Company's trading post) a few hours after Mr. Tyrrell.

"The log survey was continued eastward, and the end of the lake was reached on the evening of the 1st of August. Thence, on the river portion of the route, the distances were measured by the micrometer. A micrometer survey was made of Black River to Black Lake, and then a log traverse of Black Lake to the mouth of Hatchet River. The micrometer survey was continued up the Hatchet River to Hatchet or Wollaston Lake. The western and southern shores of this lake were traversed by log and compass, and the shores and islands delineated as well as the limited time would allow.

"We decided on trying the southern route to Reindeer Lake by the Swan River. A survey, by pacing the portages and measuring the lakes crossed by the log, was carried to the Swan River. This portion of the route consists of eight portages, from the south-eastern shore of Hatchet Lake *viâ* a chain of small lakes to the head of a small stream running east to Reindeer Lake. This stream proved so shallow that all our efforts were needed in getting down, and the micrometer survey had to be abandoned. An estimated traverse was, however, made to the lake, where we arrived on September the 2nd. A log traverse was made to Lac du Brochet Post, at the north end of this lake. Supplies were obtained, and we returned by the eastern shore to Porcupine Point, and crossed to Vermilion Point. The western shore was followed to the outlet of the lake. The shores and islands of the southern half of the lake are high and rocky. The banks are generally steep, with scarcely any timber. Many of the islands are a mass of gneiss rock, rounded by glacial action, capped by a slight covering of moss and a few small spruce trees.

"The rocks of the northern part are chiefly a coarse dark gneiss. Towards the south bands of finer grained gneiss and mica schist are seen, cut often by dykes of a light red intrusive granite. The direction of striation on the rocks at Reindeer Lake have an average course to the south 10° to 20° west magnetic. The northern limit of poplar occurs about thirty-five miles up the lake. On Deer River, however, the poplar is quite plentiful showing a great change in a few miles. Small shrubs such as the wild cherry and saskatoon berry were noticed with the poplar; the fruit on these was fully ripened and quite dried up on the 21st of September.

"A micrometer survey was made of Deer River to its junction with the Churchill, then of that part of the Churchill between the mouth of Deer River and the Frog Portage where it was concluded on the 21st of September. Intending to reach Prince Albert *viâ* Montreal Lake we turned westward up the Churchill to Stanley Mission or Rapid River, H. B. C. Trading Post. Two miles to the westward a chain of lakes and portages leads to Lac La Ronde at a level of thirty or forty feet above the Churchill River. This lake is situated in the Archæan area; it is of the same character as those to the north, irregular in outline, and dotted with many islands, especially along the western shore. Our course across it lay in the midst of a chain of islands following the strike of the rock which is principally a spotted gneiss. To the west we passed the mouths of several bays in one of which the Indians obtain a soft serpentine from which they manufacture their pipes. Leaving the lake we passed into the drift covered area and saw no more of the Archæan. Among the boulders on the shore of Big Stone Lake some pieces of a light coloured limestone were noticed, and on inquiry I was assured that this limestone occurred in place all along the extreme southern shore of Lac La Ronde.

"Montreal Lake is only a shallow basin about thirty miles long and from five to ten miles wide, situated on a sandy terrace on the northern flank of Montreal Mountain. The outlet is by a small stream flowing north eastward; it cuts through the edge of the terrace and shows a section of sixty feet of stratified sand. Northward the stream flows through several small lakes and generally low country to the south-west corner of Lac La Ronde. The timber in the rocky country bordered by the southern shore of Lac La Ronde is not large or abundant. Southward there is some improvement and large individual spruce trees occur occasionally. The "Lob sticks" at Big Stone, Hudson Bay Company Post, are fine examples of these. On the Montreal River, small Banksian pine cover the eastern slope of the sandy plateau through which the river cuts. No large timber, spruce or pine, is seen till near the lake where, at the southern end, some

groves of large spruce were seen. Montreal Mountain appears to be more than half burnt over. The largest timber seen is on the watershed south of Montreal and Deer lakes. Here the formation of the country is evidently morainic—very rough irregular hills with many boulders. Southward the country slopes gently towards the Saskatchewan. At Montreal Lake, a wagon was hired to carry our baggage to Prince Albert where we arrived on the 12th of October."

After paying the men and storing the outfit Mr. Dowling left for Ottawa and arrived there on the 18th of October.

Cost of season's exploration, Messrs. Tyrrell and Dowling, $3,430.68.

Mr. McInnes left Ottawa on the 9th of June, with instructions to make such surveys and examinations as were required to if possible complete the work on sheet No. 9 of the Ontario series. This sheet adjoins sheet 6 to the east and sheet 8 to the north. It covers an equal area of 3,456 square miles and includes Lac des Mille Lacs and Dog Lake. A large part of the area is unsurveyed and therefore much time was occupied in surveying lakes and rivers. Mr. F. B. Cushing, B.A., of Montreal, and Mr. W. P. Bull, of Toronto, joined the party at Port Arthur as assistants, and Savanne station, seventy miles west of Port Arthur, on the Canadian Pacific Railway, was reached on the 15th of June.

"Lac des Mille Lacs presents a very irregular outline and a large number of islands. The southern edge of the great gneiss area, which occupies the whole of the northern part of the lake and extends northwards beyond the Canadian Pacific Railway track, can be traced along the whole length of the lake from east to west. The contact of the Laurentian gneiss with the Huronian, though generally well marked, is sometimes difficult to define closely, the rocks over a belt of a mile or more in width partaking of the macroscopic character of both series, and only at points widely separated, ranging themselves with one series or the other. Though not apparently the contact of an intrusive mass with sedimentary strata, it shows in certain places many of the phenomena of such a contact, though one series occupies the apparent position of the intrusive as frequently as the other, and each in places incloses blocks of the other and sends off into it long arms or apophyses. The best explanation seems to be that both sets of rocks by the combined effect of heat and pressure, exerted probably at a great depth, have been rendered in places viscous (local conditions determining in each case which remained stable) and so each bears to the other the apparent relation in places of an intrusive mass.

"Three weeks were spent in an examination of the country lying to the south of Greenwater Lake. A series of lakes which lie between the

south-west end of upper Shebandowan Lake and Waykwabionan Lake was examined and found to be wholly within the gneiss area which further south forms the Giant Range, the Huronian belt of Shebandowan extending only a little over two miles to the south of Shebandowan. A micrometer survey was carried north-westwards by the Matawin River and another chain of lakes to Greenwood Lake, and here again only gneiss was found until the iron-bearing belt of Greenwater Lake was struck about a mile south of that lake. The gneiss area of Northern Light Lake was thus shown to extend continuously northwards to the northern shore of Greenwater Lake, which takes its markedly circular form from the northern edge of this gneiss area.

"In order to gain a knowledge of the country lying to the north of the railway, a trip was made from English River by way of Wawung and Pakeeshkon lakes to Muskeg Lake, and thence to Savanne River at Linkoping station on the Canadian Pacific Railway.

"With the exception of a narrow belt of Keewatin green schists which crosses English River, about twelve miles or thereabouts below the crossing of the railway and strikes for a short distance with the general course of the river, Archæan gneisses occupy the whole of the country traversed. The route lay through a series of lakes, the largest of which Pakeeshkon (or Cedar Narrows) Lake lies about twenty-five miles north of Upsala station, on the Canadian Pacific Railway. It is about fifteen miles long, and has an average width of from three miles to half a mile; its discharge flows westerly into English River. The country traversed is generally low, with no hills which rise more than 100 or 150 feet above the general level. Muskegs cover a large part of the surface; the forest growth is of small size, and consists mainly of black spruce, Banksian pine and poplar. That the land, in favourable spots, is capable of cultivation, is shown by the fact that the Indians encamped at Muskeg Lake, on the 31st of August, had had potatoes, which they had grown there, of good size and quality.

"A week was spent in a trip to the western end of Gunflint Lake where are exposed beds which are probably near the base of the Animikie, and which show interstratified beds of iron ore. Although a number of boulders showed fairly good ore, all that were seen in place were very much banded with cherty material. These banded cherty and jaspery beds occupy an almost horizontal position on the top of the upturned Archæan gneisses and schists.

"Three hundred miles were surveyed by micrometer and compass, and about 100 miles by compass and estimated distances.

"The cost of season's work was $1,275.86."

Mr. Smith left Ottawa for the field on the 7th of June, with instructions to continue the work of the preceding season in the country to the north-west of Thunder Bay. Three days were spent at Sudbury to examine, for the purpose of comparison, the contact there of the Laurentian and Huronian systems, and also, some of the nickel ore deposits in that district. He then proceeded, *viâ* Sault Ste. Marie, to Port Arthur, where he arrived on the 13th of June. Here, he was met by Mr. W. W. Leach, of McGill Colloge, Montreal, who had been appointed his assistant for the season.

Mr. Leach proceeded to English River on the 15th of June and was joined there by Mr. Smith on the following day, and on the 17th, the party being completed, proceeded to Scotch Lake to explore a reported route from there to the Seine River. Nine days were spent in sketching and exploring fourteen small lakes south of Big Scotch Lake, but no practicable route to the Seine River was discovered.

On the 27th of June Mr. Smith returned to English River and was there engaged examining the rocks along the line of the Canadian Pacific Railway, east of that station and along the boundary line between the districts of Thunder Bay and Rainy River; he also corrected the topography of Pyramid Lake crossed by this line south of the railway. He explored the English River up its source as far as the northern boundary of the Seine River sheet (No. 6 of the series). During this time Mr. Leach endeavoured to trace a route said to exist between Little Scotch Lake and Brush Creek. He found the country impassable, but added several small lakes to the topography of the district.

On the 2nd of July Mr. Leach and two men were sent to Savanne, with instructions to cross Lac des Mille Lacs, and to meet Mr. Smith on the 5th of July, near the junction of the Fire Steel and Seine rivers; Mr. Smith, after procuring supplies from Rat Portage, proceeded to the rendez-vous by Hay Creek and the Fire Steel River for the purpose of examining the rocks on that route.

Mr. Leach did not reach the meeting place till the 7th of July, owing to a serious accident in one of the rapids of the Upper Seine River, in which the Peterboro' canoe was wrecked.

After mending the canoe sufficiently to carry the party back to Carlstad where they arrived on the ninth, Mr. Smith went to Rat Portage to replace the lost supplies and equipment, returning to Carlstad on the 11th of June.

The party then proceeded down the Fire Steel and Seine rivers, exploring some lakes, tributary to the latter on the way. Leaving the Seine River at the north end of Seine Lake on the 18th, they pro-

ceeded up a route partially surveyed by Mr. Wm. Lawson in 1890, in the hope of being able to find a way through to the lakes sketched in the first part of this season's work, and thus secure a continuous geological section.

Supplies for one week were taken, but owing to the extreme difficulty of the route, the connection through was not completed when the supplies failed, although ten small and medium sized lakes, with their connecting streams were surveyed with micrometer and compass.

The party then went back to Seine Lake, and thence proceeded through a route from this lake to Moose Lake (another expansion of the Seine River, further down its course), correcting the topography of the lakes on this route, by the townships base line surveyed by Mr. Nivens, P.L.S., in 1891. Through this route and down the Seine River expansions, to Steep Rock Lake the rocks were examined more critically and in localities not hitherto visited.

Below Steep Rock Lake the rocks of Beaver Lake, north of Seine River, were then examined. Leaving Mr. Leach on the 1st of August to endeavour to pass down the outlet of Beaver Lake, Mr. Smith proceeded down the Lower Seine River, examining the rocks *en route*, and thence across Rainy Lake.

In Shoal Lake and in Rat Root Bay of Rainy Lake, he examined the conglomerates and their associations for the purpose of comparing them with the Seine River conglomerates, which are in the same horizon as those of Shoal Lake, mapped on the Rainy Lake sheet (No. 3).

Mr. Smith arrived in Fort Francis on the 6th August and was followed a few hours afterwards by Mr. Leach who had found the outlet of Beaver Lake impassable.

Fresh supplies being procured at Fort Francis the party left on the 9th of August, and proceeded up Rainy Lake and the Manitou route in order to commence work on the Manitou sheet (No. 4 of the series).

They attempted to find a route from Lake Harris (west of Manitou Lake) to Lake Lawrence and thence to the Lake of the Woods, but failing in this, after traversing six small lakes they proceeded up the Manitou route across the Wabigon Lakes to Elm Bay near Barclay, on the Canadian Pacific Railway, arriving there on the 23rd of August.

Mr. Smith went to Rat Portage on the 24th, remaining till the 29th procuring supplies, visiting the mines on the Lake of the Woods and collecting mining statistics, while Mr. Leach made a log survey of the shore of Big Wabigon Lake.

The party then left Barclay and proceeded up the headwaters of the Little Wabigon River, and up those of the Big Turtle River, to within the limits of the Seine River sheet, when the final topographi-

cal and geological work necessary for the completion of this area was performed.

On the 17th the topographical work being completed Mr. Leach proceeded to the railway at English River, closing his season's work on the 22nd, while Mr. Smith advanced up the Seine and Atikokan rivers, obtaining geological sections over the township outlines surveyed by Mr. Nivens during the previous year.

Minute attention was given to the relations of the quartz-porphyries to the surrounding Keewatin rocks, north of the Seine River and west of Steep Rock Lake, also to the relations of a disconnected area of similar quartz-phosphyries to the rocks of the so-called Steep Rock series and to the Keewatin rocks south-east of Steep Rock Lake.

Round Lake was then connected by a micrometer and compass survey to the boundary line between the districts of Rainy River and Thunder Bay.

Mr. Smith then travelled to Savanne where he arrived on the 8th of October. After settling the business affairs of the season at Port Arthur on the 10th, he went to Toronto, to procure copies of the timber limits and mining location surveys recently made in the area embraced in the Seine River sheet.

He then went to Madoc, to examine the relations between the limestone and Archæan there for comparison with the limestones of the Steep Rock series. He closed the field work of the season at Madoc on the 18th of October and proceeded to Ottawa on the same day.

The work of the season was for the most part of a purely geological character, but considerable topographical detail was secured in hitherto unexplored areas.

The field work in the Seine River area is now completed, and all portions of it, believed to be accessible, have been examined.

The work was necessarily scattered, for supplying incomplete details, and re-examining critical localities, preparatory to writing the report and compiling the map.

A sketch of the geology of the district was given in the last Summary Report. The work of the season while adding to the accuracy and completeness of previous observations suggests no modification of this sketch necessary to record here.

No important discoveries of economic minerals were made, but Mr. Smith finds indications of iron ore bodies, in micaceous schists probably of Couchiching age, and in a lower geological horizon than they are usually looked for in this district. He finds that in his field the gold-bearing veins are associated almost invariably with quartz-porphyries, which from the field evidence he is inclined to regard as the latest

important eruptives of the region. A few of these veins appear to be very rich, and in one of them an interesting association of silver-bearing minerals was observed.

Very little prospecting and no mining has been done in this area during the past season. Mining activity in the Lake of the Woods district has been seriously checked by the failure of the reduction works at Rat Portage, but at two or three of the gold mines work is still being carried on, and at the Sultana Mine, stamp mills are in course of erection.

Near Rat Portage and Keewatin some encouraging discoveries of nickeliferous ore have been made, but none of the specimens assayed show a high percentage of either nickel or copper. Discoveries of gold and also of non-titaniferous magnetic iron ore are reported from Rainy Lake.

The cost of the season's exploration was $1,258.55. Since the foregoing was written Mr. Smith was attacked by an illness which I regret to record terminated fatally on the 19th of January. He had worked eight years on the Geological Survey and was a most painstaking and promissing young geologist. This early and unexpected death is a serious loss to the Department.

Dr. Bell was requested to continue the survey and the necessary observations to complete, if possible, the sheet No. 125 of the Ontario series, Byng Inlet sheet. This sheet adjoins the Sudbury sheet No. 130, to the south, and embraces an area of about 1,800 square miles, including a portion of the Great Manitoulin Island. On the progress of this survey and on the other work of the past year Dr. Bell reports as follows :—

"After the close of the field operations of 1891, the winter months were occupied with office work in the usual way, which embraced reading proofs of the report on the Sudbury district, preparing appendices and attending to the illustrations for it, also correcting proofs of the geological map to accompany it, the preparation of a summary report for 1891, plotting the instrumental surveys which I had made during the summer and preparing other data for the map (sheet 126) on which the work of the season was to be represented. These data included the track-surveys and explorations made by the party and others, in various parts of the area covered by the sheet as well as numerous notes on geological and other observations. The adjustment of the surveys which had been made by others within the same area and the laying down of our geological notes. The specimens collected required to be carefully examined and considered in connection with the geological problems involved. The above formed the basis for work.

ing out the geology of the district which had been gone over during the summer, the solution of which was the ultimate object of the studies made during the winter. In addition to the summary report above referred to a fuller report on sheet 125, Byng Inlet sheet, was partially prepared, but it was found that before a satisfactory account of the geology of the whole area which it covers could be given, more field work would be required to be done. This has been attended to during the past summer and the necessary data have been obtained for completing the report. Besides the above principal duties of the winter months a certain amount of time was taken up in such minor matters as accounts in connection with field work, correspondence on Survey matters, answering inquiries for information, courtesies to visitors to the museum, and preparations for the following season's field-work, etc.

"With reference to the field work of 1892, the object aimed at was the completion of the geology of sheet 126, together with the making of some topographical and geological surveys required to complete sheet 125, and which will be more fully described further on. Sheet 126 embraces Grand Manitoulin Island, except the Indian reserve lying east of Manitowaning and South Bays, Cockburn Island and a strip of country along the main north shore of Lake Huron from Bay of Islands to a point west of Mississagi River, and it may be referred to for convenience as "the Manitoulin Sheet." The islands just named had been geologically surveyed by myself in 1865 and 1866 and some additional details were worked out on the first mentioned island in 1886. La Cloche Island and Peninsula had been examined geologically by the late Mr. Alexander Murray and myself in 1860, while in previous years Mr. Murray had explored the north shore and surveyed the Spanish and Whitefish rivers. It therefore only remained for me to complete the work in certain parts where it seemed defective.

"I was assisted by Mr. H. G. Skill, who had been with me during the two previous seasons, till the 27th of September, and by Mr. W. G. Miller, B.A., and Mr. R. W. Brock, both of whom had been with me in 1891 till the 7th of October. Mr. Miller having unfortunately poisoned his right hand was partially incapacitated during a portion of the season.

"Having determined to make Little Current my headquarters for the season, I left Ottawa on the 27th of June and arrived there on the 1st of July. The first few days were spent in working at the geology in the vicinity. On the 6th of the month Messrs. Miller and Brock were sent to work in that part of Manitoulin Island which lies between West Bay and Bayfield Sound. They were both fully informed as to what had already been done in that section and were each furnished with a

geologically coloured map of the region and were instructed to confine their attention to ascertaining, if possible, new facts in regard to certain formations and to tracing out their boundaries in greater detail.

"On the same day (6th July) I left Little Current with Mr. Skill in order to trace out geological boundaries in the part of the island which lies between West Bay and South Bay. We were favoured by fine weather and made rapid progress, returning to headquarters on the evening of the 12th, while Messrs. Miller and Brock got back on the 16th. The next three days were spent in repairing our canoes and visiting Strawberry Island and other localities in Manitowaning Bay.

"On the 20th I left Little Current in two canoes with my assistants and two other men for the purpose of making a micrometer and compass survey, and a geological examination, of the coast of Georgian Bay from the eastern mouth of French River to Byng Inlet, about twelve miles. Besides the geographical and geological additions to the map, which were to be derived from this work, it was intended to connect the hydrographic survey of this part of Georgian Bay with the surveys of the Crown Lands Department in the vicinity. As is well known, the north-east shore of Georgian Bay is fringed with a belt, several miles in width, of rocks and rocky islands, which are almost innumerable. The hydrographic surveys of the late Admiral Bayfield and of Commander Boulton, R.N., being intended for use from the deep-water stand-point, did not often penetrate far into this fringe of islands and rocks; while the Crown Lands surveys, having been made from the landward side, did not embrace many of these worthless rocks and islands. An intermediate zone was thus left unsurveyed, and therefore, in order to make a more complete and accurate map than had hitherto existed, it was necessary to survey this zone and to establish connections between fixed points in the two classes of surveys already made. My survey included Key Inlet (or "river") Henvey Inlet and part of Byng Inlet. I had made a geological reconnaissance of this coast in 1876 and reported the rocks to consist of common varieties of Laurentian gneiss. Additional geological facts were ascertained on the present occasion and considerable attention was given to the glacial phenomena, which present many points of interest in this part of the country.

"On our return to Little Current Messrs. Skill and Brock were sent with one man to make track surveys and cut out portages between the head of Narrow-Bay and Trout Lake to the north-east of it and also to make a new track-survey of Trout Lake and some geological explorations in its neighbourhood. In the meantime I examined some of the islands of the North Channel and a few days were spent on a trip to

Collingwood, during which Mr. Miller was left in charge of the camp on an island near La Cloche Post.

"On the 20th of August, or a few days after my return to this camp, Messrs. Skill and Brock returned from their work in the Trout Lake district. Some of the islands between Great Cloche Island and Clapperton Island were next examined and on the 24th of August we commenced a detailed instrumental survey of La Cloche Lake and a geological examination of its shores and of the surrounding country. This work occupied all the available weather till the end of this month.

"From the beginning of September till the 18th of the month the time of myself and assistants was taken up in the examination of the north shore and the islands of the North Channel from La Cloche Post to the western extremity of the sheet, with the exception of a few days, during which Mr. Skill with one man was engaged in making a track-survey of McKinnon Lake, east of La Cloche Lake, and an exploration of the intervening country.

"On the 19th of September we started, by way of Whitefish River, for the purpose of making further geological examinations of the country between Bay of Islands and Lake Panache and of the region to the southward of this lake. On the 27th we returned to Little Current, when Mr. Skill was paid off as he was then obliged to return to college.

"On the 28th of September I left Little Current by sail-boat to complete the geological examination of the western part of Manitoulin Island and after rounding the western extremity, I arrived back to the same place on the 6th of October, when Messrs. Miller and Brock were paid off on the 7th and they returned to Toronto in order to resume their college duties.

"From the 7th to the 17th of October was devoted to examining the shores and islands between Little Current and Killarney, employing two men and a sail-boat for this purpose. On the latter day, I left Killarney in a canoe with the same two men to work along the contact of the Laurentian and Huronian rocks to the northward of Collins' Inlet and returned to Little Current on the 30th. One of the two men who accompanied me on this journey was paid off on the 1st and the other on the 4th of November. The remainder of my time, before leaving for Ottawa, was spent in geological work in the neighbourhood of Shigguandah and on the north shore of Bay of Islands, in labelling and packing the specimens collected during the summer and in other duties in connection with the closing of the season's work, and I arrived in Ottawa on the 24th of November. Total cost of season's operations $1,587.27."

The detailed report on the structural and economic geology will be prepared, to accompany the map.

Mr. A.E. Barlow was engaged in carrying on the work necessary for the completion of sheet No. 131 of the Ontario series of geological maps. This sheet adjoins the Sudbury sheet, No. 130, to the east. It covers a similar area of 3,456 square miles between latitude 46° 13′ 20″ and 46° 55′ 07″ north, and longitude 78° 51′ 37″ and 80° 22′ 35″ extending from near Eau Claire station to a little beyond Warren station on the Canadian Pacific Railway. It includes nearly the whole of Lake Nipissing and the southern portions of Lakes Temagami, Temiscaming and Keepawa. Another season will be required before the work necessary for the completion of this sheet will be finished. Mr. Barlow was assisted by Mr. J. T. E. Johnston of this department, who was mainly engaged in a survey of the roads. Mr. Barlow reports as follows :—

" Leaving Ottawa on the 8th of June, a few days were spent at Sudbury collecting information with regard to the working of the nickel mines and obtaining some necessary supplies and equipment. A careful micrometer survey of the western end of Lake Nipissing was made from Cache Bay on the north to Frank Bay on the south side, in the township of Patterson. The shores and islands, which latter are here exceedingly numerous, were carefully delineated and connection made on the west arm with the survey made for the Sudbury sheet. The northern shore of this lake was also examined and also the routes from Lake Nipissing *via* Trout Lake and Nosbonsing Lake and the Mattawa River to the Ottawa. Continuing up the Ottawa to the Long Sault, another micrometer survey was made of Obashing Lake (sometimes wrongly spelled Beauchine) and the route from this to Keepawa Lake, making connection at the one side with the railway survey of the Keepawa branch up the head of Gordon Creek (Norcliffe) and with the survey of the Ottawa River at the foot of the Long Sault. A large number of smaller lakes were also surveyed in this vicinity and the outcrops of the rock exposed on the shores noted. Proceeding up Lake Temiscaming and *viâ* the Matabetchouan River to Lake Temagami, a survey was made from Muddy Water Bay, southwards through Wasæsin-a-gamo (Driftwood Lake), Jumping Caribou, Hanging Stone and Red Cedar lakes to the outlet of Temagami River. Returning to Temagami Lake a geological examination was made of the route *viâ* Gull Lake to Sturgeon River. A micrometer survey was made of Kookaganing and Ashgaming lakes from the outlet of the former into Maskinongé-wagaming, connecting with the recent township survey. During the latter part of September and the beginning of October, Mr. Johnston

was engaged on a survey of the roads in the vicinity of Sturgeon Falls and North Bay, and he carefully noted the occurrence of any outcrops of rocks as the survey progressed.

"The greater portion of the sheet 131 is occupied by the granitoid gneisses of the Laurentian. The line of junction between these and the Huronian belt to the north crosses the Sturgeon River near the Elbow, about three miles south of the Maskinongé River. Thence it runs in a north-easterly direction cutting Cross, Hanging Stone and Jumping Caribou lakes, and continues on to Lake Temiscaming.

"The Huronian rocks therefore cover a comparatively small area in the north-western part of the sheet. They consist of what has been called slate conglomerate, with which large masses of dark greenish gray diabase are associated. The strikes of the Laurentian gneiss show that it generally occurs in extensive circular or irregularly oval-shaped concentric areas which anastomose with one another. The occurrence of crystalline limestone on Iron Island, Lake Nipissing, as well as at the Talon Chute on the Mattawa River, are interesting features in regard to the Laurentian of this district, but the presence of these was noted by the Survey many years ago. On the Manitou Islands in Lake Nipissing a fossiliferous limestone was seen resting unconformably on the gneiss and dipping south-west at a low angle. A collection of fossils was made from this locality by Dr. Selwyn in 1884 and afterwards determined by Dr. Ami, from which he refers the strata to the Black River formation. On Iron Island there is also a coarse, friable sandstone or grit resting unconformably on the gneiss, which might be either Chazy, Calciferous or Potsdam.

"The measurements made were, by micrometer and compass 375 miles, pacing and compass 120 miles, patent log and compass forty-five miles. Total, 570 miles.

"In the micrometer and log surveys the lines of traverse were used as bases for triangulation and thus do not represent the actual work accomplished."

Mr. Barlow finished the season's work and returned to Ottawa on the 8th of October.

The cost of the season's exploration was $1,273.59.

Dr. Ells was requested to continue the working out of the geological structure in the counties of Ottawa and Argenteuil, more particularly along the rivers Gatineau, Du Lièvre, North Nation and Rouge, with their tributaries; extending north from the Ottawa for nearly 100 miles. On this work Dr. Ells reports as follows:—

"A great part of the exploration was carried on by means of canoes, and was greatly facilitated by using the surveys of the principal chains of lakes on the Nation and Rouge rivers, made prior to 1870 by Mr. James Low, and those made later by Mr. L. R. Orde of the large lakes in connection with the Gatineau. These surveys were made with the micrometer, and, as a rule, were found to be very satisfactory. During September and October the phosphate deposits of the Buckingham district were examined in order to obtain, if possible, further evidence regarding the mode of occurrence of the apatite in this district. In this work the topographical map made by Messrs. Ingall and White was used, and the different bands of limestone, in the area examined, were laid down on it. Mr. H. N. Topley, photographer to the department, made a series of photographs showing the contact of the apatite-bearing rocks with the gneiss, and the manner in which the apatite is distributed. The photographs have been coloured to show these contacts, and the different rock bands more distinctly.

"The boundaries of the Potsdam and Calciferous were traced from the mouth of the Gatineau to St. Jérôme as accurately as the thick covering of drift would permit. The clay deposits, which are very extensive in the Ottawa River valley, for the most part conceal the contacts, so that the lines, to some extent, must be conjectural. The edge of the Laurentian rocks, however, is generally recognized by the prominent escarpment of their southern outcrops, especially well seen for some miles on either side of Calumet station on the Canadian Pacific Railway between Montreal and Ottawa. The clay deposits extend for many miles up the Gatineau, and other tributary streams, and fine sections are furnished by excavations on the new line of the Gatineau Valley Railway, not only in the clays and sands, but also in the Laurentian rocks. The greater part of the clays appear to be of fresh water origin, though beds of marine shells were observed in a cutting about one mile north of Chelsea station.

Collections of the flora of the district, north of the Ottawa, were made by my assistant, Mr. McDougall, and a list of the flowering plants, observed during the summer has been handed to Prof. Macoun.

Though canoe routes occur in many directions, connecting by means of short portages, the headwaters of the Gatineau, Du Lièvre, North Nation, Rouge and other streams, with those of the St. Maurice on the east, and with those of the Upper Ottawa on the west, and though the occurrence of calcareous bands was noted on many of these routes, yet there are many large areas in this district, at present, practically inaccessible for detailed geological examination, being destitute of roads and densely wooded; and even on the canoe routes, many stretches along lakes and streams, show no rock outcrops, owing to

the heavy mantle of drift, and it is possible that limestone bands may occur in these, of which no trace is visible on the surface. It would therefore be exceedingly difficult and costly to trace out, and delineate on the maps these limestone bands, especially in view of the fact, brought out very clearly in the compilation of the Buckingham map, by Mr. White, that many of the old plans of the townships from Crown Land surveys are very inaccurate, and need carefully revising. From the work of the last two seasons, in which, the greater part of the roads between the Gatineau and the North River, in rear of Lachute, as well as the principal canoe routes have been surveyed, it would appear that the views of the structure as published thirty years ago need to be considerably modified. Large portions of the Laurentian are clearly crystalline igneous rocks, as for instance, the anorthosites, the pyroxenites, and great areas of syenite, granite and augen-gneiss. The estimated thickness of the stratiform portion of the Laurentian must also be greatly reduced. In it may be included the grayish quartzose and often rusty gneiss, the red orthoclase and the black hornblende gneiss, certain bands of which are highly garnetiferous, and are associated with regularly stratified areas of whitish gray quartzite, which in places resembles an altered quartzose sandstone. The interstratified character of portions of the crystalline dolomite with the grayish rusty gneiss is also very evident. With these may also be classed some areas of conglomerates where well-rounded pebbles of quartzite and gneiss are clearly scattered through beds of banded limestone.

"The structure of the Laurentian in the area under consideration seems to place the Calcareous divisions at the top of the entire series. The red and gray orthoclase gneiss passes upwards by intercalations of thin bands of limestone, into massive beds of limestone, in places several hundred feet thick.

"The limestone and the underlying gneiss occur in a series of folds, in which the synclinals are occupied by the limestone. This structure is many times repeated from the Gatineau to the eastern portion of the area examined. Frequent abrupt changes of dip occur, many of which are due to faults, or to intrusions of dioritic or felspathic rocks. The general strike of the anticlinals is N. 29° E. magnetic, the variation in this district being from 11° to 12° west. In the district between the Gatineau and the North Nation rivers, the occurrence of pyroxenic and felspathic rocks is frequent, the former is generally of some shade of green, the latter generally weathers a grayish white, and from an admixture of quartz and mica assumes sometimes the aspect and composition of granite. The pyroxenic rocks are especially important, as they are intimately associated with the occurrence of apatite, they

often run along the lines of stratification, and have generally been regarded as integral parts of the gneiss. In many places they break directly across the course of the gneiss like dykes, veins or intrusive masses. The apatite deposits are generally associated with these pyroxenic rocks, near the contact with the gneiss, but in so far as observed, in the Buckingham district, the apatite occurs in the gneiss itself only as scattered crystals, with mica, pyroxene, calcite, etc., in the bands of limestone. The horizon of the apatite-bearing pyroxenites is the upper part of the grayish gneiss series, or that part of the Laurentian directly below the limestone formation. The apatite deposits while occurring in the pyroxene near the contact with the gneiss, do not present the character of true veins. The deposits are irregular, sometimes comprising hundreds of tons, and these have frequently been completely worked out, showing them to be entirely disconnected from other deposits; sometimes strings or small leaders from a large pocket connect with another, and sometimes this succession of pockety deposits can be traced for several hundred yards. From the association of the apatite with igneous rocks, no limit can be placed upon its occurrence in depth. In the North Star mine the deposit at 600 ft. deep gave no more signs of disappearing, than do many of those near the surface. At the High Rock mine, the most productive part of the deposit was near the base of the high hill in which the mine is worked. In every observed case of the occurrence of mica and graphite in paying quantities the presence of dyke-like masses of pyroxene or quartz felspar is noted. It is probable also that the same principle applies to the deposits of asbestus, in which, however, the dyke masses are not so clearly defined, but the asbestus occurs encircling lenticular or irregularly oval masses, in veins from one-eighth to half an inch in thickness, several of which occasionally coalesce and produce a vein of fine quality, which extends sometimes for several feet, when it again splits up into the usual small strings. The asbestus from the Laurentian is generally of purer quality than that from the Eastern Townships, being free from admixture of iron grains or earthy impurities, but its shortness of fibre makes it unfit for spinning, and also for many of the purposes for which the long fibre of Thetford mines is specially adapted. The only asbestus mine being worked during the past season, was that of the Templeton Asbestus Co., on the east half of lot 11, range VIII., Templeton. Asbestus similar in quality, however, occurs on lot 16, range V., Portland East, where it was mined to a limited extent several years ago. Near the Gatineau River, a few miles north of Farrelton, deposits of similar character are found similarly situated in the serpentinous portion of the limestone, but they have not yet been worked.

"The most easterly point where it has been seen is in Wentworth, lot 20, range IX., where, however, the veins are too small to mine profitably. In fact small veins of the mineral can be found wherever the limestone becomes serpentinous.

"New deposits of mica are frequently being found, and have been opened at several points, more especially in the areas adjacent to the Lièvre and Gatineau rivers. In the former district a new mine has been opened at the Little Rapids by Mr. W. A. Allan of Ottawa, on lot 6, range I., Portland East, and at the north-east end of Kendall's Lake on lot 26, range XI., Buckingham, by Mr. W. C. Kendall, of Bassin du Lièvre. An opening was also made by Mr. Wm. MacIntosh on the west side of the Lièvre, about one mile below the High Falls. Work has been carried on by Mr. F. O. Lewis, of Montreal, in range III., lot 13, Portland West, where a number of openings have been made, and a considerable quantity of very good mica extracted. This mine is on the west side of Lake Terror, and the mica occurs partly in the gneiss and partly in the limestone.

"A number of new openings for mica have been made in the Gatineau district during the past season, some of which promise well, but these were not examined. The attempts to mine mica on the Rouge River have for the present been abandoned.

"The phosphate mines of the district are for the most part closed, owing to the present depressed condition of the market. Work was carried on during the season at the High Rock, Etna and Ross Mountain mines, and further west at the Blackburn mine in Templeton, but the output in all cases is small.

"In plumbago, the mine owned by Mr. Weart, on the north side of Donaldson's Lake, on lot 26, range VI., Buckingham, has been fitted with new machinery for cleaning the ore, and is now extracting graphite in large quantities. At the Walker Mine on lot 19, range VIII., Buckingham, a large mill for separating and purifying the graphite has been erected, but the mine is at present idle. A new opening for plumbago has been made on lot 13, range X., Buckingham, by Mr. Claxton, of Inverary, Ont., and a trial shipment of 200 tons has been sent to England to ascertain its value. The quantity of graphite here is quite extensive. It is thickly disseminated through a gray rusty gneiss, on the summit of a hill about half a mile east of the Lièvre River.

"A deposit of plumbago is being opened on the south-east end of this lake by Mr. Lewis. It occurs in veins up to two inches thick, in a hard felspathic rock. A new vein has also been opened by Captain Bowie, of Ottawa, at the south end of Big Whitefish Lake, in range XIV., lot 47, Hincks.

"I was assisted during the season by Mr. R. MacDougall, B.A., a graduate of McGill College.

"The field work commenced on the 16th of May and continued to the 26th of October.

"Amount expended, $1,375.00."

Mr. Giroux left Ottawa on the 4th of June, to continue the examination and revision of the geological structure in the counties of Berthier, Maskinongé and St. Maurice, in the province of Quebec. Mr. Giroux reports as follows on the result of his investigation :—

"Magnetic iron ore was found on lot 363, R. 11, St. Gabriel de Brandon, Berthier county, on the slope of a little hill, about eight arpents to the west of the road from St. Gabriel de Brandon to St. Norbert, where the rocks consist of gneiss varying very much in composition, being in places highly quartzose, and in others highly hornblendic. It dips N. 62° E. at an angle of 70°, and is cut by small irregular veins of white quartz and coarsely crystalline felspar. It is in some of these small veins that magnetite is present in very small bunches, measuring one-eighth of an inch to two or two and a half inches. These small veins contain also brownish mica, in crystals measuring from a quarter of an inch to four inches. The iron ore appears to be of good quality, it occurs however, in such small quantity that it is of no economic importance."

Mr. Giroux then proceeded to St. Michel des Saints in the county of Berthier and left there on the 25th of June, with four men and two canoes to descend the Mattawin River as far as the outlet of "Lac Barré," where a micrometer survey of this lake and its outlet was commenced. Lac Ignace and the chain of lakes and portages leading to Lac à Jean, at the head of Rivière à Jean, which empties into Lac sans Bout were surveyed. The country being heavily drift-covered no rock exposures were found for a distance of six or seven miles to the south-east of Mattawin River. There the gray gneiss crops out, and light brownish, coarsely crystalline syenite is met with as well as quartzose granitic rock containing inclusions of pinkish felspar. On Bottle River Lake, as almost everywhere in this section of the country, the gneiss is in places highly quartzose and in others highly hornblendic, the hornblende being almost pure in small layers or bands. When the gneiss is highly quartzose it is garnetiferous and holds small patches of pinkish calcite with hornblende in small crystals. Where the dip could be observed in this section it varied from S. 18° to 25° E. < 10° to 22°. The boulders along the shores of some of the small lakes are vermilion red and look as if they were blood-stained. These stains can be easily scratched : but as I could

not wash them off, I think they are not of organic origin but composed of sesquioxide of iron. On a small lake at the head of Rivière à Jean, there are ledges of gray, highly quartzose garnetiferous gneiss dipping N. 70° W. < 22°, but this must be merely a local change in the trend, as a short distance further south-east the rocks dip S. 42° W. < 10°. On a little lake to the north, and not far from Lac à Jean, there is an exposure about four chains wide of calcareous rock, dark gray-weathering and conglomeratic in appearance, containing angular pieces of quartz and hornblende, crystals of pinkish felspar, garnet, and a black mineral, probably tourmaline. Quartz is also present in small grains, the size of a pea. On Lac à Jean most of the gneiss is reddish brown, and an area of syenitic rock about 500 yards occurs there. From Lac à Jean to Lac sans Bout the brownish gray and dark gray hornblendic gneisses only are seen.

From the confluence or the outlet of Lac Barré into the Mattawin River to Lac sans Bout, a distance of about twenty-five miles in a straight south-easterly direction, eighteen lakes and seventeen portages were surveyed. The party then proceeded to Lac Saccacomie by Rivière à l'Araignée, Lac Violon, Lac Bleu and other small lakes. The same gneisses are very well exhibited all along, and on a little lake near Lac de la Culbute, is an anticlinal in reddish-brown micaceous and felspathic gneiss which contains pinkish felspar in very large crystals and irregular patches, as well as white quartz in small irregular veins and patches. This anticlinal is plainly seen near the end of the portage road to Lac Carufel, where the gneiss dips N. 25° E. < 10, and S. 25° W. < 17°. On a little island in this lake, and associated with the coarsely crystalline pinkish felspar and white quartz are crystals of mica, some measuring about three inches. Coarse syenite, reddish in colour, occurs on the southern shore of Lake Willy, all along the portage from this lake to Lac Saccacomie, and for about three-quarters of a mile along the northern shore of this last lake. Most of the gneiss around this lake is reddish-brown, but on the south-eastern shore a band of about a quarter of a mile wide of gray gneiss dipping S. 3° to 12° E. < 17° comes in. Some of the gneiss around this lake weathers reddish and has a mottled appearance due to the weathering out of the quartzose parts. These quartzose patches are bluish-white and appear like fish scales on the weathered surface.

The distance, in a straight course from the south-eastern end of Lac sans Bout to the south-eastern end of Lac Saccacomie, is about eleven miles, and in that distance ten lakes and eight portages were surveyed,

Being almost out of provisions, a fresh supply had to be obtained from St. Alexis, before going across to Rivière du Loup by way of Lac

Carufel. The portage from Lac Saccacomie to Lac Carufel is about two miles long and passes over a mountain, 370 feet higher than Lac Saccacomie, composed of brownish gneiss which is also well exhibited all around Lac Carufel, and in one place it contains small scales of plumbago associated with crystals of garnet and white quartz. Similar gneiss extends north-westward to Rivière du Loup and dips S. 22° to 33° E $<$ 25° to 30°.

Rivière du Loup was then ascended as far up as Pembina River, which was surveyed to Lac Pembina, passing over similar gneiss all the way. Near Lac Pembina, a vein of quartz and felspar, eighteen inches wide, cuts across the gneiss and contains large crystals of mica. A few miles north of this lake, mica in large crystals weathers greenish and has a greenish lustre in fresh fractures, and in a little lake, further up is a vein of quartz about twenty inches wide, running S. 33° E. and N. 33° W., for a distance of about five chains. On each side of this vein is a band of pinkish felspar very coarsely crystalline; at the contact of these two minerals are small bunches of magnetic iron ore and crystals of mica about one inch and a half in size. When this vein disappears it consists entirely of felspar, and then the magnetite is more plentiful in it. The quartz which appears in these felspar veins and patches varies in colour from white to bluish white, and when of the last colour it almost always contains mica in quite large crystals. On the 17th of August the main east branch of Rivière du Loup, was reached and as provisions were nearly exhausted two men were sent to St. Michel des Saints for a fresh supply, and a raft was made with which to continue the survey of this river, to its forks with Lac Sorcier branch surveyed last summer. It is on this branch of Rivière du Loup, and about three miles from the forks, that an excavation was made a few years ago in search of mica which occurred in small crystals and in very limited quantity in a dyke of very coarsely crystalline felspar and quartz on the west side of the river and in almost pure quartz on the east side. To the south of this dyke there is a bed of almost pure quartz about sixty-five feet wide which is flanked by a band of garnetiferous gneiss eighteen inches wide. Small crystals of apatite were found in this dyke, near its contact with the gneiss. The east branch of Rivière du Loup; was surveyed to its head, then the Mattawin River was ascended by a chain of lakes. On Lac des Sables, where the men sent for provisions rejoined the party on their return from St. Michel des Saints, there is a small boss of heavy black hornblendic ferruginous rock, very rough weathering and coarsely crystalline. A similar rock was also seen in two or three other places. Mica in crystals, two to two and a half inches in size, and traces of iron

ore were observed in numerous places. At Lac des Isles, there is an anticlinal, and north of this lake, as far as Mattawin River, the gneisses dip N. 10° to 37° E. < 8° to 27°. About one mile and a half south of Mattawin River, and not far from the supposed line of division between St. Maurice and Maskinongé counties, there is asmall band, about nine inches thick, of pink calcite containing a dark-green mineral, probably pyroxene.

In the section from Lac Michelin along Michelin Brook, which empties into Mattawin River not far from Rivière à la Chienne, the gneiss is generally quartzose.

The Mattawin River was then descended as far as Yinkamak Brook, a distance of about thirty-five miles. This river is very rough, there being fifteen rapids between the two points named. The rocks along this portion of the river consist mostly of gray and brownish gray gneiss, which dips S. 35° E. < 20° near Rivière à la Chienne. On the portage of Rapide de l'Arachi there is a mass of reddish syenite eighty paces wide. From the head of Le Rapide de l'Aigle No. 3 down to Yinkamak Brook the gneiss dips N. 27° to 73° E. < 10° to 40°, and white crystalline micaceous limestone can be seen in highly quartzose gneiss at a short distance from the foot of Le Rapide Pins Rouges. Magnetic iron ore occurs in small quantity at the foot of Le Rapide de l'Ours. From the mouth of Yinkamak Brook to near the foot of Lac Piza Gonge or Mistagance, the same greyish and brownish gneisses are met with. From Lac Piza Gonge Mr. Giroux returned to St. Michel des Saints, where he arrived on the 24th of September. From that date to the 5th of October, was occupied in visiting several localities to the north of Mattawin River and on Rivière du Milieu. Near Lake Cutaway, situated in the township of De Maisonneuve, the gneiss is cut by a vein of whitish felspar and white quartz containing crystals of garnet and scales of plumbago which can also be found in an outcrop of decomposed limestone situated on the outlet of Lake Cutaway, about six arpents from its head. About three-quarters of a mile from this last lake and near a little brook which empties into its outlet, some excavations were made, a few years ago, in search of mica which can be seen in large crystals on the dump alongside the pit. Pieces of apatite were also found in the dump, but none of it could be seen *in situ*. The rock there consists of a much broken quartzose, rusty gneiss containing but little mica and holding iron pyrites in small bunches and cubes.

Serpentine limestone occurs on the side of a high hill in the township of De Maisonneuve near the supposed line of division between Berthier and Maskinongé counties, and about five miles south-east of the northern boundary line of the township of De Maisonneuve. This

limestone is highly micaceous in places, mottled yellowish, friable when not serpentinous and contains scales of plumbago. The whole hill is covered with drift and therefore it could not be determined how far this limestone extended, but it can be traced for about ten chains. An excavation has been made there in search of asbestus, but none could be seen.

The mica of the De Maisonneuve mica mine occurs in a dyke of coarsely crystalline felspar and quartz; it is of a very good colour, but unfortunately the crystals are so much intermixed and twisted that it is of little value. On the east shore of Rivière du Milieu and about three miles and a half north-west of Lac des Pins, there is a deposit of iron ochre of indian red and vandyke brown colours which has been worked by Mr. Gaucher, of Montreal, who had a few tons of it dried and sent to him to test, but no work has been done lately. Limestone is burnt for lime in two places in the township of Brassard, and in one of these quarries on lot 20, range C, this rock is micaceous and serpentinous in places, and very small thread-like veins of asbestus were noticed in it. On lot 44, range B, Brassard township, the micaceous and hornblendic gneiss dips S. 75° W. $< 85°$ and is cut by a small irregular honeycombed quartz vein, which has been opened by a settler; it contains a little iron pyrite and plumbago.

From the 10th to the 17th of October, fifty-nine miles of roads were surveyed in the neighbourhood of Ste. Emilie, St. Côme, St. Jean de Matha, St. Damien and St. Gabriel de Brandon. From the 18th to the 30th of the same month was occupied in the vicinity of St. Didace, St. Alexis, Ste. Ursule, St. Paulin and St. Norbert in tracing the limit of the syenite area of that district.

The old mines and other points of interest about Joliette, Radstock, St. Alphonse and Chertsey were then examined; the Canada Iron Furnace Co. of Radnor has been working actively since the middle of September in ranges III. and IV. of the township of Joliette, St. Ambroise parish, Joliette county. It was learned from the company's foreman that the deposit of bog iron ore on range III., township of Joliette, was one of the best yet worked by the company. It varies from twelve to eighteen inches in thickness and is about three chains wide by five chains long. This company has worked at a small deposit of magnetic iron ore in concession St. Charles, Rang Double, of the parish of Ste. Ursule, and expects to ship about 100 carloads of ore from St. Ambroise parish, and about forty carloads from the parish of Ste. Elizabeth.

A small deposit of infusorial earth has been discovered near a small lake, a few miles north of Chertsey, and the inhabitants use this material for whitewashing their buildings.

Mr. Giroux went to Quebec to get copies of certain plans of surveys made lately in the northern part of Berthier county, relating to Ottawa, and before coming back went to Vaudreuil and Rigaud to get copies of plans needed by Dr. Ells.

The surveys during the season included 235 miles of rivers, lakes and portage roads by micrometer and prismatic compass, and 163 miles of roads with the wheel.

Mr. Giroux returned to Ottawa on the 22nd of November.

The cost of the season's explorations was $1,053.09.

Professor Laflamme furnishes the following statement of the observations he was requested to make in the counties of Charlevoix and Montmorency during the vacation of 1892.

"The whole time was devoted to identifying and locating the supposed Cambro-Silurian deposits said to exist in the mountains of the counties of Charlevoix and Montmorency, as well as in the neighbourhood of Lake St. John.

"The supposed outcrops of limestone, the examination of which has been loudly called for, were only dark slightly calcareous sandstones. Moreover in my long researches in these different localities I have never found these sandstones in place. I have always met with them as detached blocks, sometimes of great size, but as they are always mixed with morainic debris of all kinds, the determination of their origin is absolutely impossible.

It may meanwhile be noted, that in pursuing my work to the south of Lake St. John, I have found a series of well marked terraces at 600 to 700 feet above the actual level of the lake. I do not suppose that these indicate the ancient shore of Lake St. John; they rather owe their origin to a series of small lakes lying to the south of the great lake, the waters of which have drained themselves towards Lake St. John. It is not uncommon to find at the centre of these stages of terraces, a pond more or less large, which constitutes all that remains of the ancient lake.

"After the series of explorations that I have made extending over several years, in the search for Cambro-Silurian in the Laurentian area; I think I may say that there is no reason to believe in the existence of such deposits outside the large hydrographic depressions the centres of which are occupied by Lake Mistassini and Lake St. John. If such deposits existed elsewhere they have been removed by atmospheric and glacial erosion.

"I regret that I have to offer you such meagre results, but I have thought best to confine myself above all to the examinations of all pos-

sible layers of Cambro-Silurian in the territory assigned to me, to the exclusion of everything else."

Mr. Low, accompanied by Mr. A. H. D. Ross, B.A., as assistant, left Ottawa, on the 26th of May and arrived at Lake St. John on the 30th of May.

Here canoemen were engaged and arrangements for the transport of provisions to Lake Mistassini were made. Owing to the late spring freshets in the rivers the party were unable to start until the 13th of June.

The Achouapmouchouan River was ascended from Lake St. John fifty-eight miles to the Shegobiche branch. This stream was followed to Shegobiche Lake, and from there a portage was made to a small stream falling into the south end of Lake Ashouapmouchouan. A track survey was made of this part of the route and connected at both ends with Mr. Richardson's survey* of the main river. The Shegobiche River is a small stream much obstructed by rapids and falls and only navigable with loaded canoes during high water.

From Lake Ashouapmouchouan the Nikaubau River was followed to the height of land, and from there Obatagoman, Chibougamoo and Wakiniche Lakes were passed through to Lake Mistassini, where the Hudson Bay Post was reached on the 29th of June. On the way from the height of land to Mistassini, the rock exposures along the route were examined and a collection of specimens made from the Huronian rocks of that region, including the deposits of pyrites which occur in abundance in the green slates and diorites of Lake Chibougamoo. At Lake Mistassini the four men engaged bringing in provisions were discharged and returned to Lake St. John.

Leaving the post on the 1st of July a trip was made to the outlet of Lake Mistassini, and a survey line carried from there to the mouth of the Temiscamie River in order to connect the survey of Mr. J. Bignell from Bersimis with those of Messrs. Richardson and McOuat from Lake St. John.

Returning to the post on the 6th of July the party left again next day accompanied by an Indian guide, who knew a route to Lake Kawashagami on a tributary of the East Main River. While on Lake Mistassini a complete set of specimens was obtained from the different beds of limestone there.

At the short portage that passes between the lake and the Rupert River a micrometer and compass survey was commenced and carried from there to the mouth of the East Main River, thus

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* Report of Progress Geol. Survey of Canada, 1870-71.

connecting Mistassini with the point established by Mr. Ogilvy at East Main in 1890.

A few miles below where the Rupert River was reached it is divided by a large island, and these two streams do not again unite for nearly 100 miles.

The eastern channel was descended in a northern direction for about fifty miles, where it turns west to join the other channel. The river runs with a swift current between low rocky banks, and is greatly obstructed by small rocky islands.

Leaving the Rupert River the route passes over the watershed to Lake Kawashagami, through a number of small lakes connected by portages. The discharge of Kawashagami was then followed and the East Main River reached on the 17th of July. The distance between the Rupert and East Main rivers by this route is fifty-eight miles. The surrounding country is rough and barren, and covered with innumerable boulders. The trees are small and consist of black spruce, tamarack and banksian pine, with a few white birch and aspen poplar. Small lakes in this region fill the valleys between the low-rounded ridges of hills, and cover fully one-quarter of the surface.

The East Main River was ascended about forty miles to the first rapid above the Tshegami branch, and from there the survey was carried 308 miles to its mouth, arriving there on the 13th of August.

The East Main River, in its upper part, flows almost level with the surface of the country, and lake-like expansions with deep bays covered with islands are frequent. Many of the islands are large, and one is over twenty miles long. The portage route from the Rupert River strikes the East Main River near the foot of this island.

For over 100 miles from its mouth the river runs in a shallow valley cut into stratified sands and clays. It is fully as large as the Ottawa, at Ottawa city, with an average breadth of a third of a mile. At several places along its course the river contracts and plunges through gorges in heavy rapids and falls; smaller rapids are numerous, and altogether it is probably the most difficult to navigate of all the rivers flowing into Hudson's Bay.

The rocks along the route between Lake Mistassini and the East Main River are all of Laurentian age, being made up of red syenitic gneiss, with pink and gray, mica and mica-hornblende gneisses. Along the Upper East Main River a coarse light-gray pegmatite and black mica-schist predominate, and are associated with pink mica-hornblende gneiss. Lower down stream these give place to an area of light gray and light pink syenite; followed by dark green altered hornblende and chlorite schists, with diorite and a dark gray micaceous schist, be-

coming in places a conglomerate from the presence of rounded pebbles of syenite. This series of rocks closely resembles those north of Lake Huron. The green schists at and near their contact with the diorite masses, are highly charged with pyrites; the diorite also holds considerable quantities of that mineral. In several places large masses of almost pure pyrites were found, and specimens of these are now in the hands of Mr. Hoffmann for analysis.

This band, or similar ones cross and recross the river at intervals for nearly two hundred miles, the strike of the rocks being only slightly different from the general curve of the river. Syenite and ordinary Laurentian gneisses occupy the intervals between the bands of Huronian.

Some time was spent along the coast to the north of East Main River in an attempt to make a micrometer survey of the shore, but owing to unfavourable weather and unsuitable boats this had to be abandoned. From East Main the party travelled to Rupert House in a boat the property of the Hudson Bay Company. At Rupert House the boat belonging to the department was found, and in it passage was taken to Moose Factory. From there the Missinaibie River was ascended to the Canadian Pacific Railway, and Ottawa was reached on the 21st of September. During the summer Mr. Ross made an extensive collection of the plants of the country traversed. These have been examined by Professor Macoun, and while not new, add considerably to the knowledge of the distribution of several species.

The equipment belonging to the department and used on this exploration is stored in Ottawa, with the exception of the large boat which is stored at Moose, along with its necessary equipments.

Cost of exploration, $2,030.12.

Mr. Chalmers left Ottawa on the 17th of May accompanied by Mr. W. J. Wilson as assistant, with instructions to continue investigations in the superficial geology of New Brunswick. Kenneth C. Cochrane, of Brockville, Ont., a student of McGill University, joined Mr. Chalmers at Moncton, N.B., on the 26th of May, also as assistant.

The explorations of the season were carried on in two areas, one in eastern and central New Brunswick between the parallels of 42° and 47° N. latitude, and longitude 65° to 66° W., embracing portions of the counties of Kent and Northumberland and the eastern part of York (sheets Nos. 2 S.E. and 2 S.W. New Brunswick series of maps.) The second area comprised the chief portions of Westmoreland and Albert counties in eastern New Brunswick, and of Cumberland county in Nova Scotia, in latitude 45° 30′ to 46° 15′ N. and longitude 63° 45′ to 64° 45 W. (sheet No. 4, N.W.)

This work was in continuation of that of former years. The party first undertook the examination and study of the surface deposits of the western part of sheet No. 2 S. E. in the valley of the South-west Miramichi River. Messrs. Wilson and Cochrane traversed the roads, while Mr. Chalmers made a canoe trip along the river and its tributaries, the Renous, Dungarvon and Cain's rivers. Work was prosecuted here by Messrs. Wilson and Cochrane till the 14th of June and by Mr. Chalmers for some time later. From here they proceeded to Eastern New Brunswick and Nova Scotia to complete the examination of the area embraced in sheet No. 4 N. W. Owing to the intricate nature of the surface geology of the district included in the eastern part of this sheet, the numerous roads to be traversed, etc., it took until the 15th of September to finish the mapping. Meantime Mr. Cochrane had gone home, having quit field work, on the 10th of September. Subsequently Messrs. Wilson and Chalmers spent some days in levelling the heights of several of the Pleistocene shore lines and marine terraces in New Brunswick and north-western Nova Scotia in order to obtain levels on which to base the barometric work, and to establish more accurately the upper limit of the marine deposits of the post-tertiary age. The party then returned to the upper South-west Miramichi, taking up the work on sheet No. 2 S. W. in the eastern part of York county, N.B. Explorations in this district were extended along the line of the Canada Eastern Railway and Nashwaak River till the 14th of November. Later on some points along the railway lines in north-western Nova Scotia were examined, and further study of gravel ridges and marine terraces made till the close of fieldwork.

On the result of the work Mr. Chalmers reports as follows :—

"The season's investigations are of much interest. In New Brunswick little was added to the store of facts previously known regarding the Pleistocene geology, the observations being in almost every instance confirmatory of conclusions already arrived at. More attention than usual was given to questions relating to the dispersion of boulders, and greater detail in this investigation attempted. The relative distribution of transported boulders in different parts of the Carboniferous area, for example, was ascertained by counting them. All boulders above a minimum size of three inches in diameter on measured areas were thus examined and the different kinds noted. The results were in many cases quite different from what one would arrive at by the usual methods of observation.

"The data respecting glacial striæ and boulder transportation from the higher central parts of New Brunswick when thus examined in detail were all found to be in harmony. Good evidence of the shedding of the Pleistocene ice from the divide between St. John and

the South-west Miramichi waters south-eastward and north-eastward was obtained, and corroborative testimony on this point was adduced from the distribution of the drift.

"In Cumberland county, N.S., the phenomena relating to the surface geology are, as stated, unusually complex. The glaciation appears on the whole, to have been quite local, more so even than in New Brunswick, as might naturally be expected from the insular situation of the province. Numerous different sets of striæ occur on the slope between the Cobequid Mountains and the Straits of Northumberland and it is difficult to say in which direction the dominant ice-movement was. The higher grounds of Leicester Road and Springhill seem to have been centres of distribution for land-ice ; but floating ice has undoubtedly played an important part on the lower coastal tracts. Across the Isthmus of Chignecto floating ice seems to have moved in a general south-westward direction from the straits of Northumberland to the Bay of Fundy, but along these Straits east of Baie Verte it flowed in the direction of N. 70° E. to due east. These floating ice-jams produced heavy deposits of boulder-clay in the low-lying districts. Independent of these ice-movements, and probably of a later date, are the evidences of a northward flow of ice from the Cobequid Mountains over the tract intervening between them and the present shore of the Straits of Northumberland. To the west of Springhill and south of Leicester there was an ice-flow southward and westward towards the northern base of the Cobequids and thence deflected outwards towards the Bay of Fundy south-westwardly.

"The Cobequid Mountains themselves exhibit some very puzzling glacial features. The greater part of the northern slope is without any traces of glaciation, either in the form of striæ or boulder-clay, the rock surfaces being broken and jagged and covered mainly with their own *débris*. No great glacier from the north or floating ice has impinged against the northern face of these mountains. Wherever any traces of ice action are visible it is evident the movement was northward down the slope. On the summit there were gathering grounds from which ice flowed locally in different directions, mainly, however, southward. The effects of ice action are very unequal ; in some places the striation is very light, in others quite heavy. Great quantities of *débris* from the Cobequid Mountains cumber their slopes, and it is evident they have been the seat of erosion, at intervals, since the Carboniferous period, if not previously.

"One of the problems connected with the surface geology of the Cobequids is the presence of sandstone and conglomerate boulders scattered over their summits apparently derived from the Carboniferous rocks to the north which lie from 200 to 400 feet lower (referred

to in 2nd ed. of Acadian Geology). In the absence of any evidence that glaciers or floating ice impinged against the northern slope of these mountains or surmounted their summits, and with the positive proofs of glaciers and floating ice having moved in various directions over the district to the north, it is difficult, indeed impossible, to account for the transportation of boulders, in the direction supposed, on the view that the relative levels of these plains and the hills were the same in the glacial period as at present.

"The theory which has suggested itself to the writer in regard to this matter is that these boulders are remnants of Carboniferous rocks which formerly transgressed upon the crystallines and which have been almost wholly denuded as the mountains sustained a differential uplift relative to the adjacent country in pre-glacial or early glacial times; but further study of the phenomena is required.

"The more exact levelling of Pleistocene shore lines which has been made during the past summer has brought out some new features respecting the irregularity of the last great upheaval of the land. This upheaval seems to have been somewhat greater in New Brunswick than in Nova Scotia, and locally greater along hill and mountain ranges than in level districts. The Cobequids, for example, appear to have been uplifted more than the Carboniferous tract near the Straits of Northumberland, *i. e.* according to the levels of post-glacial marine terraces and shore lines; and similar facts in support of local irregularities in the oscillatory movement were observed in New Brunswick.

"Kames and terraced gravels, sands, etc., are found in many parts of Cumberland county, the most noteworthy of the former being the 'Boar's Back' along River Hebert. The terraces on the east side of the valley in which Halfway Lake lies appear to be marine, and if so River Hebert valley and the Parrsboro' pass in the Cobequids formed a strait during the post-glacial subsidence of the land. The materials of the terraces referred to and of the 'Boar's Back' were thrown down at this stage, and the erosion which took place during the rise of the land which followed shaped the latter. A post-glacial lake existed at Halfway River of which Halfway Lake is a remnant, and the discharge from this was by River Hebert valley. The details here are of great interest, but investigations are not yet complete.

"Observations on the subsidence of the land around the head of the Bay of Fundy in the Recent Period were continued and additional facts obtained. At the public wharf at Edgett's Landing, Albert county, in the mouth of the Petitcodiac River, stumps of trees *in situ* occur thirty-eight feet below the highest neap tides, or nineteen feet below mean tide level. They are firmly rooted in what must have been upland soil. This fact taken in connection with the evidences of recent sub-

sidence at Aulac, Intercolonial Railway, and at Fort Lawrence dock, Chignecto Marine Railway, recorded in former reports, leave no doubt that a sinking of the land has taken place here since the last upheaval in post-glacial times.

"The agricultural character of the district explored in New Brunswick during the season is closely similar to that of the Carboniferous area of the province described in previous reports. Along the South-west Miramichi and its branches, especially the Renous and Dungarvon, there are some fine intervals. In the wider parts of the main South-west valley as at Indiantown, Blackville, Doaktown and Boiestown, meadow lands of considerable area are under cultivation. The uplands are likewise of good agricultural capabilities, especially near the rivers, and wherever they have sufficient natural drainage to carry off the surplus waters. Upon the belt of country underlaid by the Cambro-Silurian and Lower Carboniferous rocks, which however, is still forest-clad, there are large tracts of excellent land available for settlement as soon as roads are opened up to them.

"The low-lying Upper Carboniferous plains and the salt marshes around the different arms of the Bay of Fundy in Westmoreland county, New Brunswick, and Cumberland county, Nova Scotia, have long been known as the best agricultural districts in the Maritime provinces. Large portions are cleared and tilled. Better systems of cultivation are now introduced, and the effect of the improved methods inculcated by the Experimental Farm at Nappan, Nova Scotia, is becoming apparent in the districts around it.

"The forest growth of the respective districts examined has been mapped with as near an approach to accuracy as the nature of the country and other circumstances would permit. In the tract drained by the South-west Miramichi, especially upon the Carboniferous area, forest fires have destroyed the larger portion of the original growth, at various times within the last three-quarters of a century. On the higher grounds to the north-west, occupied by the pre-Carboniferous rocks, the original forest prevails, often as heavy timber, consisting principally of deciduous trees, the evergreens (spruce, pine, etc.,) having been largely cut away.

"In Cumberland county, N.S., but little of the original growth remains, except on the Cobequids. On these there is a dense forest of hardwood, interspersed with spruce, pine, hemlock, etc. To the north of the Intercolonial Railway between Maccan and Salt Springs stations, also in the districts west of Springhill Mines, and between River Hebert and the Bay of Fundy, there are still areas covered by the old forest.

"The materials of economic importance which came under our observation during the past season are as follows:—

"Infusorial earth (tripolite) is found at Folly Lake, Fountain Lake and Sutherland Lake, on the Cobequid Mountains. Considerable quantities of this material occur at the two first-mentioned places, but scarcely anything has yet been done towards utilizing it. These deposits are described by Dr. R. W. Ells in Annual Report, Vol. I., 1885, pp. 70-71 EE.

"The bog-iron deposits (ferric oxide) known as the "paint mine," near Chaplin Island on the North-west Miramichi River, were re-examined, (referred to in Annual Report, Vol. III., 1887-88, p. 3 N.) This ore seems to be in process of formation and is now being deposited on the rock surface along the bank in several places through the agency of springs. Peat bogs and swamps lie behind, the decaying organic matter in these yields acids that are doubtless instrumental in the production of the ore. The "paint" formed from the oxide is reported to be of good quality.

"Bog manganese, in a loose amorphous condition, has been found near Harvey, Albert county, N.B., similar to that occurring at Weldon Creek, referred to in the Summary Report for 1891, p. 34.

"Brick-kilns are in operation near Amherst; at Oxford; on Pugwash River about half a mile from Conn's Mills, and at Wallace River near the bridge of the Oxford and Pictou Branch Railway. Brick-clays are abundant in many parts of the district.

"Argentiferous galena, and iron and copper pyrites, reported to contain traces of gold, occur along the North-west Miramichi River, between the mouths of two of its tributaries, the Tomogonops and Little rivers, in Cambro-Silurian slates which are traversed by broken quartz seams. These minerals are found under somewhat similar conditions to the pyritous and galena ores near Bathurst, on the south side of the Baie des Chaleurs, and appear to be of much the same character.

"The discovery and opening up of a coal seam in the eastern part of Gloucester county, N.B., on the south side of the Baie des Chaleurs, having been reported, I visited it late in the season. The coal crops out in the bank of a small brook on a road leading south from Upper Caraquet, and about four miles and a half distant from that place. A trench cut into the bank exposes the coal seam, which is sixteen inches thick, and has another thin seam overlying it, with a parting of fireclay between them. A short distance farther east a shaft has been sunk, but was partly filled with water on the occasion of my visit, and I did not see the coal seam there. The workmen, however, informed

me that it was somewhat thicker than where I measured it; and in the heap of coal on the bank taken from this opening, the quality seemed better, that is, the coal was harder and came out in larger pieces. The dip of the seam corresponds with that of the sandstone strata, being 5° to 10° eastward, and consequently the thickness of rock overlying it becomes greater in that direction.

"Photographs of a number of exposures of glacial striæ, some of them evidencing the action of floating ice, were taken. We also photographed several Pleistocene shore lines as well as sections in excavations of the superficial deposits, especially that showing the forest bed in the opening for the western dock of the Chignecto Marine Transport Railway.

"Field work closed on the 21st of December, and on the 25th I reached Ottawa, Mr. Wilson remaining to copy barometric readings at the Meteorological stations at Fredericton and Chatham and reaching Ottawa on the 31st of December.

"The cost of the season's explorations including Mr. Cochrane's salary was $1,407.51."

Mr. Faribault left Ottawa on the 14th June, with instructions to continue the detailed surveys of previous years and make further study of the structure of the gold-bearing rocks of the Atlantic coast of Nova Scotia.

The district surveyed lies westward of that surveyed in 1891 and extends on the north-west side of the Intercolonial railway, from the Nine Mile River to Bedford and as far as the Gore, Central Rawdon, Newport, Mount Uniacke, Lake Pockwock and Hammond's Plains; covering an area of 190 square miles in Hants county, and 160 square miles in Halifax county. Besides this, Mr. Laberge surveyed with the odometer 180 miles of roads in Halifax county and thirty-five miles in Lunenburg county, to be used as tie-lines in next year's contemplated work.

The region examined is occupied entirely by the auriferous Lower Cambrian rocks which are the extension to the south and south-east of the rocks described last year; while on the north they are unconformably overlaid by the Lower Carboniferous studied by Mr. H. Fletcher, and on the west come against the most eastern spur of a great mass of granite and granitoid rock, supposed to extend uninterruptedly to the western part of the province.

The various east and west plications of these rocks, and more especially their anticlinal axes were minutely examined and traced, as in former years, on account of their close relation to the auriferous belts.

Those of Waverley, Oldham and Carroll's Corner, traced last year to the Beaver Bank road, were followed westward. The first crosses the Windsor road half a mile north of its junction with the old Cobequid road, the old Hammond's Plains road at the south end of Sandy Lake, and Karney's road at the head of Karney's Lake, beyond which it strikes the granite mass. Many quartz veins have been prospected to a small extent along this line, particularly in the vicinity of Karney's Lake where veins showing a little gold have been opened.

Some five miles and a half further north is the anticlinal fold of the Oldham gold district which flattens out and disappears three miles east of the mine; while to the westward its axis dips westerly so fast that at the railway bridge on the inlet of Grand Lake, the lower auriferous quartzites are entirely covered by the upper graphitic slates. The latter form here a belt nearly three miles wide, crossing the Windsor road between the Upper Sackville post office and the fork of the roads, one mile south of Middle Sackville post office and striking the granite mass at Hammond's Plains. Good paving slabs and a little roofing slate were quarried in this belt at Beaver Bank station, where the stratification is horizontal and the cleavage perpendicular to it, making the splitting very easy. Outside the district of Oldham this anticlinal is apparently of no economic importance.

Two miles north of it is Carroll's Corner anticlinal. It crosses Key's Brook half a mile above the road, where some exploratory work on two or three auriferous leads was done a few years ago, and running westward crosses the Shubenacadie River, along which it is concealed by a narrow basin of Lower Carboniferous rocks, passes about Enfield station, strikes the outlet of Grand Lake and its north-western shore at the mouth of Rocky Brook, crosses Sandy Lake, the north end of Square Lake and the Windsor road at Lewis Lake and ends at the mass of granite on Pockwock Lake. That no prospecting has been done along this anticlinal west of Key's Brook is probably due to its being in great part covered by forest and thick soil, but no doubt systematic exploratory work would reveal auriferous veins, especially between Grand Lake and Lewis Lake.

The next folds further north are covered over at their eastern extremities by the Lower Carboniferous basin of the Shubenacadie River and have not been met with to the eastward. It is very probable, however, that the first anticlinal passing through South Uniacke gold district and the black slate belt north of it are the prolongation of the folds already traced immediately south of the Lower Carboniferous basin of the upper Stewiacke River. The South Uniacke anticlinal, unlike any other fold, has flat dips on its south side for a distance of over a quarter of a mile, while its north side is perpen-

dicular. The rich "Hard lead," worked by Mr. Thompson in this district, lies as much as 900 feet north from the apex of the fold. But it is important to notice here that this lead, like most of the richest leads worked in the province, is situated at the limit of the curvature of the denuded fold, or in other words where the dip of the fold, after having gradually increased from 0° at the apex to an angle varying from 45° to 90°, becomes uniform, and does not change for a certain distance. It is, to a certain degree, for the same reason that in sharp anticlinal folds the richest leads are situated near the apex, as at the districts of Salmon River, Fifteen Mile Stream, Killag, Carribou, Mooseland and the west end of Oldham; while in broad anticlinal folds, like those of Renfrew and the east end of Oldham, the richest leads are generally at a considerable distance from the apex. The anticlinal appears to extend only a short distance east of the gold district of South Uniacke, but to the westward a great many quartz leads might be prospected with advantage as far as the Windsor road which it crosses a quarter of a mile north of the county line to come against the granite west of Lacy Mill Lake.

The black slate belt, in the synclinal trough between this anticlinal and the next, is one mile and three-quarters wide where it crosses the Renfrew road about the north end of Grand Lake, but further west, at the Eller Settlement on the Windsor road, a small anticlinal fold brings up a band of lower "whin" rocks one mile wide, thus dividing the slate belt into two bands, the south one three-quarters of a mile wide extending but a short distance further west to the granite mass on West Lake, while the north band, only a few hundred feet wide, disappears and is replaced by "whin" before reaching the granite mass.

A quarter of a mile above the mouth of the Annand Brook on the north side of Grand Lake, there is a most promising deposit of good red hematite in the conglomerate of the Lower Carboniferous at its contact with the south edge of the last described ferruginous and graphitic slate, to which it owes its origin. The deposit is of the same character as that opened at Newton Mills in Colchester county. Explorations have been made lately; a tunnel, thirty-three feet long, has been driven in the solid slate and small pits have been dug in the conglomerate. It is certainly useless to look for the ore in the solid slate, but prospecting in the conglomerate along the line of contact would no doubt reveal important bodies of ore.

North of the slate belt is the Mount Uniacke anticlinal fold. Its eastern end has the form of a broad elliptical dome, on the south side of which are situated the Renfrew gold mines operated for many years,

but very little worked at present. Running westward, this anticlinal passes south of McGrath Lake, and west of Beaver Bank road it appears to have been disturbed by a fault with a thrust of a mile or so to the south on the west side. Resuming its course westward, it has all the leads of the gold district of Mount Uniacke, once so extensively worked, on its south dips, and crosses the Windsor road at the middle of the large bog, half way between Mount Uniacke station and Lakeland, beyond which it comes in contact with the granite. This anticlinal, the most important in the region surveyed and the fault above mentioned require further examination. Suffice it to say at present that systematic explorations in the last two mentioned gold districts would certainly bring to light a great many new auriferous leads and that many leads worked to small depths and abandoned in the earlier days of the districts could now be worked with profit by the improved and more economical methods of mining of the last few years.

The auriferous quartz veins worked to some extent a few years ago at East Rawdon are apparently on a small local fold of the lower "whin" rocks near the southern edge of the Rawdon slate belt and require further examination.

Some three miles and three-quarters north of the Mount Uniacke anticlinal is the broad and well known slate belt of Rawdon Hills. The eastern point of this belt extends as far as the Bar Settlement, where it is covered by the Lower Carboniferous. At Upper Rawdon it has a width of five miles and a half, on the Beaver Bank road, between George Wallace's and the Gore; at Central Rawdon, of four miles between South Rawdon post office and Woodville; it extends west a short distance beyond Upper Newport and Ardoise Hill, where it is covered by Lower Carboniferous gypsum and limestone. These rocks are lithologically the same as those of the upper graphitic slate group of the Lower Cambrian, like them they rest conformably, along their southern limits, on the lower quartzite rocks and are undoubtedly of the same age. Certain forms from the slate of the Northup mine, Central Rawdon, believed to be of organic origin, have led some to suppose that they were newer; but a large number of specimens collected here by Mr. Fletcher in 1890 and last summer by the writer, have been found on microscopic examination by Mr. T. C. Weston* to be merely dolomitic concretions.

The Rawdon slate belt is plicated in a synclinal and anticlinal fold.

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*Summary Report, 1890, page 40; Trans. N.S. Inst. Sc., Ser. 2, Vol. I, page 137.

The latter passes a short distance north of Central Rawdon, and at Upper Newport, brings up along its apex a narrow ridge of the lower quartzite group with numerous quartz veins, some of which (one mile west of Upper Newport post office) were prospected and found to be auriferous. Quartz veins of great width and length, cutting these uptilted slates at a right angle, are very numerous, and those worked so successfully a few years ago at Central Rawdon and found to contain such rich pockets, belong to the group of true fissure veins. No doubt these veins were formed by segregation out of the adjacent auriferous slates, but it is not probable that gold is as uniformly distributed through the whole thickness of these slates as it is through the "whin" series, and moreover as no structural indication is yet known as a guide to the location of the auriferous cross veins, these slates will never be as tempting a field as the "whin" series, where systematic prospecting along anticlinals directed by experienced mining engineers, well acquainted with the peculiar structure of the Nova Scotia gold districts, is likely to be successful. These Rawdon slates are, on the east, north and west sides unconformably covered by the Lower Carboniferous rocks.

The following table compiled from the annual reports of the Department of Mines of Nova Scotia, gives the yield of gold from each of the five districts examined last season, for the five years ending 31st December, 1891 :—

District.	When first worked.	Tons crushed.	Yield of gold per ton.	Total yield of gold.
			Oz.	Oz.
South Uniacke*	1889	462	10·48	4,842
Mount Uniacke	1866	7,573	0·46	3,503
Renfrew	1861	5,960	0·89	5,309
Central and East Rawdon	1884	11,389	0·79	9,058
Total		25,384	0·90	22,712

*Yield from October, 1889, to November, 1892.

The above averages of yield of gold per ton are certainly very satisfactory when it is remembered that, in most mines properly equipped and economically worked, a yield of 5 to 15 dwt. of gold per ton ought to pay.

The West Gore Antimony mine, operated from 1884 to 1890, was, when visited, filled with water, consequently very little can be said about it. The principal ore is stibnite, sulphuret of antimony or gray antimony, with a little kermesite or red antimony and traces of native antimony. It occurs in a quartz fissure vein cutting the

slates at right angles, in apparently the same manner as the gold-bearing veins of Central Rawdon. Dr. Gilpin in the report of the Department of Mines of Nova Scotia for 1884, makes the following remarks: During the past year a valuable mine of antimony ore has been opened out at Rawdon, Hants county. Two shafts, about 120 feet apart have been sunk about 175 feet, and levels driven, and 600 tons of No. 1 ore raised. The vein which is of gray antimony ore, is from four to eighteen inches in width, cutting talcose slates. There is little impurity present beyond small amounts of quartz and calcspar. An analysis by Mr. M. H. Smith showed the ores to be almost of chemical purity, having little beyond mere traces of foreign material. This discovery has led to prospecting for other deposits of the ore, and it is probable that a large district here will be found to yield it. Similar ore has been reported from Upper Stewiacke, Melrose and Trafalgar." The amount of ore annually exported since the opening of the mine is taken from the reports of the Department of Mines of Nova Scotia as follows :—

Year.	Tons.
1884	600
1885	758
1886	645
1887	400
1888	308
1889	55
1890	26

A saline mineral spring was noticed half a mile east of Renfrew, at the contact of the Lower Carboniferous and the Lower Cambrian.

One month was spent during the summer revising the work in some localities in Guysboro' and Halifax counties in order to study a few unsettled points, locate more precisely certain anticlinals and have the maps, which are now being engraved, of that portion of the province which has been under examination for the last ten years, as complete as possible and up to date.

I was ably assisted, as in previous years, by Messrs. Archie Cameron and J. McG. Cruickshank, for five months ; and by Mr. F. C. Laberge, C.E., for seven and a half months.

The expenditure on the season's explorations, including the salaries of all assistants, was $1,550.00.

Mr. Fletcher left for Nova Scotia on the 23rd of June, 1892, to continue the work of previous years in the counties of Cumberland and Hants. He was assisted during six months by Messrs. M. H. McLeod, D. I. V. Eaton and T. S. McLean, and for six weeks by Mr. W. B. Almon.

The district surveyed in Cumberland county lies west of that described in last Summary Report and in the report presented last

spring. It comprises the coast north of Minas Basin from Parrsboro' to Cape Chignecto and east of Cumberland Basin on the outskirts of the Cumberland coal-fields. The inhabitants of the villages on the shore as far as West Advocate are engaged in ship-building and sailing. On Cumberland Basin are the hamlets of Eatonville, Spicer's Cove, Apple River, Sand River, Shulie, Two Rivers, where lumbering is the chief industry, and the interior, with the exception of small settlements, such as Salem, is under forest. The whole coast, the roads and many of the principal streams were surveyed by Mr. Scott Barlow and Mr. Walter McOuat, in connection with the survey of the coal-fields made between 1871 and 1878, as described in the reports for those years, and in Part E, Annual Report, vol. I., 1885.

The geological formations include Triassic, Permian, Carboniferous, Devonian and igneous rocks, similar to those described as occurring along the eastern part of the Cobequid range of hills. The Triassic comprise chiefly masses of basalt and amygdaloid with patches of the characteristic red, soft, crumbly sandstone and conglomerate. On the south side of the hills the Carboniferous rocks appear in greatly tilted masses along the shore, whereas on the north side and along Cumberland Basin, Permian and Carboniferous rocks are found lying generally at a low angle, joining the area covered by those described by Sir William Logan in his celebrated Joggins section.* The limits of these two series do not seem yet to have been clearly defined inland. The Devonian sedimentary rocks resemble those already described in their association with masses of trap, porphyry, diorite, syenite, felsite and quartzfelsite generally massive but sometimes schistose; and their more flinty or porcellanous character near the contact with such masses is as noticeable here as at Portapique and other rivers to the westward. Dark shales and quartzites, very like the iron ore series of Londonderry, containing veins of quartz, blotches of limonite, and associated with light gray, olivaceous, soapy shales, yield at Kirkhill obscure markings of plants. Again, near the shore on Greville River, in the fine outcrops of quartz-veined quartzite and twisted slate, exposed immediately below the first dam, graphitized markings of plants were found, resembling the vegetable debris of Portapique River. These rocks are here unconformably overlaid by a conglomerate of loose texture, composed of pebbles often more than two feet in diameter, of red quartzite and other rocks probably Devonian, interstratified with lenticular patches of crumbly, brecciated red, fine, sandstone, as in other sections on the north side of the hills.

*Report of Progress Geol. Survey of Canada, 1843.

Precisely similar fossil remains were found on the shore at and near McGahey Brook, at West Advocate. Here at the mill-pond, ripple-marked, sandy flags show obscure carbonized markings resembling broken plants. About 165 yards west of the mouth of the brook, obscure traces of rootlets and Cordaites are much more abundant. East of McGahey Brook the shales show many markings like stems of *Psilophyton*, often branching, but only small fragments could be obtained owing to the jointed, cleaved and friable character of the shales. In the associated flinty quartz-veined quartzites much graphitized matter is present in layers which resemble, although greatly altered, the layers of carbonaceous matter so often found among the coarse sandstones of the Carboniferous and consisting chiefly of Cordaites. Further west on the shore these dark shales and flags come against greenish, massive, epidotic diorite and breccia, succeeded by red and gray syenite and diorite, greatly intermixed, the diorite being first blotched with the syenite, while further west the syenite predominates and is blotched, striped and veined by the diorite, the dykes or veins being sometimes horizontal, sometimes vertical.

Veins of ankerite and veins and spots of specular iron ore occur in McGahey Brook. In one of the branches of the Mahoney Brook where a mass of gray breccia, diorite and syenite is in contact with slates, the latter contain rusty-weathering veins in which calcite, baryte, specular iron ore and pyrite are present. The syenite seems to cut the slates like a dyke, carrying grains of specular iron near the contact, and in one place coarse syenite forms a sheet in the bedding.

On the shore immediately east of Henning Brook, a considerable quantity of iron pyrites is found in crystals and aggregations in a clay-stone contained in a brecciated quartzite. The ferruginous veins of the black slates of the neighbourhood hold traces of copper pyrites and among the whitish quartzites are spots of specular iron. Several barrels of fine crystalline pyrolusite were obtained last year on the shore at Lower Economy from Devonian rocks similar to those of the manganese mines of Tenycape and East Onslow.

About 125 yards west of the mouth of Barkus Brook and near the contact of the Triassic of West Advocate with the Devonian, fragments of reddish massive gypsum with crystals of anhydrite and white porous gypsum are found in the cliff and are said to be in place on the beach, representing probably another outlying unconformable patch of Lower Carboniferous like those of Clarke Head. The extent of the outcrop on the land can be only a few square feet for Devonian slates are everywhere near in runs and breaks of the bank. The Carboniferous rocks of Spencer's Island consist of red and gray rubbly sandstone grit

and shale, including black calcareo-bituminous shales sometimes coaly; but no coal of importance has been found in any part of this area a large portion of which, however, shows no exposures.

The rocks of the shore of Cumberland Basin between Eatonville and Shulie are interesting as being the extension of those of Sir Wm. Logan's section. Red Devonian slates, and syenite are overlaid near Eatonville by conglomerate upon which, as also near Sand River, ice grooves were found running N. 35° E. At the south side of Spicer's Cove, a red quartzfelsite, containing dykes and blotches of grey and dark diorite and felsite stands against an epidotic breccia and is unconformably overlaid by soft red conglomerate, with fragments of these rocks, which occupies the high cliffs for some distance, then recedes from the coast eastward along what seems to be a large fault on the north side of which are dark and light gray shales and along the line of which the rocks are greatly polished, contain hematite in the joints and a vein of baryte and calcite. The shales are greatly disturbed, are full of carbonized plants and include a two-inch seam of coal, upright trees and underclay. At the mouth of the brook in this cove there are reefs of grey, fine sandstone dipping S. 50° E. at a very low angle, underlaid by reddish or brownish sandstone, in even layers or false bedded, with patches of pebbly grit. North of the brook are outcrops of nut-and-egg conglomerate, among the pebbles of which there are some of gray sandstone containing plants and probably Carboniferous. At a rocky point beyond, brown and reddish grits with interstratified bands, sometimes ten feet thick, of nut-and-egg conglomerate show carbonized markings of plants and extend thence for some distance along the shore which runs about N. 32° E. At Pudsey's Point, a gray sandstone, largely quarried for grindstones, is overlaid by a great thickness of conglomerate to the mouth of Apple River. East of these exposures are others, also of reddish and gray conglomerate, associated with layers of gray pebbly grit, dipping 114° $<$ 2°, which is also the inclination on the right bank of the river beyond the sand beach and narrows. Similar rocks are found up both branches of Apple River, some of the pebbles of the conglomerate being of gray micaceous sandstone, of dark gray argillaceous shale and underclay and of fragments of coal. In the East branch above White's saw-mill, there are thick beds of conglomerate, most of the pebbles of which are of hard argillites and quartzites, but others of greenish-gray, soft, flaggy micaceous sandstone like that of the millstone grit or coal measures.

Alternations of brownish sandstones, of red and greenish pea-and-nut conglomerate and of dark gray and red argillaceous shale with layers of gray grindstone occupy the shore from Apple River to Hetty

Point. The red sandstone largely predominates, gray sandstone comes next in abundance, while the shales are scarce, dipping 123° at a very low angle. From Hetty Point to Two Mile Brook the cliffs are scarcely broken and show a large proportion of greenish-gray conglomerate among beds of rusty-brown sandstone, while similar rocks are met on the road to Sand River. Layers of red shale then become more frequent among the pebbly rocks and the dip at one point increases to 160°<50°. Immediately south of Sand River the rocks are also highly tilted but there is no change in their character as far as the point north-east of the river, where greenish and rusty-gray sandstone and conglomerate are overlaid by a considerable thickness of red shale which extends up the river to within 450 yards of the saw-mill. The pebbly sandstones are full of large plants and weather rusty just as in the cliffs to the south-westward. Toward Sand Cove, lower beds are rapidly underlaid by rocks containing much more red shale; but the pebbly layers are still abundant and rusty-brown sandstones largely exposed, sometimes considerably broken but perhaps only by folding of the shales upon the massive grey sandstones, the general dip being low. The gray conglomerate of Fitzgibbon Brook near Shulie, some of the pebbles of which are nine inches in diameter, is precisely like that of Apple River: it is underlaid by red shale and gray fine sandstone and by gray sandstone with pebbly patches, the shore running nearly on the strike. From the bridge on Shulie River to the mouth, the section is slightly ascending, the strata being alternations of red shales with gray and rusty-brown sandstone including several pebbly patches. At the point west of the mouth, rusty-gray and greenish-gray sandstones include three layers of red shale, 18 inches thick, beyond which there is a descent to Fitzgibbon Brook.

On Shulie River below the road from Sand River to Halfway River, gray sandstone, usually flaggy and seldom coarse, with occasional beds of red marl, presents a nearly horizontal southerly dip. Lower down gray flags dip 87°<14°, while nearer the shore, greenish-gray conglomerate is found. On the Half-way River road, mentioned above, east of Jenks Meadow Brook, great blocks of greenish and gray conglomerate are found, succeeded nearer Harrison's by others from the underlying red conglomerate.

A good section of the rocks south of Ragged Reef, is cut by the large stream at Two Rivers. At the road are large outcrops of gray sandstone, some of which is coarse, overlaid by greenish-gray and reddish-grey shale dipping 197°<9°; while upstream similar rocks, largely conglomerates, with fossil trunks of drifted trees, extend two miles up to a driving dam at which rusty-gray sandstone dips 200°< 11°. The West Branch of River Hebert and Atkinson Brook also

expose Permian rocks consisting, in the latter, near the river, of gray, rusty, flaggy sandstone with pebbly patches, dipping 170° < 8° and not unlike the rocks of Upper Maccan River. Higher up the dip becomes northerly, the rocks being gray and brownish sandy flags and shales with layers of coarse grit.

Through the kindness of Mr. J. R. Cowans, we obtained plans of the levels, slopes and faults of the working on the three coal seams at present mined at Springhill, to supplement investigations made by Mr. Scott Barlow and Dr. Ells in former years. In this extension, north and south, the workings have not passed beyond the ground proved by Mr. Barlow, but interesting questions have been suggested by the workings to the deep. Records of deep borings in this field, furnished by Mr. R. P. Fraser, Mr. James Baird and Mr. Wm. Hall, will also prove of value in the determination of the structure. In the little brook that flows past the station at Saltsprings and about 1,000 feet from the Intercolonial railway, a small seam of coal has been opened by a shaft or slope more than 150 feet deep, the inclination at the surface being vertical but flattening to 66° and the direction being 305°; while nearer the railway, the dip varies from 55° to 39°. At a depth of forty-five feet an adit connects the shaft with the brook and lower down a level has been driven north-eastward a considerable distance. The coal is irregular in thickness, being in one place, it is said, seven feet.

The section on the brook is as follows:—

	Ft.	In.	Ft.	In.
1. Red argillaceous shale with bands of gray sandstone.	.	.		
2. Coaly shale with a streak of coal	3	0		
3. Greenish, crumbly argillaceous shale, of considerable thickness	.	.		
4. Soft argillaceous shale with rootlets	1	10		
5. Coaly shale and clay in thin layers	0	6	4	9
6. Good coal	2	0		
7. Clay with rootlets	0	7		
8. Coal, somewhat impure	1	8		
9. Soft argillaceous underclay.				

This seam is supposed by some to be the 2 feet 6 in. seam worked at Sand Run mine and on the Springhill and Oxford railway and shown on Mr. Barlow's map. The thickness, however, is greater and the roof is different.

In the small brook about a mile east of the Styles mine and 100 yards west of the Economy road, two seams of coal ten feet apart very irregular in thickness and impure in quality, according to Mr. McCarthy, but containing ten inches of good coal, have been lately opened, at what is called the Stanley mine, in several small shafts, the measures dipping at an angle of 45°.

Mr. Eaton also spent two or three weeks in the Pictou coal-field to add to the topography of the large map of that district. In Hants county he surveyed with odometer 320 miles of roads between Maitland and Windsor, and in the centre of the county; while Ryan Creek and many streams in the neighbourhood of Shubenacadie and Elmsdale were surveyed by Messrs. McLeod and McLean.

The expenditure on the season's explorations, including the salaries of all assistants, was $1,630.

Chemistry and Mineralogy.

On these divisions of the work of the survey Mr. Hoffmann reports as follows:—

The work carried out in the chemical laboratory during the past year has been, as heretofore, almost exclusively confined to the examination and analysis of such minerals, ores, etc., etc., as were regarded as likely to prove of more or less economic value and importance. It embraced:—

1. Analyses of lignites, lignitic coals, coals, and semi-anthracites.
2. Analyses of natural waters—chiefly mineral waters.
3. Analyses of iron ores.
4. Analyses of numerous ores, from the provinces of Nova Scotia, Ontario, and British Columbia, for nickel and cobalt.
5. The assay of a large number of ores from the various provinces, but chiefly from British Columbia, for gold and silver.
6. The examination of a series of clays in respect to their suitability for the manufacture of bricks, pottery ware, and terra-cotta.
7. Miscellaneous examinations, which include the examination or analysis of limestones, carbonaceous and bituminous shales, marls, saline-deposits and other material not coming under the foregoing headings.

The number of mineral specimens received for examination amounted to six hundred and ninety-seven. Of these a large number were brought by visitors who obtained the desired information in regard to them at the time of their visit, or failing this—owing to a more minute examination being called for—it was subsequently conveyed to them by letter. The number of letters personally written amounted to two hundred and seventy-one, of these one hundred and ninety-three were reports embodying the results of the examination, analysis, or assay, as the case might be, of mineral specimens. The number of letters received amounted to one hundred and twenty-seven.

During the period in question a number of minerals—nearly all of more or less economic importance—have for the first time been identi-

fied as occurring in Canada. Amongst these may be mentioned Aikenite, a sulphide of lead, bismuth and copper; Anglesite, sulphate of lead which contains 68·3 per cent of lead; Calamine, hydrated silicate of zinc, a valuable ore, containing 54·2 per cent of zinc; Cerussite (crystallized), white lead ore, carbonate of lead, a rich ore of lead and containing 77·5 per cent of that metal; Euphyllite, Geocronite, a sulph-antimonite of lead; Lepidolite, a silicate of aluminium, potassium and lithium, and Gyrargyrite, ruby-silver, dark red silver ore, a sulph-antimonite of silver; a valuable ore containing 59·8 per cent of silver. The foregoing have in most instances been submitted to analysis, and the results, together with all other information in regard to the minerals, will be given in ensuing reports.

Mr. R. A. A. Johnston has applied himself with great diligence to the work in hand and by the thorough and reliable manner in which he has conducted the same, has rendered excellent service. Apart from a lengthy series of gold and silver assays he has carried out numerous analyses of important minerals, and also conducted a great variety of miscellaneous examinations. Mr. F. G. Wait has been engaged in the analysis of mineral and other saline waters, iron ores, the estimation of nickel in samples of pyrrhotite from various localities and some miscellaneous examinations.

Apart from the writing of the regular annual report "Chemical contributions to the Geology of Canada"—since published, a very full index has been prepared for the catalogue of the Mineralogical Section of the Museum, and in such wise as to show at a glance the localities of occurrence of all the more important economic minerals found in the country.

In the work in connection with the Mineralogical Section of the Museum I have been most ably and diligently assisted by Mr. R. L. Broadbent. He has been occupied in a complete readjustment of the cases containing the systematic collection of minerals in order to allow of the introduction of a number of species and varieties not previously represented; in the transference of the contents of several of the cases, from the one to the other, in the collection of economic minerals, thereby effecting a better general arrangement of the whole; in the labelling and cataloguing of all newly received specimens, and in maintaining the collection generally in an orderly condition.

Owing to the very limited space available for the display of the above mentioned collections, the arrangement of that of the economic minerals in a fairly satisfactory manner, has been beset by many difficulties and if the result attained is not all that could be desired, it is, at least, the best that circumstances would admit of. There is now

no further available space for exhibiting specimens and all new additions have to be placed away in drawers and are consequently not readily accessible to the general public.

The additions to this section of the Museum, chief among which are specimens of rich cinnabar (an important ore of mercury) from Copper Creek, Kamloops Lake, B.C., collected by Mr. E. D. Ingall—amounted to close upon three hundred specimens. Of these, the following were collected by members of the staff:—

1. Bailey, Professor L. W.
   (*a.*) Ten specimens of stilbite, one of disseminated specular iron, one of martite, two of magnetite partially altered to martite, three of white and amethystine coloured quartz and one of jasper—all from Digby Neck, Digby county, N.S.
   (*b.*) One specimen of magnetite and four specimens of ilmenite. The former from Nictaux, Annapolis county, the latter from Chegoggin Point, Yarmouth, Nova Scotia.
2. Barlow, A. E.
   Some forty specimens of niccolite and gersdorffite from lot 12, range III., of the township of Denison, district of Algoma, Ontario.
3. Brumell, H. P.
   (a) Nickeliferous pyrrhotite from Todd's mine, three miles north of St. Stephen, Charlotte county, New Brunswick.
   (b) Nickeliferous pyrrhotite from Ganong's vein, Milltown, St. Stephen, Charlotte county, New Brunswick.
   (c) Graphite from Thorn Creek, King's county, New Brunswick.
   (d) Graphite from St. John, St. John county, New Brunswick.
   (e) Iron ochre from Champlain island, north-west branch of the Miramichi river, Northumberland county, New Brunswick.
   (f) Howlite from Newport, Hants county, Nova Scotia.
   (g) Calcite, amethystine, from Markhamville, King's county, New Brunswick.
   (h) Manganite, from West Quaco, St. John county, New Brunswick.
   (i) Bog manganese, from Dawson Settlement, Hillsborough, Albert county, New Brunswick.
   (j) Limonite from Lac la Tortue, Champlain county, province of Quebec.
   (k) Auriferous quartz from lot 20, range I, of the township of Belmont, Peterborough county, Ontario.
   (l) Cement stone from the township of Thorold, Welland county, Ontario.

(*m*) Cement stone from Limehouse, Halton county, Ontario.
(*n*) Cement stone from Napanee Mills, Addington county, Ontario.
(*o*) Pottery clay from Hamilton, Wentworth county, Ontario.
(*p*) Molybdenite from the township of Hull, Ottawa county, province of Quebec.

4. Ells, Dr. R. W. :—
Chrysotile from lot 11, range VIII., of the township of Templeton, Ottawa county, province of Quebec.

5. Faribault, K. L. :—
Limonite, pseudomorph after pyrite, from gold washing at Little Ditton, Compton county, province of Quebec.

6. Ingall, E. D. :—
(*a*) Calcite, blue and green, from the High Falls, township of Bowman, Ottawa county, province of Quebec.
(*b*) Graphite in calcite, from the same locality as the preceding.
(*c*) Specular iron, from lot 11, range VI., of the township of Portland, Ottawa county, province of Quebec.
(*d*) Cinnabar, from near mouth of Copper Creek, Kamloops Lake, British Columbia.
(*e*) Native silver from the "Wellington" claim, vicinity of Bear Lake, West Kootanie district, British Columbia.
(*f*) Thirty-six samples of ore, representing material from thirty-one claims in the Kaslo-Slocan mines area, West Kootanie district, British Columbia.
(*g*) Twenty-two samples of ore, representing material from twelve claims in the Illecillewaet mines area, East Kootanie district, British Columbia.
(*h*.) Eight samples of ore, representing material from four claims at the Hot Springs or Ainsworth Camp, West Kootanie district, British Columbia.

7. Low, A. P. :—
Anthraxolite from Lake Mistassini, province of Quebec.

8. McEvoy, J. :—
Sixteen specimens of hyalite from south of Loon Lake, British Columbia.

9. Selwyn, Dr. A., R.C.C. :—
(*a*.) Samples of coal from Marten Creek, Coal Creek, and Elk River, Crow's Nest Pass, British Columbia.
(*b*.) Lignite from Estevan, Manitoba.
(*c*.) Labradorite, from Sheldrake, Gulf of St. Lawrence, province of Quebec.

10. White, J. :—
Raphilite, from the township of Bedford, Frontenac county, Ontario.

And the undermentioned constituted presentations :—

1. Beausoleil, C., M.P. :—
Magnetite, from St. Gabriel de Brandon, Berthier county, province of Quebec.
2. Bennet, L. V., Kamloops, British Columbia, per J. McEvoy (Survey) :—
Five specimens of muscovite from near junction of Canoe and Cold-water Rivers, British Columbia.
3. Brophy, John, Poltimore, P.Q. :—
Phlogopite, from lots 15 and 16, range X, of Portland West, Ottawa county, province of Quebec.
4. DeWolf and Munro, Vancouver, British Columbia :—
Muscovite from near the head waters of Clearwater and North Thompson Rivers, British Columbia.
5. Girdwood, Dr. G. P., Montreal, P.Q. :—
Manganese ore from about two miles and a half east of the head of Loch Lomond, Cape Breton county, Nova Scotia.
6. Haycock, E. B., Ont. :—
Crystal of phlogopite from the Hull mica mine, north half of lot 10, range V. of Hull, Ottawa county, province of Quebec.
7. Huntingdon, J. L. :—
Almandite, from Chegoggin Point, Yarmouth, Nova Scotia.
8. Johnstone, Wm., & Co., Montreal, P.Q. :—
Five specimens of prepared iron-ochres.
9. Jowett, W. A. :—
Jamesonite, from Vermont Creek, Middle Fork of the Spilimichene River, British Columbia.
10. Lampard, R., Montreal, P.Q., per W. F. Ferrier (Survey) :—
Sodalite from Corporation quarry, Outremont, Montreal, province of Quebec.
11. McKay, J. W., Kamloops, British Columbia :—
Cinnabar, from the Rosebush claim, near mouth of Copper Creek, Kamloops Lake, British Columbia.
12. McNeil, The W. H. & Co., Ltd., Anthracite City, N. W. T., per Dr. H. M. Ami (Survey).
Semi-anthracite, from Anthracite City, district of Alberta, N.W.T.
13. McRae, Hector, Ottawa, Ont.
(a.) Native silver from the Wellington claim, Kaslo-Slocan mines, West Kootanie district, British Columbia.

(*b.*) Cerussite, from the Wellington claim, same locality as the last mentioned.

14. Moon, A., Madoc, Ont., per W. H. C. Smith (Survey).
Talc, from lots 9 and 10, range V., of the township of Grimsthorpe, Hastings county, Ontario.

15. Nellis, T. F., Ottawa, Ont.
(*a.*) Phlogopite with inclusions of pyrite—and
(*b.*) Phlogopite with inclusions of molybdenite; both from lot 19, range XII., of the township of Hull, Ottawa county, province of Quebec.

16. Pite, W., per Dr. G. M. Dawson (Survey).
Concretionary nodule of pyrite from Peace River, N. W. T.

17. Russell, W. W.
Magnetite, from mining location R. 400, Atic-okan River, district of Rainy River, Ontario.

18. Torrance, J. F., Montreal, Que.
Friction bearing made of "fibre-graphite" (wood pulp and graphite).

19. Trowse, A., per C. W. Willimott (Survey).
Section of a crystal of phlogopite with layer of actinolite, from lot 10, range XII, of the township of Hull, Ottawa county, province of Quebec.

20. Willimott, C. E., & Co., Ottawa, Ont.
(*a.*) Cut and polished specimen of peristerite from Bromley, Renfrew county, Ontario.
(*b.*) Cut and polished specimen of aventurine felspar from Ross, Renfrew county, Ontario.

Mr. C. W. Willimott has, for the most part, been engaged in making up collections of minerals for various Canadian educational institutions. The following is a list of those who have been supplied with such collections:—

1. High School, Georgetown, O.....	consisting of	110	specimens.
2. Collegiate Institute, Morrisburg, O...	"	110	"
3. School of Practical Science, Toronto, O.	"	110	"
4. Morrin College, Quebec.....	"	110	"
5. High School, St. George, N. B.....	"	110	"
6. Collegiate Institute, Peterborough, O..	"	110	"
7. Central Schol, Moncton, N. B.....	"	110	"
8. Clarenceville Academy, Clarenceville, Q.	"	110	"
9. Queen's County Grammar School, Gagetown, N. B.....	"	109	"
10. Public School, Upper Sackville, N. B..	"	109	"
11. High School, Montreal, Q.....	"	169	"
12. Public School, Canso, N. S.....	"	109	"
13. High School, Deseronto, O.....	"	129	"
14. Public School, St. Andrews, N.B.....	"	100	"
15. Board of Examiners for D.L.S., Ottawa, O.	"	136	"
16. Grammar School, Berthier, Q.....	"	100	"
17. Collegiate Institute, Owen Sound, O.	"	129	"

18. Shelburne county Academy, Shelburne, N.S.	consisting of	100	specimens.
19. Grammar School, Sussex, N.B.	"	100	"
20. Aylmer Academy, Aylmer, O.	"	100	"
21. Collegiate Institute, Lindsay, O.	"	129	"
22. Danville Academy, Danville, Q.	"	100	"
		2498	
21. Mr. Chambers, Montreal, Q., in exchange	"	15	"
Total number of specimens		2513	

In the course of the summer he visited—for the purpose of procuring further material for the making up of collections for educational purposes—the townships of Dalhousie, Bathurst, and Burgess, in Lanark county, and the townships of Bromley and Ross, in Renfrew county, Ontario; Calumet Island and Portage du Fort in Pontiac county; the townships of Hull, Wakefield, Portland, Templeton and Buckingham, in Ottawa county; Montreal, Hochelaga county; the townships of Hatley in Stansted county; Bolton in Brome county; Oxford and Ascot in Sherbrooke county; and Tonquière and Simard, in Chicoutimi county; all in the province of Quebec. Also Minas Basin, between Partridge Island, Cumberland county, and Five Islands in Colchester county, Nova Scotia.

The material collected comprised :—

	Specimens.	Weight.
Agate	68	
Amazon stone	48	
Amygdaloid	36	
Analcite	56	
Analcite with natrolite	35	
Apatite	1	110 pounds.
Barite	30	60 "
Beryl	14	
Blende	24	150 "
Bog-iron ore	28	
Calcite, crystals	80	
Chabazite	120	
Chalcopyrite	4	312 "
Diabase	45	
Felspar	15	
Graphite	35	
Gypsum	26	70 "
Hematite	1	200 "
Heulandite	50	
Labradorite	68	
Limestone	86	
Microcline	8	
Molybdenite in quartz	38	
Muscovite	7	
Natrolite	10	
Peristerite	10	
Perthite	75	
Phlogopite	32	
Picrolite	18	25 "
Pyroxene, crystals	40	
Pyrrhotite	3	150 "
Quartz	200	250 "

	Specimens.	Weight.
Raphilite	26	80 pounds.
Sandstone	25	
Sandstone conglomerate	60	
Siderite in schist	45	
Steatite, pseudomorphous	60	
Stilbite	20	
Wilsonite	20	
Total specimens collected	1,577	

Amongst the foregoing were some handsome cabinet specimens, many of which advantageously replaced, as representing the mineral better, those already contained in the Museum.

On the arrangement and classification of the stratigraphical collection of rocks, and other work of the past year, Mr. W. F. Ferrier, lithologist, reports as follows :—

"During the year the work on the stratigraphical collection of rocks has gone steadily forward. In the early part of the year the remaining 141 drawers, containing some 4,000 specimens, were carefully gone over, and a preliminary list of the contents of all the drawers and exhibition cases is now being prepared.

"An arrangement has been made whereby all the drawers under the flat cases are now occupied by the collection of rocks, thus keeping them together, and simplifying the work of cataloguing them. Since the 12th of December, I have been ably assisted by Mr. Percy Selwyn, without whose aid but slow progress in cataloguing would be possible.

"A large proportion of my time has necessarily been devoted to the examination of the collections brought in by the field geologists, the selection of material from these collections for microscopic investigation and the study of the thin sections when prepared. A great deal of work of a miscellaneous character has also been done, such as the examination of various stone implements to determine their material, and microscopic and blow-pipe investigations of rocks, clays and minerals handed to me at different times throughout the year.

"A series of 134 thin sections illustrative of the rocks associated with the apatite deposits in the Du Lièvre district, was prepared, and will shortly be reported on by Mr. Ingall and myself.

"The collection of Archæan rocks brought int his year by Mr. Tyrrell from the region between Lake Athabasca and the Churchill River was thoroughly gone over and forty-seven thin sections prepared for study.

"Twenty miscellaneous sections were also prepared, making the total number of microscopic sections prepared during the year, 201. The large and valuable collection of Archæan rocks brought by Mr. Tyrrell from Lake Winnipeg in 1890, is being reported on as rapidly as possible.

"The report on the rocks collected by Mr. Low from the Château Richer, Que., area has been completed and printed as an appendix to that gentleman's report. Several short papers have, with your permission, been communicated to the scientific journals.

"A cabinet of 84 drawers has been constructed in the basement, in which such rock specimens as are not needed for exhibition in the Museum, but which it is thought advisable to keep at hand for reference, are being placed.

"No field work of any extent was undertaken this year, but on the 18th of June I went to Montreal for a few days and collected a fine series of the nepheline syenite and other rocks from the Corporation quarry, this collection being subsequently supplemented by about 100 specimens from the same locality, presented by Mr. T. W. Chambers, of Montreal, who accompanied me during my visit.

"As this interesting locality will soon be practically inaccessible, it was thought desirable to obtain a full suite of these specimens for the Museum and also for use in distributing collections. Numerous letters inquiring about the scheelite found by me in Marlow, Que., last year, have been received and handed to you, showing the interest taken by manufacturers of iron and steel in the discovery.

"The property has been purchased by parties who intend commencing work in the spring.

"Some fine samples have been obtained by blasting on one of the veins this fall."

Mining and Mineral Statistics.

Of the work of the division of mineral statistics and mines under his charge, Mr. E. D. Ingall gives the following particulars :—

"From the date of the last summary, 31st December, 1891, the office work of the division has been carried out as usual, the time of the staff being occupied in collecting and compiling the statistics of mineral production and general information regarding the mineral resources and mining operations and discovery, as well as in answering inquiries for such information, and office routine.

"Mr. White's time was occupied in the office in plotting the field notes of his survey of the Kingston and Pembroke Railway mineral district, and in the compilation of the map of the same. He was also engaged in revising proofs of maps, and in other work in connection with the investigation of the phosphate district of Ottawa county, Que.

"During the summer season the field work prosecuted was as follows :—

"My own time was occupied from the middle of July until my return in the middle of November, in an examination of the new and important discoveries in the mining districts of West Kootenay, British Columbia. In returning, the following visits were made, viz., to the cinnabar deposit near Kamloops Lake; to Nelson and Vernon, B.C.; to the coal mines of Canmore, Anthracite and Lethbridge; and to Rat Portage, Ont., for the purpose of collecting general information regarding mining developments, and in connection with the organization of the work of the division.

"Mr. Brumell made a tour for the purpose of collecting general information regarding mining developments and discovery in Nova Scotia, New Brunswick, Quebec and Ontario.

"Mr. White was engaged in finishing the surveys for the before mentioned map, and incidentally in collecting statistics and general mining information.

"It may not be amiss to summarize the conclusions arrived at as a result of the studies prosecuted in the new mining camps of West Kootenay.

"As it was of course, impossible to properly examine all the mineral deposits known to exist in any of these districts in the time at disposal, selections were made which should, as far as possible, be illustrative of the different districts and varieties of deposits. The local features of these, as far as exposed by the developments made, were carefully studied and illustrative specimens for the museum were collected, together with samples for assay. In the camps tributary to Illecillewaet, on the Canadian Pacific Railway, visits were made to the older claims in the immediate vicinity of that place, as well as to the newer discoveries in the Fish River Valley and around Copper Hill. These comprise the following claims, viz.:—The Lanark, Maple Leaf, Isabella, Bluebell, Jumbo, Sanquahar and Cariboo, near Illecillewaet and the Gold Hill and Copper Hill group of claims. In the Fish River valley the chief points examined were the Elizabeth, Edinburgh, King Solomon, Herringback and Fishburn claims.

"In the Illecillewaet district proper, beyond some prospecting and assessment work little was being done at the time of my visit; but development work was being conducted by Messrs. Ryckman, M.P., and Scott and by Messrs. Fishburn & Co., in the Fish River valley. The general description of the Slocan veins given below will serve equally for those of the Illecillewaet and tributary districts.

"The Slocan district on the west side of Kootenay Lake was visited during September and October.

"These new discoveries, made in the fall of 1891 and spring of 1892, are situated about the headwaters of the Kaslo River, and between there and Kalso City on the west shore of Kootenay Lake. A number of discoveries were made later in the year on the shores of Slocan Lake between the Columbia River and Kootenay Lake. These could not, however, be visited, owing to lack of time; and for the same reason it was found impossible to visit other discoveries in the Lardo River country and at various other points in the valleys of the Lower Kootenay and Columbia Rivers about which very glowing accounts came to hand.

"Kaslo was reached in the beginning of September, and after all necessary arrangements were made the trail up the valley of the Kaslo River was followed to Bear Lake, on the divide between that valley and the watershed of Slocan Lake and River, and trips were here made to the various groups of claims distributed along the route.

"Bear Lake was reached on the 19th of September, and an attempt made to reach the important group of mines on the surrounding mountains, but this purpose had to be temporarily abandoned, owing to the early advent of snow which effectually hid everything at that elevation. Whilst waiting for the melting of the snow, a short examination was made of the Ainsworth Camp for the purpose of comparing the conditions there with those of the Kaslo-Slocan camps, and thus connecting the work with that done by Dr. G. M. Dawson in 1890.

"The snow having melted sufficiently, the examination of the Kaslo-Slocan group was continued and most of the chief discoveries were visited. The return of the snow on the 10th of October, however, again prevented the study of the surface showings at the Bonanza King Claim, of which nothing could be seen but the tunnel. This was much to be regretted as it was the chief claim in the Noble Five Group, the discovery of which has led to the rush to the district, and indirectly to all subsequent discoveries. It was, however, yet found possible to see the Freddy Lee and Slocan Star mines on Carpenter Creek, owing to their being on a slightly lower level.

"In returning it was intended to visit the Wellington and White Water claims, but the snow having reached the lower levels, no further work could be attempted, and the return to Kaslo was made on the 15th of October.

"Much hopeful activity in the direction of prospecting and development work was manifest in this district, and not without foundation, high hopes were prevalent regarding its future.

"Towns were started at Nakusp and New Denver on the proposed wagon route for providing the Slocan claims with an outlet *viâ* the Columbia River line of steamers and also to Kaslo which is the terminus of the now completed wagon road, connecting with the Kootenay Lake steamers by which ore can be shipped to the smelting works in process of construction at Pilot Bay or to any point in the United States *viâ* Bonner's Ferry on the Northern Pacific Railway.

"In a preliminary report such as this it would be impossible to give the results of these investigations, other than in very general terms, and all the detail of the evidence upon which these conclusions are based will be left for the complete report that it is intended to issue later.

"However, of the geological conditions of occurrence of the deposits visited and of their visible extent, etc., the main features are given below.

"Proceeding west from Kaslo, the rocks noticed seemed to belong to two distinct series. A belt of green dioritic schistose and serpentinous rocks, following west north-west along the northern side of the valley of the Kaslo River, whilst south of these the rocks are for the most part black shales and slates with gray interbedded bands, which evidently consist for the most part of carbonate of lime. The general dark colour of this series of rocks, varying from dark gray to black, would seem to be due to the presence of carbonaceous matter, and is in striking contrast, both in colour and structure, with the general green colour and more metamorphic characters of the adjacent rocks to the north. The black shaly series are tilted, in places much folded, and also at times indurated. They frequently show local metamorphism, which latter phenomena will probably be found in all places, as it evidently is in some, to be due to the action of the intrusive igneous rocks which are visible as dikes and masses or areas, cutting both the before-mentioned series.

"The veins examined show in general the characters of fissures cutting the formation, although sometimes conforming along the strike with the inclosing rocks for considerable distances. Where occurring in connection with the calcareous bands of rock, there would seem to be a tendency to make large pockets in connection with the vein or towards widenings of the vein itself. Strippings on some of these present surfaces of considerable extent, which, however, on further development have proved not to belong to the veins proper, which, whilst generally found to be more persistent, are generally comparatively much narrower.

"Although they show variations in structure these fissures in general carry galena in ribs, nodules, etc., associated with an ochrey

gangue locally termed *carbonates*. This ochrey material is said to assay well in silver in many instances, it being doubtless enriched by the presence of more or less argentiferous carbonate of lead, or, as was plainly visible in some cases, by the presence of disseminated native silver and argentite, doubtless resulting as secondary products from the alteration of the argentiferous galena.

"The galena varies much in texture from a fine blue ore of steely grain up to coarse cube and sometimes shows a ribbed structure. With it in many cases are associated various arsenical and antimonial minerals of silver disseminated through the ore proper. The occasional presence of a certain amount of copper is evidenced by the stains of malachite and azurite, which probably originate from the weathering of the tetrahedrite as well as from copper sulphurets, which occur in slight degree. The general run of the reported assays of specimens from the district is high, averaging in the hundreds of dollars, and occasionally even reaching to the thousands, the latter results being quite possible for separate specimens when the presence of the richer silver minerals is borne in mind. At one mine which has made considerable shipments, it is claimed that these have averaged $200 per ton, and the conclusions based on the general evidence obtainable would seem to justify the expectation that the yield of the district will be found to average high in silver.

"The galena-bearing veins which cut the green schistose and serpentinous rocks, present to the eye a generally similar appearance to those found in the shale and argillite series, except of course for the absence of the associated pockets of ore mentioned in connection with the calcareous bands.

"What may prove an interesting discovery was reported late in the season from the Whitewater basin, some prospectors having brought in specimens of quartz which, according to local assayers, averaged very high in gold. No further particulars are, however, available, as the intended visit to the place was prevented by the advent of the snow. It raises hopes, however, that these schistose rocks which resemble lithologically the gold-bearing Huronian of Eastern Canada may prove even richer in this respect than the latter, especially when the much stronger evidences of complete mineralization found here, are considered.

"Assuming then that, in actual working, the ores should be found in shipping lots to maintain their high content of silver, which would seem probable in most cases, a bright future may be predicted for this district if those interested will only observe and act on the financial and economic principles necessary to success.

"The completion of the wagon road from Kaslo into the centre of the district will be of great value in the working of the mines and the existence of smelters in Canadian territory at Pilot Bay, Revelstoke and Golden will doubtless prove of great assistance when a continuous supply of ore shall be forthcoming.

"The projected railroads to give connection with the Canadian Pacific Railway at Revelstoke, and from the Slocan divide to Kaslo, will doubtless be constructed when the veins are worked on a more extensive scale.

"The assays made of the selected specimens collected during the season show the following general results:—

"In the Illecillewaet district four assays of galena from different points varied between 18 oz. and 73 oz. of silver per ton, the pyritous ores of copper being found, in the one sample assayed, to carry silver also.

"The galenas of the Fish River sub-district gave results running from 39 to 318 oz. of silver per ton. A sample of the "ochreous" material locally called "carbonates" showed 692 oz., and some of the zinc-blende nearly 6 oz. of silver per ton.

"The assays of galena from the various veins in the Kaslo-Slocan district resulted as below:—For those occurring in green schistose and dioritic series of rocks, six assays gave results ranging from 38 to 146 oz. per ton, averaging over 90 oz. One assay of a specimen of zinc-blende showed silver to the extent of 26 oz. In the same district the galenas from veins occurring in the black argillite series of rocks averaged in some thirty-one assays, 150 oz. per ton, ranging from 30 oz. to 520 oz. per ton. Assays of zinc-blende returned from 26 oz. to 73 oz. per ton. The ochreous "carbonates" occurring with the galena yielded very variable amounts of silver, the lowest return being 20 oz., the highest 1,630 oz. per ton. This great discrepancy is due to this ore being a mechanical mixture only, which is often enriched by secondary deposition of native silver and the richer silver minerals. In the whole series of assays made, numbering some sixty-five in all, gold was absent, except for mere traces found in three cases.

"The ton referred to is that of 2,000 lbs. For further details see the forthcoming report of the Chemical Branch of the Department.

"The cinnabar deposit, on the north shore of Kamloops Lake near the mouth of Copper Creek, about six miles from the western end of the lake, was visited on the 26th of October.

"Here, owing to the recentness of the discovery, the work done on the veins has not been extensive, consisting only of shots and shallow pits on the outcroppings. The area visited was covered by the Rose-

bush Claim, in which several spar and quartz veins are to be seen, averaging about a foot or so in width; on these, at a number of points, very encouraging showings of ore have been exposed, justifying the hope that still better results might be achieved by extensive developments. The cinnabar itself occurs in such a manner in the gangue in ribs, etc., that by hand picking a high grade of ore can be easily selected, and no difficulty was found in procuring handsome specimens for the museum.

"At the coal mines at Anthracite, Canmore and Lethbridge work was proceeding much as usual, but there was no time to make any close study in what necessarily had to be a mere preliminary visit.

"For similar reasons at Rat Portage nothing more could be done than to ascertain in a general way the operations of the year, and to become acquainted with persons willing to give us information later. Whilst no mining proper was being done, several of the chief companies were erecting small mills to work their ores. The custom reduction works near the town itself had been idle for some time, owing, it is said, to the inadequacy of the plant to properly extract the metals from the ores of the district.

"Mr. White gives particulars as follows, of the work he prosecuted for the division in the Kingston and Pembroke Railway Mining District:

"'The past summer was spent in completing the information for the map of the Kingston and Pembroke Mining District commenced last year. As the surveys of the older townships are very inaccurate, it was deemed advisable to run a few tie lines across the lower part of the sheet. Chained traverses were therefore carried across from the vicinity of Kingston to Perth and from Sydenham to Westport. All roads not on existing maps were surveyed with odometer and compass. The mines and openings in the southern part of Frontenac county and northern part of Leeds county were examined and their position fixed with regard to the side lines and end lines of the lots on which they are situated.

"'The low price of phosphate and mica has temporarily checked mining and exploration in this section. The only mines at present operating are the Opinicon and Nicholson mines in phosphate and the Webster Foxton & Stirling in mica.

"'The outline of the edge of the Cambrian and Cambro-Silurian rocks was traced out in detail across the lower part of the sheet. Numerous outliers of Potsdam sandstone were found in the northern part of Loughborough and Storrington townships, and western part of South Crosby showing that the Cambrian sea, at one time, covered the isthmus of gneiss that connects the main mass in Canada with that forming the Adirondack region, in New York State.'

"Mr. White left Ottawa on the 8th of June and returned the 25th of September.

"During the summer he was ably assisted by Mr. J. H. Featherston, third year student at McGill University.

"Mr. Brumell furnishes the following information, relating to his observations and inquiries in the districts he visited :

"'I left Ottawa on the 13th July for New Brunswick, where the more important mining districts were visited and the lists of operators revised. Since my last visit a rather important deposit of manganese was found in South Albert county and prospecting had been carried on continuously in the neighbourhood of Herring Cove, Albert county, in search of a large body of copper ore supposed to exist there.

"'During the past winter operations were suspended at the Britton Mine near Woodstock, it having proved to be of no value.

"'The old established mining industries of the province, such as gypsum, coal, grindstones, granite and building stone, are being carried on as in previous years. At St. John the lime industry which in previous years attained considerable importance, languished in a measure on account of the enactment of the McKinley Bill in the United States.

"'No work has been done on the nickeliferous deposits at St. Stephen.

"'On the 1st of August I went to Nova Scotia and visited the principal mining districts along the lines of railway; among others the gypsum quarries of Hants and Colchester counties, the iron mines of Pictou county, the Coxheath copper mine, Cape Breton, and others. Of new industries, the most important is undoubtedly that of iron smelting on the East River of Pictou, where at Ferrona and Bridgeville, two new furnaces have been erected, at the former place for the manufacture of ordinary pig, while at the latter only charcoal pig-iron is made.

"'At Ferrona the 'New Glasgow Iron, Coal and Railway Co.' have an extensive plant, consisting of one stack of eight tons capacity, with the necessary appurtenances and thirty-six Belgian copper coke ovens. They have also built a railway twelve miles and a half long from the works to Black Rock. The Bridgeville works are owned and operated by the 'Pictou Charcoal Iron Co.,' and consist of one stack of twenty-five tons capacity, with necessary blowing plant, etc., and a range of twenty charcoal kilns. A siding has been laid to the works from the line of the New Glasgow and Intercolonial Railway.

"'Operations at the Coxheath Copper Mines in Cape Breton were suspended during the year, and it is said that in the near future they will be reopened and operated on a large scale. The old established mining

industries, such as gold, coal, iron ore, gypsum and manganese, are being carried on as heretofore. This may also be said of building stone, granite, grindstones and mineral waters.

" 'In the province of Quebec I visited the asbestus district of Black Lake and Thetford, and the gold mines on the Chaudière and tributaries. Asbestus mining seems to have been somewhat overdone, the result being that several of the works are closed to enable the owners to dispose of heavy stocks which have been carried over; to do this there has been a very considerable decline in prices. In the Chaudière gold district work was progressing on the Gilbert River under the management of Mr. W. P. Lockwood, and development work was being actively carried on upon the Du Loup and Millstream, as well as in Ditton township further to the south-west.

" 'In Ontario I was engaged principally in correcting our lists of producers of structural and other mineral materials.

" 'Boring operations were being carried on as in 1891, over considerable areas in the south-western part of the province, notably in Welland and Essex counties, with very favourable results, large flows of gas having been found at several points. In Welland county oil had been found in two areas, the flow being from the Medina white sandstone.

" Mr. Brumell returned to Ottawa on the 7th of November."

The total cost of the season's explorations under the division of Mineral Statistics and Mines was $3,665.

Palæontology and Zoology.

Mr. Whiteaves reports that the fourth part of the first volume of 'Contributions to Canadian Palæontology,' was published in December last. It consists of a systematic and descriptive report, of one hundred and five pages octavo of letter press, illustrated by fifteen full page lithographic plates, " on the fossils of the Devonian rocks of the islands, shores or immediate vicinity of Lakes Manitoba and Winnipegosis," collected for the most part by Mr. Tyrrell in 1888 and 1889. Prior to the year 1890, not more than six species of fossils had been recorded as occurring in these rocks, but in this report as many as one hundred and thirty-three species are either identified or described.

A large series of Ammonites from the Cretaceous rocks of the district of Athabasca, collected by Mr. McConnell in 1889 and 1890, has been studied, and a paper descriptive of the species represented has been contributed to the 'Transactions of the Royal Society of Canada' for 1892. This paper will be illustrated by four full page quarto plates.

A paper entitled "Description of a new genus and species of Phyllocarid crustacean from the Middle Cambrian of Mount Stephen, B. C.," and illustrated by one woodcut, has been published in the 'Canadian Record of Science' (Montreal) for October, 1892. The specimens upon which this paper is based, were collected by Mr. McConnell in 1888 and by Dr. Ami in 1891.

The fourth part of the 'Contributions to Canadian Micro-Palæontology' was published in July, 1892. It consists of a paper on "Radiolaria from the Pierre formation of North Western Manitoba," by Dr. D. Rüst, of Hanover, Germany, who has made a life study of fossil Radiolaria, with a short introduction by Mr. J. B. Tyrrell, and is illustrated by three lithographic plates.

In Zoology, 462 specimens of birds and small mammals, from Indian Head, Assiniboia, have been received from Mr. W. Spreadborough. During the past year, Mr. S. Herring, the taxidermist to the Survey, has mounted nine specimens of mammals, eighty-three of birds and two of turtles, but most of these are intended for the Banff Museum. He has also cleaned and numbered the whole of the mounted specimens of mammals and birds in the cases in the Museum. The skin of the Pacific Walrus, referred to in last year's report, has been skilfully mounted at Prof. Ward's Natural Science Establishment at Rochester, N.Y., and is now on exhibition in the Museum. Among the more interesting specimens of native mammalia and birds received during the year are a magnificent example of the Wood Buffalo (*Bison Americanus*, var.) from the District of Athabasca or its vicinity, presented by Warburton Pike, Esq., the only specimen of the kind known to be preserved in any museum, and a pair of Whooping Cranes (*Grus Canadensis*) from near Prince Albert, Saskatchewan. While attending the meeting of the American Association for the Advancement of Science in August last, at Rochester, N.Y., Prof. Ward's establishment was frequently visited and numerous specimens of interest (especially a skeleton of the Bald Eagle and one of the Great Blue Heron) were secured for the museum of the Survey, either by purchase or in exchange.

During part of the time that the director was absent from Ottawa, on field work, the duties of acting director have devolved upon me and, in addition to the correspondence entailed thereby, about 150 official letters have been received and the same number, many of them of the nature of reports, written.

Mr. Weston reports that since the 15th of January last, most of his time has been devoted to museum work in the palæontological and

archæological divisions. He has arranged and classified many new specimens and incorporated them into their proper positions in the cases. He has labelled and developed many fossils for study and exhibition, and has superintended the mounting of various specimens. He has also prepared and examined many microscopical sections of rocks and fossils. During the months of July and August he spent a short time at Baie St. Paul, collecting specimens of garnetiferous gneiss, which were wanted for college collections, and obtained an interesting series of fossils from the Trenton rocks of the vicinity, among which are several species new to this locality. Part of these months were spent with Dr. Selwyn in investigating several features of the geology at and around Quebec City. Most of the exposures were examined and the details of their structure worked out. Dr. Selwyn and Mr. Weston succeeded in obtaining from the Mountain Hill escarpment, several species of fossils which have not previously been recorded from these rocks.

Dr. Henry M. Ami reports that during the earlier months of the year, as well as during the last two months of the same, his time was chiefly occupied in examining and determining the species of fossils from various collections in different provinces of the Dominion, which were entrusted to him. These organic remains range from the Cambrian to the Post-Tertiary. The intervening summer months, with the exception of four days spent at the meeting of the Geological Society of America, held at Rochester, N.Y., were chiefly devoted to the classification and arrangement of duplicates and to the preparation of collections for educational institutions. Of these the largest sent was a systematic collection of fossils which contained four hundred and sixty-six specimens of one hundred and fifty different species from various formations in Canada. This collection was labelled and forwarded to the Biological Department of the University at Toronto, Ont. Another collection of sixty-five specimens of Mesozoic and Tertiary fossils, was sent to the University of New Brunswick at Fredericton. These were duly acknowledged by the authorities concerned.

Classified lists of fossils were prepared for the field geologists from whose collections the specimens were identified, as follows:—for Dr. R. W. Ells—lists from Lot 20, R. VI., Stanbridge; Clarenceville; one-half mile E. of Lacolle; Missisquoi Bay south of Phillipsburg, Phillipsburg, Mystic, all in the province of Quebec; and of another extensive collection made by Dr. Ells and Mr. Whiteaves, at Phillipsburg and Mystic in August, 1890. Most of these fossils were difficult to determine but interesting. For Mr. Giroux—classified

lists of Cambro-Silurian fossils from the town of Joliette, Chaloupe River, near the bridge, seven miles N.E. of Joliette, Ste. Elizabeth, Ste. Ursule, Chicot River, St. Justin, St. Barthelémi, St. Cuthbert and other localities inthe counties of Joliette and Berthier, in the province of Quebec. For Mr. Weston—A collection of typical Trenton fossils from Bay St. Paul, below Cape Tourmente, P.Q., and for Prof. Bailey, several collections from Lunenburg County, Nova Scotia.

The extensive collections of rocks and fossils made during the previous year (1891), in the Selkirks were unpacked and for the most part labelled. The fossil remains were studied and most of them identified. It is one of the largest collections of Palæozoic fossils yet obtained from the Rocky Mountain region of Canada, and the specimens will soon be placed in the show-cases. Material for the study of the graptolitic faunas, in which Canada is so rich, has been gathered together and will be determined and classified in so far as the mode of preservation and quality of the specimens warrant. Assistance in this work has kindly been promised by Prof. Charles Lapworth of the Mason Science College, Birmingham, Eng., who is the best authority on the subject. Several thousand duplicates have been arranged and classified during the past year and preliminary studies of several groups have been made for future use and reference.

Dr. Ami also reports having prepared labels for the Cretaceous plants collected by Dr. Hayden and himself at Canmore and Anthracite, N.W.T., and recently described by Sir William Dawson.

Mr. Lambe reports that during the past year he has been engaged in the critical examination of three separate collections of recent marine sponges, which are as follows, in the order in which they were examined :—

1. A large number of sponges (about thirty species) from the vicinity of Vancouver Island, B.C., dredged by Dr. G. M. Dawson during the summer of 1885, together with some dried specimens, representing four species, collected by Dr. Dawson in 1891, in Behring Sea.

2. Some entire specimens of marine sponges, with small portions of others, representing in all about twenty-two species, from the Redpath Museum, Montreal; also two or three sponges from the museum of the Natural History Society of Montreal, mostly collected in the Gulf of St. Lawrence and off the Atlantic Coast of Canada.

3. A large and important collection of sponges, dredged by Mr. J. F. Whiteaves in Gulf of the St. Lawrence during the years 1871–72 and 1873, and about six specimens of different species of sponges collected by Dr. G. M. Dawson in 1878, in the vicinity of the

Queen Charlotte Islands, B. C. The specimens obtained by Mr. Whiteaves were dredged at depths varying from twenty-five to 220 fathoms and represent about twenty species, for the most part preserved in alcohol.

From the 25th of January to the 24th of September, he devoted himself to a microscopic examination of the specimens in collection No. 1. He reported on part of this collection in a paper, entitled "On some sponges from the Pacific Coast of Canada and Behring Sea," which was read before the Royal Society of Canada in June last. This paper is illustrated by four plates, and will be published in the current volume of the Society's Transactions. He prepared microscopic drawings of such of the sponges in this collection as are not yet reported on, which he proposes to utilize in connection with their description at a later date.

On the 26th of September, he visited Montreal and spent two days in looking over the recent marine sponges from the Gulf of St. Lawrence and the Atlantic Coast of Canada in the Redpath Museum. Through the kindness of Sir William Dawson he was allowed free access to the cases and to borrow some type specimens, and such others as he thought would prove of particular interest, as well as small portions of nearly all the remaining sponges in the collection. Through the courtesy of the Council of the Natural History Society of Montreal, he was enabled to borrow two or three Atlantic forms from the museum of the Society.

The study of collection No. 2 engaged his attention from his return to Ottawa on the 29th of September until the middle of November. A number of hitherto undescribed forms are included in this collection, whose microscopic characters were thought of sufficient interest to warrant the preparation of a number of drawings.

From the 17th of November until the present date he has devoted himself to a preliminary examination of collection No. 3.

He hopes to be able to report on all the Atlantic and the remainder of the Pacific sponges included in these collections at an early date.

During the first part of January and from the 17th to the 22nd of September, also from the 10th to the 13th of December, he was engaged in helping to identify or ascertain the characters of certain species of Gasteropoda and Trilobita, in the collections of fossils from Lakes Manitoba and Winnipegosis made by Messrs. Tyrrell and Dowling in 1888 and 1889.

Drawings were prepared for their illustration, which are reproduced in plates xlv., xlvi. and xlvii. of part IV. of the 'Contributions to

Canadian Palæontology.' From the 27th to the 30th of June, and from the 12th to the 15th of July he made drawings of some Cretaceous plants, collected by Dr. H. M. Ami in 1891, at Anthracite, B.C., to illustrate a paper by Sir William Dawson for the current volume of the Royal Society's 'Transactions.' He also made a drawing of a Phyllocarid crustacean from the Middle Cambrian, of Mount Stephen, B.C., to illustrate a paper by Mr. Whiteaves for the October number of the 'Canadian Record of Science.'

Between the 3rd and the 11th of October, he prepared drawings for four plates, to illustrate Mr. Whiteaves's paper on Cretaceous Ammonites collected by Mr. R. G. McConnell in the District of Athabasca in 1889, which will appear in the volume of the Royal Society's 'Transactions' for 1892.

The number of official letters received by Mr. Lambe during the year is thirty-three and the number written is thirty.

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

Dr. R. Bell :—

About eighty specimens of fossils from the Cambro-Silurian rocks at La Cloche Island, Lake Huron, and two species of field mice, and a specimen of *Amia calva*, from that island.

Twenty-five specimens of fossils from the western part of the Grand Manitoulin Island.

Six slabs of ripple marked surfaces, associated with fossil-like forms from the Huronian sandstones of Aird Island, Lake Huron.

Hugh Fletcher :—

About sixty specimens of fossiliferous shales and quartzose rocks from West Advocate, Cumberland Co., N. S.

Portion of small trunk of *Calamodendron* from the conglomerates at the base of the Millstone Grit of Middle River, N. S., and obscure forms from the Devonian rocks at Kirkhill, P. O., Cumberland Co., N.S.

Prof. L. W. Bailey :—

Two specimens of *Astropolithon Hindi*, from Bedford, N. S.

About twenty-five specimens of fossiliferous Lower Carboniferous limestone from the "drift" of Hickman's Island, Lunenburg Co., N.S., and seventy specimens of fossils from Bear River, N.S.

Twelve specimens of fossils from the altered shales of Nictaux, N. S., one fossil from the iron mines of Moose River, N.S., and one from the Triassic sandstone of Digby Neck.

R. G. McConnell :—

Twenty-six fossils from the Palæozoic rocks of the Howse Pass and Saskatchewan River, and twenty-three from the Cretaceous rocks of the Red Deer River, Rocky Mountains.

J. B. Tyrrell :—

Specimen of a fresh water sponge (*Meyenia fluviatilis*) from Cree Lake, N.W.T.

Dr. H. Ami :—

About forty specimens of fossils from the Black River limestone, near Hemlock Lake, Beechwood, Ottawa.

T. C. Weston :—

Thirty specimens ot fossils from Mountain Hill, Quebec City, and thirty-five from the Trenton limestone from Baie St. Paul, below Cape Tourmente, P.Q.

R. Chalmers :—

Fifty specimens of three species of shells from the Saxicava Sand of Lawrence Dock, and forty specimens of six species of fossils from the " boulder clay " at Negrotown, near St. John, N.B.

W. C. Willimott :—

Thirty specimens of two species of marine sponges, from Minas Basin, N.S.

J. White :—

About seventy-five specimens of fossils from various localities in the counties of Hastings and Frontenac, Ont.

W. J. Wilson ;—

Fifty-four specimens of thirty species of ferns from the Devonian rocks at the Fern Ledges, St. John, N.B.

The additions to the palæontological, ethnological and zoological collections in the Museum, by presentation, exchange or purchase, are as follows :—

By presentation :

Warburton Pike :—

Fine specimen of the Wood Buffalo (*Bison Americanus*) from the District of Athabasca.

E. E. Hazen Drury, St. John, N.B. :—

Six specimens of a Unio (*Unio Danæ*?) and four casts of the interior of the shell of a species of *Viviparus*, from the Laramie formation thirty-five miles north of Calgary.

A. E. A. Lowes, Yorktown, N.W.T. :—

Skin of *Thomomys talpoides*, from Yorktown.

G. R. White, Ottawa :—

Mole Shrew (*Blarina brevicauda*) in the flesh.

James Macoun :—
Two skins, one of the fur seal (*Callorhinus ursinus*) and the other of the " hair " seal (*Phoca vitulina*, var.)

Alexander McInnes (per W. Maddin) :—
Thirty-eight slabs of fossil plants from the Carboniferous rocks of Nova Scotia.

E. W. Holt, Thorne Centre, Pontiac Co., P. Q. :—
Specimen of the Star-nosed Mole (*Condylura cristata*).

Colonel C. C. Grant, Hamilton, Ont. :—
Thirty specimes of fossils from the Clinton and seventeen from the Niagara formation near Hamilton.

John Stewart, Ottawa :—
Specimen of *Edrioaster Bigsbyi*, from the Trenton limestone of Hull, P.Q.

Garnet Watt, Aylmer, P.Q. :—
Stone dish, apparently of Eskimo manufacture.

Percy H. Selwyn, Rounthwaite, Manitoba :—
Skin of the Jack Rabbit or Prairie Hare (*Lepus campestris*).

Prof. James Hall, Albany, N.Y. :—
Series of casts of fossil bryozoa from the Devonian rocks of the State of New York, etc.

Alexander Whitney, Uxbridge, Ont. :—
Young Red-throated Diver (*Urinator lumme*) from Uxbridge.

W. Rogers, Ottawa :—
Young Snapping Turtle (*Chelydra serpentina*) from the Rideau Canal, near Ottawa.

D. Herring, Toronto :—
Male Summer Tanager (*Piranga rubra*) shot at Scarborough, Ontario.

H. S. Poole, Stellarton, N.S. :—
Four specimens of fossil plants from the Lower Carboniferous rocks of Centre Bridge, Pictou Co., N. S.

R. H. Campbell, Ottawa :—
Six species of Post-Tertiary fossils from Nepean, Ont.

By purchase :

From Dr. R. Jardine, Prince Albert, Saskatchewan :—
Pair of the Whooping Crane (*Grus Americana*).

From Ward's Natural Science Establishment at Rochester, N.Y. :—
Two mounted skeletons, one of the Bald Eagle (*Haliaætus leucocephalus*) and the other, of the Great Blue Heron (*Ardea Herodias*).

By exchange :

From Ward's Natural Science Establishment :—
Fifty-six species of recent shells.

From Dr. Herman Jhering, Brazil :—

Twenty species of fresh-water and land shells from the Rio Grande do Sul.

From Dr. Arthur Dendy, Melbourne, Australia :—

Sixty species of marine shells from South Australia.

Mr. James Fletcher, in charge of the Entomological collections, reports as follows :

"The Entomological collections belonging to the Museum are in good condition. There have been no losses from accident, insect pests or fungi since I last reported to you.

"Several valuable additions have been made during 1892. Small collections were brought in from the field by Messrs. James Macoun, D. B. Dowling, J. McEvoy and W. McInnes. Donations have been received from Messrs. W. H. Danby, of Victoria, and C. DeBlois Green, of Nanaimo, B.C., from Mr. W. C. Adams, of Montreal, a small collection chiefly beetles, but containing also two specimens of considerable interest for the locality (Nova Scotia) in which they were collected. These were the rare Hawk moths *Lepisesia flavofasciata*, and *Smerinthus Cerisyi*. From Ottawa entomologists, we have also received several rarities. The rare moth *Erebus odora* was presented by Mr. Martin Griffin.

"The cabinet space is at present sufficient, but a little more will be required next year."

Botany, &c.

Owing to the continued absence, on special duty, of Mr. James Macoun, assistant in the botanical division, Professor Macoun's time has been largely occupied in the routine work of the division, and in editing part VI. of the Catalogue of Canadian Plants, which was completed and issued in July last. It contains 295 pages royal 8vo., and is a complete summary of our knowledge up to date of the Canadian mosses. The work enumerates 953 species and many varieties. Of these, 237 species are new to science.

A manual with figures and descriptions of the edible Fungi of Canada is in hand. The manuscript of the first part, Edible Mushrooms, will soon be ready. The plates are now being lithographed, and it is hoped the part will be ready to issue in the ensuing spring.

For reasons above referred to, the work on the Descriptive Catalogue of Canadian Birds, mentioned on page 87 of the Summary Report for 1891, has been interfered with, and another year will now elapse before it can be prepared for the printer ; but this may not be altogether a disadvantage, as in the meantime gaps in our knowledge of ornithological

distribution will probably be filled, thus adding to the completeness of the work when published. An examination of the bird skins collected in the autumn of 1891 by Mr. W. Spreadborough at Indian Head indicated that it would be desirable to send the same collector there again in the spring. He accordingly went there early in April and remained till the fourth week in July. During that time he collected over 400 skins of birds and some small mammals. Notes were made on the migration and the nesting habits of many birds which will be incorporated in the catalogue. Among the specimens collected is a complete series of the game birds and the hawks of the district. Many of these have been mounted and are ready to be placed in the museum proposed to be established at Banff.

Our knowledge of the birds of the Pacific coast and islands is very scanty, and before publishing any catalogue of these, it would be desirable to devote at least another summer to collecting and observing in that region. It is hoped this work will be undertaken during the ensuing spring and summer.

Professor Macoun strongly urges the necessity of better accommodation for the work of the botanical and natural history division, and points out that "the cramped quarters in which the work has to be done is even a greater hindrance to progress than the want of assistance." Unfortunately the limited capacity of the museum building renders it impossible under existing circumstances to obviate this evil, by which all the other divisions are also more or less injuriously affected.

Maps.

Maps in course of preparation and maps published during 1892.

	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 of Map of the above, ready for publication, scale 48 miles = 1 inch.	
North-west Territory, country lying between Athabaska River and Lake, and Reindeer Lake, reaching from longitude 102° to 112°, and latitude 50° to 60°, in progress. (Messrs. Tyrrell and Dowling), scale 8 miles = 1 inch.	
British Columbia, Kamloops sheet (Dr. Dawson), ready for publication, scale 4 miles = 1 inch.....	6,400
British Columbia, Shuswap sheeet (Dr. Dawson), in progress, square 4 miles = inch.....	6,400

Sq. Miles.

British Columbia, Placer Mines of Cunningham Creek (Mr. Bowman) scale about 27¼ chains = 1 inch..... 34

British Columbia, Quartz Veins and Placer Diggings, Grouse Creek (Mr. Bowman), scale about 25 chains = 1 inch.... 14

British Columbia, Placer Mines of Antler Creek (Mr. Bowman), scale about 26 chains = 1 inch..... 38

British Columbia, Lightning Creek (Mr. Bowman), scale 400 feet = 1 inch 17

British Columbia, Williams Creek (Mr. Bowman), scale 10 chains = 1 inch..... 12

The above (five) mining plans are in the engravers' hands and will shortly be ready for publication.

Rocky Mountains, region lying between Howse Pass and Athabasca Pass (Mr. McConnell, 1892), in progress, scale 8 miles = 1 inch.

Manitoba, Map showing the whole of Lake Winnipeg (Mr. Tyrrell), ready for engraver, scale 4 miles = 1 inch..... 48,600

Northern Manitoba (part of) in progress (Mr. Tyrrell), 2 miles = 1 inch..... 5,000

Northern Manitoba (Mr. Tyrrell), published 1892, scale 8 miles = 1 inch..... 20,000

N. Eastern Manitoba, Lake Winnipeg, in progress, scale 8 miles = 1 inch..... 20,000

Northern Ontario, Lake of the Woods, sheet No. 2, published 1892, scale 2 miles = 1 inch..... 2,000

Northern Ontario (Hunters Island), sheet No. 7, published 1892, scale 4 miles = 1 inch..... 3,456

Northern Ontario (north of Hunters Island), sheet No. 6 (Mr. Smith), in progress, scale 4 miles = 1 inch 3,456

Northern Ontario, Sheet No. 9 (Mr. McInnes), in progress, scale 4 miles = 1 inch..... 3,456

Ontario, Sheet No. 125 (South of Sudbury Sheet), Dr. Bell, in progress, scale 4 miles = 1 inch..... 1,800

Ontario, Sheet No. 131 (Sheet, east of Sudbury), Mr. A. E. Barlow, in progress, scale, 4 miles = 1 inch..... 3,456

Ontario, Sheet No. 115, ready for draughtsman, scale 4 miles = 1 inch 3456

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.

Ontario and Quebec, Sheet No. 121 (west of Eastern Townships, Map), Dr. Ells, in progress, scale, 4 miles = 1 inch. 3,456

Quebec, N. E. ¼ Sheet (Eastern Townships Map), published 1892, scale 4 miles = 1 inch 4,500
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 progress, 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), with engraver, scale 4 miles = 1 inch 3,456
Quebec, ¼ sheet 18, S. E. (Messrs. Bailey and McInnes), in progress, scale 4 miles about 500
Quebec, Lièvre River and Templeton phosphate region, Ottawa County, 2 sheets (Mr. Ingall), with engraver, scale 40 chains = 1 inch 220
New Brunswick, Surface Geology, ¼ sheets, 1 S. W., 1 S. E., and 1 N. E., 3 sheets (Mr. Chalmers), published 1892, scale 4 miles = 1 inch 6,650
New Brunswick, Surface Geology, ¼ sheet, 2 S.E., in draughtsman's hands, scale 4 miles = 1 inch 3,456
New Brunswick, Surface Geology, ¼ sheet, 2 S. W., in progress, scale 4 miles = 1 inch 3,456
New Brunswick and Prince Edward Island Surface Geology, ¼ sheet, 5 S.W., in progress, scale 4 miles about 1,500
New Brunswick and Nova Scotia Surface Geology, ¼ sheet, 4 N.W., in draughtsman's hands, scale 4 miles about 3,456
Nova Scotia, 16 sheets, 18 in. x 12 in. (Messrs. Fletcher and Faribault), with engraver, scale 1 inch = 1 mile 3,000
Sheets No. 1, 2, 3 and 4, of the above (16) sheets, are nearly ready for publication, scale 1 inch = 1 mile 500

Library.

During the year ended 31st December, 1892, the librarian, Dr. Thorburn, reports that there have been issued from the Survey Office 8,755 publications, consisting of reports, parts of same, special reports and maps; of these 6,207 were distributed in Canada, the remainder, 2,548, were sent to literary and scientific institutions in other countries, from many of which we have been receiving similar favours—thus adding year by year very materially to the library of the Survey.

The number of books, maps, pamphlets, &c., sent to the library during 1892, was 2,681, in addition to which 128 books were purchased, and 36 periodicals relating to scientific subjects have been subscribed for.

The number of letters and acknowledgments received during the year was 2,028, and the letters and acknowledgments sent out by the librarian amounted to 1,052.

The number of volumes bound during the year was 171. There are now about 9,500 volumes, besides about 3,900 pamphlets in the library. During the year, the space available for library purposes has been enlarged and it is found to be a great convenience for properly arranging and classifying the works pertaining to various branches of knowledge. It may be stated, however, that the annex added to the library is already nearly filled with the overflow of books which have been accumulating for years, and for which there was previously no room, except on the floor and ledges of the book cases. Care has been taken when opportunities occurred to complete imperfect sets of publications thus adding greatly to the value and usefulness of such works. The library now contains a very valuable collection of books and pamphlets, chiefly technical, on geography, geology, mineralogy, botany, zoology and other allied branches of natural science. The attention of the government has, on more than one occasion, been called by the director to the ever present risk of the whole Museum, with its immensely valuable treasures, being destroyed by fire. The rooms in the basement, where the surplus copies of the reports are stored, are so situated, that it would be next to impossible to save them in case of a serious fire, which may occur any day, in a building no part of which is fire-poof. The danger of this happening at any time is evident when we consider that neither is the Museum itself, nor are the buildings attached to it, fire-proof.

Sales of Survey publications for the year ending 31st December, 1892, amounted to $243.94.

There are other outstanding amounts of sales, which have not yet been received, amounting probably to about $2,000.

Visitors.

The number of visitors to the Museum during the year from the 1st of January to the 31st of December was 19,550, or 813 fewer than during the same period in 1891.

In this connection I may be excused if I quote certain remarks which were made in the Summary Report for 1888, as follows:—

"In my Summary Report for 1885 I called attention to the question of opening the Museum on Sunday afternoons, and I then gave some very remarkable statistics of attendance, the result of this course having been adopted at the Australian Museum in Sydney, showing that on the 52 Sundays, afternoons only, the daily attendance was

largely in excess of that of the 313 week days, the average being 986 on Sundays and 275 on week days; such a fact needs no comment, and I venture again to express a hope, in the interests of education and knowledge, that the time is not remote when a similar experiment will be tried in Ottawa.

"There will doubtless be strong objections urged against such action, based chiefly, if not entirely on the very erroneous, but unfortunately very prevalent idea, that a museum is a place of amusement, whereas it is essentiallv a place of instruction as is the church and Sunday school; and the principal difference between the two, concisely stated, is, that in the museum the *work*, and in the church and school the *word*, of the *Creator* is expounded. This admitted, there seems no obvious or intelligible reason why the one establishment should be closed and the other opened on the Sabbath."

Since the foregoing was written, I have sought opinions on this subject, and I have been much gratified to find such a large number of persons, including clergymen of various denominations, who regard the opening of the Museum on Sunday afternoons favourably, and think that to do so could not prove otherwise than advantageous to the community, and especially to that very large class of persons whose daily occupations leave them no time in which they can avail themselves of the valuable information and instruction which the Museum is designed to afford.

Staff, Appropriation, Expenditure and Correspondence.

The strength of the staff at present employed is 56, viz.; professional, 36; ordinary, 20.

No changes have taken place in the permanent staff during the year 1892.

The amount available for the fiscal year ending 30th June, 1892, was :—

——	Grant.	Expenditure.
	$ cts.	$ cts.
Civil list appropriation	48,310 00	
Geological Survey and Museum appropriation	60,000 00	
Artesian boring	3,485 52	
Civil list salaries		48,115 54
Wages of temporary employees		16,739 70
Exploration and survey		24,021 71
Boring operations, Deloraine		5,016 51
Printing and lithography		10,257 24
Purchase of specimens		340 39
Purchase of books and instruments		1,478 71
Purchase of chemicals and laboratory apparatus		240 35
Stationery, mapping materials and Queen's Printer		1,469 23
Incidental and other expenses		1,899 95
		109,579 33
LESS—Paid in 1891		5,159 75
		104,419 58
ADD—Advances to explorers for 1892-93		7,107 73
		111,527 31
Unexpended balance, civil list appropriation		194 46
do Geological Survey appropriation		73 75
	111,795 52	111,795 52

The correspondence of the Department shows a total of 10,588 letters sent and 6,830 received.

I have the honour to be, Sir,
Your most obedient servant,
ALFRED R. C. SELWYN,
Deputy Head and Director.