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SUMMARY REPORT

GEOLOGICAL SURVEY DEPARTMENT

FOR THE YEAR

STORAGE 1891



PRINTED BY ORDER OF PARLIAMENT



OTTAWA:

PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S MOST
EXCELLENT MAJESTY.

1892.

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Canada, Geological Survey

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*To His Excellency the Right Honourable Lord STANLEY OF PRESTON, Governor
General of Canada, &c., &c., &c.*

MAY IT PLEASE YOUR EXCELLENCY :

The undersigned has the honour to lay before Your Excellency, in compliance with 53 Vic., Chap. II, Section 6. the Summary Report of the Proceedings of the Geological Survey Department for the year ending 31st December, 1891.

Respectfully submitted,

E. DEWDNEY,
Minister of the Interior.

OTTAWA, 1st January, 1892.



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GEOLOGICAL SURVEY DEPARTMENT,

OTTAWA, December, 1891.

The Hon. EDGAR DEWDNEY,

Minister of the Interior.

SIR,—In presenting the summary report of the proceedings and work of the Department, as required by section 6 of the Act 53 Victoria, chap. XI, it is gratifying to be able to again record the substantial and satisfactory progress that has been achieved during the year now closed, and it is even more so, to be able to ascribe it largely to the increasing interest in the work, evinced by the members of the staff, as shown by the painstaking perseverance with which they are devoting their best energies to investigating, often under very adverse circumstances, depicting and describing the diverse and often intricate geological phenomena presented throughout the Dominion, and more especially in endeavouring to decipher what the bearing of these phenomena is and what they teach, in reference to the profitable development of the mines and mining industries of the country. Thus one or other of the members of the field staff of the Department is in a position to give intending investors and the public the most reliable, authentic and entirely disinterested information respecting mines and minerals in all parts of Canada. Notwithstanding these facts, however, we find that in most cases the opinion of some so-called, often self-styled “mining expert” or “practical miner” from Europe or the United States, is sought and acted upon in preference to that of a member of the geological corps who is thoroughly acquainted with the geological structure of the district in which the information is desired. These “expert” and “practical” opinions rarely prove correct, and their first cost, often considerable, is by no means the greatest. Not a year passes unmarked by such cases and the past season is no exception. The boring for gas at Stewarton in 1889; for water at Morden in 1890; for gas at Belleville in 1891; and for oil near Pincher Creek the past summer, are some of the instances of such useless expenditures, all of which might have been saved had the advice of the Department been sought and followed, instead of that of “expert” opinion.

In this connection and as showing the proper functions, not generally understood, of a geological survey and an associated museum, I may be permitted to quote the following remarks from “Science,” No. 464, December, 1891:—

“A geological survey, if properly organized, is composed of professional men of scientific attainments and of undoubted integrity; it is an official organization, and its examinations are made disinterestedly, and on the truthfulness of its results depends the reputation of its members. Its publications are widely circulated; they are designed to be used by the professional man and also by the layman: being official, and coming from such a disinterested source, the results are accepted generally without hesitation by the capitalists or manufacturers. Such influence and acceptance could never be reached by reports emanating from owners of property or other interested parties, nor would the judgment of such concerning theories of distribution or quality command respect unless emanating from well-known expert sources; thus the capital and enterprise necessary for the inception of such undertakings would be slow to follow such guidance. Hence, a good geological survey constitutes the best of advertising mediums, if you choose to call it such; advertising what is genuine and good, but never stooping to indiscriminate booning.

“But another means of disseminating information exists, over and above that of publications. Some people are not reached by reports, either because they are not given much to reading, or for lack of access to the publications. They may come to the state, or even be in the state, knowing little or nothing of its natural features and products. In such cases, a State Museum is the most effective means of conveying information; a museum which shall contain not only specimens of materials, but maps, models, views, diagrams and reports concerning all that is of interest in this connection: the materials in which shall be so arranged as to convey clear ideas, not only of what is in the state,

but where it is, how it occurs, and how much there is of it; which shall be supplemented by the presence of trained men, familiar with the state, who can guide the stranger in the right direction.

“In conclusion, I would say a few words concerning the educating influences of a geological survey among the citizens of the area in which it operates. Through its publications, through the intercourse with its members, and in other ways, a vast amount of information is absorbed by the people concerning the land they live in and its products. This information they apply unconsciously in their various operations. It prevents them from being led into hopeless enterprises, it leads them to discountenance extravagant expectations and to recognize charlatanism, it brings them to appreciate the truly useful and valuable, and it supplies them with a source of advice which many are otherwise destitute of.”

The foregoing description of the proper functions, educating influences and general usefulness of such an institution, is worthy of the attention and careful consideration of the public and especially of those in whose hands it rests to find the means for its establishment and support.

The early part of the year was as usual fully occupied by the members of the survey in the preparation of maps and reports and in the critical examination and classification of the numerous specimens—rocks, minerals, fossils, plants and insects—collected in the field. In the divisions of lithology, paleontology, botany and entomology valuable, gratuitous assistance has been rendered the survey by the following United States and European scientists :—

Professor G. H. Williams, of Baltimore, O.
 Professor Cope, of Philadelphia, Pa.
 Mr. S. H. Scudder, of Cambridge, Mass.
 Professor T. Rupert Jones, London, England.
 Professor H. Alleyne Nicholson, Aberdeen, Scotland.
 Dr. N. C. Kindberg, Sweden.
 Dr. Carl Müller, Germany.
 Mr. C. Warnstorf, Germany.
 Mr. C. Lyman, of Montreal.

To all of these gentlemen the best thanks of the Geological Survey of Canada are due and I have much pleasure in thus officially tendering the same.

Mr. James Fletcher has also added to his already onerous duties in connection with the experimental farm, the honorary curatorship of the entomological collection in the museum of the Geological Survey, and has devoted no little time to its arrangement and care.

In my last summary report, page 7, I referred to the annual report Vol. IV and mentioned seven of the parts then issued. The volume has since been issued. It contains ten separate reports, which with illustrations and maps, table of contents and index, constitutes a work of some 1082 pages R. 8vo. The detailed reports which will form Vol. V of the annual reports are well advanced and the volume will probably be issued before the close of the present year.

As in previous years the geological investigations were carried on in all the provinces of the Dominion, either in the direction of revising and adding to the details of portions of districts that had already been examined and reported on, or in exploring and mapping districts in which no detail had hitherto been secured.

The working parties, 20 in number, were distributed as follows :—

British Columbia.....	1	Quebec	5
Alberta	1	New Brunswick.....	1
Manitoba	2	Nova Scotia.....	3
Ontario	7		

In addition to these, explorations were made by Professor Macoun and by Messrs. Ami, Weston and Willmott for collecting in Botany and Zoology, Paleontology and Mineralogy.

From the summary statements herewith presented, it will be seen that Professors Bailey, Adams and Laflamme were only a short time in the field, during vacation, and

Mr. McConnell only during the month of June, while nearly the whole of Dr. G. M. Dawson's time had to be devoted to work in connection with the Behring Sea Commission.

A large part of my own time during the year has, as usual, been occupied in editing reports, in correspondence and in attending to the executive details of the Department, including those of the Survey and the Museum.

On the 11th of March I received a communication from Mr. Beauchemin, of St. Hyacinthe, informing me of the discovery of natural gas in that vicinity. On page 34A of my summary report for 1887, referring to this subject, I wrote: "While for reasons connected with this—the geological structure—I have never had any faith in their occurrence on the north side of the St. Lawrence, I consider that the probability of such reservoirs existing on the south side, in the country between Lake St. Peter and St. Hyacinthe, is very great."

In reply to Mr. Beauchemin's letter, I communicated the above to him, and that I would take an early opportunity to visit the locality. I was unable, however, to do so till the 7th of July, when I proceeded to St. Hyacinthe, and accompanied by Mr. Beauchemin and Mr. Desaulier, I visited the several sites where gas was reported. The first examined was on the farm of Antoine Laplante, about six miles north of St. Hyacinthe, on the concession St. Amable, two miles south-west of the village of St. Barnabé, and the same distance west of the Richelieu river. Here Laplante had recently, with the aid of a small hand-boring tool, succeeded in reaching the rock at a depth of 90 feet, a continuous, though not large, flow of gas being the result. The material penetrated consisted entirely of clay, with some small stones near the bottom. This boulder clay covers and almost entirely conceals the older rocks, and forms the level surface of the great plain of the Richelieu and Yamaska rivers. A pipe $1\frac{1}{2}$ inch diameter had been inserted in the hole, and a continuous, though not powerful, flow of gas was coming from it. On inquiry, I found that within a radius of 400 yards from this well, there were four places, sites of old wells, where gas is escaping. One of these was sunk 45 years ago, and the gas has been escaping ever since. The others are more or less recent trials for water, and have penetrated to rock through from 85 to 100 feet of clay, and in all gas comes from the bottom. In three, an inch and a-half pipe has been inserted, and the escaping gas ignites readily and burns steadily, but the pressure is light. On lot No. 18, parish of St. Hyacinthe, range St. Francis, on the farm of Emile Lorquet, close on the east side of the railway to Farnham, I also found gas escaping in a similar manner from a small pit sunk about two feet into the black soil. Near this two wells had been sunk, one 150 yards east, 106 feet deep, the other about 500 yards north, 110 feet deep, and in both, I was informed, gas had been encountered at the bottom. The sinking was through clay, like that in the bore holes on the St. Amable concession, which lies about eleven miles nearly due north, and on the other, or west, side of the Yamaska river.

These facts, in connection with what I wrote in my summary report for 1887, above referred to, are certainly interesting, but by no means sufficient to warrant any positive assertion respecting the success or otherwise of an attempt to find extensive gas or oil reservoirs in the Trenton or other Cambro-Silurian formations, which underlie the great plain of the Richelieu and Yamaska rivers, between Sorel and St. Hyacinthe. There are no surface indications in the area which would indicate any particular site as the most favourable. Under these circumstances the vicinity of, or on, the St. Amable concession is the locality I would suggest as that where a trial should be made. If successful, the cost of piping the gas to St. Hyacinthe would be a trifle in comparison with its value for heating and lighting purposes.

On Friday, the 10th of April, I left Montreal for Deloraine, Manitoba, to make arrangements with the contractor there, to continue the boring. On arriving at Deloraine, on the 17th of April, I found the boring had attained the depth of 1,740 feet, without any material change in the character of the strata from that stated page 9 of my summary report for 1890.

After discussing the situation with the local boring committee and the contractor it was arranged to continue the work. Various unexpected and unavoidable delays and difficulties have, however, since arisen, notwithstanding every effort on the part of the contractor, so that on the 31st of December a depth of only 1,808 feet had been reached. There is, however, still every reason to believe that a successful result will be attained so soon as the base of the impermeable clay shales is reached.

Since the date of my last report the expenditure has been \$6,846.18, making a total to 31st December, 1891, of \$15,494.80.

The undertaking is of national importance and should certainly be prosecuted in spite of the unfortunate accidents and delays that have occurred, until either a negative or affirmative result is attained.

I left Deloraine on the 20th of April, the 22nd was spent at Schreiber in an examination of the cuttings, in the forenoon, four miles west, and in the afternoon, two miles and a half east, and to the openings lately made on a deposit of pyrrhotite precisely like those of Sudbury and occurring on the border of a mass of diabase, associated, as at Sudbury, with schists breccias and some white granite rock, this latter being well seen near both ends of the first trestle east of Schreiber. The analysis of the samples of the ore that were collected gave only .003 per cent of nickel, but as in all these deposits the nickel is very unevenly distributed an analysis of a few small samples is of little value as an index of the contents of the whole body. At the date of my visit the snow was still thick in the woods, and I was not able to do more than ascertain that the area over which the pyrrhotite occurred was more than sufficient to constitute a good mine, and was very favourably situated for working. The deposit was, I believe, opened by Messrs. Marks, of Port Arthur, towards the close of 1890. I cannot learn that any work has been done on it since the date of my visit in April last.

The northern limit of the area of Huronian rocks, which extends from about four miles west of Schreiber, eastward, for about sixty or seventy miles, has not yet been traced out, nor has that other large area crossed by the Canadian Pacific railway between White River and Dalton stations.

It is important that this should be done so as to be able to indicate those portions of it which should be carefully explored for valuable economic minerals. With a view to comparing the rocks of these areas with those of Sudbury, I devoted several days, from the 5th to the 11th of September, to an examination of the cuttings on the line of the railway from east of the Pic River bridge to near Schreiber. Much of it is occupied by massive gabbro, diabase and red quartz syenite, and it is in and around the borders of these crystalline rocks, especially the former, that the nickeliferous deposits should be looked for. The fine samples of zinc ore that were exhibited at the Colonial and Indian Exhibition in 1886, were derived from one of these diorite masses which lies about twelve miles north, a little east, from Rossport station, and which may be connected with the Schreiber Huronian area.

On the 13th of July I left Ottawa for Pincher Creek, Southern Alberta, and arrived there on the 19th *via* Lethbridge and Macleod. My object was to visit and examine the reported discoveries of petroleum in that vicinity and in the South Kootenay pass, as well as the coal seams discovered in the Crow's Nest pass. The petroleum discovery was incorrectly referred to on page 13 of my last summary report as being in the Crow's Nest pass, and it was stated that circumstances had then prevented me from carrying out my intention of visiting the locality. On the present occasion all necessary arrangements had been made for men and horses to meet me at Pincher Creek, and these arrived there from the west the same afternoon.

I found considerable excitement existed in the village, in fact, a decided "boom" in petroleum claims, and that a company had been formed to put down a boring, the site selected for the experiment being on sec. 21, township 3, range 29, some 18 miles south, a little east, of Pincher Creek village.

On Monday the 20th of July I proceeded to the locality named, accompanied by several gentlemen interested in the work. The country traversed is fine farming land, a richly grassed undulating prairie well watered by numerous small tributaries of Pincher creek

and the Waterton river, all of which eventually find their way to the Saskatchewan. The site of the proposed boring was on a small flat on the left bank of one of the tributaries of Waterton river. A gang of men were at work erecting a derrick and preparing to put an engine and boiler, already on the ground, in place.

The evening of the 20th of July and the whole of the following day was devoted to an examination of the rocks that were exposed in the creek both below and above the site selected for boring. They were ordinary varieties of sandstone and sandy shales of the Cretaceous, with irregular dips from 15° to 20° . The last exposure of these rocks up the creek, was about three miles and a quarter, then, for about three miles further there were no exposures up to where the creek emerges from a rocky gorge, all along which there are good exposures of hard flinty red, green and grey shales and sandstones often gritty and quartzose and dipping to south-south-west at 25° to 30° . These are the Cambrian rocks which here form the base of the eastern spurs and ridges of the Rocky mountains. It was stated that both in this gorge and at several places in pools on the prairie to the eastward petroleum had been seen, but no one at the boring camp could show me any of these places.

The whole country for many miles around and up into the entrance of the South Kootenay pass, nine miles to the south, was marked off with the stakes of the oil claims. On inquiry, I was informed that an "expert" named Baring had been there and had expressed a favourable opinion as to boring where operations were being commenced. I was unable to learn any other reason for fixing on the site. The note I made under date 21st of July reads: "There is nothing whatever to indicate the existence of petroleum in this vicinity. It seems highly improbable that it should be found here, though, of course, not impossible." I subsequently heard that a copious flow of water had been struck and the boring abandoned. The cost of this very absurd and useless operation must have been considerable.

On the 22nd of July, I left the boring camp and proceeded about eight miles in a southerly direction, gradually approaching the foot of the mountains, till we struck the Kootenay branch of the Waterton river, which here leaves the South Kootenay or Boundary pass. This stream was then followed up about two miles and a-half, where we camped on the left bank, opposite a depression in the high range which here borders the pass on its southern side, and divides the waters of the Kootenay branch from those of "Cameron Falls" creek. An ascent of about two miles by a somewhat rough trail mostly over grey and white heavy bedded dolomites brought us to the summit of this depression. We then descended into the valley of Cameron Falls creek. This creek takes its rise in a small lake near Camp Akamina of the boundary survey and flows north-east about seven miles to where we struck it, and where it makes an almost right angle bend and flows south-east into Waterton lake.

Camp Akamina is thus described by Dr. G. M. Dawson: "The spot known as Camp Akamina, the eastern terminal station of the old North-West boundary commission, is situated at the head of the valley just described. It has an elevation of about 6,000 feet above the sea, and is a sheltered hollow characterized by thick spruce woods of fine growth. The boundary cairn is placed on the watershed about a mile from the camp, and though built thirteen years ago was found in perfect preservation. It is important as marking not only the forty-ninth parallel or boundary between British North America and the United States, but as lying at the adjacent angles of British Columbia and the as yet unorganized North-West Territory."*

A full description is also given in the same chapter of the character of the rocks and the appearance of the country.

Cameron Falls brook is a rapid mountain stream, eight or ten yards wide. After following it up about a mile and a-half on the left bank, Mr. Fernie, my guide, remarked that we must be close to where the oil had been found. He had scarcely spoken when, while still in the saddle and on the trail eight or nine feet above the brook, I noticed a powerful odour of petroleum. Descending to the edge of the water and stirring the stones and gravel in the bed of the stream, considerable quantities of oil at once rose to the surface and floated away. Crossing to the right bank it was again seen coming out of the

*Report on the Geology and Resources of the region in the vicinity of the Forty-ninth Parallel, Chap. III.

bank, some inches above the then level of the stream. Here, skimming it off the surface of a shallow pool, a wine bottle full was soon collected. This can now be seen in the Geological Survey Museum. Sixty or seventy yards below where the oil was seen, a rocky reef of grey siliceous dolomite crosses the creek and rises into a steep bluff on the left bank; on the right bank, seven or eight feet above the creek, a broad thickly timbered flat extends for 150 yards to the base of the bordering mountains which culminate six miles to the south-west at the boundary monument, 6,000 feet above sea level.

No work whatever had been done to test the nature of the oil sources! A comparatively small outlay for some shallow sinking or boring on the flat above described would do this.

On the 23rd, we proceeded through the pass, crossing the summit and camping on Akamina brook about six miles down on the western slope in British Columbia. On the 24th we proceeded down the valley and at about four miles north of the 49th parallel the trail came down to the level of the brook, and here on the edge of a beaver dam pool there were ledges of hard dark blue shale dipping E. 30° N. 12'. Lifting layers of this at and below the water a quantity of dark green circular patches of oil rose to the surface, and a precisely similar result followed by stirring up the mud in the bottom of the pool. This place is about fifteen miles in a direct line, west 10° south, from the occurrence on Cameron Falls creek, the main watershed of the Rocky Mountains and Mounts Kirby, Spence, and Yarrell intervening. Oil is said, by the Indians (the Stoneys) who frequent this region, to occur at other points, in the Akamina Brook valley, both above and below that recorded. The Akamina joins the Flathead river in Montana, about four miles south of the international boundary. The Beaver dam oil is of a dark greenish black and does not apparently differ much from that of Cameron Falls creek. Preliminary tests might be made here by sinking a shallow shaft in the shales at the Beaver dam pool, and by a boring on the sandy and gravelly flat country about two miles and a-half north of the boundary line.

On the 24th of July we camped in Montana on the left bank of the Flathead river, about two miles above the mouth of the Akamina or Kish-e-ne-nah creek.

On the 25th we proceeded up the Flathead valley, the trail passing for the most part along high terraces of sand, clay and gravel. At 8 a.m. we recrossed the boundary on one of these terraces and then again descended to the river where we off saddled and waited for the pack train. It arrived at 10.30; and we then ascended again to the high level terrace and turning north crossed a number of ridges and gullies into the valley of Sage creek camping on the right bank at about nine miles above its mouth.

At about a mile and a-half higher up, the creek leaves the high mountains which border its upper course in a north-easterly direction up to the main watershed some twelve or fourteen miles distant, and here at the edge of the water, on the left bank, I found hard dark flinty shales like those at the Beaver dam pool on the Akamina dipping S. 25° - 30° W. < 25°. Directly the layers of this rock are raised the oil rises and spreads over the surface of the water in such abundance that a short time suffices with the aid of a tin cup to collect a bottle full. Here, also a considerable quantity of gas escapes from the cracks and joints in the rock and ignites freely on the application of a match.

Less than half a mile higher up, on the right bank and on the opposite or west side of the valley, oil was again found issuing from the base of a bank of drift which has here filled the valley and caused the stream to make a sharp bend eastward to the base of the opposite mountain. No rock was exposed here, but every stone in the bed of the creek, especially on being broken or rubbed, gave out a strong odour of petroleum. The oil collected here, a sample of which can be seen in the museum, differs entirely in appearance from those of Cameron Falls creek and Akamina or Kish-e-ne-nah creek.

Some of it was of a light lemon yellow, but most of it nearly the colour of pale brandy and with a very powerful petroleum odour.

The general geological structure, the character of the rocks and the physical aspect of the country in the South Kootenay, the North Kootenay and the Crow's Nest and other passes of the Rocky mountains have been admirably described by Dr. G. M.

Dawson,* and the South Kootenay pass is also described in his Report on the Geology and Resources of the Forty-ninth Parallel, 1875. For details on the subjects named these works can be referred to. The present is, however, I believe the first recorded instance of the occurrence of petroleum in this region, as well as of its occurrence in Cambrian rocks. Whether the reference of the rocks to this age is correct, is not quite certain; that it is so as regards the somewhat similar siliceous dolomites and quartzose strata of the Kicking Horse pass has been proved by the discovery of a Cambrian fauna and there seems no reason to doubt that the petroleum-bearing beds of the South Kootenay pass are of the same age. At present, however, except on the traverses made by Dr. Dawson, little or nothing is known respecting the distribution of the formations in the great block of mountainous country which lies between the 49th and 51st parallels of latitude and the 115th and 117th degrees of longitude, and which comprises the Purcell, Hughes, Macdonald and Galton ranges and covers an area of about 9,600 square miles, much of it densely wooded and with peaks ranging to eight and nine thousand feet.

Leaving Sage creek we followed up the Flathead valley crossing and recrossing the river and its numerous channels so frequently that we travelled almost as much in the water as on the land. On Tuesday, the 28th of July, we travelled in this manner for ten hours without a halt, and at 6 p.m. camped on a fine grassy flat, surrounded by timber, at the foot of the abrupt ascent from the Flathead valley to the eastern summit of the North Kootenay pass.†

On the 30th of July, we camped at Lee's lake on the Crow's Nest pass trail. On the 31st Col. Baker joined me here, and on the following day we camped at the east end of Crow's Nest lake, and on the next day, 2nd of August, we reached the coal prospecting camp situated about 1,200 feet above the trail, on the ridge which runs in a north easterly direction between Marten creek and Michel creek and forms the west side of the valley of the west branch of Michel creek. From this ridge a number of spurs with steep intervening gullies descend abruptly to the trail: in these and on the intervening ridges a wonderful series of coal seams is disclosed, one above the other from near the level of the trail to the summit of the ridge.

No exact measurements were taken and it may be that some of the lower cannel seams are the upper ones repeated by faulting. The outcrops which can all be seen on the ground are as follows, twenty seams in all, showing a total thickness of 132 feet of coal:

	Fect.	
No. 1	5	} No. 1 to 10 inclusive are cannel coals.
2	3	
3	4	
4	2	
5	4	
6	3	
7	2	
8	4	
9	5	
10	6	
11	4	} So named by Col. Baker.
12 (Peter seam)	15	
13	7	
14 (Selwyn seam)	6	
15 (Jubilee do)	30	} These four are cannel coal.
16 (Williams seam)	20	
17	5	
18	3	
19	2	
20	2	

*Annual Report Geological Survey, 1885.

†Annual Report Geological Survey, 1865, p. 61 *B et seq.*

The number and thickness of these seams in the above table are as supplied me by Mr. Fernie, who has superintended all the exploratory work that has been done on the seams. Between the most eastern outcrops I examined, and the western ones close to the junction of Marten creek and the west branch of Michel creek, is a distance of about two miles along the steep mountain side, to the north of the trail. Within this distance the outcrops were seen of nearly all these seams, either on the ridges or in the sides of the ravines which score the face of the mountain. The few hours I was able to spend on the ground, while not sufficient to enable me to affirm the absolute correctness of the details of the table, were, however, ample to enable me to see that there is in the Crow's Nest pass, between the eastern summit, 4,330 feet above tide, and the valley of Elk river, in British Columbia, an area of not less than 144 square miles, that is destined to be one of the most valuable and most productive coal fields in Canada. A rough calculation would give about 49,952,000 tons per square mile. If one-half of this is available there are in each square mile 24,976,000 tons. The average elevation of the field is about the same as that of Canmore and Banff, or between 4,000 and 5,000 feet. From Pincher Creek westward to Elk river, the pass presents no difficulties for railway construction. The eastern entrance to the pass in Alberta is 3,800 feet, and where it comes out on the Elk river is 3,300 feet: the highest intervening summit being 5,500 feet. A better route to the Elk river, however, than that of the present trail, would be to follow down Michel creek, from near the eastern summit and thus avoid the western and higher summit, and reach Elk river about ten miles above the mouth of Coal creek. The distance through the pass from Lee's lake, Alberta, to the Elk river, is about thirty-seven miles.

On the 4th of August, after devoting the forenoon to a further examination of the Marten creek seams, we proceeded through the pass and reached Elk river at 6 p.m. No coal seams were seen till about four miles above the mouth of Coal creek: here at the mouth of a steep rocky gulley, about 200 yards to the right of the trail, a fine seam of coal, 7 feet thick, had been cut into. The section exposed showed in descending order:

Shale.....	10 feet.
Hard ferruginous band.....	1'
Coal.....	1·6
Shale.....	7·6
Coal.....	7·6

Cherty conglomerate and massive gritty sandstones are seen both above and below; the dip is about E. 10° N. 15°—20°. A close search along the mountain side, between here and the water-shed at the head of Coal creek, would almost certainly disclose the outcrops of many more of the Marten creek seams.

On the 5th of August, we descended the Elk river valley, about seven miles, then turning to the left ascended the mountain, a steep climb of 1,500 feet. Here on top of a broken-down cliff of massive sandstone, about 50 feet thick, we came to the first of a series of coal seams: the dip being E. 20° N. 35° and the seam 25 to 30 feet thick, with a shale parting about 2 feet: bar. 24·93. Ascending 130 feet over shales and brown thick bedded sandstone forming a similar broken-down cliff of about 50 feet, a second seam of coal was reached, also 30 feet thick: bar. 24·80. Above this four more seams were examined:

No. 3.....	15 feet, bar. 24·57
4.....	4 do do 24·50
5.....	7 do do 24·42
6.....	30 do do 24·35

Above No. 6 there are six more seams which were not visited, but the particulars of which given me by Mr. Fernie are as follows :—

No. 7.....	10 feet—100 feet from No. 6
8.....	4 do 100 do 7
9.....	7 do 100 do 8
10.....	2 do 100 do 9
11.....	7 do 100 do 10
12.....	4 do 200 do 11

The distances are approximate only, they have not been measured.

The above gives a total thickness of 148 feet of coal against 132 feet in the Marten creek area on the eastern side of the basin, while in other respects the seams correspond so closely as to make it almost certain that, except where cut out in the valleys, they are continuous beneath the whole intervening area. For much detailed information respecting the Crow's Nest pass the Annual Report of the Geological Survey, Vol. 1, part B, 1885, already cited, and the accompanying map, can be referred to.

Many of the seams are first-class coking coals and others are good gas coals, but none of them are anthracites. For analyses of those of the Jubilee and Peter seams, Marten Creek, See Annual Report Geological Survey, Vol. III, Part II, pp. 12 s. to 15 s., and for those of the "cannel" seams, Vol. IV, pp. 7 r. and 8 r.

On the 6th of August I reached Pincher Creek, and Ottawa on the 14th.

Dr. G. M. Dawson was employed during the earlier part of the present year in working up and preparing for publication the information intended to be included in the Kamloops sheet of the geological map of British Columbia and had made preparations to undertake some special examinations in the foot-hills of the Rocky Mountains and to continue the field work already begun in the adjacent Shuswap sheet during the summer. Before leaving for this work, however, he was appointed as one of the British Behring sea commissioners, and arrangements had consequently to be made such as to enable Mr. McEvoy to continue the work on the Shuswap sheet on the general plan already adopted, while Dr. Dawson was left free to devote himself for the time to the special enquiry just referred to. The completion of the Kamloops sheet and report has consequently been unavoidably delayed, but it is hoped that both may be ready in time to form a part of the next annual volume of the Geological Survey.

Mr. James McEvoy left Ottawa on the 20th of June for field work in the interior of British Columbia, and returned on the 6th of November.

He reports as follows on the special work entrusted to him, as above explained :—

The season was chiefly spent in continuing the work within the area of the Shuswap sheet of the geological map. This sheet is referred to in the report of Dr. G. M. Dawson's work in the summary report for 1890. It embraces the country immediately to the east of that covered by the Kamloops sheet and like it is laid out with sides eighty miles in length, thus covering an area of 6,400 square miles.

The first ten days of the season were occupied by a short trip into the northern part of the area covered by the Kamloops sheet to secure some additional information of the country between Loon lake and Deadman river, necessary for the completion of that sheet. While in this vicinity a number of specimens of the hyalite discovered in 1889 were collected.

After the completion of this trip the country between Chapron lake and Okanagan lake was visited. As there were no trails progress was necessarily slow ; two traverses were, however, made across it, besides several shorter ones, and three mountain summits were occupied for topographical sketches. Here, and generally throughout the western and southern portions of the area of the Shuswap sheet, the Tertiary volcanic rocks are more extensively developed than was formerly supposed. At a rough estimate they cover about a-fourth of the whole area of the sheet.

During the season Shuswap, Long, Mabel and Sugar lakes and a part of Okanagan lake were surveyed with a patent floating log and prismatic compass. Observations for latitude were taken with a seven-inch sextant to fix places not otherwise determined.

Neither Mabel nor Sugar lakes had ever been surveyed and were only very roughly indicated on existing maps. They are situated in the foot-hills of the Gold range on the Shuswap river and are about 35 miles apart by the river route. Their shores are rocky, being composed of gneiss and mica-schists of the Shuswap series, with large masses of pegmatite and graphic granite included. At the head of Sugar lake grey granite replaces the gneiss entirely, holding in many places angular fragments of mica-schist.

To the north-east of Enderby, and south of the Canadian Pacific railway, the mountains were ascended and two transit stations were established at an elevation of more than 6,000 feet. These mountains are almost bare of trees, and, where not too rugged, travelling is easy. Bear, caribou and deer are abundant.

Another transit station was made on the mountains north-east of Sugar lake on the eastern boundary of the sheet. These and several compass stations on either side of White valley, together with the points occupied in 1890, will afford sufficient data for the construction of an approximately accurate topographical map.

Southward and easterly from Salmon Arm, along Canoe creek and Deep creek, there is an extensive area of flat land, with grey silty soil, very suitable for farming. Generally this area is lightly timbered, while much of it having been burnt over would be easily cleared for cultivation.

About half way between Lansdowne, on the Shuswap and Okanagan railway, and the first crossing of the Salmon river by the waggon road to Grande Prairie, specimens of garnet were discovered. The crystals are nearly equal in size to the Stikine garnets and are enclosed in a light grey mica-schist and in places form at least half of the rock mass.

Though not included within the area of the Shuswap sheet, it may be mentioned that the numerous discoveries of silver-bearing galena and zinc blende on the North Thompson river at Mosquito Flat and above the Clearwater, are attracting a good deal of attention. These localities are situated about 50 miles and 75 miles respectively from Kamloops. The ores are said to give rich assays.

The following specimens from Mosquito Flat were assayed in the laboratory of this Department:—

1. Zinc blende with a little galena : gold, none ; silver, 11·666 ounces per ton.
2. Galena and zinc blende in quartz : gold, none ; silver, 48·125 ounces per ton.

During the season 330 miles of patent log surveys and 540 miles of track surveys were made.

Mr. McEvoy was assisted by Mr. J. McGregor, B.A.

The total cost of the exploration was \$1,459.73.

Mr. R. G. McConnell obtained leave of absence last summer for the purpose of visiting the European Alps and studying their structure as an aid to further work in the Rocky Mountains of Canada, and the field work done by him last summer was limited to an examination of part of the Bow River valley, in Alberta.

Mr. McConnell supplies the following statement respecting this examination: "This work was carried out during the month of June and was undertaken with a view of ascertaining whether the coal-bearing Cretaceous rocks of the Cascade basin recur east of the mountains. The section along the Bow proved to be too complicated and was intercepted by too many concealed intervals to trace the sequence of the formations definitely throughout, but sufficient evidence was collected to show that in all probability the conglomeritic beds exposed at the Kananaskis Falls are the equivalents of those overlying Marsh's mine, south of the Gap siding in the Cascade basin, and that the underlying dark shales consequently represent the coal-bearing formation. East of the

mouth of the Kananaskis the conglomerates and underlying shales fold over a light anticlinal, and several hundred feet of the latter are exposed without any coal seams being seen. The summit of this anticlinal, which occurs three-quarters of a mile east of the mouth of the Kananaskis river, offers the most favourable site for testing by means of a bore hole for the presence of coal. The coal horizon of Marsh's mine, assuming the identification of the conglomerates to be correct, lies at this point at a depth of 1,300 feet below the surface. There is, however, no absolute certainty that even if this depth was reached coal would be obtained, owing to the lack of persistence of the Cretaceous coal seams, and on the other hand workable seams might be struck at a much less depth. The rocks near the mouth of the Kananaskis river are comparatively undisturbed, and coal, if present, would be much less crushed and also more easily worked than is the case with many of the seams enclosed between the more highly inclined beds of the Cascade basin, and on this account a bore hole to test its presence would be desirable.

"In returning east I descended the Bow in a boat as far as Gleichen, for the purpose of studying the mode of junction between the eastern and western drift, and on the way collected a number of interesting facts bearing on this subject which will be published later on. Cost of exploration, \$324.85."

During the past summer Mr. J. B. Tyrrell, and Mr. D. B. Dowling, with Mr. J. C. Gwillim as assistant, completed the geological examination and mapping of Lake Winnipeg, and made reconnaissance surveys of many of the streams flowing into both the eastern and western sides of this extensive body of water. Mr. Tyrrell reports as follows: "The two small sail-boats that had been stored at Selkirk at the end of the season 1890 were repainted and again placed in the water. Supplies for a month were procured from Capt. Wm. Robinson, and arrangements were made with him to have provisions shipped from time to time to various places around Lake Winnipeg, where they could be obtained, in passing, without unnecessary delay. Two canoes had been ordered from Peterboro' for the examination of the streams flowing into the lake, but they did not arrive till later in the summer.

"On the 5th of July, after having been delayed in Selkirk for several days by wet and stormy weather, we started northward in tow of the steamer *Sultana*, and early on the morning of the following day reached the harbour at Swampy island, whence we sailed eastward to the mouth of Beren's river.

"Having determined to divide the party in order to accomplish a wider range of exploration during the season, Mr. Dowling was sent northward with the larger sail-boat to examine St. George and Sandy islands, to take levels on the Saskatchewan river, to follow the west shore of the lake from Limestone bay southward to the mouth of Red river, and to explore the streams emptying into that side of the lake. This work he has successfully performed, as is shown by his report appended hereto.

"From Beren's river I turned southward and devoted the summer to a close examination of the eastern shore of the lake up to the mouth of Red river, and an exploration and survey of the principal streams discharging into that portion of the lake lying north of the straits at Dog Head, including Loon, Wepiscow, Wanipigow, Manigotagan, Sand, Black, Winnipeg and Brokenhead rivers, and thus it has been possible to outline with some degree of accuracy the extent of country underlain respectively by comparatively barren granites and gneisses and by Keewatin schists and quartzites which might be profitably examined for the presence of the ores of the richer metals.

"The investigations of Mr. Low, in 1886, had shown that Beren's river, throughout the whole of the course followed on his journey to Hudson's bay, flowed through country composed of Laurentian granites and gneisses, and from the mouth of this river up to Dog Head straits, the shore of Lake Winnipeg is composed of similar rocks. At this latter point these gneisses begin to assume a very regularly banded arrangement parallel to the lake, and a few miles further south dykes of dark green trap begin to make their appearance, running in the same direction. Then irruptive rocks continue close to the east shore as far south as Wanipigow or Hole river, where they merge into an exten-

sive area of eruptive volcanic rocks and agglomerates that form the base of the Keewatin series. On ascending the streams that flow into this portion of the lake, namely, the Loon, and Wepiscow or Rice rivers, the gneiss is seen to be very regularly and evenly banded near the eruptive rocks, while further east it changes imperceptibly into the coarse grey irregularly foliated Laurentian gneiss typical of that whole region. Punk island and the many small islands between it and Black island and the main shore were examined, and while the former at its eastern end was found to be composed chiefly of St. Peter's sandstone, the latter consists of altered conglomerates quartzose sandstones, agglomerates, chloritic and sericitic schists, &c., similar to those found in the typical Keewatin in the Huronian districts elsewhere. The quartzites and conglomerates are somewhat more easily eroded than the adjoining volcanic rocks, and they therefore lie in a hollow which is flanked on one side by Black island, and on the other by the west shore, the beds standing generally at a high angle and striking parallel to the general curving trend of the shore.

"After these islands had been examined, Wanipigow or Hole river was ascended to the lake; a survey was made of the lake, and the river was also examined and surveyed to the first heavy rapid above the lake, beyond which we were unable to proceed on account of the lowness of the water. At its mouth the river breaks through a belt of evenly banded gneisses, above which it flows for ten or twelve miles through a rich alluvial plain wooded with poplar and white spruce, the banks on either side rising to a height of from fifteen to twenty feet above the water. Very little rock is to be seen, but any exposures that do outcrop from beneath the till and alluvial deposits consist of massive coarse amphibolites and green chloritic schists. On Wanipigow lake the rocks are also almost entirely of the same character, though on some places on the north shore the gneiss approaches close to the water, and the contact of the green Keewatin schists and the Laurentian gneiss is well shown. Speaking generally, the lake and valley of the river lie in a trough of Keewatin schists, the north side of which is bounded by ridges of Laurentian granites and gneisses, while the south side rises in hills of more compact green schist the contact of which with the Laurentian was not here observed.

"A stream called English river, a tributary of Wanipigow river, and the lake into which it expands in the middle of its course, were likewise surveyed. This river in its lower portion also flows over Keewatin schists, but the lowest rapid occurs at the contact of the schist and gneisses, and above this its course is through rugged country composed of high barren hills of grey gneiss thinly wooded with a stunted growth of small Banksian pine. Specimens of galena and chalcopyrite, stated to have been found on the north shore of Wanipigow Lake, were shown to the writer, and the occurrence of these minerals is not improbable along the above-mentioned contact line.

"From the mouth of the Wanipigow river to Manigotagan or Badthroat bay the shore is composed of greenish grey evenly banded gneisses with schists and altered traps of the Keewatin series, while near Clement point these are overlain by St. Peter sandstone (Chazy), this being the most northerly point at which Palaeozoic rocks have been recognized on the east side of the lake.

"Manigotagan or Badthroat river was then ascended to Rat Portage lake, a track survey was made of this lake, and the river was ascended for a short distance above it. The river is remarkably picturesque throughout, consisting of long quiet stretches of clear brown water, separated by rocky rapids or high abrupt falls which are passed on portages of an average length of from one to two hundred yards, twenty-three of which must be ascended on the way from Lake Winnipeg to Rat Portage lake.

"At the mouth of the river and up to the second portage, the rock is a thin and evenly banded hornblende schist, while throughout the rest of the distance to the latter lake it consists entirely of Laurentian granites and gneisses, rising in places in hills of from one to two hundred feet in height, the summits of which present a wintry bareness throughout the year.

"From the mouth of Manigotagan river to Pt. Metasse, north of the mouth of Winnipeg river, granites and gneisses everywhere compose the points on the shore, and these points are usually connected by gently curved sandy beaches in front of low-lying alluvial land.

"Sand river was ascended through this alluvial plain to the first rapid where it was found to be too small for further ascent with our large Peterborough canoe, but the rock, where seen, was similar to that on the shore.

"Black river was also ascended past thirty-three portages to a point south of Rat Portage lake, where a portage a mile and a-half in length strikes off to the northward. The stream is shallow and much obstructed by boulders and sandbars throughout, and the rocks on either side are everywhere Laurentian granites and gneisses.

"Winnipeg river was ascended to the mouth of the Whitemouth, and on the return a track survey was made of Lac du Bonnet.

"The rocks on the main stream are all granites and gneisses, but towards the east end of Lac du Bonnet, and around the mouth of L'Oiseau river, thin-bedded green schists and altered traps, doubtless of Keewatin age, make their appearance, striking up the valley of the latter stream.

"Above Lac du Bonnet the banks of the river, as far as examined, were chiefly composed of till, with many limestone boulders, and the rocks are scored in a S. S. E. ly as well as in a S. W. ly direction, showing that the earlier glacier moving south-eastward over the Palaeozoic Lake Winnipeg basin had extended at least this far eastward, though there is no sign of limestone drift on the main portion of Lac du Bonnet itself or on the lower part of Winnipeg river.

"From the mouth of Winnipeg river the shore of Lake Winnipeg was explored to the mouth of Red river, and a short trip was made up the Brokenhead river to the first rapid. A paced survey was also made of Elk island, and excellent sections of St. Peter's sandstone were found, both on this island and on the long point of land opposite. In this vicinity were also found many interesting sections of the drift deposits, some of which show the alluvial clay of the east shore of the lake interbedded with glacial till, proving clearly that this clay was deposited close to the oscillating front of the glacier descending from the highlands to the east.

"As the stormy autumn weather had now set in, the boats and supplies were stored with Capt. Wm. Robinson at West Selkirk, and Lake Winnipeg was left for the season. On the way east a short time was spent at Bird's Hill to examine the remarkable ridge of gravel that there rises through the surrounding hard boulder-clay, and again at East Selkirk to see the section of Trenton limestone exposed there in a quarry north of the railway. The exposure is an interesting one, as it shows a hill of limestone, the top of which has been broken up and shoved along by the glacier of the Winnipeg basin, leaving what is known as a *tail* deposit of loose material behind a protecting *crag*. It is chiefly from this broken *tail* material that the blocks of limestone used in Winnipeg for building purposes are quarried.

"I also remained for two days at Sudbury for the purpose of comparing the rocks that are there so rich in copper and nickel with those found on the east side of Lake Winnipeg, and it was very gratifying to see the remarkably close similarity between the two sets of rocks.

"During the season forty-four large and eighty-eight small photographs were taken of characteristic sections and surfaces of rock, and of particularly interesting features of the landscape.

"The following is Mr. Dowling's account of the work accomplished by him during the summer:—

"I left Beren's river on the 8th of July, after having secured the services of a competent sailor. Our first halt was at George's island, where I made a paced survey of its shores. We then called at Little George's and the Sandy island. After stopping at Poplar Point to take observations, our next halt was at Selkirk island, the shores of which were examined, and a traverse made with compass and boat log. There are here several small exposures of a hard mottled dolomitic limestone, somewhat similar to that on the mainland west of this island. We went from here to the Grand Rapids, where I levelled across to the head of the tramway with the transit, making a section on the tramway. This road is about three miles and a half long, and rises at its highest point to 128 feet above the lake, having a total rise of 71 feet between its upper and its lower end.

‘Four well-marked lake beaches are crossed at elevations of 78, 91, 95 and 118 feet above present lake level. The lower one was followed about two miles north, and its crest was found to vary in elevation from 78 to 80 feet. With an Indian and his canoe we ascended the Saskatchewan and crossed Cedar lake to the “Mossy portage,” an old portage road between Cedar lake and Lake Winnipegosis, to determine the heights of several gravel ridges. The difference in the level of the two lakes was then only nine inches, Lake Winnipegosis being the higher. After returning, a trip was made along the west shore towards Limestone bay with a Peterborough canoe that had just arrived. From Grand rapids I sent the sail-boat to Reindeer island and with the canoe went along the shore south to near Clark’s point, crossed over to St. Martin islands and thence north joining the boat at Reindeer harbour. We then sailed along the west shore to Little Saskatchewan, where the boat was left for another canoe trip. We went up the Little Saskatchewan river, to the elbow, portaged over to the South Branch of the War Path river and descended this stream to its mouth; at the time of our trip this stream was very shallow and we found it slow work getting down. The country through which it runs is sloping gently to the north-east and is wooded principally with poplar and tamarack and a few spruce. From the mouth of the Little Saskatchewan we ran along the shore with the large boat and examined the cliffs of yellow dolomite west from Cat Head.

‘From Kinnow bay to Fisher river the shore is rather low, the land behind being very little above the lake, with the exception of a few ridges of drift material that seem to trend in a north and south direction and where extending into the lake form boulder bars and boulder-strewn points.

‘At Fisher river there is a large Indian reserve having good farming land a short distance from the mouth of the river, the lower part near the lake being all splendid hay flats. The Indians seem to be very comfortable and have several good fields of grain and many fine looking cattle. The river for about twenty miles is a sluggish stream with a few shallow parts with some current. The greatest fall is at the Big Rapids and is about four feet, but in the whole length of the river to The Forks there is only about twenty feet fall. The country passed through is quite level, wooded for the most part with poplar; but a considerable portion has been fire-killed and almost reduced to prairie. Between the patches of timber open hay land was seen and swamps are reported rare, so this should make excellent land for settlement.

‘From Dog Head to Bull Head the exposures are of Trenton limestone and were examined and measured. From Bull Head to Big island the underlying St. Peter’s sandstone is frequently exposed in the same cliff with the limestone. The east side of Big island is seen to be underlain by limestone which is exposed in sections of from 10 to 20 feet extending from the north end to about the middle of the island. The southern part is covered principally with drift material causing the shore at its southern extremity to be boulder strewn and the water shallow. On the 29th of September I returned to Selkirk and stored the outfit; leaving the boat in the care of Mr. Muckle, Indian agent at Clandeboye.

‘I was about starting for Ottawa when Mr. Tyrrell returned from the lake and commissioned me to examine the rock exposures at Stonewall, Stony mountain and lower Fort Garry. At Stonewall I observed two sets of glacial grooves on the surface of the rock, the striae running S. 25° E. and S. 10° W., the latter evidently the newer.

‘The present season’s work enables us to complete the section of the Cambro-Silurian formations, which rest unconformably on the Archaean rocks of the east side of Lake Winnipeg and seem to underlie conformably the Silurian which was observed at Grand rapids by Mr. Tyrrell.

‘Typical examples of the lower division consisting of beds of friable sandstone and shales may be seen at Grindstone point and Deer island.

‘The middle division is represented by mottled yellow limestones at Selkirk, Dog Head and Beren’s island, while the upper division consists of impure limestones and shales as at Stony mountain and Clark’s point, Lake Winnipeg.

‘About forty photographs of the various rock exposures were taken. Mr. Dowling left for Ottawa on the 11th of October.’

“Cost of season’s exploration \$2,059.29.”

Mr. McInnes left Ottawa on the 17th of July, with instructions to continue the work of 1890 in western Ontario, between the Lake of the Woods and Thunder Bay, Lake Superior, and arrived at Port Arthur on the 20th. Provisions and men were obtained there for the season's work, and Mr. Chas. Marks, of Port Arthur, was engaged as assistant for the season. Mr. McInnes reports as follows:—

“On the 25th a start was made southward from Savanne by canoes, and the interval between this date and the 16th of August was spent in an examination of the country lying on either side of Kashabowie lake.

“The streams flowing into the lake were first ascended and the lakes along their course were surveyed by prismatic compass and boat log. A survey of the same character was made of Trout lake, which lies to the east of the north end of Kashabowie lake.

“The main body of this lake, which is about six miles in length and a mile and a-half in width, lies entirely within the gneiss area which occupies the greater part of the shores of Lac des Mille Lacs. This gneiss was found to extend continuously northward from Trout lake and to occupy the whole of the country northward to the Savanne river and the Canadian Pacific railway track. The country about the height of land here is an immense swamp which divides the water of Lake Superior and Lake Winnipeg, sparsely wooded with tamarack and stunted spruce, and with here and there low ridges of granitoid gneiss rising from the general level.

“After completing the survey of Trout lake, Asagesh or Crayfish river was next ascended, and a track survey made of it and a log survey of the lakes along its course. About a week was spent in surveying the lakes at the heads of its two branches and in fixing the southern limit of the Kashabowie belt of gneiss, at different points in the neighbourhood. The country about Round and Jackfish lakes was next visited, and a week was spent in tracing geological boundaries in that district. At the Huronian mine which has not been worked since 1885, the buildings, ten-stamp mill and vanners, &c., boarding house, shaft house, store houses, &c., were found in a good state of repair: the shaft was however filled with water and the vein could be seen only in the extension to the south-west at the Highland mine opening, where it is clearly defined and highly mineralized with iron and copper pyrites. There seems good reason to hope that with possible future railway extension in that direction, and the consequent improvement in means of transport, the properties on this vein may be profitably worked.

“Returning to Lake Shebandowan a survey was made of a series of lakes and streams extending northward to a point near the Canadian Pacific railway at Nordland station. The granite-gneiss was found to extend from a point near the Muskeg river which enters Lake Shebandowan from the north near its outlet northward to the railroad track, the belt of Keewatin rocks which has a considerable width on Lac des Mille Lacs having given place to the gneisses a short distance to the east of the lake.

“The remainder of the canoeing season was occupied in an exploration of the country lying to the south of Lake Shebandowan. A canoe route was followed leading southwards to Kekekuab river, a branch of the Mattawin, and returning by a chain of small lakes leading across to Greenwater lake. With the exception of one small lens-shaped area of gneiss which lies about three miles to the south of Lake Shebandowan, Keewatin diorites and schists were found to extend over the whole area southward, as far as Kekekuab lake, where the northern edge of the broad belt of gneiss of Northern Light and Seiganagah lakes is struck. A number of bands, 20 feet or thereabout in width, of magnetite interstratified with schistose layers of hornblende, quartz, &c., were noticed in the dioritic areas of the Keewatin in this district. The magnetite occurs in narrow bands a quarter of an inch in thickness with thin layers of about the same thickness of the schistose material interstratified, the whole often highly contorted and twisted locally, though preserving a general trend parallel with the enclosing diorites and schists. Specimens of this ore collected from near the eastern side of Greenwater lake were submitted to Mr. Hoffmann, the chemist of the department, who describes it as ‘a very fine grained, almost compact, schistose magnetite from Greenwater lake, district

of Thunder Bay, Ont.,—collected by Mr. McInnes, 4th October, 1891, has been examined by Mr. F. G. Wait, and found to contain :

Metallic iron.....	52.82 per cent.
Insoluble matter.....	22.31 do
Titanic acid.....	none

a good iron ore.

"This, it will be seen, is a most encouraging report, both in the high percentage of metallic iron and in the absence of titanic acid, and gives good reason for the hope that a thorough exploration of the region will reveal valuable deposits of this ore. A number of locations have already been taken up in the vicinity of the Mattawin river and during the past summer considerable work was done towards testing some of these properties, the result of which has not however been learned.

"In the district further west very commendable enterprise has been shown by the Marks Company in thoroughly testing their iron properties on the Atikokan by the diamond drill. It is stated that the results have been satisfactory. Mr. Smith who makes a separate report will deal with this region in detail.

"In the whole region explored during the summer, the areas of land adapted for cultivation are few and very limited in extent. As pasture much of it might be greatly improved. This is well shown by the luxuriant growth of red and white clover and timothy grass where seed had been scattered around the old construction camps along the line of the Canadian Pacific railway. But doubtless the future of the district will depend largely upon its contained minerals and it is to be hoped that the present very promising discoveries of extensive deposits of iron ore may be found to warrant the building of the necessary works for smelting the ores somewhere in the neighbourhood."

Mr. McInnes returned to Ottawa on the 30th of October.

The total cost of the season's explorations was \$994.71.

Mr. Smith left Ottawa on the 16th of June, and was joined in Toronto by his assistant, Mr. William Lawson, whence they proceeded at once to Port Arthur.

After securing men and purchasing supplies, Mr. Lawson left English river on the 25th of June to make a compass and log survey of the chain of lakes running south-westerly from there, which it was thought might be partly within the area of the Seine river sheet. On the completion of this survey as far as the north-eastern arm of Turtle or Crow Rock lake, he travelled to Fort Frances.

Mr. Smith went through the chain of lakes and streams comprising a hitherto unknown route from Ignace to the headwaters of the Big Turtle river. He passed down this river, surveying on the way Pekagoning lake, which encroached on the northern limit of the Seine river sheet; and from thence he proceeded to Fort Frances to rejoin Mr. Lawson and obtain supplies.

The united parties left Fort Frances on the 18th of July and ascended by the Manitou canoe route to the northern limit of the area included in the Rainy lake sheet, No. 3, already published. Work was commenced here, in accordance with instructions, on the area to be included in the sheet No. 4, north of No. 3. A micrometer and compass survey of the east side of Manitou lake was made, also of a smaller lake to the west of it; and the survey commenced in 1885 of the smaller lakes on this route, between Manitou and Little Wabigoon lakes, was completed.

From Wabigoon Messrs. Smith and Lawson surveyed a route to the headwaters of the Big Turtle river, securing another tie line connecting the surveys of 1890 with the line of the Canadian Pacific railway. From the headwaters of the Big Turtle river Mr. Smith proceeded to Martin lake to verify the existence of a band of Keewatin schists supposed to occur south of this lake: this supposition was proved to be correct. Mr. Lawson at the same time examined some small lakes shown on the timber limit surveys in the vicinity of Clear and Clearwater lakes. On their reunion they proceeded to English river.

After obtaining more supplies, they endeavoured to discover a route south-westerly from English river to the Seine river, but failed to get more than 16 miles. Then the party descended by the route traversed by Mr. Lawson in July, from the English river to Long lake, where the party again separated, Mr. Smith pushing through a hitherto unknown route to the Seine river, which resulted in the addition of six small lakes to the topography of the Seine river sheet.

Thence he proceeded to Steep Rock lake to rejoin Mr. Lawson who had descended by the Eye river to the Seine river, and thence up it to Steep Rock lake, making some geological observations needed to complete the work of 1890.

In Steep Rock lake five days were employed in investigating an apparently unconfortable series of rocks found here, and which it is hoped will afford a further clue to the elucidation of the Archaean structural geology of the district.

From Steep Rock lake Mr. Smith ascended the Atikokan river to mining locations R. 400 and R. 401 where three days were spent in obtaining a section of the iron-bearing rocks, the relative age of which is not yet determined, and in examining the iron ore deposits of these locations. From here he proceeded to Savanne, arriving there on the 1st of October.

From Steep Rock lake Mr. Lawson descended the Seine river and crossed into Beaver lake which he surveyed, and after obtaining a section from Steep Rock lake to Clearwater lake he proceeded to Savanne, where he arrived on the 3rd of October, and closed the season's work.

The topography of the Seine river sheet is now complete, several lakes unknown last season having been added, but the geological problems involved in this area are so important that a few weeks more will be required to further investigate them. A brief sketch of the geology of this field was given in the summary report for 1890, p. 28.

Mr. Smith discovered excellent indications of a broad zone of magnetic iron ore, on the west side of a lake on the Big Turtle river called "The Lake where the River Bends." The ore is associated and interbanded with micaceous schists. The bands vary from fractions of an inch to three feet or more in thickness, and this interbanded occurrence of ore and schist in its broadest development appears to be from 150 to 200 feet wide. To the south-east near the southern end of the lake this band appears to be cut off by a fault and from this fault northward the iron ore could not be traced for more than a mile and a-half, the rocks being so thickly covered with vegetable mould that exploration in this direction was difficult and uncertain. The rocks here strike north-west and south-east and dip from 45° to 55° to the south-west. They are very evenly stratiform in appearance and seem to constitute a tapering band trending eastward, then south-eastward, from the broad band of Keewatin schists so largely developed in Manitou and Little Wabigoon lakes, and from certain ferruginous angular fragments found in the north-eastern arm of Manitou lake, Mr. Smith is inclined to think that more ores may be found in this vicinity, in the same geological horizon as the above, in the near neighbourhood of the granites.

An analysis of these ores made by Mr. G. C. Hoffmann, chemist to this department, shows them to be very siliceous, yielding 40.17 per cent metallic iron and 37.21 per cent of insoluble matter, but no titanous acid.

The locality is about 19 miles south-west by south of Raleigh station on the Canadian Pacific railway. It could be reached by about 21 miles of railway through a comparatively level country. It would be possible, with light expense involved in building short tramways, to carry light ore trucks over the portages, four in number and aggregating one mile and a-half in length, to reach the Canadian Pacific railway by 40 miles of navigable water-way *via* Snake lake and Snake and Wabigoon rivers.

The ore is in such a position as to be easily mined, and considerable water power is afforded at the outlet and inlet of the Big Turtle river. Unless the ore is found, as usual in this country, to be much richer in the actual ore bodies than in the surface indications, it will, of course, be of no commercial value in competition with the rich ores of the Lake Superior district on both sides of the international boundary.

The gold locations on the lake west of Manitou lake were visited during the summer and some specimens from the veins collected. The field appearance is very encouraging. One vein in particular seems to be a very strong one and in some places is as wide as ten feet of promising looking quartz associated with soft soapy talc schist in soft chlorite schist.

The iron ores of the Atikokan river have in two locations been carefully tested this summer with very gratifying results, but the details of the diamond drill borings are not yet made public. On the completion of the Atikokan Iron Range railway it is hoped actual mining will be engaged in here. The ores are very rich and pure, running as high as 60 and 70 per cent of metallic iron.

Very little prospecting has been done in the Thunder bay and Rainy river districts this summer, said to be the result of the change in the Ontario mining laws.

The season's work was mainly geological in character, but some 150 miles of compass and micrometer lines, 100 miles of log and compass lines, and 50 miles of time traverse were run, serving as bases for the compass triangulation of islands and intermediate points.

Mr. Smith returned to Ottawa on the 10th of October.

Cost of exploration, including salary of assistant, \$1,234.

Dr. Bell was requested to complete during the summer, if possible, the geological survey of the area embraced in sheet 125 of the Ontario series which adjoins the Sudbury district sheet on the south. Mr. A. E. Barlow, M.A., was to assist Dr. Bell as during the four preceding years. With the approval of the Minister, the party was to include the following gentlemen: Messrs. A. M. Campbell, H. H. Walker, B.A.Sc., H. G. Skill, A. C. Robertson, W. G. Miller, B.A., and R. W. Brock. Mr. Barlow left Ottawa for the field on the 10th of July, and returned to this city on the 1st of October. Dr. Bell left on the 23rd of July, and returned on the 6th of October.

On the work of the party Dr. Bell reports as follows:—

“Mr. Barlow worked principally in the north-western part of the sheet, in the neighbourhood of Lake Panache, and between Collin's inlet, and the lower part of the Wahnapitae river. He also visited some localities in the Sudbury district, near the line of the Canadian Pacific railway, for the purpose of obtaining mineral specimens. The details of his work are given in his own words herewith: ‘I have to express my entire satisfaction with the manner in which all the above-named gentlemen performed the duties allotted to them.

“The central and southern part of sheet 125, amounting to about one-half its area, is occupied by the waters of Georgian bay, while many channels and inland lakes diminish considerably the area of dry land in the remaining half.

“The north-east corner of the sheet is at the western extremity of Lake Nipissing, the north-west in the township of Hallam, the south-east in that of Shawenaga, while the south-west is near the south-eastern extremity of Grand Manitoulin island. Most of the topography of the sheet could have been represented pretty well by compiling the hydrographic surveys of Commander Boulton, R.N., the river and lake surveys of the late Mr. Murray, of the Geological Survey, and the lines run for the subdivision of the land by the Crown Lands Department. Still some parts were either entirely unsurveyed, or were too poorly defined for our purposes, and we were obliged to survey them ourselves.’ The portions executed by Mr. Barlow are described by himself in the statement above referred to.

“My own topographical work embraced the following: A micrometer and compass survey of the shores and islands of the large bay between Great Cloche island and the north shore of Lake Huron. The islands in this bay are exceedingly numerous, amounting probably to a thousand or more, and as the bay has heretofore been without a name, I called it Bay of Islands, with the approval of Captain Boulton and the inhabitants and lumbermen of the neighbourhood. Cloche channel and peninsula, and the peninsula between Bay of Islands and McGregor bay were next surveyed in the same manner,

and finally the latter bay, including a very large number of islands, and also the channels in its northern part, and those lying still further north. This work was begun on the 28th of July, and completed on the 29th of August. In its performance I was assisted by Messrs. Miller and Brock.

"Track surveys were made of a lake five miles in length in the interior of Great Cloche island, and of the five principal lakes lying between Killarney bay and the Mazinhozin river, which discharges into Collin's inlet, namely, George, Trout, Sturgeon, Ka-ko-kis and West lakes with their connecting streams. A number of smaller lakes in this district were also located. In this work I was assisted by Mr. H. G. Skill and Mr. Myles Tyson, the latter of whom had a good knowledge of the local topography which proved of much service in economising our time. Being favoured with very fine weather we were enabled to accomplish this part of the work between the 5th and the 11th of September.

"On the 13th of September we proceeded by steamer from Killarney to the French river region in order to add to the geological information which had been already obtained there by the late Mr. Alexander Murray and myself and to survey and locate some topographical features not previously indicated upon any map. Careful track-surveys were made of a long narrow channel running north-westward from the expansion of the river where the North Channel West is joined by the South Channel East: of a canoe-route from the head of this channel to Trout lake, of this lake itself (which is twelve miles long) and of a canoe-route by way of Ka-was-ki-gama, or Crooked lake, to the rocky delta of the middle group of outlets of French river. Numerous minor additions were likewise made to our knowledge of the topography of this region and also some corrections of the topography already laid down upon the maps.

"The part of Grand Manitoulin island which comes within the sheet, and consists principally of its eastern peninsula, had been examined by myself in 1859, 1865, 1876 and 1886 and the boundaries of the various formations traced out and represented upon the geological maps; but for the sake of attaining greater accuracy in some localities I sent Mr. Miller with three men to go over part of the ground during the first half of September, and my own time and that of Mr. Miller and Mr. Brock for the last week of the season was devoted to the same work, so that the geological lines in this part of the sheet can now be represented in accurate detail. Mr. Skill was employed from the 19th of September to the end of that month in tracing the details of the boundary between the Laurentian and Huronian rocks, from Killarney bay north-eastward to the lakes we had surveyed behind Collin's inlet.

"In regard to the geology of the sheet, we were enabled to fill in all that was required to complete it for publication. The area of dry land is only about half that represented upon the Sudbury sheet and the distribution of the rock-formations was more easily worked out than upon the latter, as the region was more accessible and as the greater part of its area consists of Laurentian gneiss and nearly horizontal Silurian formations. We had also the advantage of the previous geological work of Mr. Murray and myself in the district. Besides these two systems the Huronian is represented by a small area in the north-western corner of the sheet.

"The Laurentian rocks which come within the sheet probably belong to the upper division of the system and consist of grey and red gneisses, generally in distinct beds, which run comparatively straight for considerable distances. The grey varieties are generally coarser than the red and their foliation is often indicated by the parallelism of the larger diameters of the grains rather than by distinct bedding or bands of colour, although these are also often present. But both the grey and red varieties become schistose in many places, and they sometimes enclose regular belts of hornblende and mica-schists, the latter always holding garnets.

"On the coast of Georgian bay, from the township of Carlyle to the eastern mouth of French river, the strike is uniformly to the north-eastward and the dip generally to the south-eastward at tolerably high angles, but in the central part of the course of French river it is mostly north-westward and westward, but with many local variations. From the eastern mouth of French river to Shawenaga bay the strike varies from north-west to south-west.

"The boundary line between the Laurentians and Huronian leaves the head of Killarney bay and runs north-eastward with a curve to the south-east and reaches the northern edge of the sheet in township 68 a short distance east of Lake Panache. From this line south-eastward as far as Collin's inlet, the rock is massive or shows only slight or local foliation and most of it might be called red hornblende-granite. A similar rock, described by Mr. Murray as (quartz) syenite, occurs for a breadth of two miles between the Western and Middle mouths of French river.

"The Huronian rocks of the north-west corner of the sheet consist principally of quartzite, but greenstones sometimes occur among them, and they are occasionally interstratified with greywackes, clay slates, crystalline schists and other rocks in smaller quantities. Among the latter is the band of dolomite described in my report for 1876, page 209. The greenstones form a much less prominent feature among the quartzites and greywackes than further inland. They consist of several narrow belts in the neighbourhood of Lake Panache and among the islands near the north shore of Lake Huron, where they are traceable for from one mile to three, and correspond in most cases with the general direction of the strike. Much smaller masses of greenstone of various forms and lying at every angle with the strike are enclosed among the quartzites in all parts of their distribution within the sheet. Along the contact between the two systems the granite and the quartzite are a good deal intermingled; large isolated pieces of the one being incorporated in the other.

"The quartzites form the La Cloche Mountains and the long and high points jutting south-westward into Lake Huron between McGregor and Killarney bays, as well as Badgeley, Centre and Heyword islands. Our surveys appear to confirm my previous opinion that the several belts of quartzite forming the La Cloche Mountains are repeated in these high points and islands which represent the opposite side of a syncline or possibly an anticline.

"In the La Cloche mountains, which rise from 400 to 750 feet above Lake Huron, and also around Bay of Islands and McGregor, the strike is nearly east and west with high or almost vertical dips, mostly to the north; but further south it follows the axes of the points and islands just mentioned.

"A belt of sericite schist was traced on the north sides of Bay of Islands and of McGregor bay and on the isthmus between them and another belt of the same rock through the islands of these bays at a distance of a mile and a quarter south of the first. The greenstones above referred to were found principally towards the south side of Bay of Islands, but in the area covered by McGregor bay and in the channels to the north of it they occur in various parts, but are most abundant in the central and western portions. Clay slates were found in some abundance in the northern part of the township of McKinnon.

"The rocks of the whole district covered by the sheet have been everywhere glaciated. A number of photographs illustrating glacial action were obtained and much interesting information was collected in reference to the phenomena of the drift."

Expended on field work by Dr. Bell, \$950, by Mr. Barlow, \$1,080.

Dr. Ells left Ottawa for field work on the 8th of June with instructions to complete the revision of the geological boundaries as laid down on the Montreal or south-west quarter sheet of the map of the Eastern Townships and then to continue the work westwards up the valley of the Ottawa and its northern tributaries. In carrying out the first part of this work which was completed on the 20th June, Dr. Ells reports that a "number of fossils were collected by Mr. W. E. Deeks, B.A., from places on the Calceiferous, Chazy, Trenton and Hudson River formations, where fossils had not previously been collected by the officers of the survey. On the 22nd of June Dr. Ells, accompanied by Mr. F. D. Adams, of McGill College, started from Grenville for Iroquois Chute on the River Rouge near Trembling lake, with a view to re-examine the character and relations of the limestone and gneiss bands of the Trembling lake and mountain, and also to trace out the western boundary of the great anorthosite area of Wolfe and Grandison.

"The country around Trembling lake was examined, then the Macaza river was ascended to its head, thence crossing to a lake on the west branch of the Devil's river. This lake is not laid down on the Provinces map, and of which we made a track survey from Devil's to its junction with the outlet of Trembling lake, there fixing the western limit of the anorthosite in this direction.

"The first part of the season to the 20th of June, was spent in the examination of the country to the south and south-west of Montreal, necessary for the completion of the south-west quarter-sheet of the Eastern Township map. Valuable collections of fossils were made from the Calcareous, Chazy, Trenton and Hudson River formations by Mr. W. E. Deeks, B.A., many of which are from places not previously examined by the officers of the survey. A very large portion of this area is covered by a deep deposit of drift, and rock outcrops are, as a consequence, rarely seen. The geological boundaries laid down on the map of 1866 were carefully followed, in so far as the drift would permit, but in such an area these must of necessity be largely conjectural.

"Accompanied by Mr. F. D. Adams, of McGill College, I started on the 22nd of June, with four canoe-men, from Grenville to Iroquois Chute, on the River Rouge, near Trembling lake. This point is forty-four miles in a direct line nearly magnetic north from the former place, but by road is not far from sixty-five miles. This distance we traversed by teams, having arranged beforehand to secure our canoes at the Chute. Our object was to ascertain the characteristics and the relations of the lowest gneiss of Trembling mountain to the gneisses and limestone bands of Trembling lake; as well as to trace out the western boundary of the great anorthosite area of Wolfe, Grandison and Archambault and its extension through the area north-west of the latter township. In the examination of the Trembling lake area all the streams and lakes in the vicinity, to a distance of six to eight miles on all sides, were visited. Trembling mountain itself was ascended and its elevation above the surface of the lake at its front found by aneroids to be 1,720 feet, or within three feet of the elevation, as determined by Sir William Logan in 1858 by triangulation. This added to the elevation of the upper terrace at Iroquois Chute, taken from the railway survey to this point from St. Jerome which is here stated to be 875 feet above Lake St. Peter, and which is approximately the same as the surface of Trembling lake, would give for the summit of this mountain a height of about 2,585 feet above the sea. From the Iroquois Chute we ascended the Macaza river, and thence up that stream and its branches to the height of land between there and the lakes at the head of the west branch of the Devil's river. Thence by portage we reached Lac des Baies and ascended the west branch of the Devil's river to its junction with the north branch, a short distance from Devil's lake. This stream is not laid down on any map, and, in fact, this section of the country is entirely unknown to any except a few hunters who occasionally cross by this route to the waters of the Mattawin. The surface is largely drift-covered and ledges are rarely seen even around the lake shores. From the Devil's lake the main stream (Devil's river) was descended to its junction with the outlet of Trembling lake: a track survey being made for about thirty-five miles. The stream is in places very rough and presents huge cliffs of gabbro at several points. By this survey the western limits of the anorthosite area above referred to can be fixed. Finding, however, that the relations of the limestones to the associated and generally underlying gneiss could not be so satisfactorily determined in this area as in that further south, owing to the prevalence of the drift, and there being no further funds at our immediate disposal, the canoe-men were brought back to Grenville by team as being the cheapest and most expeditious way and there paid off. In consequence of there being no map of the country north of the Ottawa river, in the counties of Argenteuil and Ottawa, on which the roads were laid down with any approach to accuracy, the survey of this area was taken up in company with Mr. Deeks, who had already surveyed most of the roads in the flat country between Lachute and the Ottawa and extending west to Calumet. The greater part of the roads in the counties just mentioned, as far west as Thurso and north for ten miles beyond the Iroquois Chute on Rouge river, have now been surveyed, partly by pacing and partly by wheel survey, and from these a skeleton map of this district is now being constructed on which the

distribution of the limestone bands will be shown at many points, but another season's work, devoted to the examination of the many lakes which are scattered throughout the district, will be required before the exact relations of the gneiss and limestone bands can be determined. All the roads between Point Fortune and the province boundary, on the east, and the South Nation river on the west, were surveyed to a distance of ten to twelve miles south of the Ottawa river, and the boundaries of the Calciferous, Chazy and Trenton finally revised. Much of this area is also largely drift-covered, but where rock exposures are seen they are generally highly fossiliferous, so that the determination of the formations named is comparatively easy. Good collections of fossils were obtained from various points near L'Original and Little Rideau, at both of which places Mr. Deeks found extensive quarries had been opened.

"The eastern outcrop of the anorthosite area through Wolfe, Beresford and further north and east in the county of Montcalm was traced by Mr. Adams, while in Howard and Morin its limit was noted by Mr. Deeks. Owing to the present unfinished condition of the work in Argenteuil and Ottawa counties conclusions cannot be stated. The Laurentian gneiss and limestone at Lachute are overlain by the Potsdam, of which a good exposure is seen about a fourth of a mile east of Lachute station, north of the Canadian Pacific railway, which is apparently conformably overlain by ledges of fossiliferous Calciferous rocks, the fossils being obtainable from ledges in the North river, near the paper mills, at a very low state of the water only. The Calciferous apparently extends thence to the Ottawa, though much of this area is heavily covered with drift, but at Carillon nearly horizontal Chazy sandstones are exposed which extend thence up to Grenville. At St. Andrews a prominent ridge of Laurentian red gneiss begins on the east side of the North river and extends for about seven miles eastward with a breadth of about two miles. This has not before been noted. It is separated from the area north of the Lake of Two Mountains by ledges of Potsdam sandstone. The general attitude of all the fossiliferous strata in the vicinity of the Ottawa river and for some miles to the south is horizontal.

"The limestone of the Laurentian system in the county of Argenteuil would appear from the observations of the past season to represent its upper portion. They are generally seen to occupy synclinals in the gneiss and a succession of these limestone synclinals with gneiss anticlinals can be traced for many miles across Argenteuil and Ottawa counties. The limestones hold inclusions of rusty gneiss which have once existed as interstratified bands and have been drawn out and frequently twisted into curious forms. Scattered crystals of apatite, pyroxene, graphite and sometimes garnet occur in these beds, and often fragments of crystalline orthoclase which on weathered surfaces stand out prominently, and at first sight cause the rock to assume the aspect of a conglomerate. The lower portion of the limestone bands are associated with layers of quartzite and rusty gneiss, with beds of a whitish highly felspathic rock, and these are generally repeated regularly on each side of the limestone synclinals, passing downwards into greyish, greyish-red and reddish gneiss. The general strike of the rock is a few degrees east of north, but at several points the direction changes to nearly east and west and occasionally the various members appear to be overturned. It has been found very difficult to trace the limestone areas continuously, owing in part to these being to a large extent concealed by drift, but also to the fact that many of them are local in their development, as can be seen by their frequently thinning out and ending often quite abruptly both to the north and south. In the northern part of Argenteuil the limestone decreases in development and on the branch of the Upper Rouge called the Macaza disappear altogether; this may, however, be to some extent due to the covering by drift, but not altogether. East and north of Lachute the beds of limestone also become very limited, but going west through Grenville, Petite Nation, &c., they become much more extensively developed.

"The economic features of the district examined by us north of the Ottawa, in Argenteuil and eastern Ottawa counties, are at present comparatively unimportant. Deposits of mica, graphite and asbestos occur quite frequently, and some of these have been opened up but no mining has been done in this section for many years. The most

easterly observed outcrop of serpentine limestone, with asbestos, was at Silver lake, half a mile south-west of the inland lake at Wentworth. The asbestos veins were few and of small size. Small crystals of apatite and pyroxene were observed in limestone near Maskinongé lake, one mile and a-half south of St. Jovite in Grandison, but nothing of economic importance was noted.

"The party left Ottawa on the 8th of June and returned on the 14th of October. Expenses of the season \$1,136.

Roads surveyed by waggon wheel.....	850 miles
do do pacing.....	110 do
Track survey of Devil's river.....	25 do

"My associates during the past season were Messrs. W. E. Deeks, B.A., Robert MacDougall, B.A., and J. F. E. Johnston, Graduate Royal Military College, Kingston."

Mr. F. Adams, of McGill College, kindly undertook to complete the examination and mapping of the Laurentian area which lies to the north of the Island of Montreal and on which he had been working before he retired from the survey in 1890.

On this work he furnishes the following interesting report:—

"Leaving Montreal on June 22, I joined Dr. Ells at Grenville the same afternoon and proceeded at once with him to Chute aux Iroquois and Trembling lake where we arrived on the 24th of July, this district being on the line between the map above referred to and the sheet adjoining it to the west, which is being surveyed by Dr. Ells. The special work to be accomplished in this district was the determination of the limit to the north-west of the great Morin anorthosite area and the relation of the limestone bands to it. The former was fixed by a track survey of the Devil's river, an exceedingly rough stream, which runs in a southerly direction through the unnamed township lying north-west of Archambault and joining the outlet of Trembling lake about a mile from the lake. The study of the relations of the limestone bands to the anorthosite, however, was less satisfactory, large exposures of the former being found, but their relation to the anorthosite could not be determined, in most cases owing to the heavy drift which covers much of the country.

"No further reference to the north in this district is here required, as a report on it has been made by Dr. Ells. I returned to Grenville on the 22nd July.

"On the 4th of August I again left Montreal and remained in the field until the 27th of August completing my examination of various parts of the area, working as far east as the township of Brandon which was very carefully examined.

"The geology of the whole district, which comprises an area of about 4,000 sq. miles, in the counties of Berthier, Joliette, Maskinongé, Montcalm, Argenteuil and L'Assomption, has now been worked out and it is hoped that the map will be ready this spring. Speaking generally it will extend from Berthier in the east to Trembling mountain on the west, and from Cypress lake on the north to Lachute on the south.

"The area examined is occupied for the most part by rocks of Laurentian age, which to the south-east are unconformably overlain by Cambrian or Cambro-Silurian strata. The Laurentian rocks consist of gneiss in great variety, interstratified with beds of quartzite, amphibolite and crystalline limestone. In the eastern part of the area these strata lie nearly flat, but to the west they become more and more sharply folded. Sometimes interstratified with these and sometimes intruded through them are a number of masses of gabbro or norite rich in plagioclase (anorthosite). These, together with some of the associated gneisses and limestones, were formerly supposed to constitute a separate overlying series, to which the name Upper Laurentian was given. Their boundaries have, however, now been traced out, and their stratigraphical relations determined and they have been found to be without doubt igneous rocks, while the associated gneisses and limestones form part of the ordinary Laurentian complex. The 'Upper Laurentian,' therefore, in this typical area does not exist. In addition to these basic igneous rocks, masses of eruptive granite and other acid rocks occur in several parts of the district."

Mr. Giroux was requested to go over and revise the boundaries of the Palaeozoic formations north-west of the St. Lawrence, on the south border of the Three Rivers sheet and the adjoining north border of the Montreal sheet of the Eastern Townships map in the counties of L'Assomption, Berthier and Maskinongé. On this work Mr. Giroux reports as follows:—

"I left Ottawa on the 15th of July, but owing to some difficulty I had in getting good canoe men I could not begin work before the 25th of July, on which day a micrometer survey of the L'Assomption river was begun from the dam, a short distance above the old saw mill of the town of Joliette. This river is very crooked and affords very good exposures of highly fossiliferous brownish weathering calcareous sandy rock or impure limestone full of grains of quartz. The strata are nearly horizontal. Ledges of these rocks crop out here and there, in ascending the river, for a distance of about a mile and a quarter, where there are exposures of brownish weathering coarse whitish grey sandstone (Potsdam). The beds are disturbed and the rock is very much decomposed for three or four inches from the surface. At Bordeleau's mill, two small excavations had been made where the rock contains small bunches and strings of iron pyrites. The beds dip S. 60° E. $< 12^{\circ}$. These sandstones extend as far up as Rapide à Nadeau, or about 19 miles, by the river, in a northerly direction from the town of Joliette. At the foot of this rapid there are ledges of coarse crystalline hornblende gneiss which soon changes into a more quartzose grey gneiss. About one-third of a mile further up the river two farmers spent all their money digging for gold in patches of calcite which they mistook for quartz. The small scales of mica, the fine fragments of hornblende, and a few crystals of iron pyrites which shine in the rock are probably what led these men astray.

"We ascended the river to the mouth of Black river, and in all that distance, about 40 miles, the Laurentian rocks are well exposed; they consist of gneisses which vary greatly in composition, being at times very micaceous, then hornblendic, and then again very highly quartzose and garnetiferous. As a rule the foliation is very indistinct, and it is only in very few places that the dip which varies in direction and from an angle of 27° to 37° degrees could be observed. The banks of the river are very irregular in height, varying from 25 to about 125 feet, and are composed of fine and coarse sand, with bands of small pebbles which are always underlain by bluish grey clay. In some places, however, the banks are all clay. As a rule rock exposures can be seen at rapids only; but as these are numerous a good section is afforded. All along Black river from its mouth up to Black lake, a distance of seven miles, there are fine exposures of various gneisses. In some places it presents a mottled appearance due to patches of almost pure quartz, and others of hornblende and mica. In places the rock shows specks of graphite and iron rust. The predominating colour of these gneisses is brownish grey, weathering grey and having a general strike of N. 30° E. to N. 30° W.

"Black lake measures about six miles around and has low shores which are even swampy in places. In the bottom of the largest bay known by the name of 'Monatac bay,' an old Indian by the name of Monatac settled about 60 years ago and reported that he had a gold mine near his shanty which was generally believed. Even now, many persons in the district firmly believe that there must be a great deposit of gold there. I examined the spot and found ledges of grey gneiss containing yellowish brown mica, the old Indian's gold! We then ascended Black river as far up as range line XII-XIII of the township of Brandon. Thence, we portaged across to Lake Matambin which we surveyed, and then descended the river Matambin to Lake Maskinongé. Around Lake Matambin are ledges of brownish grey gneiss and grey mottled yellowish quartzite, micaceous where the banding is distinct.

"Matambin river is very crooked and is of very little geological interest, as it shows only one small exposure of dark hornblendic gneiss from its head to its mouth.

"At the south-eastern end of Lake Maskinongé there are exposures of about 300 feet wide of a fine-grained reddish gneiss, much broken, reddish weathering and cut in different directions by irregular veins of reddish coarsely crystalline quartz-felspar and chlorite rock. More exposures of brownish grey and grey very highly quartzose gneisses can be seen on

the west shore of the lake from about a mile and a-half south of Matambin river; the foliation is very indistinct, but in some places it was distinct enough to determine the strike as S. 31° E. with easterly dip. About a quarter of a mile from these gneisses are ledges of a reddish brown, fine-grained, compact, highly felspathic rock. This extends to a cliff of about 150 feet high and about 700 feet long, composed of much twisted and mixed quartzose felspathic hornblendic and micaceous gneisses. These and the above described rocks are the only ones seen on Lake Maskinongé, the shore of the northern part being low and sandy, and the rest of the southern shore covered with boulders.

"The survey and examination of Lake Maskinongé being completed, we ascended the Mastigouche river for a distance of fourteen miles. We then made a portage across the mountains to Lac à la Chute, two miles and a-half north-north-west. From the mouth of the river up to the portage there are many ledges of various kinds of gneiss to be seen dipping approximately S. 35° E. $< 25^{\circ}$. About a quarter of a mile from the mouth of this river there is a small exposure of a greyish quartzose calcareous rock, containing much white calcite in places and full of iron pyrites and rounded grains of a light green mineral (pyroxene.) Hills of gravel and sand, 10 to 60 feet high, occur in places along this distance. Mastigouche river is very rough from the portage road above mentioned to Lac à la Chute. There are nine falls one after the other in this short distance. All the rocks are varieties of gneiss. Traces of magnetic iron ore occur in places, and in others large crystals of brittle black mica. The Mastigouche river was surveyed for about 20 miles north of Lac à la Chute before taking an easterly direction through a chain of small lakes which led us to two lakes, one being the head of the east branch of the Mastigouche, and the other the head of the west branch of the river Du Loup. These two lakes are separated by a band of gneiss only about 25 feet wide, and therefore the watershed portage was easily crossed. The country comprised between Lac à la Chute and 'Lac Sans Bout,' which is a few miles south of 'Lac au Sorcier,' is very poor both in timber and soil. The land is swampy and stony: scrubby spruce growing on rocks covered with very little decomposed vegetable matter and wet moss-covered surface gives the country a very uninviting appearance. From 'Lac Sans Bout,' which is about six miles long, we proceeded to 'Lac au Sorcier,' and then down the river Du Loup, which was surveyed to its mouth. The timber in the neighbourhood of the two last mentioned lakes consist of spruce, tamarack, a few pines and scrub cedars, and is the best seen on all our route. The river Du Loup is very rough, and its bed is generally covered with immense blocks and boulders of gneiss. Good exposures of gneiss are often met with, and the rapids and falls there are on this stream from its head to a few miles below Hunterstown are too numerous to detail. At about 22 miles south of 'Lac au Sorcier' there are very fine exposures of grey gneiss, showing a much contorted banding, but with a general dip of S. 20° E. $< 20^{\circ}$. At Hunterstown there is a band of whitish grey micaceous limestone, about five feet wide, interstratified with the gneiss. No ledges of rocks newer than Laurentian can be seen on the river Du Loup. Fossils were collected from the following places: Chicot river, north of St. Cuthbert, Fafard's quarry, Defond's quarry and McGee's quarry, all close to one another, in the parish of St. Cuthbert, from Barrette's quarry in the parish of St. Barthélmi, Gagnon's quarry in the parish of St. Justin, and from many other places.

"The Canadian Pacific branch railway, from Joliette to St. Gabriel de Brandon, was surveyed, and also many roads, so as to fix the boundary of the Paleozoic rocks and define as well as possible the different formations of the Cambro-Silurian, but the country being so much drift-covered, it is very hard if not impossible to do so accurately.

"A pretty good deposit of bog iron ore was observed in the county of Joliette, along the railway. The Canada Iron Furnace Co., of Radnor, began to work this deposit last July, and their foreman informed me in September, 1891, that he thought he would be able to ship about 200 car loads of the ore to the blast furnace in Radnor by the fall.

"Prospecting for gold in the Laurentian system, in the county of Joliette, has been going on for years, and there was quite an excitement created in the town of Joliette last summer about a gold mine having been discovered along the Brassard or Mattawin

road at a place called 'La Barrière,' in the unsurveyed portion of the township of Courcelles. This place was opened and worked by a company styled: 'Compagnie des mines d'or de Mattawin.' In the report of the Commissioner of Crown Lands of the Province of Quebec for the year 1890, Mr. Obalski, the Government mining engineer, speaking of it says:

"From the latter property, several samples taken by myself in a small vein a few inches wide, were assayed by Messrs. Ladoux & Co., New York assayers, and while two of the samples gave no traces of gold, a third gave the following result:—

Gold, 1.83 oz. per ton of 2,000 pounds.

Silver, 2.65 oz. do

"I collected samples from the mine and Mr. Obalski was kind enough to give me some of the quartz of which Messrs. Ladoux & Co. report so favourably, and these samples were given to Mr. Hoffmann, chemist to the Geological Survey, to analyze and were found by him to contain only a trace of gold and no silver.

"I returned to Ottawa on the 6th of November, having during the season surveyed 315 miles of rivers, lakes and roads, viz., 215 miles of rivers and lakes by micrometer and 100 miles of roads by pacing. Expenditure for the season, \$806."

Professor Laflamme was requested to make an examination of certain portions of the north-west shore of the St. Lawrence, between Malbaie and Tadousac with a view to revise and complete the delineation of the geological formations in that district. On this work Professor Laflamme reports as follows:—

"The Cambro-Silurian formations, so often seen in contact with the Archæan rocks along this coast, are generally extremely contorted. There are nearly everywhere traces of displacements and overturnings, in which respect they differ widely from the same formations as found in the neighbourhood of Quebec and Lake St. John.

"It seems to me that these perturbations, the complicated positions of the beds, the numerous fractures met with on all sides, might well have something to do with the slight earthquakes which occur generally several times in a year in this part of the country.

"From statistics which I have collected on the spot, these seismic phenomena have at present a tendency to diminish in intensity and violence. Yet it is quite probable that the maximums may recur from time to time, at intervals, which it is almost impossible to determine precisely.

"Observations on the earthquakes, as gathered from the inhabitants, are too divergent and contradictory to give any assistance in locating the centre or centres of disturbances.

"The only mineral of economic importance met with during the exploration is limestone. It is used for lime and for building stone. I have already mentioned in my last year's report the sandstone of Malbaie, which furnishes excellent building material.

"The limestone which occurs as a band of greater or less width along the coast disappears completely two or three miles below Malbaie. Thence to Tadousac, nothing but steep banks of Laurentian granite are met with. The general aspect of the country is absolutely the same as along the Saguenay shore, and the mineral composition of the rocks in both places is identical.

"At the request of a number of persons I have examined certain deposits of minerals which were thought to be of value. Unfortunately, none of them realized the hopes conceived of them."

Mr. Low, assisted by Messrs. H. Y. Russel, B.A.Sc., A. A. Cole, B.A., and J. B. de Boucherville, B.A., was engaged during the past summer in working out the geology, and in correcting and extending the topography of that part of the N.W. $\frac{1}{4}$ sheet of the Eastern Townships map between its eastern boundary and the St. Maurice river, comprising the southern portions of the counties of Champlain and Portneuf.

Mr. Low left Ottawa on the 9th of June, and was joined in Quebec by Mr. Russel, where a few days were spent tracing plans in the Crown Lands office and in examining the rock sections on the north side of the city. The boundary of the anorthosite area which extends eastward from behind Chateau Richer to beyond Ste. Anne de Beaupré, was traced to the limits of the N.E. sheet of the map. Men having been engaged the party proceeded to Rivière à Pierre station on the Quebec and Lake St. John railway, and there separated, one party, under Mr. Russel, to make pace surveys of the roads already mapped and chain surveys of new roads; and the other party, consisting of Mr. Low and two canoemen, to examine the rocks along the principal water courses.

The Batiscan river was first descended from Laurentides station to its mouth. The rock exposures along the river are numerous to within three miles of Ste. Geneviève where the country becomes low, and the river banks are cut out of deposits of stratified clay and sand.

Along the upper part of the river the rocks are tilted at high angles, and are much contorted both on dip and strike; but throughout the part below Notre Dame des Anges the dips are quite moderate and are almost always towards the east. At Notre Dame a large area of massive quartzite is seen, having a breadth of over one thousand yards; this passes gradually into a light coloured quartzose mica gneiss on both sides. Quartz veins penetrate the quartzite and hold large crystals of a light coloured mica, along with black tourmaline and hornblende. A small crystal of apatite was also found here. Some of the mica is large enough to be of commercial value, but is often considerably crumpled. The St. Maurice river was next examined from the Grandes Piles to its mouth. The rocks here were found to be like those of the lower part of the Batiscan river inclined at low angles towards the east. The gneisses have a more basic character than those to the eastward, and in many places ilmenite or titanite iron ore is a constituent mineral. This is generally found in small grains disseminated through the rock, but at times is found in larger masses, chiefly in pegmatite veins. White and red crystalline limestone occurs in small bands or veins in several places near the Petites Piles; it is rendered impure by a large mixture of green pyroxene and yellow mica.

The next exploration was from Lake Edward to the St. Maurice river, coming out on that stream at La Tuque. This journey was made by an old overgrown portage route which leaves Lake Edward on its west side, opposite the Grand Island and passing through five small lakes on the headwaters of the Petite Vermillon river and five others on the Petite Bostonnais river into Little Wayagamack lake, and thence by Lake Wayagamack and the latter river into the St. Maurice, some three miles below La Tuque. The Wayagamack lakes are fine bodies of water, the smaller having a shore line of nine miles, the larger of twenty-six miles: both lakes are surrounded by fine wooded hills, and their clear water is full of large trout.

From La Tuque, the St. Maurice river was descended to the Grandes Piles; numerous bands of white crystalline limestone were noted at different points along the river occurring in a basic ferruginous gneiss. The largest mass of this limestone is found in the second range in the township of Polette, two miles inland from the river; here the exposures show a development of white limestone over four hundred yards wide which is said to extend inland some three miles further. Much of this limestone is fine-grained and free from impurities, while the remainder is coarser grained and holds reddish mica, green pyroxene and traces of graphite. Crystals of mica are said to have been found here, but no specimens of it that would be of economic value were seen.

On a point about one mile above the mouth of the Mattawin river is a large vein of dark red pegmatite holding masses of magnetite, the only known locality in this region of such ore free from titanite acid.

The next canoe trip was taken through lakes Long and Mekinac, the last being a fine body of water some fourteen miles long with perpendicular cliffs on the east side, rising in places six hundred feet above the lake. Its water is clear and very deep, as a chance sounding gave two hundred and sixty-five feet. The cliff on the east side gives an almost uninterrupted section, which shows the gneisses to be arranged in a series of

folds, with high dips to the westward and low ones towards the east. A few small veins of crystalline limestone were seen near the axes of the anticlinals. The discharge of Lake Mekinac was followed to its discharge into the St. Maurice river. On the north side of the Mekinac river and along a tributary flowing out of Trout lake, large masses of iron ore have been found in a dark greenish red gneiss composed chiefly of orthoclase and epidote, but as all the ore yet found contains a large percentage of titanitic acid it is practically of no value. Similar ore is found in a large quartz vein, on the west side of the St. Maurice river, about seven miles above the Grandes Piles and near Lake Bouchard, in the Seigniory of Radnor, also in the township of Shawenegan, and about the lakes of the Laurentide Fishing Club. In the vein at Lake Bouchard a small mass of apatite was found associated with the iron, mica and pyroxene.

On the 6th of August the road surveys having been completed, that party was disbanded, Messrs. Cole and Boucherville returning home and Mr. Russel joining in the canoe work.

The Black river was explored from the crossing of the Quebec and Lake St. John railway as far as its junction with the Ste. Anne river, and then a trip was made from Lake Edward to Lake Batiscan by way of the Lac des Passes route, the return journey being down the Eclair river, the discharge of Lake Batiscan.

The rock sections along the new line of railway from Rivière à Pierre to St. Tite junction were next examined and were followed by a canoe trip through lakes Long Masketsy and Roberge to the headwaters of the Eaux Mortes river, which was descended to Lake Mekinac; thence a portage route was followed through Trout, Sleigh, Castor and Batiscan lakes to the St. Maurice. The remainder of the season was taken up visiting the mineral localities of the region and in a short trip up the Jacques Cartier river for a more detailed examination of some of the rocks exposed in the adjacent country.

At Lac Tortue the Canada Iron Furnace Company have lowered the water of the lake some four feet, and as the lake is very shallow with slightly sloping banks, a large area is laid bare around its edge, and here the bog-iron ore which has been formed in the lake as flat concretions is washed out of the surface mud with hand sieves, while the ore in the deeper part of the lake is raised by a dredge which carries three rows of buckets on an endless belt.

Apart from Lac Tortue, in all the flat country about Three Rivers on both sides of the St. Lawrence, bog-iron ore is found in patches which vary from three to eighteen inches in thickness. The ore is gathered by the farmers from their lands, and brought in and sold at the furnace. As iron smelting has been in operation about Three Rivers since 1737 the supply of ore in the vicinity is somewhat exhausted, but new supplies of great extent have been found about Gentilly, opposite Three Rivers, and along the Joliette branch of the Canadian Pacific railway, so that enough ore will be forthcoming to run the new furnace at Radnor which will have a capacity of thirty to fifty tons a day, smelting magnetite from St. Jérôme along with the bog ore.

Ochre is a common mineral in this part of the province and is at present worked in two localities at St. Malo, eight miles from Three Rivers, and at St. Tite junction on the Piles Branch railway.

At St. Malo the deposit has been proven across twenty-two lots and in width from one hundred to three hundred yards, with a depth from one to twenty feet. At St. Tite junction the ochre occurs in two gulleys which join, and run into the St. Maurice; the ore has been proven along both gulleys for nearly half a mile and has everywhere a considerable thickness.

The St. Maurice Metallic Paint Co. and the Johnson Paint Co. have furnaces for burning the ore at St. Malo, the former grinding the burnt material at Cap Magdeleine near Three Rivers, the latter at Montreal. At St. Tite junction a furnace and grinding mill are in course of erection by the Radnor Paint Co. During the summer upwards of five hundred and fifty miles of canoe exploration was accomplished in the northern portion of this region, together with eighteen miles of chained and four hundred and eighty-three miles of paced survey along the roads of the settled southern area. Total cost of the exploration \$1,414.06.

Mr. Robert Chalmers left Ottawa on the 6th June for New Brunswick with instructions to continue the detailed survey and mapping of the superficial deposits in the counties of Westmoreland, Kent, Albert and Northumberland, and the investigation of the glacial phenomena connected with these deposits. The following is his report on the progress of this work :—

“The maritime parts of this area have now been pretty thoroughly studied. But the district drained by the south-west Miramichi river requires further exploration, especially that portion lying to the west of the main river, and another season's work will be necessary to complete the whole.

“A great part of the area examined is level or slightly undulating, but in Albert county it is hilly and broken. Around the head of the Bay of Fundy the surface is diversified by ridges which attain a height of from 200 to 400 feet. Between these, tongues of salt marsh extend up the valleys. These marshes are a characteristic feature of the scenery.

“The surface geology of this part of New Brunswick is of profound interest : and the glaciation of the isthmus of Chignecto, in its relation to that of the mainland of New Brunswick and of Nova Scotia, is of special importance. The facts when studied in detail will, in my judgment, show the action of floating as well as of land-ice. On the site of the marine railway, now under construction across the isthmus, and along the New Brunswick and Prince Edward Island railway, the exposed ledges exhibit striae varying from S. to S. 50° W. (true meridian). These have been produced by ice moving across the isthmus from the north-east. And as no high land exists in that direction nearer than Labrador or Newfoundland, the hypothesis of their having been caused by floating ice during the Pleistocene subsidence of the land here seems a reasonable one. This view is supported by the facts respecting the glaciation of the higher grounds on both sides of the isthmus. In Eastern Albert and in Westmoreland and Kent counties, N.B., the striae indicate ice movements directly towards the Bay of Fundy and Strait of Northumberland, while in Cumberland county, N.S., the land-ice appears to have moved down the slopes westwardly towards the open Bay of Fundy, or Pleistocene sea, then forming a strait between New Brunswick and Nova Scotia. On the whole, the district is one offering special advantages for the study of the relative movements of land and floating ice.

“An increased interest was given to the study of glacial phenomena and Pleistocene changes of level by the visit in October of Baron G. de Geer, a member of the Geological Survey of Sweden, who is actively engaged in similar investigations for that survey. He made special investigations in New Brunswick respecting the height of the Pleistocene shore line, or, as he terms it in Scandinavia, the ‘marine limit,’ and by independent measurements made at St. John, Moncton, Bathurst and Dalhousie junction he found that this limit of the marine beds, as laid down by me, is approximately correct. The hypothesis that the Pleistocene upheaval was greater in New Brunswick than in Nova Scotia was sustained by observations made by Mr. Wilson and myself later on. East of Nappan River, N.S., we discovered a well-defined shore line 135 feet above high tide level and traced it upwards of four miles. The importance of this Pleistocene ‘marine limit’ lies in the fact that when the land was at this level (*viz.*, 225 feet at Moncton, N.B., and 135 feet at Nappan, N.S., lower than it is at the present day), the Bay of Fundy would be connected with the Straits of Northumberland, and, consequently, those parts of the isthmus of Chignecto on which striae are found would be submerged to a depth sufficient to allow floating ice to pass over them.

“A discovery of some importance made by Mr. Wilson was that of marine fossils in the boulder-clay at Negrotown Point, St. John Harbour. The deposit was also examined by Baron de Geer and myself.

“The recent and stratified deposits of Westmoreland and Albert counties are varied and interesting, and those of tidal origin, *viz.*, the salt marshes, are unique. These marshes comprise, in Westmoreland and Albert counties alone, an area of 35,000 acres, and have long been noted for their fertility. Of late years, however, they have deteriorated. This remark applies more especially to those portions which have been

dyked and cropped continuously for a century or more, without the application of any fertilizing material to the soil, which has, in consequence, become deficient in plant-food. Lime and wood ashes have been recommended; but improving them in this way is slow and expensive. A scheme inaugurated by the more intelligent farmers of Sackville would, if systematically carried out, be more effective and economical, viz., the cutting away of portions of the dykes and aboideaux and flooding the marshes with the tidal waters of the Tantramar and other rivers, which flow through them. The tides, which rise high enough to overflow these marshes, if the dykes were broken, carry in red mud and deposit it on their surface. This is an admirable fertilizer, its efficiency having been abundantly proved by the experience of the Sackville farmers. This system of improving them will probably be adopted by all the owners of exhausted marsh lands around the Bay of Fundy. It seems the natural method of restoring them, partially at least, to their original fertility.

"The depth of the marsh mud is variable, but increases seaward. Immediately underlying it is a layer of fossiliferous blue clay, which rests on a peat or forest bed. At Aulac, Intercolonial railway, the latter attains a thickness of 20 feet, and is overlain by 80 feet of marsh mud. These marsh and peat beds indicate, therefore, a subsidence of the land here within the recent period of about 80 feet. Intelligent observers inform me that the peat or forest bed is continuous or nearly so, throughout, underlying the salt marshes everywhere.

"In reference to the soil on the higher grounds, it may be stated that the eastern part of Westmoreland county comprises some of the best agricultural lands in the province. Along the Petitcodiac river there are also fine farming tracts. On the Millstone Grit area, however, the soils are deficient in lime, and would be much benefited by frequent applications of it.

"In Westmoreland county, the forest growth is recent, except in a few limited areas. The more extensively wooded portions of Albert and Kent counties are, however, covered by the original forest, which still contains large spruce, hemlock and hardwood trees. In the last-mentioned county, forest fires are rapidly destroying the timber tracts.

"The materials of economic importance found in the surface deposits of the district examined may now be briefly referred to.

"Bog-manganese occurs in Albert county, near the Dawson settlement. On a branch of Meldona creek, an extensive bed of it has been opened up, and a branch of the Albert railway constructed to it. Kilns for drying the material have also been erected. This deposit covers about 25 acres of ground, and appears to be quite thick—in one opening the thickness being 26 feet. The ore is a loose amorphous mass, which can readily be shovelled up, and contains, in layers and patches, a considerable percentage of bog-iron ore, or red ochre. Indeed, very little of the material appears to be wholly free from iron, though large portions have merely a trace of it. The deposit lies at the foot of a hill, and its accumulation there appears to be due to springs. These are still running down the hillside, and, doubtless, the process of producing bog-manganese is still going on. Operations have temporarily ceased at this mine. Indications of other and similar beds of bog-manganese have been met with at the base of this hill further west.

"Bog-iron ore was found on the south side of Buctouche Harbour, Kent county, occupying an area of several acres. Where openings were made in two places, the deposit showed a thickness of from 12 to 15 inches.

"Just south of Richibucto Head, another deposit of this material was observed, but its extent and thickness was not ascertained. Bog-iron ore was also noticed on the south side of the mouth of Kouchibouguac river by Mr. Wilson, and in a number of other places. No use has yet been made of it.

"Peat bogs occur at Richibucto Head inside of the sand beaches, also along the Kent Northern railway above Kingston. Two bogs were seen along the Intercolonial railway between Beres Mills and Canaan stations. Smaller peat bogs were noted on the isthmus of Chignecto, and in numerous other places.

"Brick kilns are in operation at Lewisville, near Moncton, and at Folly Point, Westmoreland county, deposits of brick clay are common in many parts of the district.

"Gravel pits have been opened at Albert, on the Albert railway; at Memramcook (gold is reported to have been found in the latter); at Westmoreland Ridge, near Aulac, and on the Kent Northern railway, near Mill Creek, gravel and sand deposits are quite abundant in the district.

"My assistants during the season were Messrs. W. J. Wilson and W. D. Matthew, of St. John, N.B. Mr. Wilson, who has assisted me during part of four seasons, was in the field from the 1st of July to the 15th of August, and from the 14th of October to the close of field work, on the 20th November. Mr. Matthews was with me from the 15th of June to the 24th of July. Both these gentlemen performed their duties in every respect most satisfactorily. Mr. Wilson and I reached Ottawa on the 2nd of December, and he is now assisting in the preparation of the maps for publication."

The cost of the season's work, including the salaries of Messrs. Matthew and Wilson, to the 15th of August, is \$957.02.

Mr. Fletcher was instructed to continue the work of previous years in Nova Scotia. He left Ottawa for the field on the 17th of June and returned on the 15th of December. He was again assisted, during the entire season, by Messrs. M. H. McLeod and D. I. V. Eaton, and during several months by Professor Coldwell and Messrs. W. B. Almon and F. A. Coldwell.

Mr. Eaton, who was for some days employed in tracing and reducing plans in the office of the Iron Company at Londonderry, and in the Crown Lands Office at Halifax, did not reach Ottawa until the 24th of December.

Mr. Fletcher's summary of the season's field work is as follows:

"The observations and surveys during 1891 were chiefly in the counties of Colchester and Cumberland, in the districts of Onslow, Londonderry, Economy and Parrsboro', north of Cobequid bay and Minas basin, comprising an area of about 500 square miles.

"The head of Cobequid bay presents many thousand acres of dyked marshes under excellent cultivation and the upland also is fertile. Numerous thriving, pretty villages dot the low shore as far as Economy, below which the scenery is strikingly wild and picturesque, and the coast is well known to collectors for the abundance and beauty of the rare minerals found in its trap formation, no part of the world except the trap district of India being, according to Professor Marsh, richer in zeolites than the shores of the Bay of Fundy. The mountains are for the most part under forest except in small settlements or where tracts have been cleared in the neighbourhood of the Londonderry mines to furnish charcoal for iron smelting.

"The geological formations are the extension of those described in the Summary Reports for 1889 and 1890, comprising Triassic, Carboniferous limestone, Devonian and igneous rocks; and the additional evidence collected greatly strengthens the views expressed in those reports regarding their relations to one another.

"Red, soft, crumbly Triassic sandstone fringes most of the shore as far as Five islands, below which it is only in small patches where protected from the fury of the tides—which rise to a height of 50 or 60 feet, with currents running eight miles an hour—by imposing precipitous capes and islands of basalt and amygdaloid built up in fine symmetrical columns or worn into deep caverns, pointed arches and lofty pinnacles.

"The Carboniferous limestone appears in the rivers or on the shore at several points between the head of Cobequid bay and Economy. From Swan creek to the mouth of Parrsboro' river it rests in small patches upon Devonian rocks and the unconformity of these two series is well displayed; the former having the usual association of dark grey and red soft marl, sandstone and conglomerate with gypsum and fossiliferous limestone, while the latter consist of crumpled slates and quartzites, cut by igneous dykes, and by veins of limonite, ankerite, quartz, &c., but full of fossil plants and *Naiadites*. From another unconformable contact immediately west of Partridge Island, the Carboniferous limestone rocks occupy most of the shore as far as Port Greville, presenting remarkably

fine illustrations of contorted and faulted strata, some of which have been greatly disturbed without affecting the beds above and below. Among these is a band of coaly bituminous shale, two feet thick, full of fossil plants, Crustaceans and *Nautilites*. Another belt of this formation extends from Phinney's brook to Spencer's island.

"The Carboniferous limestones have been quarried near Partridge island and at Clarke's Head. At another quarry at Kirkhill, two miles and a-half north-west from Parrsboro', a dark grey flaggy limestone, in a nearly vertical attitude, includes lenticular layers of coal, one of which is said to attain a thickness of two feet at the bottom of a shaft 75 feet deep. The coal ignites readily, burns with a bright flame, leaving a light porous coke which yields a quantity of whitish or reddish calcareous ash. Another deposit of from two to four feet of slaty coal at Brookville was examined in 1878 by Mr. Scott Barlow. It has been opened by several pits in De Wolf brook, a short distance up stream, in a conglomerate composed of pebbles of the slates and quartzites of the adjoining brooks and of the shore, interstratified with layers of soft argillaceous shale fit for whetstones and whitish quartzose sandstone. Other unimportant discoveries of coal have been made in the East River of Five islands, Great Village river and other streams.

"The Devonian rocks are precisely like those of Riversdale, Union, Stewiacke and the coast of Hants county, described in the Summary Report for 1890. Sir Charles Lyell in 1843, while including the beds on the Shubenacadie river with the Carboniferous limestone formation, states that in five cases where Sir J. W. Dawson and he traced the junction, they found it to be a line of fault, and at the point of contact one face of the fault was in every case formed of gypsum. He further states that this is not in a rent or fissure, but seems to belong to the stratification which is nearly flat. In the Cobequid Hills, and also at some points on the shore, the Devonian rocks are intersected by masses of syenite and diorite. They come from beneath the Lower Carboniferous, on the shore between Moose creek and Partridge island, and again between Port Greville and Phinney's brook, where they are associated with a mass of crystalline limestone, apparently a vein. The iron ores of Londonderry—which give employment to 150 miners, and yield annually about 40,000 tons of ore—of Portapique and North rivers, of Birch Hill and other places, are also in these rocks as well as the veins of quartz, baryta, limestone and dolomite of Londonderry, Five islands and Phinney's brook; while the asbestos (fibrous hornblende) of Lynn and Harrington river, and the altered diorites or serpentine, and the felsites of New Prospect occur among the associated igneous rocks.

"In addition to the fossils mentioned last year as having been obtained from the Economy river, in the neighbourhood of the gold (?) mine of Peleg brook, numerous stipes of ferns resembling, according to Sir J. W. Dawson, *Aneimites acedica* of the Lower Carboniferous, were found among the dark slates of Murphy brook.

"The newer or Triassic series of igneous rocks has attracted attention from all who have visited this district, and many of the contacts with the Triassic sandstone and other rocks have been minutely described. Along the line of junction the two are intimately mixed and angular masses of both are cemented into a sort of breccia passing into amygdaloid with cavities filled with zeolites. The amygdaloid contains magnetic iron ore in masses and veins one foot wide and under, exceedingly irregular in their course, and often terminating abruptly, so that little dependence can be placed upon them for mining, although the ore is very rich. Of this nature are the iron ore deposits of Gerrish Mountain, Cape Sharp and Cape d'Or. Native copper and ores of this metal and traces of manganese ores are also found in the trap. Collections of its characteristic minerals may be made from veins, nodules and geodes at Five islands, Two islands, Wasson's Bluff, Partridge island, Cape Sharp, Spencer's island, Cape d'Or and other places. The minerals referred to comprise amethyst of great beauty and brilliancy, moss and fortification agates of rich colours and varied surface, red and yellow jasper, pure white chalcodony of very fine texture and smooth surface, well adapted for cameos and other ornaments, and sometimes curiously zoned or marked with stripes of different shades of colour; calcespar in rhombohedrons or of the

dogtooth variety : zeolites, including stilbite, henlandite, analcime, laumonite, thomsonite, chabazite and other species in beautiful crystalline aggregations or in perfect distinct crystals. Asbestos in small seams is found at Blue Sack.

"At the mouth of Fox river is a bank of fine sand, and great accumulations of drift sand, gravel and clay occur in this region."

The expenditure on the season's explorations, including the salaries of all assistants, was \$1,430.66.

Mr. Faribault continued and made good progress with the very excellent detailed work he is doing in mapping the structure of the gold-bearing rocks on the Atlantic coast of Nova Scotia and on which he furnishes the following report and interesting remarks. Personal observation enables me to concur in the opinion he expresses both as regards the correspondence of the Quebec gold-bearing rocks with those of Nova Scotia, and also as regards the position of the rich leads and their relation to axial folds. The latter, if correct, must prove of the greatest practical importance if intelligently applied in the further development of gold mining in Nova Scotia and also in directing prospecting for veins in the alluvial fields in Quebec.

"On the way to Nova Scotia, I took occasion to visit the Little Ditton gold district in the Eastern Townships of Quebec, with the view of comparing the Lower Cambrian rocks there with the auriferous series of Nova Scotia. Like all those who have examined both localities, I have no doubt that these auriferous rocks are of the same age. The Little Ditton rocks like those of Nova Scotia may be divided into two distinct groups, a lower or quartzite group and an upper or graphitic ferruginous slate group. They present the same lithological character as the two groups in Nova Scotia, and there are good reasons to believe that the gold of the Ditton alluvial deposits is derived, as in Nova Scotia, from numerous quartz veins which run along the sharp anticlinal axes into which these rocks have been folded. Although a great deal may be expected of the deep deposits of the old rivers which have not yet been worked, the future of the gold mining industry in Quebec must as elsewhere lie in the working of the solid veinstone.

"The section surveyed this season in Nova Scotia lies westward of that surveyed in 1889 and 1890, and extends along the sea shore from Porter's lake to Halifax harbour, and northerly to the Shubenacadie and St. Andrew's rivers, covering an area of 305 squares miles in Halifax county and 70 squares miles in Colchester county. Besides this, Mr. Eaton surveyed 130 miles of roads in Hants county to be used as tie-lines in next year's contemplated work.

"The greater part of the region is occupied by the auriferous Lower Cambrian rocks cut by the western end of the belt of granite examined last year which extends to within two miles east of Waverley, and also by a small granite mass three miles north of Waverley. In the northern portion, the gold-bearing rocks are overlain by the Lower Carboniferous formation along the valleys of the Shubenacadie, Gay's and St. Andrew's rivers and a few of their tributaries.

"Two or three beds of dolomitic limestone from six inches to four feet thick were found at various places at the bottom of the upper graphitic ferruginous slate group, between layers of greenish talcose slate. These beds may contain fossils, but search made for them has so far proved unsuccessful.

"The anticlinal axes were minutely examined and traced, as in former years, on account of their close relation to the auriferous belts. Within the region examined, the geological structure of the gold district of Lawrencetown, Montague, Waverley and Oldham was carefully studied. Lawrencetown has been but little worked. The yield of the three other districts has been as follows :—

DISTRICTS.	Yield for 1890.	Total Yield from 1862 to 1891.
Montague	2,263	32,581
Oldham	2,775	41,242
Waverley	403	53,874
Total in Nova Scotia	24,358	506,675

"Special attention was given to the gold district of Oldham, it being a typical district, worked to a great extent and exposing to great advantage the quartz leads, all of which were prospected by means of surface trenches on account of the small thickness of the drift. A detailed geological map of this district, on a scale of 500 feet to one inch, with sections, was compiled on the ground. It shows the elliptical structure of the anticlinal fold, with all the known quartz veins, both interbedded and transverse; and also the numerous faults affecting them, and proves clearly that the richness of a lead depends altogether on its position and relation to the structure of the elliptical dome of the fold to which it owes its origin. In this work I am specially indebted to Mr. J. E. Hardman, B.Sc., M.E., manager of gold-mining properties in Oldham and Waverley, for much valuable information which his great experience in gold-mining enabled him to give.

"Auriferous leads have also been prospected at Elmsdale, South East Passage, and other places along anticlinal axes; and traces of antimony ore are reported to have been found at Wyse's Corner.

"Some facts which have an important bearing upon the question of deep mining, may here be introduced, in view of the great interest taken at present by the mining community in the subject. From a study of the districts east of Halifax, and especially of that of Oldham, it is plain that whenever an interbedded lead is followed some distance on the surface or to great depths, its relation to the axis of the anticlinal, and consequently to the stratigraphy of the fold, is constantly changing, and its size and workable value must consequently be affected; so that it is improbable that a lead found rich and of good size on the surface can be followed profitably to great depths. The limit of depth may vary from a few feet to 400 or 800 feet according to the structure of the anticlinal fold, the position of the lead and the extent to which it has been denuded. The problem of deep mining seems thus to depend on the location of a zone of rocks containing the parts of the leads which are of sufficient richness, because they keep the same relative position to the axis of the anticlinal. In most of the districts the zone of rich leads has the anticlinal axis for its centre, and it is probably the centre of the auriferous zone to a depth practically unlimited. Such is the case in the eastern part of the province, at Seal Harbour, Isaac's Harbour, Goldenville, Harrigan Cove, Salmon River, Fifteen Mile Stream, Killag, Moseland, Moose River, Caribou, Gold River, Lawrencetown, Waverley and Oldham. In the few other districts where the auriferous zone is worked only on the north or south side of the anticlinal, the zone would, for the same reason, be parallel to the axis of the anticlinal to an inaccessible depth, as in Isaac's Harbour, Wine Harbour, Beaver Dam, Tangier and Lake Catcha.

"I would, therefore, strongly recommend that deep perpendicular shafts be sunk on the anticlinals, and that cross-cuts be driven on both sides at various depths to test leads which do not crop out to the surface, many of which would probably prove very rich, as they would be cut in their most favourable stratigraphical position and could easily be worked by means of levels and overhead stoping from the cross-cuts and the one perpendicular shaft. This system might be adopted with advantage at the North Star property of Isaac's Harbour, at Goldenville, where both sides of the anticlinal have been worked from 500 to 600 feet deep and abandoned, but the middle of the auriferous zone has never been tried; at Fifteen Mile Stream, in the vicinity of the Serpent lead; at Moose River, where Mr. D. Tonquoy has his main shaft; at Waverley, on the east and west side; and at Oldham, west of the Black brook. No such systematic workings have, however, yet been undertaken in Nova Scotia, that I know of, except in Oldham, where Mr. J. E. Hardman began last summer to sink a perpendicular shaft on the anticlinal dome. The result of his undertaking is awaited with great interest.

"The pay streak of the leads in different districts is also a subject of great importance to miners; but, unfortunately, the data necessary to draw conclusions are very meagre, as in most of the mines, especially in old workings, no systematic records of the yield of different parts of the leads have been kept. I hope, however, to be able to throw some light on the subject from the notes I have gathered this summer.

"The materials of economic importance met with in the Lower Carboniferous comprise chiefly unexhaustible and valuable deposits of limestone and gypsum. One belt of fine grey limestone at Gay's River corner carries a good percentage of argentiferous galena : it runs east and west, rests unconformably upon the lower quartzite group, was worked some years ago where the south-west branch of Gay's river crosses it, and also prospected last summer at Carroll's corner, where some mining areas were taken up.

"The gold district of Gay's river was re-opened last spring by the Cole Stream Gold Mining Company, who put up an extensive 50 stamps steam mill and other large buildings. They sank a shaft, immediately north of Daniel McDonald's old works, which gave the following section of the Lower Carboniferous :—

	Feet.
Surface drift.....	20
Conglomerate containing gypsum, non-auriferous.....	35
Coarse sandstone.....	2
Auriferous, irregular conglomerate.....	8

"This lower auriferous conglomerate is wholly composed of debris of the adjacent Lower Cambrian rocks, apparently in an old river bed, and rests on the lower graphitic ferruginous slate group. Beds of conglomerate similarly situated along the northern boundary of the gold-bearing rocks may prove sufficiently rich to be worked, but the great excitement caused two years ago by exaggerated reports of discoveries of gold in various places, remote from the gold-bearing rocks, have led a great many to take up valueless ground. (See Summary Report for 1890, page 41.)

"The clay deposits on the Shubenacadie river, between Enfield and Shubenacadie railway stations, are well-known for their superiority for brick making, and brick yards have been in operation along the river bank for a great many years.

"Sand from the Dutch settlement is also used in New Glasgow for the manufacture of the best quality of glass and for moulding purposes.

"I was ably assisted, as in previous years, by Messrs. Archie Cameron and J. McG. Cruickshanks, for six months. I had also Mr. D. I. V. Eaton some two months surveying roads, and Mr. Walter C. Adams for two months.

"The season's work extended till 25th December, and the expenditure entailed, including salaries of all assistants, is \$1,420."

From the 17th of July to the 1st of October Professor Bailey, assisted by Mr. Lee Street, continued the examination and survey in south-western Nova Scotia, which was commenced in 1890, and on this he reports as follows :—

"The earlier part of the season was devoted to the examination of portions of Queen's and Shelburne counties for the exploration of which there had not been sufficient time during the previous season. These include a large part of the district traversed by the Port Medway river; the Liverpool river from Lake Rossignol to Liverpool; Fairy lake, Tobetic lake, Lake Rossignol and the associated smaller lakes; the Shelburne river, Broad river, the Roseway and the Clyde; together with several islands off the coast. Particular attention was also paid, in accordance with your instructions, to the determination of the position and extent of the various areas of granite associated with the Cambrian rocks both along the coast and in the interior of the counties named.

"In the prosecution of this work it was found necessary, in consequence of the very irregular boundaries of the counties, as well as from other considerations, to extend the observations in some instances beyond the limits of Queen's and Shelburne, to which they had previously been confined. A portion of the season was accordingly devoted to the examination of those parts of Lunenburg, Annapolis and Yarmouth counties, which are immediately adjacent to those last mentioned.

"The results obtained in these explorations, together with those of the previous season, have been embodied in a report which will be immediately submitted. In attempting, however, to prepare a map to accompany this report, great difficulty has

been experienced from the great want of accordance shown by the county maps upon which the field investigations are based. Not only do these differ in the position of lakes and rivers, and show numerous omissions, but even the same county lines upon adjoining maps, such as those of Shelburne and Yarmouth, though drawn upon the same scale, differ widely both in length and direction. Large tracts have, indeed, never been surveyed, and there does not appear to exist at present any materials from which anything like an accurate topographical map of the region can be constructed. The roads in the several counties which have been measured by odometer are fairly accurate, but a certain number of tie-lines, at least, are required to check the latter. Such maps as could be constructed from the data available will be submitted with the report."

The work of the Mining Division was continued by Mr. E. D. Ingall, assisted by Mr. H. P. Brumell in the general work of the division, and by Mr. Jas. White, who was engaged in making mining surveys on the Kingston and Pembroke railway iron phosphate district.

Of the progress of the work under his charge, Mr. Ingall furnishes the following notes :—

"During last winter Mr. Brumell and myself were occupied with the usual work connected with the collecting of mining information, statistical and otherwise, for the annual report of the division, and with the compilation and writing up of the same for publication. Besides this the usual preliminary summary April statement of Mineral Production for 1890 was made up and issued, the complete report for 1889 on coming to hand from the printer was similarly sent out. As far as the office routine connected with the above work would permit, advancement was made with the completion of the Directory of Mineral Occurrences, the representation of the same on maps, several of which are now almost complete. In answer to enquiries a number of 'memoranda of information' have been issued, often embodying material the collection of which occupied in the aggregate much time.

"Mr. White has been engaged plotting his surveys, preparing the maps for publication required before the geological investigation of the River du Lièvre phosphate deposits could be completed.

"These maps being available for use, it was considered advisable that I should during the summer, and as far as time permitted, attempt the further field studies necessary to enable a report to be issued embodying the results of these and previous investigations, which were necessarily discontinued on my appointment to the charge of the Mining Division.

"Before commencing this work, however, an effort was made to publish the Annual Report of the Division several months earlier than usual. All arrangements were made and the field work was set aside for that purpose, but meeting with insurmountable difficulties in connection with the printing, this intention had to be abandoned. The commencement of the field work was delayed until the 12th August, much fine weather was lost, and its continuance was necessitated as late as the 27th of November in order to complete the first sheet of the map of the du Lièvre phosphate district.

"During the above mentioned period the work done was altogether concentrated in the valley of the River du Lièvre. The details of the pyroxenite belt on which are situated the High Rock, Union and other mines had been as far as possible worked during previous seasons. Recent developments, however, created facilities for the extension of this work, and this belt was followed to the northern limits of the map, the High Falls mine.

"Most of the season, however, was spent in the study of the group of mines situated on the Little Rapids belt, and at the Emerald mine, all of which had necessarily received only limited attention previous to this. The Little Rapids belt was traced for several miles with a view to obtain another instance of the continuity of these pyroxenite belts. Special attention was paid to the details of the rock structure, where the extensive and plentiful exposures around the mine workings, gave a chance to accomplish this.

"The phenomena encountered being read by the light of the knowledge of the rocks of the district, accumulated during past seasons, presented many interesting points which will be set forth in the detailed report.

"During the latter part of the season I received very efficient aid from Mr. M. A. Bucke, who not only made topographical surveys around the mines, but also assisted generally in the geological work and rendered good service in the delineation of the rock areas.

"Owing to my own time having been altogether taken up with the above mentioned geological studies, the only general investigation of the mining industries of the Dominion were necessarily limited to those which it was possible for Mr. Brumell, the assistant to the division, to undertake. During the summer he was engaged as in former years in visiting sundry mining districts in order to study the extent and condition of the industry at these points. His studies were principally confined to the provinces of New Brunswick and Ontario. He furnishes the following notes on his work :—

"In New Brunswick the following points were visited and investigations made :—

"Gloucester county.—Development work was being actively prosecuted on a vein of argentiferous galena by Messrs. Payne and Ellis, of Bathurst. The vein is on Rocky brook, a branch of the Millstream : work had also been done on a deposit of magnetic iron ore in the same vicinity.

"Albert county.—Investigations were made in the southern part of this county, where a considerable amount of prospecting was being carried on, notably around Shepody mountain and to the westward, where on Sawmill creek a bed of mica-schist, said to contain gold, had been opened up. Work was being carried on as in previous years at the gypsum quarries of the Albert Manufacturing Company, at Hillsboro' and E. W. Lynd's, at Hopewell, and operations had ceased at the Crinora Manganese Company's property in Dawson settlement. A small amount of work had been done at Gawland mountain, without, however, sufficiently promising results to warrant further operations.

"King's county.—The manganese property at Markhamville was still being operated, though smaller quantities of ore were being obtained, active prospecting was being carried on by means of diamond drills. Owing to the institution of the lately enacted mining law of the province, the manganese mine at Jordan mountain was idle. At Namwigewauk prospecting had been carried on to prove the gold bearing character of the conglomerate ridges of the vicinity. This work had been done under the auspices of the New Brunswick Mineral Developing Company.

"St. John county. A new plumbago property has been opened up at St. John, and a considerable amount shipped.

"Victoria county. Gypsum quarrying on the Tobique was being carried on as in former years.

"Carleton county.—Apparently fruitless efforts were being made at the Britton mine, Woodstock, in search of the gold and silver promised by several assays made of picked specimens.

"Charlotte county. Considerable work had been done in prospecting for nickeliferous pyrrhotite on several bodies of which small shafts have been sunk.

"Throughout the province there seems to have been a general revival of interest in mining matters.

"Visits were also made to various parts of the province in search of further information relating to structural materials. In Quebec the only point, outside of Montreal and Quebec, visited was St. Hyacinthe, where small quantities of 'shale gas' of no commercial value had been found.

"In Ontario, west of Toronto, visits were made to several central points for the collection of data regarding structural materials, petroleum and salt, as well as to Essex and Welland counties where active boring operations in search of natural gas and petroleum were being carried on.

"In Hastings county, active mining had been commenced by the South Africa General and Developing Company, on a rich gold property in Belmont township, and on a deposit of magnetite in the same township by the Belmont Bessemer Ore Company of New York. At Belleville unsuccessful efforts had been made to obtain natural gas by boring.

"Work was begun on the 12th of July and continued with occasional interruptions until the 15th November.

"The surveys in the Kingston and Pembroke railway district were continued with a view to illustrating the mineral developments there. To this end it is proposed to make detailed surveys of the chief mines and also the roads and other topographical features serving to show the conditions of economic mining development in the district. Of this work Mr. White writes as follows :—

"During the summer surveys were made of the roads in the northern part of the district with odometer and compass. The principal iron and phosphate mines were mapped on scale, but otherwise the time at disposal and the nature of the country did not permit of any very accurate or detailed topographical work. As the iron mines had been closed for some time, the pits and underground workings were all full of water and any information relating to them had to be gleaned from outside sources. Another season's work will be necessary to complete the information for the map. During the past year no iron ore was raised in the district and but little phosphate, nearly all the mines producing the latter closing down in July and August. I was assisted during the early part of the summer by Mr. M. A. Bucke.

"The field work was begun on the 17th of July and completed on the 9th of October, when, after packing and storing the outfit, the party returned to Ottawa.

Since the return from the field Mr. Ingall and Mr. Brumell have been occupied with the usual routine and with the detail of the office work connected with the material for the annual mining report of the division. Mr. White has been engaged since his return in making additions and corrections to the topographical sheets of the map of the River du Lièvre district, which were rendered possible as the result of surveys made during the summer. The manuscripts of these are now complete, and the engraving of the upper half is nearly finished, so that the topographical edition should be shortly available. The geological notes for these must necessarily await the elaboration of the material resulting from the geological field studies. This will of necessity take some time, including, besides many other things, the close study of some hundreds of specimens. It is hoped, however, that it can be commenced as soon as the work on the annual report of the division is well started.

The expenditure for field work in connection with the division was \$2,529.24, made up as follows :—Expended by Mr. White in mapping the Kingston district, \$984.96 ; expended by Mr. Brumell in general mining investigations, \$771.58 ; expended by Mr. Ingall in further prosecuting the geological studies of the phosphate deposits, begun in previous years, \$772.70.

CHEMISTRY AND MINERALOGY.

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

"The work in the chemical laboratory during the past year, has been carried out upon the same lines as those heretofore followed. It was chiefly confined to the examination and analysis of such minerals, &c., &c., as were considered likely to prove of economic value and importance. The ground covered included :

"1. Analyses of fuels, comprising a semi-anthracite and coals from various localities in British Columbia, all of which proved to be of excellent quality.

"2. Analyses of mineral waters and brines. Of the former, some of those from British Columbia may not improbably, judging from the results of a qualitative analysis, prove of therapeutic value. Some of the latter belonged to, and constituted the last of, a series of saline waters—the examination of which had been commenced in the previous year—representing all the principal salt-springs on Swan and Winnipegosis

lakes in the province of Manitoba, and on the Red Deer river, district of Saskatchewan, North-West Territory. The object of the inquiry was to ascertain if these brines could be advantageously used for the manufacture of salt.

“3. Analyses of limestones and dolomites. In continuation of the series of analyses of limestones and dolomites already carried out in connection with an inquiry into the individual merits of a number of these stones—from various localities—for structural purposes and suitability as a flux in smelting iron and lead ores or as a glass-making material.

“4. Analyses of nickel and cobalt ores. The greater number of the specimens examined consisted of pyrrhotite from various localities in the districts of Nipissing and Algoma, province of Ontario. These were all found to contain a satisfactory percentage of nickel. A pyrrhotite from what is reported to be an extensive deposit, in Charlotte county, New Brunswick, was also examined and found to contain 1.72 per cent nickel, 0.16 per cent cobalt, and 0.31 per cent copper. This material closely resembled much of the ore found in the above mentioned districts. Besides these, many other samples of pyrrhotite from other parts of the Dominion were examined.

Reference may, not inappropriately, here be made to certain other nickeliferous ores, the occurrence of which has been pointed out in previous reports of this Survey. One of these, a steel-grey pyritous ore, from the Wallace mine on Lake Huron, contained 13.93 per cent nickel; whilst of two others found on Michipicoten island, Lake Superior, the one, consisting of an intimate mixture of the arseniurets of copper and nickel, was found to contain from 17.03 to 36.39 per cent nickel, and the other, a hydrated silicate of nickel, gave, after drying at 100° C., 23.91 per cent nickel.*

“5. Gold and silver assays of ores from the provinces of Nova Scotia, New Brunswick, Quebec, Ontario and British Columbia. The greater number coming from the last named province.

“6. Analyses of iron ores from the provinces of Nova Scotia, Ontario and British Columbia.

“7. Miscellaneous examinations. These include the partial analysis or testing, as the case might be, of brick and pottery clays, cement-stones, phosphatic rock, graphite, talc, &c., &c. The talc referred to was almost snow-white in colour and would appear to be almost, if not quite, as well adapted for use as a ‘filler’ in the manufacture of paper, as the talcose mineral found at Edwards near Gouverneur, Saint Lawrence county, in the State of New York.

“In addition to the work included under the foregoing headings, examinations and analyses have been made of several minerals recently met with, and now for the first time identified as occurring in Canada. The more important, from a commercial standpoint, of these are:—Gersdorffite, nickel arsenosulphide, a rich nickel ore from the township of Denison, district of Algoma, and Danaite, a cobaltiferous variety of mispickel, a useful ore of cobalt, from the township of Graham, also in the district of Algoma. These, with some others of more purely scientific interest, add materially to the list of minerals already known to occur in Canada.

“Amongst the many specimens received in the course of the year, were three of more than usual interest, viz., samples of cinnabar ore and native mercury from Seshart channel, Barclay sound, Vancouver island, British Columbia, and a sample of native platinum found, in association with gold, on the bars of the North Saskatchewan river, in the neighbourhood of Edmonton, district of Alberta, North-West Territory. Native platinum had previously only been met with, in Canada, in British Columbia, and, in small quantities, in Beauce county, in the province of Quebec.

“During the period in question, seven hundred and five mineral specimens were received for the purpose of identification or the obtaining of information in regard to their economic value. The greater number of these were brought by visitors, and the information sought in regard to them was not infrequently communicated to them at the time of their calling. In other instances—those where a more than mere cursory

* *Geology of Canada*, 1863. Chap. XVII, XIX, XX, pp. 505-7 : 614 and 737-38.

examination was called for, or a partial or even complete analysis was deemed desirable, as also in the case of those specimens which have been sent from a distance—the results were communicated by mail. The number of letters written, chiefly in this connection, and generally of the nature of reports, amounted to two hundred and ninety, and the number of those received to one hundred and sixty-one.

“Mr. R. A. A. Johnston has diligently applied himself to, and most satisfactorily carried out, the work entrusted to him. In addition to the gold and silver assays, analyses of limestones, dolomites and nickel ores, he has conducted a great variety of miscellaneous work. Mr. F. G. Wait was principally engaged in the analysis of mineral and other saline waters.

“On the work connected with the mineralogical section of the museum, I have been most ably and zealously assisted by Mr. R. L. Broadbent. He has been engaged in the permanent labelling of specimens—a work which must of necessity be a more or less continuous character by reason of the many frequent additions to the collection; the re-adjustment of some of the cases, incident upon the introduction of several new table-cases, for the purpose of allowing of a more systematic arrangement of the economic minerals of some of the provinces—and in maintaining the collection in general in an orderly condition.

“The catalogue of this section of the museum, in the preparation of which I have had the hearty co-operation of Mr. Broadbent, will appear in the course of the coming year (1892).

“Very many of the mineral specimens have been replaced by more characteristic ones, and the collection augmented by the addition of some one hundred and twenty others. Of these, the following were collected by members of the staff:—

1. Ami, H. M. (Survey):

Argentiferous galena from the Elizabeth claim, Fish river, West Kootanie district, British Columbia.

2. Bailey, Professor L. W. (Survey):

(a.) Staurolite from North East Harbour, Shelburne county, Nova Scotia.

(b.) Garnet on diorite from Chegoggin, Yarmouth county, Nova Scotia.

(c.) Garnet rock from Chegoggin, Yarmouth county Nova Scotia.

3. Barlow, A. E. (Survey):

(a.) Cyanite, seventy specimens. (b.) Fibrolithe, eight specimens. (c.) Gersdorffite, ten specimens. (d.) Huronite, forty specimens. (e.) Niccolite, six specimens. (f.) Nickeliferous pyrrhotite, one hundred and twenty specimens.

(g.) Oligoclase, eight specimens. All from the Sudbury district, province of Ontario.

4. Brunell, H. P. (Survey):

(a.) Petroleum from Walker's 'No 2' well, Marshfield, south-west corner of lot 11, range IV, of Colchester, Essex county, Ontario.

(b.) Petroleum from St. Joseph, parish of Dorchester, Westmoreland county, New Brunswick.

5. Dawson, Dr. G. M. (Survey):

Coal from the Canmore mine, one mile from Canmore station on the line of the C. P. R., south-east side of Bow river, district of Alberta, N. W. T.

6. Ferrier, W. F. (Survey):

About two hundred specimens of scheelite, tungstate, &c., from lot 1, range VII, township of Marlow, Beauce county, Quebec.

These include many fine and rare crystals, as well as a few large specimens suitable for the economic collection.

Ninety specimens of the silver ores from lots 1, 2, 3, and adjoining ones, ranges XIV, XV, and XVI, Risborough township, and lot 1, range VII, Marlow township, Beauce county, Quebec; also about twenty-five specimens of minerals associated with these ores, some of which have not yet been fully identified.

6. Giroux, N. J. (Survey):
Chromite (two specimens) from the townships of Leeds and Thetford, Megantic county, province of Quebec.
7. McEvoy, J. (Survey):
Muscovite (three specimens) from near the junction of Canoe river with the Coldwater, British Columbia.
8. McInnes, W. (Survey):
 - (a.) Argentite with pyrite, fluorite and calcite, from the Beaver mine.
 - (b.) Argentite and sphalerite with fluorite from the Beaver mine.
 - (c.) Argentite with native silver, and sphalerite, in calcite and quartz, from the Porcupine mine.
 - (d.) Galena with sphalerite, in quartz, from the Badger mine.
 - (e.) Magnetite, from Greenwater lake.—All from the district of Thunder bay, Ontario.
9. Selwyn, Dr. A. R. C.:
Auriferous quartz, from the Gladstone mine, township of Marmora, Hastings county, Ontario.
10. Smith, W. H. C. (Survey):
Magnetite, from Big Turtle river, district of Rainy river, Ontario.
11. White, J. (Survey):
 - (a.) Celestite, from lot 7, range X, of Bagot, Renfrew county, Ontario.
 - (b.) Moulding sand, from lot 3, range V, of north Sherbrooke, Lanark county, Ontario.

And the undermentioned constituted presentations:

1. Campbell, John, Nanaimo, British Columbia:
Limonite, from Texada island, British Columbia.
2. Chubbuck, C. E. D. Ottawa:
Phlogopite, from lot 13, range XV, of Hull, Ottawa county, province of Quebec.
3. Claxton, F. J., Victoria, British Columbia.
Cinnabar ore, from Seshart channel, Barclay sound, Vancouver island, British Columbia.
4. Coughlin, D.:
Nickeliferous pyrrhotite, from lot 9, range VI, of Lorne, district of Algoma, Ontario.
5. DeWolf and Munro, Vancouver, British Columbia.
 - (a.) Pottery clay, from Guichon creek, Nicola river, British Columbia.
 - (b.) Specular iron, from the junction of Nicola and Coldwater rivers, British Columbia.
6. Davey, Capt. T. R., per W. F. Ferrier (Survey):
From the Harvey Hill mines, Leeds township, Megantic county, Quebec.:
Chalcopyrite, twenty-five specimens.
Bornite, twelve specimens.
Chalcocite, eight specimens.
Molybdenite, three specimens.
7. Firth, W., per R. G. McConnell (Survey):
Vivianite, from the 'Ramparts,' Porcupine river, Yukon district.
8. Hammond, H. C., Winnipeg, Manitoba, per Dr. G. M. Dawson (Survey):
Argentiferous galena, from Vermont creek, McMurdo district, East Kootanie, British Columbia.
9. Haycock, E. B., Ottawa:
 - (a.) Phlogopite, with plant inclusion, from north half of lot 10, range V, of Hull, Ottawa county, province of Quebec.
 - (b.) Phlogopite, dressed sheet, from same locality as the preceding.
10. Laperrière, M., per N. J. Giroux (Survey):
Pierolite, from lot 18, range IV, of Durham, Pontiac county, province of Quebec.

11. Mackay, J. W., per Dr. G. M. Dawson (Survey) :
Native copper, from above Stein creek, Fraser river, British Columbia.
12. McLellan, S :
Phlogopite, from lots 11 and 12, range XVI, of Hull, Ottawa county, province of Quebec.
13. McCuaig, R. C. W., Ottawa :
Muscovite, from lots 4 and 5, range XI, of the township of Miller, Frontenac county, Ontario.
14. McRae, Hector, Ottawa :
(a.) Apatite in pyrite, from lot 11, range V of Templeton, Ottawa county, province of Quebec.
(b.) Core of garnetiferous granite, from boring at last mentioned locality.
15. Nellis, T. F., Ottawa :
(a.) Phlogopite with inclusions of albite, apatite, garnet and pyrite, from lot 10, range XII, of Hull, Ottawa county, province of Quebec.
(b.) Phlogopite with inclusion of molybdenite, from same locality as the last.
(c.) Phlogopite with inclusion of pyrite, from same locality as the two preceding.
16. Poole, H. S., Stellarton, Nova Scotia :
Sphalerite and chalcopyrite, from the Albion mines, Pictou county, Nova Scotia.
17. Rüeser, F., Kootanie Smelting and Trading Syndicate, Revelstoke, British Columbia, per H. M. Ami (Survey) :
Ingot of argentiferous lead, smelted from ore from the Monarch claim, at the Revelstoke smelter.
18. Ryckman, S. S., M.P., Hamilton, and W. H. Scott, of Illecillewaet, British Columbia :
Argentiferous galena, from the Elizabeth claim, Fish river, West Kootanie district, British Columbia.
19. Smart, Capt. W. J., Montagu, Nova Scotia :
Auriferous quartz, from the Rose lead, Montagu mine, Halifax county, Nova Scotia.
20. Jones, F., Clinton, British Columbia, per Dr. G. M. Dawson (Survey) :
Native gold, from the Bonanza claim, Cayoosh creek, near Lillooet, British Columbia.
21. Sperry, F. E., Sudbury, Ontario, per A. E. Barlow (Survey) :
Polydymite, from the Vermilion mine, lot 6, range IV, of Denison, district of Algoma, Ontario.
22. Warmington Stone and Marble Company, Garden River, Ontario.
(a.) Limestone polished, from Echo lake, district of Algoma, Ontario.
(b.) Limestone polished, from Garden River, district of Algoma, Ontario.

"Mr. C. W. Willimott has, for the most part, been engaged in making up collections of minerals and rocks for various educational institutions. The following is a list of those to which such collections have been sent :—

1. St. Mary's Academy, Windsor, Ont	Consisting of 103 specimens.		
2. City Museum, Vancouver, B.C.	do	106	do
3. Collegiate Institute, Napanee, Ont.	do	106	do
4. Protestant Board of School Commissioners, P.Q.	do	106	do
5. College of Hull, Hull, P.Q.	do	96	do
6. Elgin Street School, Ottawa, Ont.	do	96	do
7. Model School, Windsor Mills, P.Q.	do	108	do
8. Upper Canada College, Toronto.	do	108	do
9. Waterville Model School, Waterville, P.Q.	do	108	do
10. Public School, St. Stephen, N.B.	do	96	do
11. do St. Lambert, P.Q.	do	91	do
12. Preston Mechanics' Institute, Preston, Ont	do	96	do

13. St. Patrick's High School, Halifax, N.S., consisting of	96	specimens.
14. Legislative Assembly, Winnipeg, Man....	do	108 do
15. High School, Bowmanville, Ont.....	do	106 do
16. do Oshawa, Ont.....	do	91 do
17. do (Victoria), Moncton, N.B..	do	108 do
18. Panet Street School, Montreal, P.Q.	do	91 do
19. Mount Allison University, Sackville, N.B.	do	145 do
20. Bathurst Village School, Bathurst, N.B.	do	108 do
21. Central School, Brantford, Ont.....	do	108 do
22. Lunenburg County Academy, Lunenburg, N.S.....	do	108 do

"The following collections are in course of preparation for, and will shortly be sent to, the undermentioned institutions :—

1. Collegiate Institute, Morrisburg, Ont....	consisting of	108	specimens.
2. do Peterborough, Ont..	do	108	do
3. School of Practical Science, Toronto, Ont.	do	108	do
4. Morrin College, Quebec, P.Q.....	do	108	do
5. High School, St. George, N.B.....	do	108	do
6. do Georgetown, Ont.....	do	108	do
7. Central School, Moncton, N.B.....	do	108	do

"A collection of two hundred and fifty specimens, sent by the College of St. Laurent, Montreal, for identification, was named and returned.

"In the course of the summer months Mr. Willimott visited—with the object of procuring further material for the making up of collections, and cabinet specimens for the Museum—the townships of Buckingham, Hull, Low, Masham, Portland, Templeton, Villeneuve and Wakefield, in Ottawa county, province of Quebec; those of Bromley, Brudenell, Ross and Sebastopol, in Renfrew county, and that of Cameron, district of Nipissing, in the province of Ontario.

"In the prosecution of this work he has succeeded in collecting a large and varied assortment of minerals, and at the same time made many interesting and useful observations in regard to their mode of occurrence. The collection comprised :—

	Specimens.
Albite, massive.....	50
Albite, crystals.....	15
Albite with smoky quartz, fluorite and amazon-stone.....	25
Apatite, crystals.....	230
Apatite in calcite.....	36
Biotite.....	44
Fluorite with albite and sphene.....	50
Fluorite with amazon-stone.....	40
Graphite.....	48
Gummite.....	12
Hornblende, groups of crystals.....	20
Hornblende with tremolite.....	96
Microcline, massive.....	60
Microcline, crystals.....	8
Mountain cork.....	20
Muscovite.....	75
Orthoclase, groups of crystals.....	75
Phlogopite.....	45
Phlogopite, crystal.....	1
Pyrite with pyrrhotite.....	110
Pyroxene, crystals.....	300
Pyroxene, groups of crystals.....	50

	Specimens.
Quartz.....	35
Quartz, groups of crystals.....	50
Scapolite, crystals.....	6
Scapolite, groups of crystals.....	60
Spessartite.....	50
Sphene, crystals.....	30
Sphene in calcite.....	20
Tourmaline, crystals.....	17
Tourmaline in albite.....	88
Uraninite (diss.).....	36
Wollastonite in calcite.....	50
Miscellaneous associations.....	30
Three minerals (under examination) represented by.....	77

Total number of specimens collected..... 2,039
Galena from Bedford (applied for)..... 300 lbs.

"The foregoing include very many handsome cabinet specimens, the most conspicuous amongst which are some white and reddish crystals of albite; crystals of black tourmaline; fine specimens of spessartite; crystals of Wollastonite in sky-blue calcite, one some two inches in length and a little over one inch in breadth and well terminated; a crystal of phlogopite, fifteen inches and a-half long, three inches and a-half diameter at the top, four inches and a-half diameter at the centre, and weighing some fifteen pounds; also a very handsome group of crystals of microcline."

Mr. W. F. Ferrier, lithologist, reports that during the year, as in 1890, he has been engaged in the study, arrangement and classification of the stratigraphical collection of rocks. Early in the year new cardboard trays were ordered to fit the drawers under the flat cases devoted to this collection. Thirty-nine of these drawers were gone over, the specimens cleaned and provisionally arranged in the new trays, worthless material was rejected and three boxes of duplicates were carefully labelled and placed in store. This work involved the handling of over 1,800 specimens. There are 141 more drawers, all the specimens in which will have to be similarly gone over before the best and most suitable series can be selected for the exhibition cases, and their systematic arrangement carried out.

Superintending the preparation of the rock sections required for the microscopical determination of the characters of the specimens also occupied considerable time; 142 such sections were prepared and studied during the year.

On the 21st of July Mr. Ferrier left Ottawa to make some lithological investigations in the Eastern Townships, more especially in Broughton and Leeds.

In the spring while examining the rocks collected by Mr. Webster in 1879, Mr. Ferrier had recognized in a specimen from lot I, range VII of Marlow, a small fragment of scheelite or tungstate of lime. He therefore also visited this locality and succeeded in finding it in some quantity in quartz veins, cutting Cambrian slates, and accompanied by its decomposition product tungstic acid. Galena, copper and iron pyrites, blende and other minerals were also found in the veins.

On the 10th of August he returned to Ottawa and was occupied chiefly in microscopical work till the 30th of September when he again visited the locality, remaining there till the 8th of October. The tungsten minerals were found in nearly all the veins examined, but in some only in small quantity.

The best locality, apparently, is that from which the original specimen came, where they are rather abundant in the vein. Though little more than a foot wide at its outcrop, further development might reveal the tungsten ore in quantities sufficient to justify mining on this vein. No ore of tungsten had hitherto been recognized in situ*

*Geology of Canada, 1863, p. 503.

in Canada. Its discovery is of interest at a time when so many experiments are being made with steel, in view of the remarkable and valuable properties possessed by tungsten steel.

Tungstic acid has also been used in calico printing to produce a yellow colour.

The discovery is also interesting in connection with the fact that scheelite is very commonly accompanied by ores of tin and that for several years past I have indicated this south-eastern portion of the province of Quebec as the district where this ore should be sought, and where, if anywhere in Canada, the search might prove successful. In Phillip's mineralogy it is stated: "This mineral (scheelite) occurs both crystalline and amorphous, particularly in the depositories of tin ore at Schlackenwald and Zinnwald, in Bohemia, and in Monroe county (Conn.), United States."

Mr. Ferrier collected many fine crystals of scheelite as well as large samples of the ore, for the museum. An analysis, by Mr. R. A. A. Johnstone under the supervision of Mr. Hoffmann, was made in the laboratory of the survey, and showed the scheelite to contain 79.9 per cent of tungstic acid, or within 7 per cent of the theoretical quantity.

The full analysis will appear in Mr. Hoffmann's report on the chemical work of the survey.

Since the 8th of October Mr. Ferrier was chiefly occupied in the examination of specimens collected during the summer by various members of the staff in order to ascertain their character by means of the microscope and blow-pipe. These examinations include a detailed report on specimens from Chateau Richer, Quebec, to accompany Mr. Low's report on work in that district, and also a microscopical examination of Huronian rocks from the Sudbury district collected by Mr. Barlow. This was being proceeded with at the close of the year. The cost of the season's work in the field was \$209.89.

PALEONTOLOGY AND ZOOLOGY.

Mr. Whiteaves reports that the third part of the first volume of "Contributions to Canadian Paleontology" was published in May last. It consists of a systematic and descriptive report, of fifty-eight pages octavo, illustrated by six full page lithographic plates, on the fossils of the Devonian rocks of the Mackenzie River basin, for the most part collected by Mr. R. G. McConnell in the years 1887, 1888 and 1890. A full suite of the specimens to which it refers has been placed on exhibition in the museum, and such duplicates as remain have been labelled for distribution to educational institutions in Canada.

A paper on "the Orthoceratidae of the Trenton Limestone of the Winnipeg basin" has been written for the Transactions of the Royal Society of Canada, and is now printed in the volume for the current year. This paper consists of 10 pages quarto, illustrated by seven full page lithographic plates.

During the past year, also, three descriptive and illustrated papers on purely paleontological subjects have been written for and printed in the "Canadian Record of Science." The first of these, which is entitled "Descriptions of Four New Species of Fossils from the Silurian Rocks of the South Eastern Portion of the district of Saskatchewan," was published in the April number of the "Record," and consists of eleven pages octavo of letter press, illustrated by one full page lithographic plate. The second, which, with the third, was published in the October number of the "Record," consists of a description of a large new species of *Panoplia* from the Corniferous limestone of St. Mary's, Ontario, and is illustrated by one full page lithographic plate. The third is a note "on the Occurrence of Paucispiral Opercula of Gasteropoda in the Guelph formation of Ontario," and is illustrated by one woodcut.

The third part of the "Contributions to Canadian Micro-Paleontology," by Professor T. Rupert Jones, F.R.S., referred to in the last annual report as having been received in MSS., was published in August. It consists of forty-two pages of text, illustrated by four full page lithographic plates.

It has been decided to devote the second volume of the "Contributions to Canadian Paleontology" to an illustrated monograph on "Canadian Fossil Insects," which Pro-

fessor S. Scudder, of Cambridge, Mass., the most experienced authority on this subject in America, has kindly promised to prepare. The first part of this volume, consisting of a paper, of twenty-six pages large octavo, and illustrated by one full page lithographic plate, "on the Tertiary Hemiptera of British Columbia," was published last April, and the second part is now nearly ready for the printer.

The manuscript of a considerable portion of the fourth part of the first volume of the "Contributions to Canadian Paleontology" has been written and eight of the lithographic plates required to illustrate it have been printed off. As stated last year, this report, when complete, will consist of a descriptive and systematic report on the unusually large collections of fossils made by Mr. Tyrrell in 1888 and 1889 from the Devonian rocks of lakes Manitoba and Winnipegosis. That part of the letter press which is now nearly ready for the printer consists of descriptions or identifications, as the case may be, of the whole of the species of sponges, corals, echinodermata, vermes, polyzoa, brachiopoda and of part of the pelecypoda, represented in those collections, and it is hoped that the whole report will be ready for publication in the spring. The Stromatoporoids in these collections have already been kindly reported upon by Professor H. Alleyne Nicholson, of the University of Aberdeen, in a paper in the Annals and Magazine of Natural History (London, England) for April, 1891, in which the species are described and figured.

Since the systematic "List of the Fossils of the Hamilton Formation of Ontario" was published in 1887, in the second part of the first volume of "Contributions to Canadian Paleontology," so many additional species from that formation have been received and so much new information about its fauna has been obtained, that it is thought desirable to publish a supplement to this list at an early date. With a view of making this supplement as complete as possible, about a week last summer was spent in an examination of all the exposures of the Hamilton formation near Thedford and Arkona and in a study of the fossils obtained therefrom during the past four years by the Rev. Hector Currie, of Thedford. Some interesting additions to this local fauna were thus made, and the writer is greatly indebted to Mr. Currie for his courtesy on this, as on a previous and similar occasion, and for the loan of some of the rarest specimens of fossils from his cabinet.

In Zoology, an important collection of the mammalia, birds and reptiles of the Rocky Mountain park, and a series of about 175 specimens of birds and small mammalia from Indian Head, Assiniboia, have been received during the year from Professor Macoun. A few interesting additions have been made to the zoological collections in the museum through Dr. G. M. Dawson, in connection with the British Behring Sea Commission, being chiefly donations from various gentlemen, or purchased as noted elsewhere. These include the skin and skull of a Pacific walrus, the skeleton of an adult male fur seal, some bones of the extinct *Rhytina* of Behring Island, a specimen of the sooty albatross from the coast of British Columbia, &c.

Besides a few birds which have been put up as skins, nine specimens of Canadian mammalia, one hundred and six specimens of birds, and one turtle, have been skilfully mounted during the past year, by Mr. S. Herring, the taxidermist to the survey, but most of these are intended for the museum which it is proposed to establish in the Rocky Mountain park at Banff. Among the more interesting specimens of native mammalia recently added to the survey museum, and not already enumerated, are a Rocky Mountain sheep, a fine example each of the "fisher" and cross fox, both from Norway House, and presented by Mr. Horace Belanger, and a yellow-haired porcupine from Illicillewaet.

During the director's absence from the city, on field work, the duties of acting director have, as usual, devolved upon Mr. Whiteaves, and, in addition to the correspondence entailed thereby, 263 official letters have been received during the year and 227 written.

Mr. Weston reports that, with the exception of one month spent in field work, the whole of his time, from the 15th of January up to the end of the year, has been occupied in work in the paleontological and archaeological branches of the museum, in the rear-

rangement of specimens and the incorporation of new ones into the collection, in the writing of labels, in making improvements in the contents of many of the glass cases, in the preparation of fossils either for study or for exhibition in the museum, in the making of microscopic sections of rocks and fossils, and in other office work. From the 1st to the 27th of July he was engaged in the examination of various rocks in the city of Quebec, on the north shore of the Island of Orleans and along the north shore of the St. Lawrence between the mouth of the St. Charles river and St. Joachim. At each of these localities interesting collections of fossils were obtained, some of which will, it is expected, throw additional light on the stratigraphical relations of the rocks from which they were obtained. Among these fossils are a large series from the Hudson River formation along the north shore of the Island of Orleans, and a fine collection from the Utica slate in the vicinity of the mouth of the St. Charles river.

Mr. H. M. Ami reports that during the past year, with the exception of two months spent in the field, he has been employed in the examination and determination of the species in various collections of fossils made by members of the staff. He has completed the examination and comparison of some graptolites from the graphite-bearing slates of St. John, New Brunswick, and has made a list of fossils from an outcrop of Silurian rocks, on the east branch of the River Philip, Cumberland county, Nova Scotia, recognized by Mr. Scott Barlow in 1876. It lies sixteen miles to the west from the outcrop of the same formation at Wentworth, on the Intercolonial railway. For Mr. A. Low he has identified and prepared lists of the species in four collections from the Trenton limestone below St. Alban, above and below St. Casimir, and on River Charlotte, P.Q. He has also examined a small collection of graptolites from Côte Sauvageau, near Quebec city, and has prepared lists, for publication in Dr. Ellis' report, of fossils from Philipsburg, St. Armand, Mystic, Stanbridge, Lake Memphremagog, and other localities in the province of Quebec, that were collected in 1890 by Dr. Ellis and Messrs. Whiteaves and Deeks. The specimens examined from these well-known Cambro-Silurian localities were about 1,300. A preliminary examination has been made by him of about 500 specimens of fossils, collected by Mr. Giroux in the counties of Joliette, Berthier and Maskinongé, with a view of revising the boundaries of the Chazy and Trenton formations in those districts. Miscellaneous collections of fossils from Ontario, Quebec and Nova Scotia, made in past years by Messrs. Weston, McInnes, A. Ogden, and H. Fletcher, from rocks of Cambro-Silurian and Silurian age have been examined and lists of the species prepared.

Some progress has been made in making up collections from the duplicate specimens in the museum, for distribution. Specimens have been sent to Mr. G. F. Matthew, St. John, N.B., and to Col. Grant and Mr. Wm. Turnbull, of Hamilton, in exchange for specimens received from them. Suitable collections of fossils are being prepared for the University of Toronto, the University of Fredericton, for Acadia College, Wolfville, N.S., and for other educational institutions. He has examined and, so far as their condition permitted, named, for the Rev. J. Carrière, principal of St. Laurent College, a miscellaneous collection of fossils, ranging from the Cambrian to the Cretaceous. Labels have been prepared, to be printed, for specimens in the museum from the Trenton, Devonian and Post Pliocene formations. He assisted in reading and correcting the proofs and revises of a palaeontological publication prepared for the Survey, by Professor Rupert Jones.

From the 17th of July to the 15th of September Mr. Ami was occupied in field work, chiefly on and in proximity to the line of the Pacific railway in the Selkirks from Revelstoke eastward to Beaver Mouth and Donald, and thence to the summit of the Rocky mountains east of Field. He carefully examined the natural exposures and rock cuttings between Revelstoke and the summit of the Selkirks, but was as unsuccessful in finding fossils in these rocks as Dr. Selwyn and Dr. Dawson had been when they examined them in 1890.

Between Beaver Mouth and Donald, two miles west of the latter, the numerous exposures were likewise carefully examined and in these he succeeded in finding an abundant fauna; crustaceans, pteropods and brachiopods: the genera, *Olenellus*,

Agnostus and Hyolithes were noticed, thus confirming the supposed Lower Cambrian age of these rocks. East of Donald, at the Glenogle slate and flag quarries, between Palliser and Golden, an interesting collection was made of the graptolites of that locality. At Field the trilobite beds on the western flank of Mount Stephen were visited, and an interesting collection made, containing about 25 species and 500 specimens of the Middle Cambrian fauna, first discovered in Mt. Stephen by Mr. McConnell.* At Anthracite, near Banff, about 100 specimens of fossil plants were collected from the Cretaceous rocks of that vicinity.

Besides the foregoing examinations Mr. Ami reports having ascended Moose creek, the south branch of the Illecillewaet for two miles and that the only rocks seen were dark coloured argillites inclined at a high angle. On the 10th of July, with a view to finding the contact of the gneissic rocks with the newer overlying series of the Illecillewaet valley, he left the railway five miles above Illecillewaet and ascended the Flat creek trail seven miles to the summit. He then descended by Slick creek and Jeopardy slide five miles into the Fish river valley. One day was spent in the Fish river valley and the exposures for four miles down on the left bank to the mouth of Granite creek were examined. Granite creek was ascended for about one mile, to about 1,500 feet above Fish river, at which elevation massive granite occurs and apparently extends to the summit of the range. Specimens of all the rocks here seen were collected, and also samples from a vein of argentiferous galena then recently discovered and on which some 18 claims had been registered. On the 12th of July, he returned to Illecillewaet. The next day Corbyn trail was ascended to the summit of the range between the Illecillewaet and the North Fork, and specimens of the rocks were collected.

Five specimens of the galena above referred to have been assayed in the laboratory of the survey, giving 108.6, 109.3, 149.9, 175.7 and 204.1 ozs. to the ton of 2,000 lbs. and about 80 per cent of metallic lead.

Mr. Lambe reports that during the first half of the year he was engaged in a study of the large collections of fossils made by Messrs. Tyrrell and Dowling from the Devonian rocks of Lakes Manitoba and Winnipegosis in 1888 and 1889, assisting in their identification and determination. He has prepared drawings of a large number of the species of sponges, corals, polyzoa, brachiopoda, pelecypoda and gasteropoda contained in these collections, which, with the exception of those of the gasteropoda, have been already lithographed on stone and the entire issue of 1,100 copies printed, forming plates 33, 34, 35, 36, 37, 38, 39 and 40 for the Contributions to Canadian Palaeontology, vol. i, pt. iv. (Shortly to appear.)

During the latter half of the year he was occupied in an examination of the Orthoceratidae from the Trenton rocks of Lake Winnipegosis, assisting Mr. Whiteaves in their identification and determination. He has prepared drawings of these fossils, which form part of collections made by Mr. Weston in 1884, by Mr. Tyrrell in 1889, and by Messrs. Dowling and Lambe in 1890, reproductions of which appear in plates 5, 6, 7, 8, 9, 10 and 11 of the Transactions of the Royal Society of Canada for 1891 (now in the printers' hands) illustrating Mr. Whiteaves' paper on the Trenton Orthoceratidae of Manitoba, &c.

He has begun a classification of collections of fossils recently made from Lake Winnipeg, and has made a number of drawings for the better illustration of *Edrioaster Bigsbyi*, Bill.; *Amygdalocyrtites florealis*, Bill.; and *Pleurocystites filitertus*, Bill., from the Trenton rocks at Ottawa. During the month of January, he was engaged in an examination of some fossils collected by Mr. McConnell in the Athabasca river, in 1890, and in preparing drawings for their illustration. These are published, in plate 32 of the Contributions to Canadian Palaeontology, vol. 1, pt. iii. He has devoted some time to the examination of the fossils described in the papers published by Mr. Whiteaves in the Can-

* Annual Rep. Geol. Survey, 1886, Part D.

adian Record of Science for April and October, referred to on p. 49 of this report, and has made all the drawings that are reproduced to accompany these papers.

In August he visited Peterborough, Woodstock and St. Mary's, Ont., and made collections of fossils from the exposures of Trenton limestone in the former place and from the Corniferous rocks of the latter, and later, in October, he spent a few days with Dr. Ells, in the vicinity of L'Orignal and Hawkesbury, Ont., collecting fossils from the Trenton and Chazy rocks near these localities.

The following is a list of specimens collected by officers of the survey during the past year, or presented to its museum through them :—

Dr. G. M. Dawson :

Specimens obtained in connection with the Behring Sea Commission, as under :—

Eight Haida (Queen Charlotte Island) trumpets and whistles, and one castanet
—Purchased.

One pair snowshoes, King's Island, Okeegmut tribe, Eskimo.	} Presented by Capt. M. A. Healy.
One bird snare made of whalebone, Kotzebue Sound, Eskimo.	
Net, Kotzebue Sound, Eskimo.	
Skin of Pacific walrus, from Behring Strait.	

One pair snowshoes, Nunivak Island, Behring Sea, Magemut tribe, Eskimo.	} Presented by Capt. Hadley, H.M.S. "Pheasant."
One bird-dart, Nunivak Island, Magemut tribe, Eskimo.	

Specimens of Sponges and Sertularians from various localities.

One skull of the Pacific walrus (*Odobenus obesus*), from Kamtschatka.—Purchased.

Seal and sea otter spear, and throwing stick for same, Atka Island, Aleut.—Purchased.

Sixteen skins of birds from Behring Sea.—Collected by J. M. Macoun.

Four skins of birds from Behring Island.	} Presented by Mr. N. Grebnitzky.
Bones of <i>Rhytina Stelleri</i> .	
Skeleton of male fur seal.	

Skull of *Rhytina*, from Behring Island.—Purchased.

Several specimens of *Velutina coriacea* from St. Paul's Island.

J. F. Whiteaves :—

A number of specimens of fossils from the Hamilton formation near Thedford and Arkona, Ont.

Prof. Macoun :—

About fifty specimens of fossils from the Lower Carboniferous rocks of the Rocky Mountain park, Alberta.

R. W. Ells & W. E. Deeks :—

About 1,000 specimens of fossils from various localities in the counties of Missisquoi, St. John, Laval, St. Hyacinthe, Bagot and Iberville, in the province of Quebec, and Russell and Prescott, in the province of Ontario.

R. G. McConnell :—

Twenty fossils from the Cretaceous rocks of the foot-hills of the Rocky mountains.

J. B. Tyrrell :—

Head of caribou (*Rangifer Caribou*) from Hole river, Manitoba.

T. C. Weston :—

About 250 specimens of fossils from various localities along the north shore of the St. Lawrence, between Quebec city and Cape Tourmente, also on the Island of Orleans.

L. M. Lambe :—

200 specimens of fossils from the Trenton and Chazy limestone at Peterborough, L'Orignal and Hawkesbury, and about 100 from the Carboniferous limestone of Woodstock and St. Mary's, Ont.

A. P. Low :—

About seventy-five fossils from the Trenton and Black River limestone of Jacques Cartier county, P.Q., also twenty specimens of Post-Tertiary fossils from the same district.

R. Chalmers :—

A number of specimens of four species of fossils from excavations in marine alluvium at the west end of the Chignecto ship railway, at the head of the Bay of Fundy, and fossil wood of two species of trees from New Brunswick.

Numerous examples of twelve or more species of fossils from the Leda Clay and interglacial beds at Duck Cove and Negrotown Point, Lancaster, St. John county, N.B.

H. M. Ami :—

About 600 specimens of fossils from the Selkirk and Rocky mountain ranges, along the line of the Canadian Pacific railway.

Specimen of the yellow-haired porcupine (*Erethizon dorsatus* var. *epiranthus*), from Corbyns' trail on the Illecillewaet.

N. J. Giroux :—

About 500 specimens of fossils from the Cambro-Silurian rocks at numerous localities in the counties of Joliette, Berthier and Maskinongé, in the province of Quebec.

D. B. Dowling :—

About 500 specimens of fossils from the Cambro-Silurian and Silurian rocks of the west shore of Lake Winnipeg and islands adjacent thereto.

A few Indian implements and small pieces of pottery from the mouth of the Little Saskatchewan river, Manitoba.

J. McEvoy :—

Ten fossils from the Carboniferous limestone of White valley, Okanagan valley, B.C.

James Macoun :—

Twenty-five specimens of fossil plants from Hastings, near Vancouver, B.C.

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

By presentation :—

Horace Belanger, chief factor Hudson's Bay Co., Norway House :—

Fine specimen each of the fisher (*Mustela Pennanti*) and cross fox (*Vulpes vulgaris* var. *decussatus*) from the Nelson river, Keewatin.

Patrick Neville (Deputy Inspector of Mines, N.S.), Bridgeport, C. B. :—

Thirty-three fine slabs of fossil plants from the Sydney coal field, and a lower jaw of a walrus from Cape Breton.

William Maddin (Deputy Inspector of Mines, N. S.), Westville, N. S. :—

Thirty specimens of fossil plants from the Springhill coal mines, N. S.

H. S. Poole, Stellarton, N. S. :—

Thirty specimens of fossil plants from the coal mines near Stellarton.

James Robertson, Albert Mines, Albert county, N. B. :—

Twenty-five specimens of two species of fishes (*Rhadinichthys*) from the Albert mines.

J. W. Tyrrell, C.E., Weston, Ont. :—

Eskimo mittens and boots of seal skin, the latter with waterproof feet; Eskimo boots, waterproof; Eskimo boots, harp-seal skin, with feet of the skin of the square-flipper seal; and Eskimo slippers; all from North Bluff, Hudson Strait.

- J. B. Tyrrell, Geol. Survey, Ottawa :—
 Cree-Stony Indian saddle from Wolf creek, Alberta.
- Hyacinthe Proulx, Ottawa :—
 Stone gouge found near the Rideau river, Carleton county, Ont.
- Frank Butler, Ottawa :—
 Hunter's knife and pipe-bowl from Alberta, used by Blood Indians of the Blackfeet tribe
- John F. Fenton, Huntley, Carleton county, Ont. :—
 Indian stone implement of singular and unusual shape, found by donor on his own farm, con. 3, lot 8, Huntley.
- Martin Griffin, jun., Ottawa :—
 Egg of wood peewee (*Contopus virens*).
- J. D. Moore, St. Mary's, Ont. :—
 Specimen of *Orthoceras* from the Corniferous limestone of St. Mary's.
- Prof. Henry M. Seely, Middleborough College, Middleborough, Vt. :—
 One species of fossil from the Cambrian, two from the Calciferous, and two from the Chazy of the states of Vermont and New York.
- Prof. F. Schmidt, St. Petersburg, Russia :—
 Nine species of fossils from the Cambrian and Silurian rocks of Estland and the Baltic.
- Alfred Ogden, House of Commons, Ottawa :—
 Twenty specimens of fossils from the Trenton limestone at Rochesterville, Ont
- By Purchase :
 From J. Stewart, Ottawa :—
 Thirty-three rare or unusually perfect specimens of fossils from the Trenton limestone, near Ottawa.
- Rev. G. W. Taylor, Victoria, V.I. :—
 Specimen of an undescribed decapod crustacean from the Cretaceous rocks of Vancouver island.

BOTANY, &c.

In the last summary report on the work of this division it is stated that Professor Macoun was occupied on Part VI of the Catalogue of Canadian Plants, and on the Catalogue of Canadian Birds. Part VI has been completed, more than one-third of it has been printed, and the completed Catalogue of Canadian Birds will be ready for the printer before the end of the present month.

As these works are the result of the observation and collections of more than thirty years, it is hoped they will be well received, and prove useful to botanists and ornithologists throughout the world.

On the further work of this division during the year, Professor Macoun reports :—

“In compliance with your suggestion, that I should undertake the preparation of a Catalogue of Canadian fungi, with special reference to the edible and to the poisonous species, I have been working at it at intervals during the past six years. I now know nearly 800 species of Canadian Fungi, and during the coming summer hope to be able to gather enough material to enable me to write up the whole subject next winter.

“The agaries, which include most of the edible and poisonous fungi, change so rapidly after being gathered that drawings must be made from the fresh plant, and it is desirable that some arrangement be made to get this done during next spring and summer. During the month of September last large collections were made in the vicinity of Ottawa of these species, and Mr. Lambe made water-colour drawings of them in the evenings. He did the work remarkably well, and I would respectfully suggest that a small sum be placed in the estimates to remunerate him for this work in the past and for the prospective work of next spring and summer. I may say that unless an arrangement is made with some person in Ottawa to make the drawings, I can proceed no further with this desirable and useful work.

"Having completed the collection of material for the Catalogue of Birds, I am now gathering data for a Catalogue of Canadian fresh-water Fishes, and should like you to authorize me to prosecute that work as a supplement to my other work when in the field.

"Early last May you requested me to endeavour to complete the set of photographs of Canadian trees, and about the last of that month I went to the Niagara district where I knew there were many rare and well-grown specimens. I was not disappointed, and in the course of a little over two weeks forty very fine trees were selected, of which Mr. Topley took excellent photographs. My time being limited, I had to return to Ottawa before good specimens of all the western trees could be selected, as I had been requested by you to proceed to Banff in order to make a collection of specimens of the fauna and flora of the Rocky Mountain park and vicinity for the museum proposed to be established at Banff.

"About the 1st of May, I telegraphed to Victoria, to Mr. William Spreadbough, who had been with me two years in British Columbia, to come to Banff and commence making a collection of the birds and mammals. He reached Banff on the 7th of May and at once commenced work. He was very successful and had obtained 251 skins before I joined him.

"On the 20th of June I left Ottawa and reached Banff on the 25th, commencing work the same day. From that date to the 24th of August, I was continuously employed collecting and drying plants, and in making notes on the flora and fauna of the park. These notes have been put into order since my return, so that should a report on the natural history of the park be at any time required it can be written in a very short time. During the two months I spent at Banff and in its vicinity I collected over 1,000 species of plants, and since my return have examined and arranged them all. Most of these have been mounted, labelled, and placed in a cabinet made for their reception.

"Early in May, at your request, I instructed the taxidermist to commence setting up birds for the Banff museum, and as far as I am aware he has been at that work ever since.

"The avi-fauna of the Rocky Mountain park will be found to consist of about 150 species, but it seems desirable that all the waders, swimming birds and grouse of the prairie region should be included in the collection, as nearly all travellers are sportsmen and they should be enabled to see for themselves the great variety of game birds that inhabit the Canadian prairies.

"A few small mammals and all the species of fishes known to be in the waters of the park were obtained. The skins of the larger fishes were brought to Ottawa, and numerous entire specimens of the small minnow that lives in the warm water of the sulphur springs. That it does live in the warm water is undoubted, but it also lives in cold water and there attains a larger size. We traced it from the warm springs through pools of water in the tufa mounds below them to the marshes on a level with the Bow river. We saw none in the river, but it may be there nevertheless. The chief peculiarity about this fish is its large pectoral fins—very large in proportion to its size.

"Knowing that the Catalogue of Canadian Birds would likely be printed this winter, I and Mr. Spreadbough went from Banff to Indian Head, a locality peculiarly well suited for collecting the birds of the prairie region. After three days I came on to Ottawa, while Mr. Spreadbough remained there collecting for four weeks. The result was 152 skins of birds and small mammals, and a list of all the birds found in September in that district.

"Since my return to Ottawa, I have been busy—when not engaged on either of the catalogues above mentioned, on the routine work connected with the Natural History branch. This work is greatly hampered by the very insufficient accommodation afforded for its prosecution. You are aware that for three years this has been obvious, and though the attention of the Department of Public Works has been called to it repeatedly, nothing has yet been done to remedy it.

"It was intended that Mr. Jas. M. Macoun should accompany me to Banff, but his appointment as secretary to Dr. G. M. Dawson, of the British Behring Sea Commis-

sioners, made a change in plans necessary. After my departure for Banff Mr. J. M. Macoun continued the work upon which he had been engaged since the opening of spring, viz., collecting plants in the vicinity of Ottawa, the flora of eastern Ontario being but poorly represented in our herbarium. On the 1st of July he was appointed secretary to Dr. G. M. Dawson, Behring Sea Commissioner for Canada, and since that date he has done no work for this branch excepting after office hours. While in Behring sea he collected plants whenever an opportunity was afforded and brought back with him the most valuable collection of arctic and sub-arctic plants that has yet been received into our herbarium. Many new species have already been described and others have not yet been determined.

"Since his return to Ottawa on the 20th of October, his duties in connection with the commission have occupied him during the regular office hours. In the evenings and at other times he has continued the usual routine work in the Natural History branch, and has been completing the collection of plants intended for the Banff museum; in a few weeks all work in connection with it will be finished. He has been, besides, engaged in examining and naming the various collections of flowering plants that were made during the summer, or that have been received from other collectors, and getting out the specimens to mount. Since the 20th of October, 1,711 sheets of specimens have been labelled and mounted.

"All work, except the mounting of specimens, in connection with the herbarium has, as in former years, been done by Mr. J. M. Macoun. During 1891, 5,378 sheets of specimens were mounted and placed in the herbarium, many more than during any previous year. Of these 4,490 are flowering plants and 888 are cryptogams. Of the flowering plants 1,943 are Canadian, 2,142 are European and 405 are from the United States.

"4,526 sheets of specimens were sent to public institutions and to private individuals in exchange for desiderata. Of these 1,391 are cryptogams and 3,135 are flowering plants. Of the above total 1,823 specimens were presented to the following American and European institutions:—

British Museum	212
Central Experimental Farm	172
Department of Public Instruction, Quebec	55
McGill University	100
National Museum, Washington	428
Harvard University	112
Shaw School of Botany, St. Louis	200
Columbia College	221
Michigan Agricultural College	183
Department of Agriculture, Washington	140

"Among the more valuable collections of plants received for the herbarium during the year may be mentioned those sent by J. A. Morten, Wingham, Ont., Jas. White, Edmonton, Ont., and Wm. Scott, Ottawa, and about 1,000 species presented to the herbarium by W. Bicknell, Bordighera, Italy. The latter is a remarkably fine and valuable collection, for which the special thanks of this Survey are due to Mr. Bicknell.

"Since the 31st of December, 1891, in connection with the work of this division, 429 letters of sufficient importance to copy were written and about the same number received."

MAPS.

Maps in course of Preparation and Published during 1891.

North-West Territory, 9 sheets, 20 to 26 inches long, by 16 inches broad, showing waters followed by the members of the Yukon Expedition, 1887-88, and reaching from longitude 111° to 144°, and latitude 59° to 68°, to accompany report by Mr. McConnell, published 1891. 8 miles=1 inch.
 Index map of the above do do 48 miles=1 inch.
 13a—5

North-West Territory, Athabaska and part of British Columbia, to illustrate work of Mr. McConnell, 1889-90, and reaching from longitude 110° to 120° and latitude 54° to 60°, in draughtsman's hands.....	8 miles=1 inch.	
British Columbia, Kamloops sheet (Dr. Dawson) ready for publication.....	4 miles=1 inch.	sq. m. 6,400
British Columbia, Shuswap sheet (Dr. Dawson) in progress.	do	6,400
British Columbia, Placer Mines of Cunningham Creek (Mr. Bowman).....	About 27½ chs=1 in.	34
British Columbia, Quartz veins and Placer Diggings, Grouse Creek (Mr. Bowman).....	do 25 chs=1 in.	14
British Columbia, Placer Mines of Antler Creek (Mr. Bowman)	do 26 chs=1 in.	38
British Columbia, Plan of Lightning Creek (Mr. Bowman)	400 ft.=1 in.	17
British Columbia, Plan of Williams' Creek (Mr. Bowman).....	About 10 chs=1 in.	12

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

Manitoba; Map showing the whole of Lake Winnipeg (Mr. Tyrrell) in progress	4 miles=1 inch.	48,600
Northern Manitoba (part of) in progress (Mr. Tyrrell)....	2 miles=1 inch.	5,000
do (Mr. Tyrrell) ready for publication ...	8 miles=1 inch.	20,000
Western Ontario, Lake of the Woods, sheet No. 2, ready for publication.....	2 miles=1 inch.	2,000
Western Ontario (Hunter's Island sheet) sheet No. 7 (Dr. Lawson) ready for publication.....	4 miles=1 inch.	3,456
Western Ontario, (north of Hunter's Island) sheet No. 6 (Mr. Smith) in progress.....	do	3,456
Western Ontario, sheet No. 9 (Mr. McInnes) in progress.	do	3,456
Ontario, sheet No. 130, Sudbury mining district (Dr. Bell) published with part F, Annual Report, vol. V., 1890-91.	do	3,456
Ontario, sheet No. 125, south of Sudbury sheet, in progress	do (about)	1,800
do do No. 115, ready for draughtsman	do	3,456
do General map in progress.....	do	
Quebec, N.E. ¼ sheet (Eastern Townships map) ready for publication.	do	4,500
do S.W. do in progress.	do	4,500
do N.W. do do	do	4,500
do and Lake St. John district, 2¼ sheets in progress (Mr. Low).....	do	6,912
Quebec, ¼ sheet, 18 S. E (Messrs. Bailey & McInnes), ready for engraver.....		3,456
Quebec, ¼ sheet, 18 N. E. (Messrs. Bailey & McInnes), in progress.....	do (about)	500
Quebec, Lièvre River and Templeton phosphate region, Ottawa county, 2 sheets (Mr. Ingall); sheet No. 2 engraved; sheet No. 1 ready for engraver.....	40 chns=1 inch.	220
New Brunswick, surface geology, ¼ sheets, 1 S.W., 1 S.E., and 1 N.E., 3 sheets (Mr. Chalmers), ready for publication	4 miles=1 inch.	6,650
Nova Scotia, ¼ sheet, 11 N.W. in the engraver's hands....	do	
do ¼ sheet, 11 S.W. (Messrs. Fletcher & Faribault), published 1891.....	do (about)	650
Nova Scotia, ¼ sheets, 4 N.E. and 4 S.E. (Messrs. Fletcher & Faribault), in progress.....	1 inch=1 mile.	

LIBRARY—SALES AND DISTRIBUTION OF PUBLICATIONS.

The librarian, Dr. Thorburn, reports that during the year, from the 2nd of January to the 31st of December, there have been distributed 8,593 publications of the Geological Survey Department, comprising annual reports, parts of these, special reports and maps. Of these, 5,918 were distributed in Canada; the remainder, 2,675, were sent to foreign countries as exchanges to scientific and literary institutions, and to a number of individuals engaged in scientific pursuits. In most cases, the institutions and individuals receiving the survey publications reciprocate by supplying the library with copies of their publications, or otherwise rendering important assistance in the work of the survey.

It may be stated that the general list of exchanges now amounts to 782, and, besides these, there are upwards of 1,000 others receiving reports on paleontology, mineral statistics and botany. Due care has to be exercised in the distribution of the publications. Were all the applications granted, the supply, which is limited, would soon be exhausted. It is deemed advisable to retain a sufficient number in stock with which to supply future requirements. A large number of the earlier reports are already out of print, and can no longer be supplied.

The number of books, pamphlets and maps presented to the library last year was 2,307. Besides these, 146 books were purchased, and 38 periodicals, on geological, mineralogical and natural history subjects, were subscribed for.

The number of books bound in 1891 was 256.

The letters and acknowledgments sent to the library for publications distributed during the year were 1,952, and the number of letters sent out by the librarian was 1,053.

There are now about 9,000 volumes and 3,600 pamphlets in the library.

Attention is again called to the altogether insufficient space available for library purposes. The cases are all filled, and a large portion of the books are piled up round the library floor and in other parts of the building, and consequently, in many cases, it is difficult to find works which are required for consultation by members of the staff.

Sales of survey publications for the year ending 31st December, 1891, amounted to \$3,550.03.

VISITORS.

The number of visitors to the museum during the year was 20,363, being an increase of 2,063 over 1890, and of 10,814 since 1882, the first year of the opening of the museum in Ottawa.

STAFF, APPROPRIATION, EXPENDITURE AND CORRESPONDENCE.

The strength of the staff at present employed is 56, viz., professional, 37; ordinary, 19.

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

Mr. W. F. Ferrier, appointed lithologist.

Mr. N. J. Giroux do assistant geologist.

Mr. A. E. Barlow do do

Mr. S. Barlow, chief geographer, promoted to the rank of chief clerk.

Mr. H. P. Brumell, promoted from the third to the second class.

The amount available for the fiscal year ended 30th June, 1891, was :—

	Grant.	Expenditure.
	\$ cts.	\$ cts.
Civil list appropriation	47,330 00	41,792 50
Geological Survey and Museum appropriation.....	60,100 00	19,001 16
Artesian boring appropriation	10,000 00	27,473 81
Civil list salaries		6,514 48
Wages of temporary employes.....		9,605 39
Exploration and survey		1,823 55
Boring operations, Deloraine, Man		309 40
Printing and lithography		545 30
Stationery, mapping materials and Queen's Printer.....		508 05
Purchase of specimens		1,805 72
Purchase of books and instruments.....		
Purchase of laboratory apparatus and chemicals.....		
Incidental and other expenses.		
Less—Paid in 1890.....		109,379 36
		6,534 66
		102,844 70
Add—Advances to field explorers.....		5,159 75
Unexpended balance, civil list appropriation.....		5,537 50
do general do		3,888 05
	117,430 00	117,430 00

The correspondence of the department shows a total of 10,852 letters sent, and 6,947 received.

I have the honour to be, Sir,

Your most obedient servant,

ALFRED R. C. SELWYN,

Deputy Head and Director.