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THE OTTAWA NATURALIST.

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TRANSACTIONS

OF THE

OTTAWA FIELD-NATURALISTS' CLUB.

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1890.

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EDITORIAL.

Being convinced that the publication of the OTTAWA NATURALIST, in monthly parts, is by far the best method of keeping the Club before the public, and also of keeping up the interest of our own members, the editor requested the Council to bring the subject up for discussion at the last annual meeting. It was there referred back to the Council, and at the first meeting of that body it was unanimously decided that for the future our magazine should be issued monthly. It will be observed that an important change has been made in the Council by the addition of three lady-members. It is the earnest desire of the council that the Ottawa Field-Naturalists' Club should be thoroughly successful in every way, and as we have a large number of ladies in the Club, it was considered that by having them represented on the Council, we might frequently get suggestions as to ways in which we could make the excursions or other proceedings of the Club more agreeable to this most important part of our membership. It has always been understood that our Club, while working hard at scientific development, at the same time wishes to be recognized primarily as an institution for teaching, popularising, and making attractive the by-ways of knowledge. The members of the Field-Naturalists' Club are not by any means all scientific; but we are proud to include in our ranks many young students as well as many old children, young in the knowledge of nature—the glorious and enchantingly beautiful world with which a beneficent Creator has surrounded us. The editor again appeals to the members to endeavour to increase the membership. The magazine is now open for the publication of papers on the natural history of any part of Canada, and we are most anxious to obtain members in all parts of the Dominion. The excellent papers now in hand authorize the statement that the magazine will be well worth the subscription even to outside members, who cannot reap the other advantages offered by the Club to its local members. The editor begs to remind the readers of the OTTAWA NATURALIST that although the subscriptions have heretofore been collected at the end of the Club year, they are payable in advance. If members would take this notice as an application and send in their subscriptions, it would save both much trouble and a considerable amount of postage.

J. F.

ANNUAL REPORT OF THE COUNCIL.

To the Members of the Ottawa Field-Naturalists' Club:

Your Council has to report that the club has been carried on during the year now closing with increased interest and gratifying success.

The number of new members elected during the year is 28; the membership now standing at about 230.

There were three general excursions held during the summer: the first was to King's Mountain, Chelsea, by vans; the second was to Montebello by steamboat, and the third to Ox Bow or Big Gully, near Casselman, by rail. A fourth excursion was arranged to Kirk's Ferry, but the weather being unfavourable it was postponed from time to time, and was finally abandoned altogether.

The Saturday afternoon sub-excursions were not so successfully carried on as in former years. In the beginning of the season separate parties were formed in some of the sections, and went in different directions, which interfered considerably with the attendance and also the enthusiasm of the leaders, and the result was that comparatively few sub-excursions took place. It is to be hoped that an effort will be made this spring to establish the interest which previously existed in connection with the sub-excursions, and have them carried on as before.

The winter course of meetings comprised seven soirées and nine afternoon elementary lectures. At the soirées the following papers were read:—Dec. 13th, inaugural address by the president, Dr. R. W. Ells, on the "Geological Progress in Canada." Jan. 10th, "The Mistassini Region," by Mr. A. P. Low; "The Serpentines of Canada," by Mr. N. J. Giroux. Jan. 24th, "Glaciation in America," by Dr. A. C. Lawson. Feb. 7, "Some Geological Facts Observed on a Trip to the Straits of Belleisle," by Dr. Selwyn; "A Bird in the Bush," by Mr. W. A. D. Lees. Feb 21st, "Some Notes on the English Sparrow," by Mr. J. Ballantyne; "The Wolf," by Mr. W. P. Lett. March 7th, "On Some of the Larger Unexplored Portions of Canada," by Dr. G. M. Dawson; "A Naturalist in the Gold Range, B.C," by Mr. J. M. Macoun. March 14th, annual reports of the leaders of the various branches. These soirées took place every alternate Friday evening; the attendance was large and much interest was manifested.

The afternoon lectures were commenced on the 13th of January and continued every Monday afternoon till the 10th of March, as follows : one on geology (volcanoes and their associated phenomena) by Dr. R. W. Ells ; one on palæontology by Mr. W. R. Rillings ; two on botany, one by Mr. Wm. Scott, and one by Mr. J. M. Macoun ; one on zoölogy, by Mr. J. Ballantyne, two on ornithology, by Mr. W. A. D. Lees ; one on entomology, by Mr. T. J. MacLaughlin ; and one on conchology, by Revd. G. W. Taylor. The attendance at the lectures, especially of ladies, was exceptionally good. The interest in the work of the club by our lady members is becoming more marked every year, and the council desires to express the hope that the suggestions made and favorably discussed at previous meetings, with regard to the election of lady representatives on the council, will be carried into effect at the present meeting.

The treasurer's report will be submitted to you, from which it will be seen that the financial condition of the society still remains satisfactory.

The librarian's report will also be laid before you, enumerating the many valuable additions received during the year ; from it you will learn that an effort is being made by that energetic officer to catalogue the publications on hand, and to have some of the more valuable volumes bound.

The proceedings of the club have been published in the OTTAWA NATURALIST during the year, together with accounts of excursions, meetings and all other matters of interest in connection with the work of the year, so that it is considered unnecessary to prolong this report. In conclusion, the council begs again to draw the attention of this meeting to the question of publication and in view of the general expression of regret, among the members, at the change from the monthly to the quarterly plan of publication, would recommend that authority be granted to return to the plan of publishing the NATURALIST monthly.

The editor has expressed his opinion, that with the material now in his hands, there will be no difficulty in keeping up the monthly issue.

All of which is respectfully submitted.

Signed on behalf of the council.

T. J. MACLAUGHLIN, *Secretary.*

TREASURER'S REPORT.

To the Council of the Ottawa Field-Naturalists' Club.

GENTLEMEN,

I have the honour to report that the finances of the club are in a better condition than they have ever previously been, Owing to some unforeseen circumstances, including a short illness on my own part, just before the annual meeting, by which I was prevented from collecting several subscriptions and advertisements which were due the balance shown on the balance sheet, is much smaller that it would otherwise have been. The arrears have again been considerably reduced during the past year, and of those still upaid, nearly all have promised to pay up before the next annual meeting. With the assistance of the Secretary and Librarian, I have been able to keep the expenditure down to the very lowest figure, as will be seen by the balance sheet submitted herewith, which I trust will be found satisfactory.

TREASURER'S BALANCE SHEET, 1889-90.

RECEIPTS.			EXPENDITURE.		
1889.			1890.		
Mar. 20. Balance		$30 69	Mar. 18. The OTTAWA NATURALIST, Vol. III, Nos. 1-4	182.28	
1890.			Postage	6.76	
Mar. 18. Subscriptions					$189 04
1889-90	$157.00		Extras. — Flora Ottawaensis	4.75	
Arrears	24.00		Extras—Authors'	10.46	
		181 00			15 21
Advertisements		23 00	General Printing		3 90
Authors' extras		12 75	Stationery		2 50
Transactions sold		11 52	General Postage		5 22
Excursion receipts		65 85	Rent of Lecture Room.		12 00
			Binding		8 40
			Excursion Expenses, Conveyances, etc.	47.95	
			Circulars	5.23	
			Postage	4.84	
					58 02
			Balance		30 52
		$324 81			$324 81

JAMES FLETCHER,
Treasurer.

OTTAWA, March 18, 1890.

THE MISTASSINI REGION.

By A. P. Low, *B. App. Sc.*

(Read January 10th, 1890.)

For several years past an exciting controversy has been carried on in the public press as to the size, shape, and position of Lake Mistassini; and a number of writers on the strength of hearsay evidence, aided by brilliant imaginations, have indulged in many extravagant statements in regard to this "Great Inland Sea of the North-East," some affirming that it equalled, if indeed it did not surpass, Lake Superior in size, and that in comparison with it our other inland lakes were mere ponds.

This evening I propose to give a brief statement of the known facts about Mistassini from observations and measurements made by different members of the Geological Survey Staff, and at the same time to outline the route followed, to and from the lake, by the last expedition sent out by the Government.

Before entering upon this, a short historical summary of previous explorations may prove interesting to some present.

Although rumours of a great body of fresh water, larger than any south of the height of land, seem to have reached the French trading in the Saguenay country, soon after Champlain's arrival in Canada, it was not until 1672, that Père Chas. Albanel, a Jesuit missionary, visited the lake. He had been sent overland to Hudson Bay by authority of the French Governor, to visit the posts of the Hudson Bay Co., then but a short time established in the southern part of the bay.

The route followed on this occasion was up the Saguenay to Lake St. John, thence by the Ashouapmouchouan River to its head, across the height of land, and through lakes Chibougamoo and Obatagoman, large bodies of water feeding the Notaway River, which flows into James Bay. From here by short portages into Lake Wawaniche, and so into the S.W. Bay of Mistassini.

Père Albanel, from his account recorded in the "Relations des Jesuites," appears to have passed up this bay to the end of the point separating it from the S.W. Bay, and from there crossed the mouth of

the latter, and proceeded along the west shore to the outlet of the Rupert River, down which he voyaged to the James Bay.

The following is a translation of the account given by Père Albanel in the " Relations of the Jesuits " :—

" June 18. We entered Great Lake Mistassini, which is so large that it takes twenty days of fine weather to make the tour. This lake takes its name from the rocks of prodigious size with which it is filled. It has a number of very beautiful islands, ducks and fish of all kinds, moose, bears, cariboo, porcupine and beavers are here found in great abundance. We had already made six leagues to the traverse of the islands which cut the lake in two, when I perceived something like an eminence of land at such a distance that the eye could just reach it. I demanded of our people if it were near the point where we must go. ' Keep quiet,' said our guide, ' and do not look there, if you do not wish to perish.' The Indians of these parts believe that whoever wishes to cross the lake must carefully guard from looking at the route, especially at the place to which they must cross, a single glance, they say, will cause the rising of the waters and great tempests, which will surely upset them."

This is the whole of the description given by Père Albanel in connection with Lake Mistassini, but he must have made a rough map of the route followed, as we find on a map of Canada compiled by Père Laure in 1720, a plan of Mistassini with the route followed by Albanel on it. The statement that it took twenty days of fine weather to make the circuit of the lake, has formed the base on which all the extravagant estimates of the size of the lake have been built.

The arguments used being in about this style : If it takes twenty days to go round the lake, ten days would be required to go from end to end, and as an Indian can paddle from three to four miles per hour, and the paddling time of a summer's day would average from twelve to fifteen hours, therefore the lake must be from three hundred and sixty to six hundred miles long.

Unfortunately, like other estimates based on what might or could be, this falls to the ground, because the Indian, although he *can* paddle from three to four miles an hour, finds it too hard work when he is in no particular hurry, and also, that, although he may travel from twelve

to fifteen hours per day, he does not. From experience of Indian travel, I find that he loses considerable time taking down, and putting up his bark house morning and evening, and, while travelling, stops to look at every bird or animal that may come within range of his far-seeing eye ; and not only this, but he stops at about every point which may happen to jut out in his way, where, it the kettle is not boiled, at least a slight lunch is made off a smoked fish or some similar luxury, and everybody gets out of the canoe, except the old squaw in the stern, who remains guard over the canoe and provisions, and keeps the accompanying dogs from a too free use of the latter.

To sum up, an Indian on his annual summer excursion, such as a trip around Mistassini would be, does not average more than ten miles a day, so that the estimate given by Père Albanel proves correct when taken in the proper way.

The French botanist, Michaux, visited the lake in 1792. He followed the route taken by Albanel, and quotes him in his description. Michaux found several new species of plants along the route, one of which he named after the lake, *Primula Mistassinica.*

In 1820, Mr. Jas. Clouston made an exploration of the country east of James Bay for the Hudson Bay Company. On his map, the south end of the lake, below the Rupert River, is well laid down; but he does not appear to have gone round the north end.

For nearly one hundred years the Hudson Bay Company have had a trading post on the lake, and early in the present century their great rival, the North-West Company, had a similar establishment at the south-west end.

In 1870, Mr. James Richardson was sent by the Geological Survey to explore the country north from Lake St. John to Mistassini. He visited the southern bay, and reached the Hudson Bay Post, but was obliged to return from there on account of his provisions running short.

The year following, Mr. Walter MacOuatt was sent to continue the work, and made a survey of the two southern bays and the west shore to beyond the outlet of the Rupert River, when he was obliged to stop for the same reason as Mr. Richardson.

In 1882, some members of the Quebec Geographical Society having read Père Albanel's account of the lake, which, added to the extrava-

gant stories of Indian and half-breed hunters about Lake St. John, convinced them that they had a perfect inland sea, and the Government was petitioned to finish the surveys previously begun. Their request being granted, the party to which I was attached was sent out in 1884, with Mr. John Bignell in charge.

Mr. Bignell was recalled in the spring of 1885. On his return to Quebec, many startling statements as to the great extent and immense size of the lake appeared in the press of that city and were copied by the newspapers all over the land. On my return, in the fall of 1885, I reported on the measured size of the lake, but, as it fell far short of the previous stories, and as the press of Quebec continued to support Mr. Bignell's statement—based on Indian exaggerations,—the general public were in a state of uncertainty which to believe. During the past summer, however, Prof. Louden and Mr. MacDonald, of Toronto, resolved to make a trip to the lake to solve the problem. A full account of their trip was published in the newspapers, which, I am happy to say, corroborated my report ; and thus the matter is settled.

The great area of country stretching from the Gulf of St. Lawrence north-westward to Hudson Bay forms a low-lying plateau of Archean rocks. The height of this plateau averages about 1,500 ft. above sea level, rising slowly from about 1,000 ft. near the edge to about 2,000 ft. in the interior. The surface of this plateau is by no means flat, being covered with low rounded hills, which are roughly arranged in a series of ridges more or less parallel to themselves and the general strike of the rocks. These hills are the stubs of extensive and elevated mountain chains which, from exposure to subaëreal denudation for countless ages, and from having been subjected to the glacial action of later geological times, have been ground down to their present unimposing state. In the interior the difference of level between these ridges and the valleys separating them is small, the hills seldom rising 100 ft. above the general level. As the coast is approached the difference is more marked, the long action of ancient rivers having deeply cut out the principal valleys below the surrounding country, thus causing a more marked contrast in level and at the same time much finer scenery.

Near the height of land, the valleys between the low hill ridges are often quite wide, and are everywhere covered by innumerable lakes, many of which are of great area, but more often of small size.

These lakes are always connected by small streams, with rapids or falls between them. The streams flowing from these different lake chains join to form the many large rivers which flow out of this area. Along the lower courses of these large rivers, lakes are not common, the greater volume of water having cut through and removed the boulder drift and solid rock barriers, which cause many of the lakes in the interior. From this description it will be seen that our northern country is everywhere covered with a net work of waterways, navigable without much difficulty in any direction with light canoes capable of being transported across the intervening portages.

It was by one of these waterways, the Bersimis river route, that we reached Mistassini.

This river empties into the Gulf of St. Lawrence some 160 miles below Quebec. At the mouth is situated a large village of Montagnais Indians. These Indians are under the care of Roman Catholic missionaries, and are well advanced in civilization, many of them owning log houses and resorting to the woods only in the fall, where they hunt furs all winter, returning to the village in the spring, and there remain mostly in an idle state during the summer, living on the proceeds of their winter's hunt.

The journey was undertaken in small bark canoes, two men paddling each. The first 45 miles was a monotonous paddle along shore against a strong even current; between high vertical clay and sand banks, in a river valley from $\frac{1}{4}$ to 1 mile wide, with walls of gneiss rising from 300 to 600 ft. above the river. The hills and river bottom are covered with a dense forest, the trees being white and black spruce, tamarac, balsam fir, balsam and aspen poplar, white and yellow birch. There is no pine. These trees afford logs 24 inches in diameter at the butt, and are cut into deals by a steam mill at the river mouth.

At the end of this stretch, which took three days to paddle, the first of a long series of portages was reached. The first portage passes a double fall of 100 ft., with a large whirlpool between, on the edges of

which thousands of logs are piled up. Above this the river for 30 miles is a succession of falls with sluggish water between.

These portages culminate in one 10 miles long, the first 4 miles being up a mountain 1,000 ft. high, and unavoidable, as the river in this distance breaks through a high range of hills, and falls 500 ft. through a deep canyon with perpendicular walls.

In 1870 a great fire passed through this country, destroying hundreds of thousands of square miles of valuable timber, the area burnt reaching from the St. Maurice river on the west to beyond the Bersimis on the east, and from Lake St. John to the Height of Land. This vast region has a very desolate appearance, the blackened tree trunks standing or partly fallen on barren sandy soil or bare rocky hills, which have been whitened by the kaolinising action of the fire on their felspathic ingredients; a second growth, of small spruce and banksian pine is beginning to replace the old forests, and a profusion of blueberries grow everywhere, the only and great consolation for the desolate scenery. When the river was again reached, but one portage was encountered to Lake Pipmaukin, 40 miles distant.

Here our meagre diet of pork and flour was augmented by a supply of fish, large pike being taken on the troll below, while above the portage quantities of fine brook trout, averaging 3 lbs in weight, rose readily to the fly. These fish had apparently come out of the lake to deposit their spawn on the shallow gravel bars, in the swift running water of the river.

The date was the last week in August, and as I have since remarked these fish on the spawning grounds everywhere about this time, I think it would be well to have the present close season advanced a month, as now, the fish are taken upon the spawning beds with great ease in the open season.

Lake Pipmaukin is full of deep bays, and has an area of over 1,000 square miles. We were delayed here until Sept. 19th, partly owing to equinoctial gales which prevented us from crossing the lake in our small canoes. During the month of September the temperature fell every night to near or below freezing point, and sheet iron stoves were put up in the tents, which greatly added to our comfort.

From Lake Pipmaukin a portage route was followed up a small river emptying into the lake, and then through a number of small lakes westward into the Manouan River, a branch of the Peribonka, which flows into Lake St. John. This river was ascended to a large lake of the same name at its head. But few pleasant days had been experienced since leaving Lake Pipmaukin, and here on Oct. 5th we had our first snowstorm about 5 inches falling, part of which never left the ground. From here the men were sent by a similar portage route to the Peribonka River with half loads, as the small streams would not permit full loads being carried. On their return, fearing to be frozen up before ascending the Peribonka, it was resolved to push on as far as possible before the ice rendered canoe travel impossible, so the Peribonka was reached and ascended, a distance of 30 miles to a small western branch on the route to Mistassini. This branch was followed six miles to a small lake, which was found to be frozen over, and so our canoe voyage ended Oct. 23rd. No one was sorry, for the travelling, owing to the cold stormy weather, was extremely disagreeable; the paddles were often caked with ice, and only by vigorous paddling could a moderate warmth be kept in the body, while the feet were always cold, and several times we were obliged to stop during the day and build fires to restore the circulation in our benumbed hands and feet.

From Oct. 23 to Nov. 29th we remained at this small lake, the men being engaged making snowshoes and long narrow toboggans, on which our provisions and outfit were now to be transported. Here traps were set and hunting indulged in. The traps caught a couple of otters, some mink, and a few martens. Good sport was had shooting muskrats on the ice before the lake froze solid, and a stew of these animals proved very acceptable after our long diet of salt pork. Before winter set in little game had been seen, a few spruce partridges, sheldrakes, fish eating ducks, whistlers and sea gulls only being shot, but everything in the shape of fresh meat went into the pot and was eaten with relish. On Oct. 25th the first ptarmigan were seen, and from that time continued to be killed in moderate numbers.

These birds in the winter pass southward from their breeding grounds in the barren lands some distance north of Mistassini, and feed on the buds of willows growing in the marshes and around the lakes.

During seasons when the snow is deep and their food supply consequently scarce, they proceed as far south as Lake St. John, and have even been killed immediately north of Quebec.

On Nov. 27th we commenced our winter's journey to Lake Mistassini, and as each day's journey was the same, a description of one will do for all. Breakfast was taken in the tents at daylight, and then everything packed up and laid outside; the stoves were taken down and a fire lighted, at which the frozen bottoms of the tents were melted in order to fold them; these were laid on the sleighs, the baggage and provisions laid on, wrapped in the tents or coverings, and securely lashed with long lines; at this work considerable time was lost, so that the line of march was seldom taken up before 8.30 a.m. The guide, with a light load on his sleigh, led the way and broke the path, the rest following in Indian file, each dragging a load of 200 lbs. weight. Thus the party journeyed on through the desolate country over low rounded hills and across long narrow lakes lying north and south. As the height of land was approached, the timber was found to consist almost wholly of black spruce and tamarac of small size, which scantily covered the rocky hills and swampy lake borders. At noon a stop was made near a lake or small stream, and dinner prepared at a fire built on the snow, after which the march was continued until about 4 p.m., when we pitched our tents for the night.

A place being selected for the tents, the snow was evenly packed down by tramping on it with snowshoes, then the tent and stove set up, a good supply of brush laid on the bottom, and covered with waterproof sheet and blankets, a fire lighted, and soon the tent was perfectly warm and comfortable, even with the thermometer outside 40° below zero.

The men were employed until dark cutting the night's supply of fire-wood, after which supper was eaten, a pipe smoked, and then all turned into the blankets.

The weather during December alternated between extremely cold and clear, and wild stormy days; on the stormy days the camp was not changed and the men employed the time in hunting beavers in the small lakes about. When signs were discovered, the whole party proceeded to the spot; the ice was cut round the margin of the pond and stakes placed across the outlet and inlets to prevent the escape of the

beavers, any holes in the bank similarly stopped; attention was then turned to the house, a trough was first cut in the ice around it, when the outlets were found, a small stick was hung in front of each, and a man put on guard. The rest then broke into the house with axes and ice chisels and so routed out the inhabitants, when one started out he disturbed the stick and the man on watch plunged his arm into the water and in an instant had it on the ice where it was immediately dispatched with a club. If luck was good, two or three beavers would reward a day's work of this kind, but several times blanks were drawn.

In this manner the journey was continued and the height of land reached December 9th.

Here an escarpment running N. E. and S. W. was descended 300ft. to a comparatively level country stretching away to the northward. Just beyond the height of land is a large lake called Temiscamie; this was crossed and the river flowing out followed 16 miles, when a portage of 2 miles was crossed into the head of Lake Mistassinis or Little Mistassini.

This lake lies parallel to the big lake on its East side, and its level is some 40 or 50ft. above the latter. On its east shore, perpendicular cliffs of limestone rise in places 50 or 60ft. above the water; this limestone is of a greyish blue colour and is often quite cherty, a similar rock is seen on the shores of the larger lake, both in fact resting in great basins scooped out of these rocks, which seem to be an outlier of Cambrian rock, similar to those of the east coast of Hudson Bay, which here rest in an old depression in the Archean.

Little Mistassini was followed to its southern end, where a portage of six miles was made to the great lake and its shore followed some 35 miles to the Hudson Bay Post which was reached December 23rd. The last ten days journey was very hard as provisions ran out, first the pork and then the flour, and starvation was kept off partly by a generous contribution of fish from an indian encampment which we happened upon near the end of Mistassinis and by a small supply of provisions from the post, also by finding on lines set through the ice a few large turbots (*Lota maculosa*) called Maria by the Hudson Bay people and common to all the great lakes of the north. The post was reached in a blizzard, from the effects of which everybody suffered for several days, black patches of skin showing where the frost had done its work.

On Christmas day we dined at the Hudson Bay Post and were regaled on roast beaver and lynx, the former has the flavor of strong mutton while the latter closely resembles young pig, the flesh being white and delicate. These were followed by a real plum pudding. The ordinary fare at the post consisted of salt fish and watery potatoes, three times a day, relieved with an occasional meal of partridges or rabbits, and with fresh fish once a week.

January was spent around the post, considerable cold weather being experienced, the mean temperature from 3 daily readings with max. and min. was 18.5° below zero, the highest being 16° above and lowest being 56° below zero, which point was reached twice during the month.

On February 2nd, I left with two men for Lake St. John, the men drawing our small outfit and provisions of flour, lard, and tea on their toboggans. The first night out we slept in the teepee of an indian who was to guide us over the height of land. This is made of a number of poles meeting in the centre and covered with birch bark ; it has a large opening at the top, for the escape of the smoke from the fire built on a few stones in the centre of the floor. The bottom and sides are lined with green boughs. It is a most uncomfortable dwelling, as the smoke which fills the upper part, renders standing up or even sitting upright impossible, when lying down the feet are roasted by the fire while the head and shoulders are freezing from the cold draughts which penetrate through the cracks and openings in the birch bark covering.

On the trip to Lake St. John the journey was very similar to that already described ; we passed from the southern end of the lake immediately over the height of land and then followed the Chef river of the Ashouapmouchouan and thus reached our destination.

Being unable, on account of heavy falls of snow, to drag our tent and stove, they were abandoned and we were obliged to sleep during the greater part of the trip in barricades. These are made by digging a hole in the snow 12ft. long by 6ft. wide down to the ground and lining one end with boughs with a fire in the other end. No great discomforture was experienced in this mode of sleeping, as we crawled into our blanket bag, made of woven strips of rabbit skin ; this, although the finger can easily be pushed through it anywhere, is a remarkable non-

conductor of heat, and thus retained all the body heat even with the thermometer far below zero.

The return journey from Lake St. John to Mistassini was commenced April 9th. Mr. J. M. Macoun and 6 men accompanied me. As the season was now getting late, the toboggans used in the winter were exchanged for low sleds shod with mill saws, the teeth of which were removed. This change was made on account of the soft snows in the spring sticking to the wooden bottoms of the toboggans and rendering them exceedingly heavy to draw; the higher sleigh also protecting the goods on them from the water lying upon the ice of the rivers and lakes.

The route followed by the party this time, was up the Ashouapmouchouan river to its head on the height of land, 50 miles westward of Mistassini, thence over the ice of three large lakes, Obatagoman, Chibougamou and Wahwaniche into the southern part of Mistassini.

The travelling at this time of the year was simply delightful. A start was made at break of day, breakfast being over and everything packed in readiness before that time. The cold during the night freezing the snow, melted by the sun's rays on the previous day, formed a hard crust everywhere, over which we travelled without snowshoes until dinner time between 8 and 9 o'clock. After this the sun softened the crust and snowshoes were worn, the walking becoming heavier and heavier until about 12 o'clock when the crust was wholly melted and all travelling impossible. Then camp was made and supper eaten, after which everybody went to bed to rise between 1 and 2 a.m. In this way the Hudson Bay post was reached April 29th. The only adventure was an involuntary three days' fast, owing to a period of soft weather setting in before reaching the post, rendering travel impossible and causing our estimated quantity of provisions to fall short by that amount. At this time four of the men walked sixty miles in forty hours without a bite to eat, which shows the endurance of these indian and half-breed hunters.

From April 29th to May 28th, a period of enforced inaction occurred owing to the breaking up of winter.

On May 24th the thermometer registered 80° in the shade, the highest temperature recorded during the summer, and we experienced the novel sensation of floating about on ice floes in the morning, bath-

ing in open water at noon, and sweltering in the shade in the afternoon, attended by swarms of hardy and energetic mosquitoes.

It was surprising to note the rapidity with which the ice disappeared from the S.E. Bay. On the morning of the 24th it was firm enough to support a man with a sleigh-load of provisions, by noon only loose pieces were to be seen floating about, while in the evening every sign of ice had disappeared. This rapid melting of the ice is probably caused by a general rise of temperature of the water of the lake from the number of small streams flowing in, until a point is reached sufficiently above freezing to allow an expenditure of heat sufficient to melt the ice in all parts simultaneously, which has been previously rotted and honeycombed by the sun's rays.

The ice in the main body of the lake, owing to its greater volume of water, did not break up for a week later. From May 28th until June 27th our men were away for provisions stored during the winter at Lake Ashoupmouchouan. During their absence Mr. Macoun and I were employed with latitude observations, attending to weather readings, noting the arrivals of the birds, and collecting and noting the growth and development of the various plants, besides this we also made and planted a small garden, putting in the seed brought in for experiment. The following birds were noted throughout the winter about Mistassini : The chikadee, winter wren, pine grosbeak, white winged crossbill, common red-poll, snow bunting, black snow-bird, whiskey jack or Canadian jay, downy woodpecker, day owl, spruce partridge, partridge, and willow ptarmigan. On May 2nd a flock of Canadian geese passed north. On the third a number of golden-eyed ducks alighted in the open water of the narrows. A single pair of the greater yellow legs was seen, and a robin was heard on the 7th.

Then came quite a rush during the next 10 days.

On the 10th a white bellied swallow, the 11th ruby crowned kinglet, sheldrake and ring-billed gull ; on the 14th the cow-bird, rusty grackle, belted kingfisher and loon ; on the 15th the sea coot, and tree sparrow ; on the 20th, the water-thrush, Swain's sparrow, white-throated sparrow and dusky duck,. Then before June 1st hermit thrush, yellow bird, magnolia warbler, black-capped yellow warbler, song sparrow,

raven, night hawk, ring-necked plover, surf duck, sheldrake, Forster's tern and the black throated diver.

While the following arrived between that date and June 15, Tennessee warbler, black poll warbler, yellow bellied flycatcher, golden-winged woodpecker and fish hawk. The cedar bird and night heron being noted later on in the season.

It was not until May 24th that a flower was found in bloom, when a few blossoms of *Epigœa repens* were discovered; but a week later the whole of the woods about were carpeted with this lovely bloom.

During the first week in June the only herbaceous plants in flower were sweet colt's-foot (*Nardosmia palmata*), the strawberry, the white violet and the beautiful little *Primula Mistassinica.* In damp or wet grounds, however, leather leaf, sweet gale, the green alder, red and fetid currants, and the laurel (*Kalmia glauca*) were in great abundance.

During June about 100 species of flowering plants were noted, but with the exception of *Calypso borealis,* which is quite common about the lake, none were of particular interest or rarity.

Shortly after the breaking up of the ice in the lakes, the Indians belonging to the post arrived with their families, bringing in the furs collected during the winter. Mr. Millar and his assistants were kept busy gathering these and crediting the value of them against the accounts of the owners. The fur trade is run altogether on the credit system. The Indian receiving debt in the fall in the shape of shot, powder, tea, flour, sugar and clothing, the amount being regulated by the amount of fur brought in the previous year, and the prospects of a successful hunt during the coming season. No cash is known, and trade is carried on by a system of barter, the standard being a "mid beaver skin," by which is meant the skin of an average sized beaver. From this as a basis the values of other skins are determined; for example, a large beaver is worth $1\frac{1}{2}$, a small $\frac{1}{2}$, a marten 2 a mink 1, an otter 3 to 4, a bear 4 to 8, a silver fox 9 to 15, and so on. The values of the articles of trade are regulated in a similar manner. One beaver will purchase any of the following:—6 lbs. flour, 2 lbs. sugar, 1 lb. tobacco, $1\frac{1}{2}$ lbs. tea, 2 lbs. pork, 1 lb. gunpowder, 2 lbs. shot, 1 cotton handkerchief and other things in proportion. Now, as the

average debt allowed each hunter is little over one hundred beavers, one can see that after purchasing the necessaries for the ensuing year but little remains for luxuries in the shape of red handkerchiefs, etc.

On the arrival of a new lot of Indians the women already at the post went to the water's edge to greet the new comers, which they did by embracing and kissing, and then indulging in a good cry all round ; their emotions being thus appeased they soon became merry and talkative. Twenty-six families belong to this post, about 150 persons in all. They speak a dialect of the Algonquin or Cree language, being a tribe of that great family which inhabits the country from the Rocky Mountains to the Atlantic. As a rule they are not of great stature, though some of the men are fine stalwart fellows, six feet tall.

Form long contact with the Hudson Bay Co. and missionaries they are all pretty well civllized, everybody being able to read and write in a kind of syllabic shorthand, invented to fit the language by the English missionaries to the west. An Indian's writing materials consist of a piece of birch bark and a burnt stick, while a forked stick placed in a prominent position on a portage or at the forks of a river serves as a post-office.

They are all perfectly honest, and would not touch provisions left in the woods even to save themselves from starvation.

Although all are nominally Christians, they still cling to many of their old beliefs and superstitions ; anyone who claims to be a conjuror or medicine man is held in great respect and dread by the rest of the community. The conjurors claim to be able to commune in spirit with other conjurors, and also by the aid of spirits to foretell the future, and learn what is happening at the moment to persons at a distance. By the aid of charms and spells they are believed to bring sickness, and even death to anyone who may offend them. They also pretend that the spirits would supply them in times of hardship and famine with deer's meat, fish, and a little flour, but no tobacco or whiskey.

Allegorical animals are dreaded and propitiated by these indians, the greatest among these is the big muskrat who travels under the snow, there is also a big beaver, and a big dog, who does not walk on the ground but upon the trees. In Mistassini is a large trout, so long that he cannot turn round, who causes all the storms on that lake by

moving its tail. They have also enormous giants living in the solid rock. They also believe that certain of the animals understand their language, especially the bear who is a close relation of theirs, and an indian never shoots one without first offering an apology for the act. Great respect is paid to to the bones and flesh of the bear and beaver, their skulls are always scraped clean, and set up on poles facing the sun.

Cannibalism is abhorred; the belief being that anyone indulging in human food immediately becomes crazy and is forced to wander about in a starving state until death affords relief; on suspicion of such an act the suspected party is killed. Maniacs are tied to stakes and allowed to starve to death; this is a cruel practice but is thought necessary for the safety of the community at large, as no proper restraint can be put upon such da gerous persons.

All the able-bodied men are employed during the summer in transporting the furs down the Rupert river to Hudson Bay, and in bringing in the stock of provisions and goods for the next season's trade. Six large canoes, each manned by six men are required to bring in the outfit, and every capable male is required for this work, only the very young and old remaining behind.

On the arrival of our men with the provisions, we left the post June 30th, with a large and small canoe, having secured the services of two old indians who were too feeble to undertake the voyage to the coast with the brigade. Passing up the S. E. bay we soon reached the big narrows and continued up the lake through a string of large islands in its centre, until we reached a point opposite the outlet of the Rupert river, when we crossed to the W. shore taking one sounding of 374 ft. Owing to the large stone employed in this operation and a threatening thunderstorm, we were unfortunately unable to take more. Passing the Rupert, the work of survey was taken up at the place where Mr. MacOuatt finished, and from there carried completely round the north end and down the east side to the big narrows, where connection was again made with MacOuatt's work, thus completing the work commenced by Messrs. Richardson and MacOuatt.

From the results of this work, it is found that Lake Mistassini is a loug and narrow body of water, stretching from north-east to

south-west, with a perceptible curve between the ends, the concavity of the curve being towards the south-east. It lies between N. Lat. 50° and 50° 24′, W. Long. 72° 45′ to 74° 20′, or 300 miles directly north of Lachute. The length, in a straight line between the extremities of the north-east and south-west bays, is nearly one hundred miles, the average breadth of the main body being about twelve miles. At either end of the lake, a long point stretches out, dividing the ends into two deep bays. Between the points, and seemingly a continuation of them is a long chain of rocky islands, which, by overlapping each other, almost divide the lake into two parts, so that a view of the opposite side is rarely obtained in going around the shore. A slight decrease in the present level of the lake would result in the production of two separate lakes, as the water between the islands is quite shallow, and forms a contrast in this respect, with the great depth between the islands and shore on either side. Here the lake is very deep, the isolated sounding, made in crossing, having given 374 feet, at a point which, I was informed, was not the deepest part of the lake.

The bay at the south-east end of the lake is called Abatagush. This bay, sixteen miles from its mouth, is again divided by a long point into two other bays. About four miles from the end of this point, and on it, the Hudson Bay post is situated.

The eastern part, called Cabistachgan Bay, runs slightly east of south, in an irregular course, for about twelve miles, the Little Perch River coming in at its head. The western part is much larger and more irregular. It stretches south for sixteen miles, a small river from Lake Wakiniche falling into it at that distance. A side branch of the bay runs to the westward for upwards of ten miles. The general width of Abatagush Bay is one and one-half miles. The south-west, or Poonichaun Bay, for a distance of twenty miles from its entrance, has an average breadth of about five miles. Its shores are broken by smaller bays, and its surface is covered with islands, varying from six miles long by one and one-half wide, to mere boulders. After the first twenty miles, the bay narrows to an average breadth of less than one-half mile, and continues in a south-westerly course for a long distance, as the end was not reached after ascending it fourteen miles The

Indians say that a large river empties into the lake at the head of this bay. The north-east and north-west bays are not so deep as the southern ones; the distance from the end of the point to the mouth of the Papasqutsatee River, a large stream coming in at the head of the north-west bay, being fifteen miles, with an average breadth of rather more than four miles. From the mouth of the Toquaoeo River, which enters the north-east bay at its head, to the end of the point, the distance is nineteen miles, the average breadth being under four miles. By this river a canoe route goes to a Hudson Bay post, called Nitchicoon, situated on a branch of the East Main River, to the north-east. This stream falls rapidly during the dry season, being an exception to the other rivers running into the lake, which, taking their rise in large lakes, are not generally affected by local rainfall.

Besides those above referred to, the large river flowing out of Lake Temiscamie, and passing through Lake Mistassini, enters the lake on the east side about twenty miles from the head of the north-east bay. Almost directly opposite this river, on the west side, a smaller stream, called the Wabassinon River, enters.

The shore of the lake is indented by a number of smaller bays, and many islands also occur along its margin. The shores are mostly rocky, with no marshes or beach, a fact accounting for the absence of any great uumber of wading birds or graminaceous ducks. The western bank rises from thirty to sixty feet above the surface of the water, and is in many places perpendicular. The eastern bank is not so elevated, and rises more gradually.

To the south of Mistassini, and running north of east, is a ridge of hills forming an escarpment about 300 feet high, and constituting the Height of Land between the waters flowing to the St. Lawrence and those draining to Hudson Bay, and the present division lines between the Province of Quebec and the North-east Territory. To the north is another range, passing within ten miles of the lake and trending away to the westward. The highest of these hills does not rise more than 500 feet above the level of the lake.

The country in the vicinity of the lake is generally slightly rolling, with rounded hills, rising from thirty to sixty feet above the water, nd interspersed with numerous small lakes and marshes.

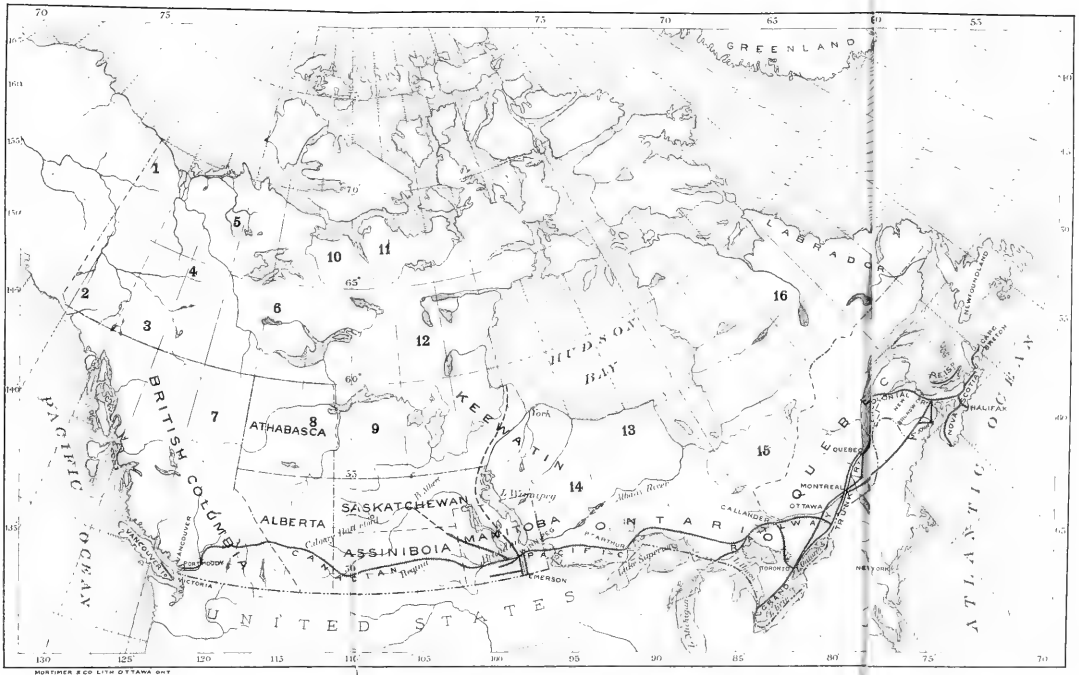
On the main body of the lake, and to the northward, the summer season is shorter and colder than in the vicinity of the post. During the month of July, the low lands bordering the lake were frozen solid within one foot of the surface, in all places where the trees were at all dense. This marked difference is undoubtedly due to the proximity to such a large body of cold water, which lowers the general temperature of the air during the warmer portions of the year. The soil overlying the Laurentian gneisses and schists is light and sandy, only a thin layer generally resting on these rocks.

At the Hudson Bay post, the most favorable point on the lake for agriculture, a poor crop of potatoes is raised yearly. They are small, as the tops are always frozen before reaching maturity. In the spring, as soon as the frost was out of the ground, I sowed garden peas, beans, corn, and turnips. On August 20th the peas were beginning to fill the pods, the beans were in flower, and the corn only eighteen inches above the ground; the turnips also were growing nicely. I believe that barley has been sown here, but would not ripen.

Covering the higher ground, at the southern end, white spruce, poplar, balsam-fir and white birch trees were found, some of which had a diameter of eighteen inches, three feet from the ground. The swamps are covered with a thick growth of small-sized black spruce and tamarac, and the small areas of burned land are generally clad with a second-growth of banksian pine.

Having no pork, our men from lake St. John refused to remain longer, so Mr. Macoun and I were again alone at the post awaiting the arrival of the brigade from the coast, having engaged a passage down the Rupert river in the canoe returning there.

After the arrival of the canoes, we left on Aug. 22nd, and travelling from daylight to dark in a large canoe with ten paddles, we reached Rupert House September 3rd. From that place we crossed the south end of James Bay to Moose Factory, and then went up the Moose River to the C. P. Ry. at the Height of Land, where we left the canoes after an interior water journey of over 1000 miles.



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DOMINION OF CANADA.--OUTLINE MAP SHEWING THE LARGER UNEXPLORED AREAS, 1890.

(To illustrate paper by George M. Dawson.)

ON SOME OF THE LARGER UNEXPLORED REGIONS OF CANADA.

(By G. M, Dawson, D.S., Assoc. R.S.M., F.G.S., F.R.S.C.)

(Read 7th March, 1890.)

If on reading the title of the paper which I had promised to contribute to the Ottawa Field-Naturalists' Club, any one should have supposed it to be my intention to endeavour to describe or forecast the character of the unexplored areas mentioned, I must, in the first place disclaim any such intention. The very existence of large regions of which little or nothing is known, is of course stimulating to a fertile imagination, ready to picture to itself undiscovered "golden cities a thousand leagues deep in Cathay," but such unscientific use of the imagination is far removed from the position of sober seriousness, in which I ask your attention to the facts which I have to present.

Fortunately, or unfortunately as we may happen to regard it, the tendency of our time is all in the direction of laying bare to inspection and open to exploitation, all parts, however remote, of this comparatively small world in which we live, and though the explorer himself may be impelled by a certain romanticism in overcoming difficulties or even dangers met with in the execution of his task, his steps are surely and closely followed by the trader, the lumberer, or the agriculturist, and not long after these comes the builder of railways with his iron road. It is, therefore, rather from the point of view of practical utility than from any other, that an appeal must be made to the public or to the government for the further extension of explorations, and my main purpose in addressing you to-night is to make such an appeal, and to show cause, if possible, for the exploration of such considerable portions of Canada as still remain almost or altogether unmapped.

What I have to say, in fact, on this subject, resolves itself chiefly into remarks on the map exhibited here, upon which the unexplored areas to which I am about to refer, are clearly depicted in such a manner, I believe, as almost to speak for themselves.

It is very commonly supposed, even in Canada, but to a greater extent elsewhere, that all parts of the Dominion are now so well known that exploration, in the true sense of the term, may be considered as a thing of the past. This depends largely upon the fact that the maps of

the country generally examined are upon a very small scale, and that upon such maps no vast areas yet remain upon which rivers, lakes, mountains or other features are not depicted. If, however, we take the trouble to enquire more closely into this, and consult perhaps one of the geographers whose name may appear on the face of the map which we have examined, asking such awkward questions as may occur to us on the sources of information for this region or that, we may probably by him be referred to another and older map, and so on till we find in the end that the whole topographical fabric of large parts of all these maps rests upon information of the vaguest kind.

Of most of the large areas marked upon the map here shown, this is absolutely true, and the interests of knowledge with respect to these would be better subserved if such areas were left entirely blank, or, at least, if all the geographical features drawn upon them appeared in broken lines, in such a way as to show that none of them are certain. In other regions, the main geographical outlines, such as the courses of the larger rivers, are indicated approximately, with such accuracy as may be possible from accounts or itineraries derived from travellers or from officers of the Hudson Bay Company; or from the descriptions or rough sketches of Indians or other persons by whom the region has been traversed, but who have been unprovided with instruments of any kind and whose knowledge of the country has been incidentally obtained.

There is, in the case of such partially explored regions, more excuse for the delineation of the main features on our maps, as these may be useful in imparting general information of a more or less inexact kind. We can scarcely, however, admit that such regions have been explored in any true sense of that term, while they are certainly unsurveyed, and very little confidence can be placed in maps of this kind as guides in travel. When, ten years ago, I struck across from Fort McLeod, on the west side of the Rocky Mountains, with the purpose of reaching Fort Dunvegan on the Peace, through a country densely forested and without trails or tracks of any kind, I had so much confidence in the existing maps of that region as to assume that Dunvegan was at least approximately correct in position on them. As often as possible I took observations for latitude, and each night

worked out our position by latitude and departure, till at a certain point I was about to turn off to the north of the line previously followed with the confident anticipation of finding Dunvegan. Just here, very fortunately, we fell in with some Indians, and though our means of communicating with them were very imperfect, we gathered enough to lead us to accept the guidance of one of them, who promised to lead us to the fort, but took an entirely different direction from that I had proposed taking. He was right, but Dunvegan proved to be, as shown on the maps, nearly forty miles west of its real position. Fortunately no very great importance attached to our reaching Dunvegan on a given day, but none the less, this practical experience proved to me very conclusively the desirability of showing features in broken lines, or otherwise indicating their uncertainty when they have not been properly fixed.

It must be confessed, however, that most of the travellers ordinarily to be found in these unexplored regions, being Indians or hunters, traders and others travelling under the guidance of Indians do not depend on the latitudes or longitudes of places, or on the respective bearings of one place from another. The Indians follow routes with which they have been familiar since childhood, or when beyond the boundaries of their own particular region of country, go by landmarks, such as mountains, lakes and rivers which have been described to them by their neighbours. Their memory in this respect is remarkable, but it must be remembered that among their principal subjects of conversation when sitting about the camp-fire are the distances in day's journeys from place to place, the routes which they have followed or have known others to follow, the difficulties to be encountered on these, the points at which food of different kinds may be obtained, and the features which strike them as being remarkable in the country traversed. Returning, however, from this digression, which began with the statement that accurate maps of such regions as are at present merely traversed by traders and Indians, are not imperative from the point of view of such travellers, it may with confidence be affirmed that such maps and the explorations upon which they are based, are absolutely essential to civilized society, to show in the first place what the natural resources of these regions are and how they may be

utilized, in the second by what highways such regions may be most easily reached.

A glance at the map will show, that while many of the larger unexplored areas may be affirmed to lie to the north of the limit of profitable agriculture, considerable regions situated to the south of this limit still await examination. Large districts, again, in which no farmer will ever voluntarily settle, may afford timber which the world will be glad to get when the white pine of our nearer forests shall become more nearly exhausted, while with respect to mineral resources, it is probable that in the grand aggregate the value of these which exist in the unexplored regions will be found, area for area, to be equal to those of the known regions, comparing each particular geological formation with its nearest representative. On the grounds alone, therefore, of geographical knowledge, and of the discovery and definition of the reserves of the country in timber and minerals, the exploration of all these unknown or little-known regions may be amply justified.

Taking a line drawn north and south in the longitude of the Red River valley, which is, as nearly as may be, the centre of Canada from east to west, it may confidently be stated that by far the larger part of the country in which agricultural settlement is possible lies to the west, while the great bulk of the actual population lies to the east of this line. Looking to this grand fundamental fact, I believe it may safely be affirmed that some members of this audience will live to see the day when these conditions with respect to population will be boldly reversed and in which the greater number of our representatives in Parliament gathering here will come from this great western region.

This disposition of the cultivable land depends partly upon the physical characteristics of the country, and in part on its climatic conditions. Beyond Winnipeg, and stretching therefrom to the west and north-west, is the great area of prairie, plain and plateau which, wider near the forty-ninth parallel than elsewhere on the continent, runs on in one form or other, though with diminishing width, to the Arctic Ocean. This is, generally speaking, an alluvial region, and one of fertile soils. Very fortunately, and as though by a beneficient provision of nature, the climatic features favour the utilization of this belt.

The summer isothermals, which carry with them the possibility of ripening crops, trend far to the north.

Let us trace, for example, and as a rough and ready index of the northern limit of practicable agriculture of any kind, that isothermal line which represents a mean temperature of 60° Farenheit in the month of July. Passing through the southern part of Newfoundland and touching the island of Anticosti, this line runs to the north end of Mistassini Lake, and thence crosses Hudson Bay, striking the west shore a short distance north of York Factory. Thence it runs westward, skirting the north end of Reindeer Lake, and then bending to the north-west, crosses Great Slave Lake, and touches the southern extremity of Great Bear Lake. From this point it resumes a westward course and crosses the Yukon River a considerable distance to the north of the confluence of the Pelly and Lewes, turning south again almost on the east line of Alaska. We need not, however, further follow its course, as owing to peculiar climatic conditions on the West Coast, it ceases there to be any criterion as to the conditions of agriculture.

The character of much of the western interior country is such, that its exploration and survey is comparatively easy, and it will be observed that here the larger unknown regions are to be found only far to the northward, leaving in the more rugged and inhospitable eastern region vast islands of unexplored country in much more southern latitudes.

It may be said, in fact, that comparatively little of the region capable, so far as climate goes, of producing wheat is now altogether unknown; but it may be added, that increasing as the world now is in population, its people cannot much longer expect to find wheat-growing lands unoccupied in large blocks. The time is within measurable distance when lands with a fertile soil though more or less rigorous climate, in which only barley, oats, hemp, flax and other hardy crops can be matured, will be in demand, and we are far from having acquired even a good general knowledge of these lands in Canada.

For many of the unexplored regions marked upon this map, however, we can in reason appeal only to their possible or presumable mineral wealth as an incentive to their exploration, and if some of them should prove wholly or in great part barren when such explora-

tion shall have been carried out, it will not be without utility to acquire even this negative information, and write upon them in characters as large as need be, "No thoroughfare."

I will now ask your further attention for a few moments while I run over and make some remarks in detail on the various unexplored areas as indicated on the map. It must first, however, be explained in what manner the unexplored areas referred to have been outlined. All lines, such as those of rivers, chains of lakes or other travelled routes, along which reasonably satisfactory explorations have been made and of which fairly accurate route-maps are in existence, are given an approximate average width of about fifty miles, or twenty-five miles on each side of the explorer's or surveyor's track. The known lines are thus arbitrarily assumed to be wide belts of explored country, and that which is referred to as unexplored, comprises merely the intervening tracts. By this mode of definition, the unexplored regions are reduced to minimum dimensions. Neither are any comparitively small tracts of country lying between explored routes included in my enumeration, in which the least area mentioned is one of 7,500 square miles; nor are the Arctic islands, lying to the north of the continent, referred to. Because of the empirical mode in which the unexplored areas have thus been delineated, it has not been attempted to estimate with more than approximate accuracy the number of square miles contained in each, my purpose being merely to render apparent the great dimensions of these areas.

In enumerating these areas, I shall not refer to the various explorations and lines of survey by which they are defined and separated one from another, as this would involve mention of nearly all the explorers who have traversed the northern part of the continent. I shall, however, note such excursions as have been made into or across the regions which are characterized as unexplored.

Beginning, then, in the extreme north-west of the Dominion, we find these areas to be as follows :—

1. Area between the eastern boundary of Alaska, the Porcupine River and the Arctic coast, 9,500 square miles, or somewhat smaller than Belgium. This area lies entirely within the Arctic circle.

2. Area west of the Lewes and Yukon rivers and extending to the boundary of Alaska, 32,000 square miles, or somewhat larger than Ireland. This country includes the head-waters of the White and probably of the Tananà rivers, and, being comparatively low and sheltered from the sea by one of the highest mountain ranges on the continent, the St. Elias Alps, doubtless possesses some remarkable peculiarities of climate.

3. Area between the Lewes, Pelly and Stikine rivers and to the east of the Coast Ranges, 27,000 square miles, or nearly as large as Scotland. This has been penetrated only by a few "prospectors" from whom, and from Indians, the courses of rivers shown on my maps published in connection with the Yukon Expedition Report are derived. It lies on the direct line of the metalliferous belt of the Cordillera, and its low lands are capable of producing hardy crops.

4. Area between the Pelly and Mackenzie Rivers, 100,000 square miles, or about twice the size of England. This belongs partly to the Yukon basin and partly to that of the Mackenzie, and includes nearly 600 miles in length of the main Rocky Mountain Range. Many years ago, Mr. A. K. Isbister penetrated the northern part of this area for some distance on the line of the Peel River,* but, owing to the manner in which he had to travel, but little accuracy can be attributed to his sketch of that river. Abbé Petitot also made a short journey into its northern part from the Mackenzie River side, but with these exceptions, no published information exists respecting it.

5. Area between Great Bear Lake and the Arctic coast, 50,000 square miles, or about equal to England in size. Nearly all to the north of the Arctic circle.

6. Area between Great Bear Lake, the Mackenzie and the western part of Great Slave Lake, 35,000 square miles, or larger than Portugal. With respect to this region and that last mentioned, it must be explained that I have felt some doubt whether they should be characterized as unexplored on the basis previously explained as that which is generally applied. Between 1857 and 1865, Mr. R. Macfarlane, of the

*Some account of Peel River, North America, by A. K. Isbister, Journ. Roy. Geog. Soc., vol. xv., 1845, p. 332.

Hudson Bay Company, carried out an intelligent and valuable examination of part of the region north of Great Bear Lake, some results of which have lately been published,* and in both of these areas, between 1864 and 1871, the indefatiguable missionary, Abbé Petitot, made numerous journeys, of which he subsequently published an account.† As Petitots's instruments consisted merely of a compass, and a watch which he rated by the meridian passage of the sun, it must be assumed that his mapping of the country does not possess any great accuracy. His work, however, considering the difficulties under which it was performed, is deserving of all praise, and his several descriptions of the character of the country traversed are most valuable. It does not appear from his account of these regions that they are likely to prove of great utility to civilized man, except as fur preserves, or possibly from the minerals which they may contain. He writes: "Ce pays est composé de contrées silencieuses comme le tombeau, des plaines vastes comme des départements, des steppes glacés plus affreux que ceux de la Sibérie, de forêts chétives, rabougries comme on n'en voit que dans le voisinage des glaciers du Nord."

7. Area between Stikine and Liard rivers to the north and Skeena and Peace rivers to the south, 81,000 square miles, or more than twice as large as Newfoundland. This includes a portion of the western Cordillera, and, between the Liard and Peace rivers, a large tract of the interior plateau region of the continent, parts of which, there is reason to believe, consist of good agricultural land. Its western extremity was crossed in 1866 and 1867 by the exploratory survey of the Western Union or Collins' Telegraph Company, then engaged in an attempt to connect the North American and European telegraph systems through Asia. No details of this part of their exploration have, however, been published, and if we may judge from other parts of their line, since checked, the survey made was of too rough a character to possess much geographical value.

8. Area between Peace, Athabasca and Loon rivers, 7,500 square miles, or about half as large as Switzerland.

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*Canadian Record of Science, Jan., 1890.
†Bulletin de la Société de Géographie, Tom x, 1875.

9. Area south-east of Athabasca Lake, 35,000 square miles. This again may be compared in extent to Portugal.

10. Area east of the Coppermine River and west of Bathurst Inlet, 7,500 square miles. This again may be compared to half the area of Switzerland.

11. Area between the Arctic coast and Back's River, 31,000 square miles or about equal to Ireland.

12. Area surrounded by Back's River, Great Slave Lake, Athabasca Lake, Hatchet and Reindeer lakes, Churchill River, and the west coast of Hudson Bay, 178,000 square miles. Much larger than Great Britain and Ireland, and somewhat larger than Sweden. The lakes and rivers shown in this great region depend entirely on the result of the three journeys made by Hearne in 1769–1772.* Hearne really wandered through parts of this region in company with Indians whom he was unable to control, his ultimate object (which he at length accomplished) being to reach the Coppermine River, in order to ascertain for the Hudson Bay Company, whether it was possible to utilize the native copper found there. Not even roughly approximate accuracy can be assigned to his geographical work. Referring to the position of the mouth of the Coppermine, he writes:—"The latitude may be depended upon to within 20 miles at the utmost." In reality it afterwards proved to be 200 miles too far north. This country includes the great "barren grounds" of the continent, and is the principal winter resort of the musk ox as well as of great herds of caribou. Hearne's general characterization of it is not very encouraging, but certainly we shall know more about it. He writes:—"The land throughout the whole track of country is scarcely anything but one solid mass of rocks and stones, and in most parts very hilly, particularly to the westward, among the woods." The extreme north-eastern extremity of this region was also crossed by Lieut. Schwatka in the course of his remarkable journey to King-William Land, but his geographical results possess little value.†

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*A Journey from Prince of Wales Fort, in Hudson Bay, to the Northern Ocean, 1796.

†Schwatka's Search by H. W. Gilder.

13. Area between Severn and Attawapishkat rivers and the coast of Hudson Bay, 22,000 square miles, or larger than Nova Scotia. Several lakes and rivers are shown upon the maps in this region in practically identical form since Arrowsmith's map of 1850, but I have been unable to ascertain the origin of the information.

14. Area between Trout Lake, Lac Seul and the Albany River, 15,000 square miles, or about half the size of Scotland.

15. Area to the south and east of James Bay, 35,000 square miles, which also may be compared to the area of Portugal. This region is the nearest of those which still remain unexplored to large centres of population. It is probable that much of it consists of low land which may afford merchantable timber.

16. Area comprising almost the entire interior of the Labrador peninsula or North-east Territory, 289,000 square miles. This is more than equal to twice the area of Great Britain and Ireland, with an added area equal to that of Newfoundland. Several lines of exploration and survey have been carried for a certain distance into the interior of this great peninsula, among which may be mentioned those of Professor Hind, Mr. A. P. Low and Mr. R. F. Holme.* The limits of the unexplored area have been drawn so as to exclude all these. The area regarded as still unexplored has, however, it is true, been traversed in several directions at different times by officers of the Hudson Bay Company, particularly on routes leading from the vicinity of Mingan on the Gulf of St. Lawrence to the head of Hamilton Inlet, and thence to Ungava Bay. These routes have also, according to Mr. Holme, been travelled by a missionary, Père Lacasse; but the only published information which I have been able to find is contained in a book written by J. M'Lean,† and in a brief account of a journey by Rev. E. J. Peck.‡ Mr. M'Lean made several journeys and established trading posts between Unguva and Hamilton Inlet in the years 1838-1841, while Mr. Peck

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*Explorations in Labrador, 1863, Annual Report Geol. Surv. Can., 1887-88, Part J. Proc. Royal Geog. Soc., 1888. Ott. Nat. Vol. IV.

†Notes of a twenty-five years' service in the Hudson's Bay Territory. London, 1849.

‡Church Missionary Intelligencer, June 1886. Proc. Roy. Geog. Soc., 1887, p. 192.

crossed from Little Whale River, on Hudson Bay, to Ungava in 1884. Something may be gathered as to the general nature of the country along certain lines, from the accounts given by these gentlemen, but there is little of a really satisfactory character, while neither has made any attempt to fix positions or delineate the features of the region on the map. In all probability this entire region consists of a rocky plateau or hilly tract of rounded archæan rocks, highest on the north-east side and to the south, and sloping gradually down to low land towards Ungava Bay. It is known to be more or less wooded, and in some places with timber of fair growth, but if it should be possessed of any real value, this may probably lie in its metalliferous deposits. In this tract of country particularly there is reason to hope that ores like those of Tilt Cove, in Newfoundland, or those of Sudbury, in Ontario, may occur.

To sum up briefly, in conclusion, what has been said as to the larger unexplored areas of Canada, it may be stated that while the entire area of the Dominion is computed at 3,470,257 square miles about 954,000 square miles of the continent, alone, exclusive of the inhospitable detached Arctic portions, is for all practical purposes entirely unknown. In this estimate the area of the unexplored country is reduced to a minimum by the mode of definition employed. Probably we should be much nearer the mark in assuming it as about one million square miles, or between one-third and one fourth of the whole. Till this great aggregate of unknown territory shall have been subjected to examination, or at least till it has been broken up and traversed in many directions by exploratory and survey lines, we must all feel that it stands as a certain reproach to our want of enterprise and of a justifiable curiosity. In order, however, to properly ascertain and make known the natural resources of the great tracts lying beyond the borders of civilization, such explorations and surveys as are undertaken must be of a truly scientific character. The explorer or surveyor must possess some knowledge of geology and botany, as well as such scientific training as may enable him to make intelligent and accurate observations of any natural features or phenomena with which he may come in contact. He must not consider that his duty consists merely in the perfunctory measuring of lines and the de-

lineation of rivers, lakes and mountains. An explorer or surveyor properly equipped for his work need never return empty handed. Should he be obliged to report that some particular district possesses no economic value whatever, besides that of serving as a receiver of rain and a reservoir to feed certain river-systems, his notes should contain scientific observations on geology, botany, climatology and similar subjects which may alone be sufficient to justify the expenditure incurred.

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EDITORIAL ANNOUNCEMENT.

We have great pleasure in announcing that, through the courtesy of Dr. MacCabe, the Principal of the Ottawa Normal School, the commodious class-rooms of that institution have been placed at the disposal of the Ottawa Field-Naturalists' Club for our course of soirees and popular lectures, as well as the use of a separate room for library purposes. This change will be appreciated by all who take an interest in the Club, since the large attendance at the past season's lectures renders increased accommodation a necessity. In view of this great assistance in carrying on the Club work, the Council has resolved that the students of the Normal School, as many as so desire, shall be heartily welcome to attend any of the lectures of the course, and shall also be admitted to the privileges of membership in so far as reduced rates for the summer excursions may apply.

The first general excursion of the season will take place on the 31st of May. It has been decided to visit a locality slightly nearer than King's Mountain, the distance to which has been found rather too great by some of our members. For this reason Butternut Grove, near Old Chelsea, has been chosen. Tickets: Members, 50 cents; non-members, 60 cents.

Sub-excursions as usual will leave the Post-office at 2 o'clock every Saturday afternoon until further notice.

DIRCA, L. (Leather wood. Moose-wood.)

1922. D. PALUSTRIS, L.

Rich woods. Ap.—4. (B) The small yellow tubular flowers, 3 or 4 in number, produced early in spring from buds enclosed in dark brown hairy scales. Leaves oval, short-petioled, pale green. Bark fibrous and very tough, much used in the woods instead of twine.

ELÆAGNACEÆ. Oleaster Family.

SHEPHERDIA, Nutt.

1924. S. CANADENSIS, Nutt.

Rocky woods. May—1. (B) A straggling dicecious shrub with yellow flowers opening before the leaves. The leaves and young shoots covered with brown peltate and white stellate hairs.

SANTALACEÆ. Sandal-wood Family.

COMANDRA, Nutt. Bastard Toad-Flax.

1928. C. UMBELLATA, Nutt.

Dry rocky woods. Rockcliffe. Hull. King's Mountain. May—4. (B) A low herb with pale green oblong leaves and a terminal corymbose cluster of white flowers. Parasitic on the roots of shrubs. I have traced the connection of the roots with those of *Prunus Virginiana* and *Viburnum pubescens* to which they were attached by an enlarged cone-shaped disk.

EUPHORBIACEÆ. Spurge Family.

EUPHORBIA, L.

1935. E. MACULATA, L.

Sandy fields. Common. July—2. (B) Annual.

1939. *E. Helioscopia*, L. (Sun Spurge.)

Introduced. Roadsides and gardens. July—3. (B) The centres of the flower-clusters yellow. Pods smooth. Annual.

1940. *E. Cyparissias*, L.

Perennial. A garden escape. July—1. Stems densely clustered. Stem-leaves linear crowded.

1941. *E. Peplus*, L. (Horned Garden Spurge.)

Introduced. Border of field, Green's Creek. Parliament Hill. Aug.—2. Annual. Horns of the 4-lobed involucrum long. Lobes of the pod 2-wing-crested on the back.

ACALYPHA, L. Three-seeded Mercury.

1945. A. VIRGINICA, L.

Low ground in shade. July—4. (B) An inconspicuous weedy plant with green flowers and long-petioled leaves.

URTICACEÆ. Nettle Family.

ULMUS, L. Elm.

1946. U. FULVA, Mx. (Red Elm. Slippery Elm.)

Rocky woods. Ap.—4. (B) Flowers almost sessile. Branches wide-spreading, with the leaves towards the tips of the branchlets. Buds and branchlets downy.

1947. U. AMERICANA, L. (White Elm. Swamp Elm.)

Low woods. Ap.—4. (B) Our most beautiful forest tree. Flowers on drooping pedicels. Buds and branchlets glabrous.

1948. U. RACEMOSA, Thomas. (Rock Elm. Corky White Elm.)

Rocky woods. May—1. (B) A small tree in this district; but very large in Western Ontario. Easily distinguished by the corky ridges on the branches and the racemed flowers.

These three are the only elms we have in Canada, notwithstanding the various local names.

CELTIS, L. Nettle Tree.

1949. C. OCCIDENTALIS, L. (Sugar-berry. Hackberry.)

River banks. Rare. Billings Bridge. Malloch's Bay. Britannia. May—1.

A rather small forest tree with the appearance of an Elm. Leaves sharply serrate, reticulated, ovate-lanceolate taper-pointed oblique at base and asymmetrical. Flowers green, axillary, peduncled. The fertile flowers solitary or in pairs; the staminate flowers fascicled along the base of the branchlets.

HUMULUS, L. Hop.

1950. H. LUPULUS, L. Wild Hop.

Not indigenous in this locality. River side. Hull. Billings Bridge. June—4.

CANNABIS, L. Hemp.

1951. *C. Sativa*, L. (Hemp.)

Introduced into Canada as a fibre-plant. Very common in waste places. July—1. (B)

URTICA, L. Nettle.

1954. U. GRACILIS, Ait. (Common Nettle.)

Low ground. July—1. A tall slender species sometimes growing 10 feet in height. Stinging hairs few. (B)

LAPORTEA, Gaudich. Wood Nettle.

1959. L. CANADENSIS, Gaudich.

Low woods. Common. July—1. A graceful plant with large pale, alternate, serrate leaves and conspicuous diœcious flowers. Whole plant covered with rigid stinging hairs.

PILEA, Lindl. Clearweed.

1960. P. PUMILA. Gray. (Richweed.)

Low cool woods and around springs. July—1. (B) A small, smooth and pellucid annual, without stinging hairs.

BŒHMERIA, Jacq. False Nettle.

1961. B. CYLINDRICA, Willd.

Low woods and thickets. July—1. A taller plant than the last with more of the appearance of a nettle; but stringless. (B)

JUGLANDACEÆ. Walnut Family.

CARYA, Nutt. Hickory.

1964. C. ALBA, Nutt. (Shell-bark Hickory.)

River side. Rare. A few trees at Casselman and at Deschenes Rapids. June.

1967. C. AMARA, Nutt. (Bitter-nut Hickory.)

Rocky woods. Hull. Billings Bridge. June.

JUGLANS, L. Walnut.

1968. J. CINEREA, L. Butternut.

Rocky woods. Common. June—1. One of the grandest of our forest trees. (B)

MYRICACEÆ. Sweet-gale Family.

MYRICA, L. Wax Myrtle.

1970. M. GALE, L. (Sweet Gale.)

In Peat-bogs, along the borders of lakes. Common in its proper habitat. The dicœcious flowers precede the leaves. Whole plant strongly aromatic. May—2.

1973. M. ASPLENIFOLIA, Endl. (Sweet Fern.)

Comptonia asplenifolia, Ait. Gray's Man. 458.

Sandy and clayey woods. Ironsides. Aylmer. Ap.—4. Local. A pretty aromatic shrub, 1—2 feet high, with fern-like linear-lanceolate leaves six inches in length, which are pinnatifid with many rounded lobes.

CUPULIFERÆ. The Oak Family.

BETULA, L. Birch.

1974. B. LENTA, L. (Cherry Birch. "Black Birch.")

B. excelsa of Aiton.

Rich woods. May—1. (B) A large forest tree with thick bark, which is smooth and dark brown, like that of the cherry, when the tree is young. Fruiting catkins oblong-cylindrical, over an inch in length, the scales short with divergent lobes.

1975. B. LUTEA, Michx, f. (Yellow Birch. Gray Birch.)

B. excelsa of Pursh.

Low rich woods. May—1. Bark of trunk yellowish or silvery-gray, hanging in thin filmy layers. Fruiting catkins oblong-ovoid, under an inch in length, the scales thinner than in No. 1974, twice as large with narrower, barely spreading, lobes.

1977. B. PAPYRIFERA, Mx. (Paper Birch, Canoe Birch.)

B. papyracea, Ait. Gray's Man. 459.

Woods and river banks. May—1. (B) Leaves ovate.

1979. B. PUMILA, L. (Low Birch. Swamp Birch.)

Peat bog. Mer Bleue. Rare. May—4. A small shrub, with erect branches, not glandular; young branches and roundish leaves soft-downy when young.

ALNUS, Gærtn. Alder.

1985. A. INCANA, Willd. (Common Swamp Alder.)

Borders of streams and swamps. Ap.—2. (B) Usually our first plant to flower. This and *Acer dasycarpum* always preceding all others. The catkins which (of both sorts) were formed the previous summer, flowering long before the leaves expand.

ELEMENTARY LECTURE—PALÆONTOLOGY.

By Walter R. Billings.

(Read January 20th, 1890.)

A fossil (from *fossus* the Latin for "dug up") Lyell defines as "any body or *the traces of the existence of any body*, whether animal or vegetable, which has been buried in the earth by natural causes."

What these natural causes were is a question which has engaged the attention of thoughtful men from early historical times, and so far back as 5 centuries before Christ, Zenophanes of Colophon (500 B.C.), Herodotus, and Empedocles of Agrigentum (450 B.C.), followed somewhat later by Aristotle (384-322 B.C.), appreciated to some extent the true character of, and gave rational explanations concerning, the presence of these remains. They concluded that when the bottom of the sea had been in a soft condition that the remains were entombed, and that the sea, deserting some lands and invading others, had brought the earlier sea bottom within reach of easy inspection. Aristotle's opinions concerning the spontaneous generation of animals, which he believed could originate from moist earth or the slime of rivers was applied by his followers to fossils as well, for it seemed to them a much simpler way of accounting for the remains of animals in the rocks, than the marvellous changes of sea and land otherwise required to explain their presence, and this view later on obtained credence more readily, owing to its accordance with the Biblical theory of the creation of man out of the dust of the earth. The Romans merely repeated the ideas of the Greeks on this subject, some holding with the earlier writers, others with Theophrastus, the pupil of Aristotle, that they were produced by a certain plastic virtue latent in the earth until, near the close of the second century, we find Tertullian instancing the remains of sea animals on the mountains far from the sea as proof of the general deluge recorded by Moses.

During the thirteen or fourteen centuries onward from the close of the second century all departments of knowledge were enveloped in darkness, and no attention was paid to fossils excepting that occasional repetitions of the ideas of the ancients were made without appreciation or any special show of interest.

In the beginning of the sixteenth century the study of fossil remains may be said to have really begun. Leonardi da Vinci, the renowned artist and scientist, and Fracastro, of Verona, both maintained that the fossils were entombed in the sea mud instead of being sports of nature generated by fermentation through the influence of the stars or by spontaneous generation, theories which were thus for the first time seriously questioned, and which, in spite of all opposition, retained a dominant influence for two centuries later. Some claimed that the shells had been left by Noah's deluge, but, in opposition, Fracastro offered a mass of evidence which, although to us apparently conclusive, was not in accordance with the predominant theory of the time, and was in consequence fiercely assailed. He considered that inundation too recent and too transient; it consisted mainly of fresh water, and any organic remains resulting therefrom would necessarily be found in superficial deposits instead of in the interior of mountains.

And Fabia Colonna appears to have been the first to point out that some of the fossil shells found in Italy were marine and some terrestrial. However, these correct generalizations were the exception, not the rule, for during the sixteenth century fossils were usually considered as "sports of nature." The eminent botanists, Tournefort and Camerarius, believed in the dissemination of the seeds of minerals and fossils throughout the sea and the earth, and in the subsequent development into the characteristic forms by augmentation of atoms or particles as in crystals, stalactites, and stalagmites. Lhwyd, in his Lithophylacii Brittanici Ichnographia (Oxford, 1599), taught that the spawn of marine animals, after being raised with the vapors from the sea, conveyed inland by and precipitated from clouds, permeated into the interior of the earth where they produced the fossils. In addition to these there is the theory popular for many centuries, and now not entirely thrown aside although never a favourite with scientists, viz., that fossil animals and plants were formed by the Creator just as they are found in the rocks in pursuance of a design beyond our comprehension.

In the seventeenth century by means of collection, description and discussion of fossils the study was considerably advanced, and, although the "sports of nature" theory was still "on deck" up to the end of the century, clear ideas began to prevail and the study to advance

rapidly. Steno, a Dane, to whom are owing many important views in regard to the origin of different kinds of strata, first recorded the fact that the oldest rocks are unfossiliferous. In spite of the advance in knowledge the general belief was that fossil remains were deposited by the Mosaic deluge, and this belief being opposed by courageous men and the conflict as to the nature of the fossils being fairly settled, the ground of discussion was transferred to Noah's flood, and until the close of the eighteenth century the theologians had their own way—they pointed out that Noah's deluge was universal, that all life, except what Noah saved, was destroyed, and that it followed that fossils were relics left by the flood. Several dissented, Voltaire and Buffon among the number, but the latter being politely invited by the College to recant and fearing the delicate attentions of his opponents, recanted accordingly.

The beginning of our century marked the commencement of the study of fossils as a science, and the advance since then—and for the first time in history—has been rapid and continuous. I regret we have not time to refer to its triumphs in detail.

This brings us back to Lyell's definition of a fossil as "any body or *the traces of the existence of any body*, whether animal or vegetable, which has been buried in the earth by natural causes." At first all objects dug up, whether organic or mineral, were called fossil, but when organic remains became generally understood the distinction was made. Palæontology is a modern term, which first came into use in 1830. Petrifactions form the most numerous class of fossils, being actual portions of animal or vegetable organisms, such as the shells of molluscs, the skeletons of corals, the crusts of crustaceans, the bones, teeth and scales of fish, the bones and teeth of reptiles and mammals, the bark, leaves or seeds of plants, "and these may be preserved very much in their original condition, or may be altered subsequent to their burial." But, in addition to these two principal kinds, there are the *traces* referred to in the definition quoted, among which traces are the moulds or casts of shells, and the footprints left by animals upon sand or mud. The "*alterations subsequent to their burial*" are usually replacements which either show intimate structure as well as in the original, or fail to do so, the failure or success being proportionate to the rapidity or slowness of decay. The soft or fleshy parts in all cases disappear.

There is a popular fallacy that the human body sometimes turns to stone after burial, and this error is owing to the fact that the fat and muscular tissues change after death to a waxlike substance called adipocere, which being tolerably firm, often preserves the form and features of the body in a more or less perfect condition for a few years after death, but this only retards, not prevents, the final and complete decomposition of the soft parts.

Moulds or casts may be either of the interior or of the exterior of the shell of the mollusc, the cup of a coral or crinoid, or the skeleton of any organism possessing such.

Taking as an example the shell of a mollusc which, after being filled with mud and buried in the ocean bed, was subjected to influence which dissolved out the shell—an interior and exterior cast, with an empty space between, would be the result. However, it is very rarely that a cavity is left, as in any porous matrix mineral particles would be deposited until a filling is formed. A familiar instance of a cavity or mould is that of a citizen of Pompeii found during the excavation of the streets of that city. The man had probably been suffocated in the showers of ashes from Vesuvius. A plaster cast was made of the cavity, and the form of the Pompeiian restored to human gaze after a lapse of 1,800 years.

Through careful oberservation of readily accessible rock masses in various countries as to their super-position, mineral characters, and included fossils, geologists have been enabled to break up the entire stratified series into a number of different divisions or formations, each characterized by general uniformity of mineral composition, by peculiarity of position with regard to the others and by a peculiar assemblage of fossils; and further, to break up each of the primary divisions into a series of smaller ones similarly characterized and distinguished. In no known locality can all these rock groups be seen surmounting one another in uninterrupted succession. There are localities where representatives of the Cambrian, Silurian, Old Red and Carboniferous are to be found following one another in regular succession. But, on the other hand, there are localities where the Carboniferous rests on the Silurian and the Old Red is absent, and this may have been owing either to the elevation of the Silurian beds above the sea immediately

after their deposition and their remaining so until the Old Red period had passed; or to the Old Red having been deposited on the Silurian, the whole elevated above the sea and subjected to denudation sufficient to remove the Old Red; in either case when the land was again submerged the formation then in process of deposit would be laid down directly on the Silurian. One thing should be carefully noted, viz.: that the rocks never occur in an inverted order, *i.e.*, no one of the Cambrian beds is to be found resting on any of the Silurian, nor any of either of these on a representative of the Old Red.

As each superimposed stratum is older than that underlying it, so the fossils contained in an overlying bed are less ancient than those in the bed beneath, and thus the succession of organic remains are the evidences of the growth and development of living forms.

As aforesaid, each formation and each of its subdivisions is characterized by a peculiar assemblage of fossils, and, owing to this, when we find the peculiar assemblage repeated, we know that we have a repetition of the formation in which it was originally discovered; and thus a knowledge of the fossils contained in any particular bed or group of beds, enables us to determine the relative age and position of the beds compared with other beds in the same region or other regions. How far this test may be applied with certainty to minor rock groups or sub-divisions, we have not time here to consider, but its value to determine formations has never been questioned. Further, although the combination or assemblage of fossils is peculiar to that formation or sub-division, each fossil of it is not, for it may go on upward through several formations before it disappears: one thing, remember, that when it once disappears it never reappears.

Let us suppose that in any one country we discover the order and relative succession of the rocks, and that we have examined and noted the mineral character of the beds as well as the fossils they contain. Now to identify any outlying beds throughout the neighbourhood, the mineral character alone would be a sufficient means of identification for most of the beds, while superposition would do for the remainder. But to determine the stratigraphical position of rocks in a far off region from mineral evidence obtained in this country would be vain—here a comparison of the fossils would be the only reliable test. For instance, the

mineral character of our Trenton group of rocks at Ottawa is sufficiently constant to make it a good test almost anywhere within a radius of 200 miles, and where the least doubt arises, superposition would be another ready means; but the Trenton group of Missouri, for instance, is of a beautiful creamy-buff dolomite, very unlike our ugly sad-coloured limestone, and here we have to fall back on our fossils for light as to the age of the rock.

As a proof of the great value of fossils as evidence, I quote the evidence of Dr. Hall, New York State Geologist, given in 1854, before a select committee of the House of Commons of Canada, as follows:— "One of the great practical advantages resulting in New York I conceive to have been the proof that no valuable or workable coal exists within the State. This fact, although of a negative character, has for ever set at rest all explorations for coal, while it has been ascertained that during fifty years previous to the commencement of the survey not less than one million of dollars had been expended in abortive search for fossil-fuel, where a well-informed geologist would have at once pronounced the undertaking useless and certain to prove a failure." Through a study of the fossils it was established that in New York "both salt and gypsum are products of the * * * Silurian Period, while previously it had been believed they belonged to the New Red * * and consequently that coal would be found in these rocks as in Europe * * * The evidence from fossil character soon proved the futility of such an expectation. Thus, in this instance, *mineral evidence* set the public wrong and *fossil evidence* corrected the error. Again the occurrence of the rock known as the Oneida Conglomerate was, from its mechanical structure, believed to be identical with the Millstone Grit of England, which underlies the coal, and examinations for coal were * * to some extent made. From the fossils in the rocks above and below it has been proved to belong to the older Silurian beds. Thus, in this case also, mineral evidence misled the public, and fossil evidence corrected the error." * * * *

An instance in which a knowledge of the fossil remains of a formation was of still greater importance than a knowledge of its mineral character is the lead-bearing formation of the States of Wisconsin, Illinois and Iowa. For many years a serious misapprehen-

sion existed in regard to the true position of the lead-bearing rock ; and only so lately as 1850 was it determined by a proper examination of its fossils that instead of being in the Niagara group, as formerly supposed * * * it belonged to the Lower Silurians." Since this discovery, miners search for lead in those rocks only where the characteristic fossils occur.

" Miners of coal and other products recognize the surrounding strata, and determine their proximity to the productive by the presence of certain fossils well known to them at sight."

The formation of the Geological Survey of Canada put a stop to much useless expenditure in the same way, and proofs of the non-existence of workable beds of coal throughout the old provinces of Upper and Lower Canada, due to the labours of the Survey, put a stop to many futile researches after that mineral and the consequent waste of money. At Gaspé and at Owen Sound in those early days parties were prevented from sinking shafts in bituminous shale by Mr. Logan, whose knowledge of the fossils told him there could be no coal there ; although practical colliers had declared in favour of its occurrence. Such instances, however, could be multiplied but our time does not permit.

Besides enabling us to determine the relative age and position of each deposit in which we find them, they enable us to arrive at the mode of deposit and the condition of the district or region at the time of its formation. If it contains the remains of animals such as now inhabit rivers, we know that it must have formed part of a river bed or been deposited by the overflow of a stream ; if it contains remains of molluscs, fish or crustaceans such as inhabit lakes, we know it was deposited beneath a lake ; and if it contains marine animals or seaweeds, we know it was a sea bottom.

We may go more minutely into the matter than this, for if the fossils resemble those now inhabiting shallow seas, or if they are rolled and broken and accompanied by remains of land organisms, there can be little doubt they are a shore deposit or were laid down in a shallow sea in the vicinity of the coast ; but if the remains are those of deep sea organisms mixed sparingly with extraneous forms, a deep sea origin may be decided upon. In some cases we find an ancient coral reef, in others a bed of social shells like the oyster, each case telling a tale not

to be mistaken. Occasionally there are beds of dwarfed marine species telling of a brackish sea, and others related to those we find in estuaries at the present time. You will observe that the remains mentioned are aquatic organisms only, but all these deposits contain, in more or less degree, ærial and terrestrial animals and plants. Many of these frequented the seas and lakes, and their remains readily found place in the deposits pertaining thereto, while others have been drowned in lakes or rivers and have been carried out to sea by streams. Some remains of land animals occur in "sub-aerial" deposits, such as blown sand accumulations on the land.

And, further, we may form a fairly reliable opinion of the climate which obtained during the deposit of these, thus, *e.g.*, the Eocene deposits of Greenland, a country now buried under ice, contain the trees, shrubs and plants of the temperate regions—the Eocene of Western Europe contains remains of cowries, volutes and palms closely related to those found in combination with a mean temperature 30° warmer than at present.

As has been stated the various formations are characterized (1) by the association of certain fossils, (2) by the predominance of certain families or genera, or (3) by an assemblage of fossil remains representing the life of the period in which the formation was deposited. But the record of the life of the whole series from bottom to top is not an uninterrupted one, and this "imperfection of the Palæontological Record," as it is termed, is to be regretted, because our knowledge of prehistoric life is almost entirely limited to the palæontological evidence at our disposal. At the outset is what is known as "unrepresented time" or better, perhaps, as "the imperfection of the Geological Record," owing to the fact that many missing or undiscovered rock groups are buried beneath others or beneath the waters of the sea out of sight; that a large portion of the earth, including two great continents, is as yet unexplored; and also that denudation has played the same havoc with the deposits of bygone ages that it has played with those of to-day.

No better example of "unrepresented time" can be had than that oft-quoted break in the strata of Great Britain between the secondary and tertiary epochs. In the upper cretaceous beds there are 500 species of described fossils, and of these only one brachiopod and a few

foraminifera have yet been detected in the overlying eocene beds. The explanation of this is that the break in the life of these two periods represents an incalculable lapse of time. The cretaceous area was elevated and its fauna emigrated ; when it was again depressed the lapse of time was so great that the life which immigrated then from neighbouring seas was composed of new forms. Indeed, the eroded character of the cretaceous rock upon which the tertiary was laid down would in itself prove the great lapse of time.

But "the imperfection of the Geological Record" accounts for only some of the causes of "imperfection of the Palæontological Record," for, if the series of sedimentary rocks had been preserved to us in its entirety and open to our inspection, there would yet be the deficiencies owing to (1) the facility with which different animals may be preserved as fossils, (2) the liability to be deposited where they may be preserved, and, finally, (3) the liability to be obliterated or destroyed after being deposited.

To the varied facility with which different animals may be preserved as fossils, enormous deficiencies in the palæontological record are due. In the polyzoa, cœlenterata, anneloida and annulosa a large proportion, comprising entire classes possess no hard parts, and consequently are unrepresented as fossils, and even in the mollusca and vertebrata some families are lost to us through the same cause. Birds, owing to their lightness, float after death on the water until devoured, and mammals, the majority of which live on land, have fewer opportunities of being buried in aqueous accumulations, consequently are not so often represented as those forms which are essentially marine.

In addition to these is the disappearance of fossils from rocks originally fossiliferous. Metamorphism or the subjection of the rock to a sufficient heat to cause rearrangement of the particles, and consequently an obliteration of the fossils, is the chief cause to which we have to look for the irreparable loss of an enormous mass of palæontological evidence. The life of the great Laurentian series of rocks comprising 30,000 feet (say 6 miles) in thickness of sediments, has been entirely blotted out by this cause. Another cause of obliteration is the percolation of water holding carbonic acid (rain water, for instance) through sand or loose rock.

Lack of time forbids my consideration of such interesting matters as " zones," " the doctrines of colonies," and other interesting divisions of this portion of the subject.

An important part in the formation of rock masses has been played by fossils, for although the sand and clay rocks have not been shown to be of organic origin, yet the greater part of the lime rocks, some of the flint rocks and all the coal and blacklead, with presumably the phosphates, were built up of the remains and through the agency of the animals and plants of the periods of their deposition.

The greater part of the limestones and chalks are compact masses of organic remains of corals, molluscs, echinoderms, foraminifera, calcareous algæ, and other organic forms which possessed lime skeletons. Many flinty deposits are due to polycystina, diatoms and sponges, and the coal, blacklead and other forms of carbon have undoubtedly been produced through the agency of plants.

It is not generally known that geology originated from a study of fossils, and that without palæontology there would have been no science of geology—that is to say, palæontology was the foundation, not a branch, of geology.

Zoology and botany also owe much to the study of fossils. The classification of both animals and plants has been rendered much more nearly complete, through the insertion of many intermediate orders, the blastids, the cystids, the cyclocystids, the peculiar palæozoic starfishes, the receptaculites, the trilobites, the eurypterids, the many orders of fishes from the old Red, the labyrinthodonts, the wonderful reptiles of the secondary, the odontoterms or toothed birds, including the archæopterix (a bird with a tale of a reptile), the strange Eocene mammals and ungulates, the extinct marsupials of Australia and edentata of South America, and the Pliocene hippopotami of Asia and Africa are some of the examples.

Vertebrate palæontology has furnished data for some fairly well proven genealogies of various existing animals, especially of the large mammals, which have been traced back through allied forms, in a closely connected series to early tertiary times. In several cases, notably in that of the horse, the series are so complete that there can be little doubt that the line of descent has been demonstrated.

Comparative anatomy and embryology owe much to the study of fossils, especially a greatly enlarged knowledge of the vertebrate skull, the limb arches and the limbs, together with the law of brain growth, found to exist among extinct mammals and other vertebrates, which law Marsh, its discoverer, states as follows:—"All tertiary mammals have small brains. There was also a gradual increase in the size of the brain during this period. The increase was confined mainly to the cerebral hemispheres, or higher portions of the brain. In some groups the convolutions of the brain have gradually become more complicated. In some the cerebellum and olfactory lobes have even diminished in size." Since this general statement further research has shown "that the same general law of brain growth holds good for the birds and reptiles from the Secondary epoch to the present time," and the facts so far gathered indicate that as a general law this will hold good for all extinct vertebrates.

To Archæology also, Palæontology has rendered great service in extending our knowledge of the antiquity of the human race. Evidences which after having long accumulated to be rejected merely because not in accord with accepted theories, have been during this century re-examined and added to, until now they are strong enough to make the conclusion inevitable that the occurrence of the remains of man in the Pliocene now fairly establishes the fact of the existence of man in that period.

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REPORT OF THE CONCHOLOGICAL BRANCH.

(Read March 13, 1890.)

The leaders of the Conchological Branch have to report that they have personally been able to do little work in the field during the past season, and they are not aware that any other members of the club resident in Ottawa have taken up the study. This is greatly to be regretted for, as will be seen from the present report, much remains to be done before the list of Ottawa mollusca can be considered complete.

A very prolific locality (the wood between St. Louis dam and the Experimental Farm) was visited by the writers on one or two occasions, and in moss collected there many interesting though minute land

shells were found—*Pupa contracta, Vertigo pentodon, V. curvidens, V. ovata, V. Gouldii* (very common), *V. simplex, V. Bollesiana, Zonites milium, Z. exiguus*, etc., etc.

In a little wood near the Canada Atlantic Railroad at Archville *Zonites minusculus* and *Binneyanus* were found, together with *Punctum pygmæum* in some numbers, and *Pupa contracta, Vertigo ovata, V. Bollesiana* and *V. pentodon.*

At the outlet to Leamy's Lake, a capital locality, were found, *Sphærium rhomboideum, S. partumeium* and other freshwater shells and a small *Pisidium* there taken is thought by Mr. Latchford to be *P. rotundatum*, new to our lists.

But though little field work has been done, the leaders have devoted considerable time to the study of the species in their collections, and they have reached the conclusion that some alterations are necessary in the Ottawa lists. This is specially the case in puzzling groups such as the Amnicolæ and Pupidæ, and papers on the local species of these groups are in preparation.

Up to the present time there have been recorded in the transactions of the club, 126 species of land and freshwater mollusca. Of these the writers are of opinion that 5 must be dropped :—

Amnicola Sayana, Anth.—Tr. I. iii, 57. These were *A. granum*,

A. decisa, Hald.—Tr. I. iii, 57. These were *A porata.*

Limnæa lanceata, Gould.—Tr. I. iii, 58. These were *L. stagnalis*, young.

Physa brevispira, Lea.—Tr. I. i. 39, 62. These were *P. Billingsii.*

Planorbis lentus, Say.—Tr. I. i. 39. These were *P. trivolvis.*

In place of these, 6 other species can now be added :—

Sphærium stamineum, Conrad. Rideau River at rifle range.

Pisidium rotundatum, Prime. Outlet to Leamy's Lake.

Amnicola Cincinnatiensis, Anth. Rideau Canal.

Amnicola pallida, Hald. Local specimens of this species are in the Geological and Natural History Survey Museum.

Vertigo curvidens, Gould. Woods near St. Louis dam.

Helix dentifera, Binney. The Ox-bow farm, Casselman.

The number of species on the list is now, therefore, 127, namely :—Freshwater bivalves, 41; freshwater univalves, 39; land shells, 47.

There are, however, some species about which the writers are very doubtful, and which may eventually have to be dropped.

Appended to this report is the Ottawa list of land and freshwater mollusca as it at present stands.

References are added to the pages in the Transactions on which the species are recorded or referred to, and a ? is prefixed to all names that are still in any way doubtful.

GEO. W. TAYLOR,
F. R. LATCHFORD.

NOTE.—The papers with reference to Ottawa Land and Freshwater Shells that have been published in the Transactions of the Club up to date are as follows :—

Heron, G. C.—On the Land and Freshwater Shells of the Ottawa. Trans. vol. I, pt. i, p. 36 and 62.

Latchford, F. R.—Notes on the Ottawa Unionidæ. Trans. vol. I, pt. iii, p. 48.

Latchford, F. R.—Observations on the Terrestrial Mollusca of Ottawa and vicinity. Trans. vol. II, p. 211.

Small, H. B., and Symes, P. B.—Report of Conchological Branch for 1881. Trans. vol. I, pt. iii, p. 57.

Poirier, P.—Report of Conchological Branch for 1882. Trans. vol. I, pt. iv., p. 74.

Latchford, F. R., and Poirier, P.—Report of Conchological Branch for 1883. Trans. vol. II, p. 130.

Latchford, F. R., and Poirier, P.—Report of Conchological Branch for 1884. Trans. vol. II, p. 263.

Latchford, F. R., and Poirier, P.—Report of Conchological Branch for 1885. Trans. vol. II, p. 350.

Latchford, F. R.—Report of Conchological Branch for 1886. Otrawa Naturalist, vol. I, p. 107.

Latchford, F. R.—Report of Conchological Branch for 1887–88. Ot. Nat. vol. III, p. 65.

Taylor, G. W., and Latchford, F. R.—Report of Conchological Branch for 1889. Ot. Nat. vol. IV, p. 52.

List of the Land and Freshwater Mollusca of Ottawa as recorded in the Transactions of the OttawaField-Naturalists' Club, up to April 1st, 1890.

A.—Freshwater Bivalves.

1.—Sphærium sulcatum, Lam. Trans. Ot. F. Nat. Club vol. I, pt. i, p. 40; II, 265-6.
2.— " striatinum, Lam. Tr. I, i, 40.
3.— " stamineum, Conr. Ot. Nat., vol. IV, p. 53.
4.— " rhomboideum, Say. Tr. I, i, 40.
5.— " occidentale, Prime. Tr. I, i, 40; Ot. Nat. I, 107.
6.— " partumeium, Say. Tr. I, i, 40.
7.— " secure, Prime. Tr. I, i, 40; II, 132, 264.
8.— " rosaceum, Prime. Tr. II, 351.
9.— " truncatum, Linsley. Tr. I, iii, 59.
10.—? Pisidium Adamsi, Prime. Tr. I, i, 40.
11.—? " compressum, Prime. Tr. I, i, 40.
12.— " abditum, Hald. Tr. I, i, 40; II, 264.
13.— " ventricosum, Prime. Tr. I, i, 40; II, 264.
14.—? " rotundatum, Prime. Ot. Nat. IV. 53.
15.—Unio complanatus, Sol. Tr. I, i, 40; iii, 49; II, 265, 266; Ot. Nat. I, 114; III, 65, 66.
16.— " gibbosus, Barnes. Tr. I, i, 40 (as dilatatus); iii, 50; Ot. Nat. I, 114; III, 66.
17.— " ellipsis, Lea. Tr. I, i, 40 (as U. olivarious); I, iii, 50; Ot. Nat. I. 114; III, 66.
18.— " rectus, Lam. Tr. I, i, 40; iii, 50; Ot. Nat. I, 114; III, 66.
19.—Unio radiatus, Lam. Tr. I, i, 40; iii, 50; II, 264.
20.— " luteolus, Lam. Tr. I, iii, 51; II, 265.
21.— " Canadensis, Lea. Tr. I, iii, 52.
22.— " borealis, A. F. Gray. Tr. I, iii, 52, pl. II, fig. 1, 2, 3; Ot. Nat. I, 114; III, 66.
23.— " cariosus, Lea. Tr. I, iii, 51.
24.— " occidens, Lea. Tr. I, iii, 51; Ot. Nat. I, 114; III, 65, 66.
25.— " subovatus, Lea. Tr. I, i, 40 (as cardium); I, iii, 51.
26.— " alatus, Say. Tr. I, i, 40; iii, 52; Ot. Nat. I, 114; III, 66.
27.— " gracilis, Barnes. Tr. I, iii, 52; Ot. Nat. I, 114; III. 66.
28.— " pressus. Lea. Tr. I, iii, 52; iv, 74.

29.—Margaritana marginata, Say. Tr. I, i, 40; iii, 54.
30.— " undulata, Say. Tr. I, i, 40; iii, 54; Ot. Nat. I, 114; III, 66.
31.— " rugosa, Barnes. Tr. I, i, 40 (as costata); iii, 54.
32.—Anodonta edentula, Say. Tr. I, iii, 55.
33.— " undulata, Say. Tr. I, i, 40; iii, 55; Ot. Nat. I, 114; III, 66.
34.— " subcylindracea, Lea. Tr. I, iii, 55.
35.— " Benedictii, Lea. Tr. I, iii, 55; II, 266.
36.— " Lewisii, Lea. Tr. I, iii, 56.
37.— " implicata, Say. Tr. I, iii, 56.
38.— " Footiana, Lea. Tr. I, iii, 56.
39.— " lacustris, Lea. Tr. I, iii, 56; II, 265.
40.— " fragilis, Lam. Tr. I, iii, 56; iv, 74; II, 265.
41.— " fluviatilis, Dillwyn. Tr. I, i, 40 (as cataracta); iii, 56; II, 263, Ot. Nat. III, 66.

B.—Freshwater Univalves.

42.—Campeloma decisum, Say. Tr. I, i, 39; II, 132, 263, 265, 266.
43.—Valvata tricarinata, Say. Tr. I, i, 39; II, 263.
44.— " sincera, Say. Tr. I, i, 39 (as humilis); II, 264.
45.—Amnicola porata, Say. Tr. I, i, 39; iii, 57; II, 265.
46.— " pallida, Hald. Ot. Nat. IV. p. 53.
47.— " limosa, Say. Tr. I, iii, 57.
48.— " Cincinnatiensis, Anth. Ot. Nat. IV. p. 53.
49.— " granum, Say. Tr. I, i, 39; iii, 57 (as Sayana, Anth.).
50.—? Pomatiopsis lapidaria, Hald. Tr. I, i, 39.
51.—Goniobasis livescens, Menke. Tr. I, i, 39; iv, 74.
52.—Limnæa stagnalis, Linn. Tr. I, i, 39; II, 131, 263.
53.—? " decollata, Mighels. Tr. I, i, 39.
54.— " columella, Say Tr. I, i, 39; II, 132.
55.— " megasoma, Say Tr. I, iii, 58; iv, 74.
56.— " palustris, Miill. Tr. I, i, 39 (as elodes and umbrosa); II, 264.
57.— " catascopium, Say. Tr. I, i, 39; II, 264, 266.
58.— " emarginata, Say. Tr. I, iii, 58; II, 264.
59.— " caperata, Say. Tr. I, i, 39; II, 264.

59*a*.—Limnœ—var. umbilicata, Adams. Tr. I, iii, 58.

60.— " desidiosa, Say. Tr. I, i, 39; II, 263, 265.

61.— " humilis, Say. Tr. I, i, 39.

62.— " gracilis, Jay. Tr. I, i, 39; 62, pl. II, f. 4.

63.—? " lepida, Gould. Tr. I, iii, 58.

64.—Physa Lordii, Baird. Tr. I, i, 39 and 62, pl. II, f. 3; iv. 74; Ot. Nat. III, 67.

65.— " gyrina, Say. Tr. I, iii, 58; II, 264.

66.— " ancillaria, Say. Tr. I, i, 39; II, 263. 264.

67.— " Billingsii, Heron. Tr. I, i, 39 (as brevispira, Lea); I, i, 62, pl. II, f. 5.

68.— " heterostropha, Say. Tr. I, i, 39; II, 264, 265, 266.

69.— " hypnorum, Linn. Tr. I, i, 39.

70.—Planorbis campanulatus, Say. Tr. I, i, 39; II, 263.

71.— " trivolvis, Say. Tr. I. i, 39; II, 263, 4, 5, 6, Ot. Nat. III, 67.

71*a*.— " —var. macrostomus, Whiteaves. Tr. I, i, 39; Ot. Nat. III, 67.

72.— " bicarinatus, Say. Tr. I, i, 39; II, 132, 266; Ot. Nat. III, 67.

73.— " exacutus, Say. Tr. I, i, 39; II, 264.

74.— " deflectus, Say. Tr. I, i, 39; II, 264, 265.

75.— " albus, Müll. Tr. I, i, 39 (as hirsutus); II, 266.

76.— " parvus, Say. Tr. I, i, 39.

77.—? " Billingsii, Lea. Tr. I, i, 39.

78.—Planorbis armigerus, Say. Tr. I, i, 39.

79.—Ancylus parallelus, Hald. Tr. I, iii, 58.

80.— " rivularis, Say. Tr. I, i, 39.

C.—Land Shells.

81.—Selenites concava, Say. Tr. I, i, 40; II, 130, 212, 263.

82.—Limax agrestis, Müll. Tr. I, iv, 74; II, 131, 222.

83.— " campestris, Binney. Tr. I, i, 39; II, 131, 223.

84.—Vitrina limpida, Gould. Tr. I, i, 39; II, 222.

85.—Zonites (Mesomphix) inornatus, Say. Tr. I, i, 40; II, 212, 263, 264.

86.— " (Hyalina) nitidus, Müll. Tr. I, i, 40, 62, pl. II. f. 6; II, 131, 213.

87.—Zonites (Hyalina) arboreus, Say. Tr. I, i, 40; II, 213, 263, 264.
88.— " " radiatulus, Alder. Tr. I, i, 40 (as electrina); II, 213, 263, 264 (as viridula).
89.— " (Hyalina) indentatus, Say. Tr. I, i, 40; II, 214, 264.
90.— " " minusculus, Binney. Tr. I, iii, 59; II, 214.
91.— " " milium, Morse. Tr. I, i, 40 note, 62, pl. II, f. 8; II, 130, 214.
92.— " (Hyalina) Binneyanus, Morse. Tr. II, 214; Ot. Nat. I, 107.
93.— " (Hyalina) ferreus, Morse. Tr. II. 215.
94.— " " exiguus, Stimpson. Tr. I, i, 40; II, 130, 214,
95.— " (Conulus) fulvus, Drap. Tr. I, i, 40 (as chersina); II. 215, 263, 264.
96.— " (Gastrodonta) multidentatus, Binney. Tr. I, i, 40; II, 215.
97.—Tebennophorus Carolinensis, Bosc. Tr. I, i, 39; II, 224, 265.
98.—? " dorsalis, Binney. Tr. II, 264.
99.—Patula alternata, Say. Tr. I, i, 40; II, 215, 263.
100.— " striatella, Anth. Tr. I, i, 40; II, 216, 263, 264.
101.— " asteriscus, Morse. Tr. II, 130, 216.
102.—Helicodiscus lineatus, Say. Tr. I, i, 40; II, 216.
103.—Punctum pygmæum, Drap. = minutissimum, Lea. Tr. I, i, 40, 62, pl. II. f. 7; II, 221; Ot. Nat. I, 107.
104.—Helix (Mesodon) albolabris, Say. Tr. I, i, 40; II, 218, 264, 351.
105.— " " dentifera, Binney. Ot. Nat. IV. 53.
106.— " " thyroides, Say. Tr. II, 219, 265.
107.— " " Sayii, Binney. Tr. I, i, 40; iv, 74; II, 219, 263, 264.
108.— " (Stonotrema) monodon, Racket. Tr. I, i, 40; II, 217, 263.
109.— " (Vallonia) pulchella, Müll. Tr. I, i, 40; II, 221.
110.— " (Strobila) labyrinthica, Say. Tr. I, i, 40; II, 217, 265.
111.—Pupa corticaria, Say. Tr. I, i, 40; II, 226.
112.— " armifera, Say. Tr. II, 225.
113.— " contracta, Say. Tr. I, i, 40; II, 225, 265.
114.— " simplex, Gould. Tr. I, i, 40; II, 227.
115.— " milium, Gould. Tr. I, iii, 59; II, 130, 227.

116.—Vertigo ovata, Say. Tr. I, i, 40; II, 226.
117.— " Gouldii, Binney. Tr. I, i, 40; II, 130, 226.
118.— " Bollesiana, Morse. Tr. II, 226.
119.— " ventricosa, Morse. Ot. Nat. III, 68.
120.— " pentodon, Say. Tr. I, i, 40; II, 225.
121.— " curvidens, Gould. Ot. Nat. IV. 53.
122.—Ferussacia subcylindrica, Lin. Tr. I, i, 40 (as B. lubricus); II, 224.
123.—? Succinea aurea, Lea. Tr. I, iv, 74.
124.— " avara, Say. Tr. I, i, 39; II, 131, 229.
125.— " obliqua, Say. Tr. I, i, 39; II, 229, 263; Ot. Nat. I, 107.
126.—Succinea ovalis, Gould. Tr. I, i, 39; II, 130, 227, 265.
127.—Carychium exiguum, Say. Tr. I, i, 40.

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BOOK NOTICE.

The School Fern-Flora of Canada; by Prof. George Lawson, Ph.D. LL.D., F.R.S.C., pp. 221-251, 1889. We have to thank our esteemed member Dr. Lawson for a copy of his School Fern-Flora of Canada, which has been published as an appendix to a reprint of Dr. Asa Gray's "How Plants Grow," lately issued by Messrs. A. & W. Mackinlay, of Halifax, N.S. The whole volume containing both works will be supplied by the publishers for 75c, but a discount of 20% will be allowed if ten or more copies are taken. As is well known, Dr. Lawson has made a special study of our Canadian ferns, and there is no doubt that the publication of this paper will be welcomed by many of our members who are frequently enquiring for a small and intelligible work upon this favourite branch of our native flora. There are no plants which are so universally admired as ferns, and none of greater interest than those which grow wild in our northern woods and rocky ravines. Botanists and lovers of nature are now provided with a means of identifying any fern they may find growing wild, for this little work, which is illustrated by one plate upon which 17 genera are figured, "comprises descriptions of all ferns known to inhabit the Dominion

together with an account of their geographical range or prevalence in the several Provinces, and special localities for the rarer species."

The author has adopted names for some of the genera and species which will be unfamiliar to our botanists who have worked with Gray's manual; but it is probable that in most instances these will be accepted; it seems a great pity, however, that the synonyms were not given for at least those species which appear in the Manual under other names. A little more information on the part of the author with regard to some of the localities, particularly those of this district, would decidedly have made the work more useful. These, however, are small defects which will probably be remedied in a future edition. On the whole Dr. Lawson's little book is a welcome addition to the works upon our Canadian flora.

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EXCURSION TO LACHUTE.

An invitation has been received from the Natural History Society of Montreal for the members of the Ottawa Field Naturalists' Club to join them upon their annual spring excursion.

The excursion this year is to be on Saturday, 7th June, to Lachute, on the Canadian Pacific Railway, a beautiful spot about 45 miles from Montreal, which experience has shown presents many attractions for students in every branch of natural history. Addresses will be delivered by Sir William Dawson, Prof. Penhallow, and other eminent naturalists.

Through the courtesy of Mr. W. C. VanHorne, President of the Can. Pac. Ry., tickets will be issued to members of our club and their friends at the low rate of $1.50 for the return trip. These tickets will be issued by the railway authorities, at the railway station or at the Sparks St. office, upon presentation of our club excursion tickets; these can be obtained from any member of the council (the names of all of whom appear on the cover of the Naturalist). As large a delegation as possible to represent the club is of course desirable.

The train leaves the Union Station at 7 o'clock A.M.

NEW MEMBERS.

(Elected since the Annual Meeting, March 18th, 1890).

Alexander, Mrs. J.
Alexander, Miss Isabel.
Angus, Miss L.
Bailey, Prof. L. W., *M.A.*, *Ph. D.*, *F.R.S.C.* (Fredericton, N.B.)
Baldwin, Miss E. G.
Baldwin, Miss H. A.
Bolton, Rev. C. E. (Wiarton, Ont.)
Borden, F. W., *M.D.*, *M.P.* (Canning, N.S.)
Brodie, R. J., *B. App. Sc.*, (Smiths Falls, Ont.)
Crawford, Mrs. Mary.
Darcy, Miss T.
Fisher, S. A., *M. P.* (Knowlton, Que.)
Fletcher, Miss C. F. S.
Gemmell, R. E.
Hardie, Miss Jessie.
Hay, W. H.
Henderson, Thomas.
Laflamme, Revd. J. A. K., *D.D.*, *F.R.S.C.* (Quebec).
Lovick, Miss G.
Matheson, W. M.
MacCabe, J. A., *LL.D.*
MacDougall, P. A., *M.D.*
McNaughton, H. F.
O'Brien, S. E.
Plunkett, J. M.
Robert, J. A., *B. App. Sc.* (Montreal).
Ryckman, Revd. E. B., *D.D.*
Saint-Cyr, D. N. (Quebec).
Saunders, W. E. (London, Ont.)
Saunders, Fred.
Senecal, C. O., *C.E.*
Smithson, Miss B. H.
Steckel, R., *C.E.*
Surtees, Robert.
Sweetland, John, *M.D.*
Topley, Mrs. W. J.
Waghorne, Rev. A. C. (New Harbour, N'f'l'd.)
Wait, F. G.
Weldon, Prof. R. C., *M.P.* (Halifax, N.S.)
Wood, Josiah, *M. P.* (Sackville, N.B.)

NEW CANADIAN MOSSES.

Described by Dr. Nils C. Kindberg, Linkoping, Sweden, 1889.

(Communicated by Prof. John Macoun, M.A., F.L.S., F.R.S.C.)

Dicranum rugosum, Kindb. N. sp.

Leaves very undulate, acute, from the middle dentate at the papillose borders; cells not rarely porose, the upper short, the others long and narrow, except the hyaline alar and the pale-yellow basal ones; costa narrow, subpercurrent, dentate at the back from the middle. Barren. Allied to *D. Shraderi.*—In damp woods near Halifax, Nova Scotia (June 21st, 1883). J. Macoun, Coll.

——Var. rugulosum, Kindb. N. v.

Differs in the leaves, being slightly undulate, subobtuse, canaliculate; the alar cells pale brown, the costa less dentate. Capsule oblique, evidently furrowed in a dry state.—In the Big Swamp, Murray, Northumberland Co., Ont. (October 10th, 1878.) J. Macoun, Coll.

Dicranum Drummondii, Bland, v. trachyneuron, Kindb. N. v.

Stems shorter than type. Leaves smaller, narrower and looser, more densely and evidently serrate on the borders, subuliform-cuspidate; alar cells yellow; costa not excurrent, rough also below the middle and upwards.—Cedar swamps at the base of the Oak Hills, Hastings Co., Ont. (August, 24th, 1876.) J. Macoun, Coll.

Desmatodon cernuus, Bruch & Schimp. var. xanthopus, Kindb. N. var.

Leaves less chlorophyllous than the type, costa virescent. Capsule larger; teeth more united; pedicel yellow.—On the the banks of Boggy Creek, Manitoba, where the "Carleton trail" crossed it (August 10th, 1872.) John Macoun, Coll.

Encalypta rhabdocarpa, Schwæger. var. leiomitra, Kindb. N. v.

Calyptra smooth; peristomial teeth blunt; spores larger, about 0.05 mm.; costa vanishing at the apex of the leaves.—On rocks along the Clearwater River, Athabasca, Lat. 57° (July 11th, 1888.) J. M. Macoun, Coll.

Physcomitrium strangulatum, Kindb. N. sp.

Differs from *P. pyriforme* in the leaves being shorter, obovate-lingulate, more or less acuminate, often serrate below the middle; costa longer, subpercurrent; capsule (unripe) larger, constricted under the orifice; calyptra longer; lid without a beak; pedicel flexuous or curved. —In a ditch, Port Dover, Ont. John Dearness, Coll.

Webera fontana, Kindb. N. sp.

Allied to *W. albicans*, but quite green, leaves not decurrent, more denticulate, at least to the middle. Barren.—In wet springy places at Canaan Forks, Queen's Co., New Brunswick (November, 1889). J. Moser, Coll.

Bryum pendulum, Schimp. × cylindricum, Kindb. N. Subsp.

Capsule narrow, cylindric-oblong; lid deplanate; spores small, scarcely 0.22 mm. long; flowers dicœcious; stem-leaves ovate; costa red, short-excurrent.—On wet rocks, Kananaskis Falls, Rocky Mountains (June 23rd, 1885). J. Macoun, Coll.

Thelia compacta, Kindb N. sp.

Stems closely creeping. Tufts green, very dense and thick. Branches erect, terete, obtuse and unilateral. Leaves cochleariform, rotundate-obtuse and short-apiculate, very scabrous at the back, with simple incurved papilliferous ciliæ; borders spinulose-dentate or fimbriate-ciliate; ciliæ long, curved up and dentate; costa obsolete or very short. Perichetial leaves oblong-lanceolate, narrowly-acuminate, fimbriate. Capsule pale-brown, ovate-cylindrical; teeth subulate, short and broad, horizontally divaricate when moist, distantly articulate, dusky, the top article cleft; basilar membrane short, scarcely $\frac{1}{4}$ the length of the teeth, without segments; operculum conic obtuse, not curved, $\frac{1}{3}$ the length of the capsule; pedicel smooth scarcely 1 cm. long. Differs from *Thelia hirtella* in the longer branches, the larger and more pellucid leaves, the greater leaf-cells and the longer, thicker capsule, also in the peristome. —Abundant on the stems of young maples in the central counties of Ontario. Fruiting abundantly in Seymour, Northumberland Co., and forming thick girdles about four feet from the ground. John Macoun, Coll.

Leskea nervosa, Myrin, var flagellifera, Kindb, N. var.

Stem furnished with numerous flagelliform branchlets ; leaves small.—On trees in McKay's woods near Ottawa (Oct. 24th, 1885). J. Macoun, Coll.

Thudium lignicola, Kindb. N. sp.

Monœcious. Tufts yellowish or bright green. Stems simply pinnate with few rhizoids and short, scarcely ramose, paraphyllia ; branches close, distichous, attenuate, flexuous or slightly recurved. Stem-leaves from the broad cordate base attenuate to a long, often curved, point, faintly striate, reflexed on the borders ; branch-leaves shorter, acuminate ; all denticulate from the middle upward and papillose at the back or on both sides ; cells obscure and rounded ; costa vanishing in or below the apex. Capsule cylindical, arcuate and light brown ; teeth pale ; ciliæ long, perfect ; annulus double ; lid conical. Differs from *T. Blandovii* in the shorter areolations of the leaf-cells, the smaller capsule and the shorter paraphyllia.—On rotten logs along the base of the Porcupine Mountains, Manitoba (July 29th, 1881). John Macoun, Coll.

Cylindrothecium cladorrhizans (Hedw) Sulliv. Non Schimp.

This species differs from the European *Cylindrothecium Schleicheri* Bruch, & Schimp, principally in the easily detached annulus of the capsule (Demeter Revue Bryol, 1885, No. 6).—On rotten logs and on stones and roots of trees in woods ; Ontario. Common at Ottawa.

Brachythecium rivulare, Bruch Ms. × Novæ-Brunsviciæ, Kindb. N. Subsp.

Stem irregularly divided ; branches simple and elongate. Leaves glossy, ovate, blunt or short-acute, striate, decurrent, indistinctly denticulate above or from the middle ; cells dilatate, principally the lower and the uppermost, the alar and basilar finally orange-reddish, the alar rarely greater ; costa short and simple.—On a horse trough at Canaan Forks, Queen's Co., New Brunswick (October, 1889). J. Moser, Coll.

Brachythecium cyrtophyllum, Kindb. N. sp.

Habit of a small form of *B. albicans*. Plants cæspitose, green and faintly glossy. Stems irregularly divided, not creeping ; branchlets

filiform sub-obtuse. Leaves small, close, loosely appressed when dry, open-erect when moistened, ovate-acute or short acuminate, not sulcate or decurrent, serrulate at least above the middle; borders recurved below the middle; areolation loose; upper cells narrowly rhomboidal, inner sublinear; alar quadrate somewhat numerous, chlorophyllose; costa stout reaching to $\frac{2}{3}$. Perigonial leaves ecostate. Dicœcious.—On elm logs in thick woods, Brighton, Northumberland Co., Ontario (October 6th, 1888). J. Macoun, Coll.

Isothecium (?) Dawsoni, Kindb. N. sp.

Tufts soft, bright green, intricate. Stems slender, filiform, irregularly branching, sparingly radiculose; branchlets short, flexuous or incurved. Leaves small, spreading, loose or not crowded, ovate-oblong, cuspidate or filiform-acuminate, at the base slightly reflexed on the borders, denticulate above, pellucid but sometimes faintly papillose; most of the cells narrow-lanceolate, the basal and marginal quadrate-oblong; costa none or very short and simple. Capsule oblong, pale brown, not striate; lid obliquely short beaked; annulus large, pedicel smooth, bright red-yellow, $\frac{1}{5}$ cm. long. Dicœcious. Habit of *Pylaisia velutina*.—On the base of trees in woods, Jupiter River, Anticosti (August 26th, 1883). J. Macoun, Coll.

Rhyncostegium (?) aneuron, Kindb. N. sp.

Tufts dense, green and glossy. Leaves distichous, crowded and patent, flat, ovate-oblong, acute or short-acuminate, estriate, entire or denticulate above the middle, decurrent; cells very long and narrow, the alar large, hyaline and subquadrate; costa none or obsolete. Capsule cylindric-obovate, horizontally curved; teeth yellow; pedicel smooth, 2 cm. long; lid unknown. Probably dicœcious.—This species could possibly be referred to *Plagiothecium*. On dead wood in Dow's Swamp, near Ottawa (October 17th, 1884). J. Macoun, Coll.

Amblystegium speciophyllum, Kindb. N. sp.

Plants loosely cæspitose, dark green. Stems capillary, irregularly ramulose, not or sparingly radiculose. Leaves small, long-distant, spreading, subcordate or oval oblong, blunt or sub-acute, entire or denticulate; cells short; costa sub-percurrent, broad, sometimes very distinct.

Barren. Probably dicecious. Habit of *Amblystegium Sprucei.* On rocks at Canaan Forks, Queen's Co., New Brunswick (November, 1879). J. Moser, Coll.

Amblystegium tenuifolium, Kindb. N. sp.

Plants loosely coherent, green ; stems capillary, irregularly ramulose. Leaves small, far apart, spreading, very narrow, ovate-lanceolate acute, often denticulate ; cells dilated but elongate ; costa more or less distinct. Barren. Habit of *Amblystegium Sprucei.*—On the borders of a pond near London, Ont. (June, 1889). John Dearness, Coll.

Hypnum (Harpidium) Moseri, Kindb. N. sp.

Differing from *H. uncinatum* in the leaves not being striate, but sometimes recurved at the base ; costa faint, often failing ; differing from all other *Harpidia* in the stem being densely radiculose.—On the base and trunks of poplar trees in woods at Canaan Forks, Queen's Co., New Brunswick (December 30th, 1889). J. Moser, Coll.

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REPORT OF THE ORNITHOLOGICAL BRANCH FOR THE YEAR 1889.

To the Council of the Ottawa Field-Naturalists' Club :

GENTLEMEN,—The leaders of the Ornithological Branch have the honour to report that during the year 1889 two additions were made to the list of Ottawa birds, viz.: *Falco peregrinus anatum* (Bonap.), Duck Hawk, mentioned in the Spring report published 1st August, and *Somateria dresseri* (Sharpe), American Eider A young male of this species, in the plumage of the female, is reported by Mr. G. R. White as having been shot by him on the Ottawa River a short distance below the city on 9th November. Another specimen (a male in mature plumage) said to have been shot on the Gatineau river, was bought on the By-Ward market, and is now in the museum of the Geological Survey. In this connection it is interesting to note the capture at Toronto, November 25th, of a male of the King Eider (*S. spectabilis,* Linn.), the first positive record for Ontario. A Cardinal Grosbeak

(*Cardinalis cardinalis*, Linn) was observed several times during the spring of 1888 by Mr. H. B. Small and others in a garden on Wilbrod Street, but was not reported to the leaders at the time. It has not been deemed advisable to add this species to the list in the face of the possibility that it may have been an escaped cage bird.

The Field Sparrow (*Spizella pusilla*) was observed in two different localities in 1889, and remained during the Summer, but in neither case was the female seen, nor was the nest discovered. On 13th July Mr. R. B. Whyte found a Sora Rail (*Porzana carolina*) dead in his garden, bearing marks of having met its death by flying against some object, probably at night. A Hudsonian Chickadee (*Parus hudsonicus*) was seen on 20th October, an unusually early date for the species.

Notes of the supposed observation of *Geothlypis agilis* and *Turdus aliciæ* were inserted in the report for the year 1888 (Vol. II. p. 150). Neither of these has been confirmed, and for the present, at least, they are dropped from the list. Appended are lists of the departures of summer birds and the arrivals of winter ones.

Summer birds last seen :—

July 7.—*Seiurus aurocapillus*, Ovenbird.
8.—*Geothlypis philadelphia*, Mourning Warbler.
20.—*Habia ludoviciana*, Rose-breasted Grosbeak.
21.—*Dolichonyx oryzivorus*, Bobolink.
28.—*Spizella pusilla*, Field Sparrow.

Aug. 3.—*Contopus borealis*, Olive-sided Flycatcher.
6.—*Melospiza georgiana*, Swamp Sparrow.
8.—*Dendroica pennsylvanica*, Chestnut-sided Warbler.
8.—*Sylvania canadensis*, Canadian Warbler.
8.—*Passerina cyanea*, Indigo Bunting.
10.—*Tachycineta bicolor*, Tree Swallow.
11.—*Totanus solitarius*, Solitary Sandpiper.
11.—*Molothrus ater*, Cowbird.
25.—*Sturnella magna*, Meadowlark.
25.—*Chelidon erythrogaster*, Barn Swallow.
25.—*Icterus galbula*, Baltimore Oriole.
25.—*Coccyzus erythrophthalmus*, Black-billed Cuckoo.

Aug. 28.—*Progne subis*, Purple Martin.
Sept. 1.—*Agelaius phœniceus*, Red-winged Blackbird.
1.—*Myiarchus crinitus*, Crested Flycatcher.
1.—*Setophaga ruticilla*, American Redstart.
1.—*Petrochelidon lunifrons*, Cliff Swallow.
1.—*Trochilus colubris*, Ruby-throated Hummingbird.
1.—*Helminthophila ruficapilla*, Nashville Warbler.
2.—*Chætura pelagica*, Chimney Swift.
2.—*Tyrannus tyrannus*, Kingbird.
8.—*Clivicola riparia*, Bank Swallow.
8.—*Vireo olivaceus*, Red-eyed Vireo.
14.—*Vireo gilvus*, Warbling Vireo.
15.—*Dendroica blackburniæ*, Blackburnian Warbler.
15.—*Sphyrapicus varius*, Yellow-bellied Sapsucker.
15.—*Pandion haliaëtus carolinensis*, American Osprey.
15.—*Mniotilta varia*, Black and White Warbler.
15.—*Actitis macularia*, Spotted Sandpiper.
15.—*Dendroica maculosa*, Magnolia Warbler.
15.—*Dendroica virens*, Black-throated Green Warbler.
15.—*Seiurus noveboracensis*, Water Thrush.
17.—*Poocœtes gramineus*, Vesper Sparrow.
22.—*Carpodacus purpureus*, Purple Finch.
22.—*Geothlypis trichas*, Maryland Yellowthroat.
22.—*Ampelis cedrorum*, Cedar Waxwing.
23.—*Empidonax minimus*, Least Flycatcher.
24.—*Chordeiles virginianus*, Night Hawk.
25.—*Melanerpes erythrocephalus*, Red-headed Woodpecker.
25.—*Colaptes auratus*, Flicker.
25.—*Urinator imber*, Loon.
26.—*Buteo latissimus*, Broad-winged Hawk.
28.—*Vireo solitarius*, Blue-headed Vireo.
28.—*Sayornis phœbe*, Phœbe.
28.—*Dendroica æstiva*, Yellow Warbler.
28.—*Anas obscura*, Black Duck.
28.—*Anas boschas*, Mallard.
28.—*Aix sponsa*, Wood Duck.

Sept. 28.—*Anas carolinensis*, Green-winged Teal.
29.—*Spizella socialis*, Chipping Sparrow.
29.—*Podilymbus podiceps*, Pied-billed Grebe.
29.—*Contopus virens*, Wood Peewee.
29.—*Certhia familiaris americana*, Brown Creeper.
30.—*Turdus fuscescens*, Wilson's Thrush.
30.—*Cistothorus palustris*, Long-billed Marsh Wren.
30.—*Fulica americana*, American Coot.
Oct. 2.—*Ardea herodias*, Great Blue Heron.
2.—*Botaurus lentiginosus*, American Bittern.
3.—*Quiscalus quiscula æneus*, Bronzed Grackle.
3.—*Galeoscoptes carolinensis*, Catbird.
5.—*Dendroica coronata*, Myrtle Warbler.
6.—*Ammodramus sandwichensis savanna*, Savanna Sparrow.
9.—*Troglodytes ædon*, House Wren.
10.—*Zonotrichia leucophrys*, White-crowned Sparrow.
13.—*Scolecophagus carolinus*, Rusty Blackbird.
13.—*Gallinago delicata*, Wilson's Snipe.
13.—*Ceryle alcyon*, Belted Kingfisher.
14.—*Sialia sialis*, Bluebird.
16.—*Falco sparverius*, American Sparrow Hawk.
17.—*Circus hudsonius*, Marsh Hawk.
17.—*Otocoris alpestris praticola*, Prairie Horned Lark.
19.—*Totanus melanoleucus*, Greater Yellow-legs.
20.—*Passerella iliaca*, Fox Sparrow.
20.—*Zonotrichia albicollis*, White-throated Sparrow.
22.—*Merula migratoria*, American Robin.
24.—*Spinus tristis*, American Goldfinch.
27.—*Regulus calendula*, Ruby-crowned Kinglet.
28.—*Melospiza fasciata*, Song Sparrow.
29.—*Troglodytes hiemalis*, Winter Wren.
29.—*Spizella monticola*, Tree Sparrow.
Nov. 1.—*Branta canadensis*, Canada Goose.
1.—*Anthus pennsylvanicus*, American Pipit.
1.—*Sitta canadensis*, Red-breasted Nuthatch.
1.—*Glaucionetta clangula americana*, American Golden-eye.

Nov. 3.—*Regulus satrapa*, Golden-crowned Kinglet.
4.—*Junco hiemalis*, Slate-coloured Junco.

Winter birds first seen :—

Oct. 19.—*Acanthis linaria*, Redpoll.
20.—*Parus hudsonicus*, Hudsonian Chickadee.
29.—*Lanius borealis*, Northern Shrike.

Nov. 1.—*Plectrophenax nivalis*, Snowflake.

Dec. 22.—*Pinicola enucleator*, Pine Grosbeak.

WM. A. D. LEES,
JOHN MACOUN, } *Leaders.*

OTTAWA, 14th March, 1890.

During the discussion which followed the reading of the above report, Prof. Macoun questioned the accuracy of the results obtained by Mr. Lees's system of observation with an opera glass, and asked for a detailed explanation of the system. Mr. Lees explained that, having first acquired from a study of the commoner birds a fair knowledge of the characters distinguishing the families or higher groups, each new species met, having been first assigned to its appropriate family or group, was carefully scrutinized with the aid of the glass, and its markings literally read off and compared with one after another of the descriptions in the text book, till one was found to correspond with it. In this way the list of unidentified species in each family was gradually narrowed down till it became comparatively easy to hit upon the proper description at once. In many cases the bird had to be carefully stalked and followed for some time, and in some it was not until it had been seen on several different occasions that it was finally and satisfactorily identified, the greatest care being taken to avoid mistakes. Besides the text-book, recourse was also had to the colored plates in De Kay's "Natural History of New York," and to the mounted specimens in the Geological Survey Museum. He also pointed out that two persons working together, as he and Mr. N. F. Ballantyne had done, could give mutual assistance of great value, one holding the glass and

the other the book. Mr. Kingston, who also observes with a glass, stated that instead of taking a text-book to the field he noted in a small book kept for the purpose, the size and markings of each bird, following the same order in every case, and compared the descriptions with those in the books afterwards. On these explanations being given, Prof. Macoun expressed himself satisfied that, with proper care, there was no reason why these systems or either of them should not lead to accurate results. He also said that for amateur ornithologists they were much to be preferred to the system of shooting, so often followed to excess and without discrimination.

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REPORT OF THE GEOLOGICAL BRANCH.

(Read March 14th, 1890.)

To the Council of the Ottawa Field-Naturalists' Club:

GENTLEMEN:—In presenting to you the summary Report of the Geological Branch of the club's work for the year 1889 to 1890, the leaders desire to announce that continued interest in this line of enquiry is still manifest amongst many of our members. It would be very strange indeed if it were otherwise, seeing that the district in which we live is replete with interest on every side to the student of Geology. The field of our observations has been only run over, and whilst considerable work and good results have been obtained and wrought by members of our Club, yet, the region offers inducements on every hand. Whether we have to deal with one or other of the three great systems of rock-formations in this district, viz., the Laurentian or Archæan, the Palæozoic, the Post-Tertiary, each one offers enough material to be worked out and new facts to be developed and systematized for years to come.

I. In the Laurentian rocks of the Ottawa district, the mode of occurrence, distribution and genetic history of the crystalline limestones, of the iron ores, the phosphate deposits and the relations of these to the areas of intrusive granites, pegmatites and gneisses and

numerous dykes of diabase, diorite and other constituents togethe with the occurrence of the ophites, serpentines, jaspers, graphite, mica galena and other minerals and rocks (characterizing that period of time in the history of the earths' crust in our locality) are all questions which naturally present themselves for study, furnishing abundant material for investigations in mineralogy and petrographical science of the highest type.

The vast amount of mineral wealth which the Ottawa region affords is known to be such as to predicate a bright future for mining operations at our very doors. The Buckingham, Bristol, Templeton and Hull mines of iron, apatite, mica, &c., are still in their infancy, new, rich and valuable deposits are found almost weekly by experts, so that this region bids fair soon to become a very extensive and important mining centre.

II. In the Cambro-Silurian or Ordovician deposits at Ottawa we find a continuous sequence of sedimentary rocks from the Potsdam formation through the Calciferous, Chazy, Bird's Eye and Black River, Trenton and Utica to the Hudson River formation with the possible occurrence of the basal beds of Silurian rocks east of the city.

Up to the present time these various formations have afforded a great deal of fine material and fossil remains teem throughout the various measures to such an extent that nearly every outcrop may be said to be fossiliferous from the bottom to the top.

At the sub-excursions held during the past collecting season, new material was found, and it is the experience of every collector in the Ottawa district that each days' systematic search in any formation will afford new and interesting discoveries. Some of our formations like the Trenton and Utica have been fairly well examined, but more detailed and systematic work is what is now required in all of them.

III. In the field of Post-Tertiary or Surface Geology there remains much to be done. The evidences and phenomena characterizing the glacial epoch are so numerous, varied and replete with interest owing to the peculiar orographic features of this region on the border line of the great Archæan nucleus and plateau that there can scarcely be said to be a more inviting field of research anywhere in Canada. Mr. Ami has continued his investigation into the history of these various deposits,

and has been able to collect additional material during the past season of considerable interest and value In the history of the more recent overlying marine clays and subsequent sands, ancient beaches, river channels, gravels and estuarine deposits as well as in the marl deposits of this region he has also collected a large amount of valuable data.

With a view to bring before the members of our Club and palæontologists generally as well as geologists, each work bearing on Canadian geology and palæontology as soon as published, one of your leaders has undertaken the task to review the same and note them in the OTTAWA NATURALIST.

To accompany the description of a new *Turrilepas*, viz., T. Canadensis, Woodward—which had been sent to the author for determination—Mr. Ami wrote a stratigraphical note and added a section, all of which were published in the July number of the Geological Magazine, London, England, for 1889.

Quite a number of obscure forms of graptoloidea were discovered in beds of Lower Trenton age at Hull. These, along with another series from Lewis' sHill and Concession Street form an interesting group of Trenton Graptolites which it is hoped soon to supplement with better material and study.

Two additional specimens of *Brachiospongia digitata*, Owen, were discovered in Hull, also specimens of *Lichas Trentonensis*, Conrad, in the Trenton quarries, Hull, Que.

At the sub-excursions held during the past season quite a number of members of the Club availed themselves of the opportunities afforded of examining the geological features of this region and obtained considerable information and some interesting specimens.

With regard to the attempt made by a local company to sink a drill-hole for "natural gas, petroleum, salt or any other kind of mineral or substance that can be utilized."—to quote the words of one member of the company—they were made aware that the hole was being drilled at a point which would not give the locality a fair test by any means, and that moreover the most bituminous rocks and formations known in the district were absent at that point—between Bank and Percy street south, and near to the Canada Atlantic Railway line. The great improbability then stated has only been corroborated by the evidence

obtained in the work and the "Table showing the Rock-Formations of the district" by Mr. H. M. Ami* in their natural order has been thoroughly confirmed by the drillings obtained at the works. Many of these were examined by Mr. Ami and their evidence was quite conclusive.

Special examinations were made of the Post-Tertiary formations at Poupore's Quarry, Hull, and a valuable series of photographs taken by Messrs. H. N. Topley, Mr. McConnell and Mr. Low, in company with Mr. Ami. These illustrate very well the mode of occurrence and distribution of these deposits at the locality in question.

Whilst the excursions afford information to a larger number of members of the Club—it is manifest that only when work is of a more individual, close and systematic nature does it result in being of a more useful kind. Small working parties are found to be of incalculable value in obtaining reliable information and carrying on original work in any district.

In conclusion, your leaders hope that the interest manifest in Geological work by the members of our Club may continue, and the whole is respectfully submitted.

H. M. Ami,
A. P. Low,
Leaders.

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EXCURSION No. 3.

Members will please take notice that the next General Excursion of the Club will be held on Saturday the 19th July. The place chosen is Montebello, a thriving village, charmingly situated on the North bank of the Ottawa River, about 40 miles from the city. It is noted for its surrounding forests, mountains and numerous cold water brooks and springs, and near it is the fine mansion of the Papineau family. The Steamer *Empress* will leave the Queen's Wharf at 7:30 A. M. and return at about 7 P. M. The following rates will be charged: Adults, 50c.; Children over 6 and under 12 years, 25c. The locality is rich in minerals and of much general interest to geologists, while the fauna and flora are abundant and of an exceedingly varied character.

*The Ottawa Naturalist, Vol. II., No. 6, p. 96.

THE WOLF (CANIS LUPUS).

By William Pittman Lett.

The present, according to the Ontario Game Act, is what is known to sportsmen as the "close season," that *pax vobiscum* interval, during the continuance of which the wild birds and wild animals of the forests, the rivers and the lakes are supposed to be allowed to rest in undisturbed tranquility, unawed by the presence of man, unstartled by the deadly reverberations of the rifle or the shotgun.

Next to the matchless and magnificent surroundings of a happy sojourn in a tent, in the lonely and beautiful solitudes of the wilderness—next to a successful hunt with congenial companions, skilled in the mysteries of wood and water craft—may be classed the enjoyment of telling your experience, what you know, what you have learned, amid the solemn, sublime and illimitable glories of nature. The pleasureof the situation is enhanced, when the detonating story of the camp fire is told to kindred spirits, to sportsmen, to naturalists, to reading and thinking men, who are certain to appreciate the attractions of the narrative if it has any, sure to comprehend all, and perhaps much more than you are able to tell them.

I need scarcely say that I am delighted to find myself standing once more before the Field-Naturalists' Club of the City of Ottawa. Perhaps I have said as much before. Very likely I have. "Out of the fulness of the heart the mouth speaketh." In whatever I attempt I am ever and always an enthusiast. If I place myself in a lowly rank in that frequently misjudged and misunderstood band, nevertheless, under the light of history, I come to the conclusion that at appointed times—in favourable crises—enthusiasts have been the men who in various eras in the past, have created religious, moral, social, political and scientific earthquakes in the world. I have accidently stumbled upon an interesting and practically inexhaustible subject. I can't pursue it now. I just leave it, by simply saying, that in my opinion, one hour of enthusiastic energy in any cause, is worth a whole year of cold, calculating induction. Enthusiasm is the electricity of intellect, it is the sweeping flame of earnest endeavour. It is the strong, soaring wing

of the spirit which carries the votary of truth above the mountain top, and enables him to get a nearer view of the stars.

Every man is an enthusiast, whose prophetic eye can see through the mist—who, gifted with a prescinct insight into the abstruse problems, obstacles and contingencies of his day, takes off his coat, rolls up his sleeves, and cries, come on! to difficulties in the glorious warfare for human liberty, human progress, material development and scientific investigation.

NOW FOR THE WOLF.

Hark to that minstrelsy, ringing and clear!
'Tis the chorus of death on the trail of the deer;
The fierce forest bloodhounds are gathering in might,
Their echoing yells wake the silence of night,
As relentless they stretch over mountain and plain,
The blood of their fast speeding victim to drain;
They close—he stands proudly one moment at bay—
'Tis his last—they are on him, to ravage and slay!

The wolf belongs to the genus *Lupus*, or the canine family. According to "Audubon and Bachman's Quadrupeds of North America," the wolf has six incisors in the upper and six in the lower jaw ; one canine tooth in each jaw, and six molars above and six below.

GENERIC CHARACTER OF THE WOLF.

The three first teeth in the upper jaw, and the four in the lower jaw are trenchant, but small, and are also called false molars. The great carnivorous tooth above is bicuspid, with a small tubercle on the inner side; that below has the posterior lobe altogether tubercular. There are two tuberculous teeth behind each of the great carnivorous teeth. The muzzle of the wolf is elongate, tongue soft, ears erect, but sometimes pendulous in the domestic varieties. The fore feet are pentedactylous, or five toed, the hind feet tetradactylous, or four toed. The teats are both inguinal and ventral.

The grey wolf of Canada—the typical large wolf of North America —is about five feet six inches in length from the point of the nose to extreme end of the tail; ordinarily twenty-six inches high at the shoulder; larger ones, however, measuring twenty-eight inches and upwards in

height, and they weigh from eighty to one hundred pounds when in good condition.

I give the latter measurements and weight from the bodies of wolves which I have killed, and I am confident that I am rather under than over the actual size and weight of the American wolf.

There are several varieties of American wolves, differing so much from each other, chiefly in colour, as to lead naturalists to the conclusion that they are different in species, and do not originate from the same primeval stock. They are all about the same size, and when they chance to meet, band together in the same pack.

In size and other distinctive peculiarities, the larger wolves differ from the prairie wolf and the coyote. Both of these smaller varieties burrow in the ground; are much less savage or destructive, and much more docile and affectionate in a state of domestication; and also, much more easily tamed than are those of any variety of the larger species.

According to the best zoological authorities, all the varieties of the larger species of wolves are dwellers upon the surface of the earth, sleeping in the open air, or making their dens in caves or crevices of rocks.

The most valuable skins are obtained from the white arctic wolf. The next in thickness of fur and costliness, is the skin of the grey wolf of North America, and so on down to the pelt of the black wolf, which being a southern animal, ranging in a warmer habitat, carries the coarsest and thinnest coat of the entire genus, and his skin consequently is of the least value.

The grey wolf, the variety most common in Canada, bears a striking resemblance to the European wolf. There are, however, differences between them, which appeared at one time to be distinct and permanent. Naturalists of later years seem to be unanimous in the conclusion that the wolves of the old and the new world belong to one species.

The American wolf, notably the Canadian variety, is at least equal in size to that of any other country.

Billings tells us, that the body of the American wolf is long and gaunt, muzzle elongate and somewhat thicker than that of the Pyrenean wolf, head thick, nose long, ears erect and conical, eyes oblique, as is the case with all true wolves; pupil of the eye circular, tail straight and bushy. The animal does not carry it curled over his back like a dog.'

To this correct and excellent description I may add that the eye of the North American wolf is of a greenish colour; its expression is sneaking and sinister, intermingled with an aspect of extreme cunning similar to, but far surpassing in force that of the yellow eye of the fox. As stated above, the tail of the wolf is bushy, but corresponding with the size of the animal it is neither so long, nor so elegantly rounded and heavy as that of the fox.

At one time the grey wolf was found all over the American continent, as far south even as the Gulf of Mexico. It is still to be met with in considerable numbers on the great plains of the west, in the northern and western States, on the slopes of the Rocky Mountains, and in more or less abundance, according to favorable location, in all the remote or sparsely settled portions of Canada, New Brunswick, Newfoundland and Cape Breton.

As before remarked, the black, red and grey, as well as the white wolves of the arctic regions are believed by scientific naturalists to belong to one and the same species. In physical conformation, size, weight and general character they are specifically identical. The difference of colour alone, attributable to the influences of diversity of climate, appears to be the only distinguishing feature between one variety and another. In voice, form, and manner of hunting their prey, all the varieties of the North American wolf are essentially similar.

In early times in Canada, and in the valley of the Ottawa, not less than in other places, wolves were dangerously abundant. In all new settlements, sheep, when a farmer was fortunate enough to possess any, had to be carefully penned up every night, otherwise wool would certainly have been found flying before morning.

It was not alone that in one of those nocturnal raids many sheep were devoured. This was not the worst feature in the transaction. A couple of these bloodthirsty marauders, in a single night, would kill fifteen or twenty sheep, simply tearing their throats for the purpose of sucking the blood, without otherwise mutilating the carcasses.

After such a catastrophe cheap mutton was easily procurable; frequently too at a season of the year when the old pioneers were obliged to live without meat of any kind, fresh or salt, for months at a stretch. For the benefit of those who may be unacquainted with the hardships

and privations endured by the enterprising men who with axe and handspike opened up the blooming glades of civilization in our ancient forests, I may say that this enforced economical fast usually did not terminate until the pigs were killed in December.

My subject this evening is the wolf. Let me call him, *pro tempore*, to suit the occasion, *Lupus Canadensis*, as I shall deal chiefly with the wolf of the Ottawa Valley, perhaps as large, as fierce, as cunning, and as sanguinary an animal of the amiable family to which he belongs, as can be found in any part of the world.

Apart from the information which I have gathered from the authentic records of natural history, I have had a somewhat intimate acquaintance of a personal nature with this voracious bandit of the wilderness—an acquaintance based upon practical observation, supplemented by the agency of steel traps.

It is a commonly received opinion that the fox surpasses all other animals in cunning. I have had what I consider good and sufficient reasons for doubting the correctness of this conclusion. I do not like to disturb an old popular belief, nevertheless I think that anyone who tries to catch a wolf in a steel trap, will agree with me in the fact, that the wolf is a much more cunning animal than the fox.

In my younger days, I trapped many foxes and wolves, as well as fishers, minks and muskrats. I used no pungent oils, or other extraneous attractions to wile them, but simply matched my own intelligence against their cunning, and in the case of the wolf, I have often for many successive days, found myself completely circumvented.

In proof of the persistent cnnning of the wolf, I may relate a circumstance which bears directly upon the point. While out trapping in the month of November, 1840, I fastened a piece of liver upon the knotty spike of a hemlock tree, about three feet from the ground, and set a well concealed trap under it. The wolves frequented the spot every night, and although they trampled a circle in the snow about six feet from the tree, or twelve feet in diameter, their dread of the trap prevented their touching the meat, notwithstanding the fact that it remained in its original position until the first day of April.

A short distance from the same spot, during the same year, I caught three wolves, twenty-seven foxes, three fishers and a marten. I

had more real difficulty in capturing the three wolves than I experienced in catching all the others.

I captured the wolves in the following manner. I deposited a quantity of pigs' livers and other offal in the centre of a dense cedar swamp, near the present site of the Carp village, in the Township of Huntly. I had heard wolves howling there after deer on several occasions previously, and I was aware that they had killed a number of sheep and a few young cattle in the neighborhood. The wolves soon scented the bait, and gathered around it. I frequently had the pleasure of listening to their inimitable music in the vicinity of the bait. I visited the spot about three times in each week, always stepping carefully in the same tracks, going to and returning from the bait. I found that during the first three weeks they had not ventured closer than within six or eight feet of the bait, although the snow was beaten down by their tracks all around it.

Early in the fourth week I found that they had devoured the greater part of the bait. The hour for action had arrived. I then renewed the bait, and set a trap in front of it, where they had again commenced eating. After the trap was set I was particular in leaving the snow and the surroundings exactly as I found them. Next morning I found the springs of the trap bare; the snow had been scraped away and the bait eaten on the other side. I then set another trap on the opposite side, and next morning found the snow and covering scratched away from both traps. I was somewhat puzzled, but determined to persevere. I then set both traps in such a manner, that, should the wolves attempt the scratching trick again, the first part of the traps that could possibly be touched would be the pan. The wolves came that night, and one of them remained there; for, to my great satisfaction, I found him fast in one of the traps in the morning. He was a fine, large specimen, twenty-eight inches high at the shoulder, correspondingly long and bulky, and weighing at least eighty pounds.

As it has fortunately turned out for the purposes of this paper, I subjected *Mr. Lupus* to a critical examination. I stirred him up smartly, and experimented upon him, with the view of practically learning something which I did not then know about the members of his interesting race. I endeavoured to make him give tongue, but all my efforts

proved fruitless. I could not induce him to utter a single sound, nor did he attempt to snarl or growl even under strong provocation. I noticed that whenever I stepped off a few paces, at each step he raised his body until he stood at his full height. At each step as I approached him again, he lowered himself until he lay flat on the ground with his head between his paws, in which position he remained as long as I stood beside him. He seemed exceedingly shy and timorous; but he was far too cunning to display any ferocity.

An otter, a fisher, a lynx or a marten would have growled, snarled and fought viciously under similar conditions.

I feel convinced that with a collar and chain, I could have led him home without difficulty. I put this opinion to the test, in the following manner. For the purpose of fastening the trap, I had cut down a balsam sapling about two inches in diameter, the root end of which I cut off square, into which I drove a staple. To this staple I locked the trap chain with a small padlock. I then replanted the tree exactly in the spot where it had grown, aud where the wolves had been in the habit of seeing it night after night for weeks.

When I had completed my zoological experiments—never then expecting to tell you anything about them—I unlocked the chain and started towards home. The wolf arose and followed me quietly for about a quarter of a mile, when I accidently tripped over a pine root and fell. Had I not known something about the history and character of my companion, there might have been, then and there, a tragedy of peculiar interest. The instant I fell, and before I attempted to rise, I turned my head quickly and looked my prisoner in the eye. I found him with his eyes flashing and his whole body gathered for a spring. The moment I caught his eye he cowered before my gaze. Had I not been prompt, it is quite within the bounds of possibility that my audience might not have heard my story. However, I was young, strong and active then, and you may rest assured that I could not have been silenced without a determined and sanguinary struggle.

Long before the occurrence of the incident just related, I had learned that it was dangerons to fall even in the presence of a domesticated wolf.

I need scarcely say that I did not trouble my amiable companion

to follow me any farther, but with one blow of a heavy stick which I carried for the purpose, I laid him out, as doubtless in his time he had laid out many a beautiful deer preparatory to devouring him.

The three wolves I had killed formed part of a pack which had, a few weeks before their tragical departure for "the happy hunting grounds," committed serious depredations. I put the succeeding two, each of which was equal in size to the first, through a like process of investigation, but failed to elicit anything new.

I had frequently heard the pack in full cry at night. Had it been close at hand, the sound might have proved terrifying to persons not gifted with an ear capable of appreciating nature's majestic harmonies. To me, however, the nocturnal chorus of those wolves, seemed the clearest and most melodious musical effort I had ever listened to. Since then I have heard wolves frequently, but nothing in their tones has caused me to change my opinion.

The Madawaska River, so far as unrivalled natural beauty could make it so, was once the foaming Queen of the Ottawa's magnificent tributaries—has along its turbulent course many rapids and chutes of marvellous grandeur and beauty. One of these chutes, situated about one hundred miles from Ottawa, is called "Wolf Portage." It was so named on account of deer being chased by wolves into the constantly open water at that point. In winter time the hunted deer were in the habit of plunging into the rapids to escape the fangs of their sanguinary pursuers. In catching their prey at the foot of the portage the wolves displayed much cunning. When a deer took the water at the head of the chute, it was quickly carried over the rough rapid into the gradually narrowing ice-enclosed glade or channel at the foot. Just at the spot where the current drove it against the ice, under which it would immediately be whirled, a number of wolves stood on the ice, and the instant the deer touched its edge, it was seized, dragged out on the ice and devoured.

On the Madawaska River, in the early lumbering times, the skeletons of wolves could always be seen in winter lying on the ice at the foot of the Wolf Portage.

So numerous were the wolves in the woods on the Madawaska, that during the years 1840 and 1841, the deer were driven completely

out of the section of country lying between the High Falls and the Keminiskeek Lake, a distance of sixty miles in length, and ten miles from each side of the river. The deer began gradually to reappear there in 1844, and when they returned to their old haunts along "The Hidden River," the wolves followed them to their ancient habitat. For many years deer have been abundant in the Madawaska region.

The old "Stony Swamp," west of Bell's Corners on the Richmond Road, was at one time, much infested by wolves, on account of its having been a famous fastness for deer. The wolves of that section did considerable damage to the flocks of farmers in the neighborhood.

In connection with this well known old road, I remember an incident which took place in the year 1830. It may not be known to everyone that at that early period in the history of the County of Carleton, oxen were chiefly used for all purposes of draught and travel by the farmers of that day, simply because they had no horses. Farm produce was then drawn to Bytown Market on ox sleighs, and then, as now, the journey to the market was performed partly in the night.

One clear moonlight night a farmer from the westerly part of the Township of Nepean, was driving his oxen through the lonely windings of the road in the Stony Swamp. The season was winter. He had a small dog with him which was running along a short distance in front of the team. Suddenly he heard a piteous howl, and on looking in the direction of the sound, he saw an enormous wolf darting away through the trees with the struggling dog in his mouth.

During the first few years of the early settlement of Hull, wolves were very numerous and destructive in that neighborhood. They had killed many sheep, and had also very much disturbed the minds of timid people. Something decisive had to be done to abate the nuisance. A hunter set a trap and succeeded in catching one of the offenders. He skinned part of his head and sides, and fastened a broad red collar, to which was attached a bell, around his neck. The rather cruelly treated wolf was then liberated, and according to the story, wolves became scarce in the neighborhood of Hull for a number of years.

In the year 1839, in the beautiful month of October, when the maple trees, the gorgeous sentinels of earth, seem to wear the elegant livery of heaven, I was out one morning duck shooting on the River

Goodwood—so called after a river running through or near the estate of the late Duke of Richmond. The time was the early twilight, just preceding the dawn. Suddenly I heard the voices of a large pack of wolves in full cry after a deer. The wolves were running in thick cover on the opposite side of the river, which, at the point where I stood, was about forty yards wide. The moment was an exciting one; but I have no recollection of having been frightened in the least. I stood close to the edge of the water, ready to tackle them with a single-barrelled muzzle-loader, charged with No. 3 shot, and, at the time, regretted very much that they did not show themselves. The pack passed rapidly on through the dense undergrowth on the opposite shore, and caught the deer in a few minutes, a conclusion indicated by their silence. Sportsmen will not consider the story complete if I do not tell them that daylight immediately appeared, and the No. 3 was put to its legitimate use; and if I remember correctly, ten wild ducks constituted the result of that morning's tramp before breakfast.

On various occasions since the incident above referred to, I have listened to the magnificent melody of the hounds in full cry upon the steaming trail of the deer. Sportsmen need scarcely be told how far such a concert surpasses the highest effort of instrumental music. Everything considered, such a wild, weird, clear sounding musical performance as that with which I was favoured on the morning in question, I have never since heard. The "angry growl" attributed to the wolf by the novelist and literary theorist, who possibly never heard or saw one, and probably know as little, either practically or otherwise, about the animals, as the generality of would-be-witty writers do about the correct mode of rendering the Tipperary idiom—is just so far from the natural habit of the wolf as is the capacity of that animal to play the bagpipes.

Talking of the bagpipes reminds me of an incident which I remember reading about in my young days. In the early settlement of Canada, a Scotch piper was on his way through a forest path to a merry making In passing through a thicket his ears were assailed by the howls of a pack of wolves close around him. There was no use in running away, so Sandy struck up "The Campbells are coming," with might and main, and away scampered the wolves as if pursued by a

prairie fire. I do not believe that any animal in America could stand his ground and listen for two minutes to the Highland bagpipes.

So far as I am personally concerned, if accompanied by two thoroughbred bull terriers, and armed with a good Winchester repeating rifle, I shall be delighted at any time or place, in open daylight, to pay my respects to six of the largest wolves in America.

About twelve years ago, the hunting party to which I had the pleasure to belong, was encamped on the bank of Bearbrook, about twelve miles from Ottawa. It was during a cold time in the month of December, a fact which I distinctly remember, in consequence of having had to cut a large supply of birch stovewood to keep the tent warm. During our stay in camp on one occasion about midnight, we were awakened by the howling of wolves near at hand, accompanied by a noise like that produced by a large animal jumping through the snow. Rifles were instantly grasped, but the noise suddenly ceased, and all again was still. By the tracks found in the snow next morning, we discovered that a large buck had galloped within less than one bound of the back end of our tent, and had then turned aside. Upon following the tracks of the deer a short distance, the fresh tracks of two wolves were found on the trail. We did not follow them far. Had we done so, we should, doubtless, soon have discovered the mangled remains of the deer. Had the buck made one more bound in the direction in which he was going, we should have had an immediate row in that tent of more than ordinary interest and excitement. I have often regretted that the deer and the wolves had not landed on top of us in the tent. In that case I could have given you a true story eclipsing in romantic interest the most florid imaginary efforts of the most ingenious newspaper reporter of the present day.

Wolves were very numerous in the Township of Gloucester up to a few years ago, and doubtless there are many still in the solitudes of the vast tamarac swamps still existing within less than twenty-five miles of the City of Ottawa.

During the winter of 1868, Doctor Bell, of New Edinburgh, was driving through the long swamp east of Eastman's Springs. At that time there were lots of wolves within even ten miles of the city of Ottawa. While jogging along at an ordinary gait, the Doctor's horse suddenly

became restive, stood still and pricked up his ears in a startled manner. Just then a deer crossed the road a few yards in front of the horse. The poor animal was tired, its tongue was hanging out, and its panting could be heard quite distinctly. The howling of wolves was then heard close at hand, and after a few seconds eleven of those ferocious forest sleuth-hounds rushed across the road on the track of the deer. What a glorious chance for a sure eye, a steady hand, and a good repeating rifle. Although a keen sportsman, the worthy Doctor was armed only with what modern pathological science regards as the most killing weapon of the Faculty, his lancet.

Roman history, at least tradition, tells us that Romulus and Remus, the founders of the ancient city of the Seven Hills, were suckled and reared by a she wolf. If this story be true, the foster mother of those distinguished sons of the Tiber, in her nature, was not all wolf. This incident has been partially paralleled by the story of Androcles and the Lion, and that of Mabdonata and the Puma. All three of these interesting incidents are highly creditable to the character of the brute creation.

It is certain that the ancient Romans inherited none of the characteristic cowardice which fine drawn physiological science might trace to the source of their ancestors' early sustenance. Nevertheless the blood-thirsty instincts of the lupine race were amply exemplified by the humane and gentle rule of many of the Roman Emperors, notably Nero, Caligula, Galba, and Vitellius. Patriotically ferocious selfishness was also conspicuous in the too often misjudged character of Brutus; whose treason against the purest instincts of humanity, in my opinion, was only surpassed by the atrocious turpitude of Judas Iscariot!

The old wolf foster-mother of the founders of Rome, may have polluted some of the rivulets of Italian blood. You may search in vain amongst the Knights of the Stiletto, and the wretched organs-grinders of to-day, for a single heroic counterpart of those stalwart Roman warriors who carried off the Sabine women and bore the victorious eagles of Julius Caesar through ancient Gaul and Britain!

In the history of British America the instances are very rare indeed in which wolves are authentically reported to have attacked human beings. Emboldened by numbers, and stimulated into audacity by

hunger, the wolves of Russia and Siberia have, for ages, been a perpetual terror to night travellers in the frigid and inhospitable countries referred to; in the wild forests, and dangerous fastnesses of which, they are met with in such vast multitudes.

In a land where the humanizing influences of a refined civilization, are even yet in their extreme infancy, the dead and wounded, for hundreds of years, upon the battle-fields of intestine wars, were left to rot or be devoured by wild animals. Is it any wonder then, that the wolves of Russia have acquired a taste for human blood, and like the Bengal Tiger, have become man-eaters ?

In contradistinction to the habits of their European congeners, North American wolves, although comparatively bold under the pressure of hunger, commonly dread the presence of man, and flee from him in terror as do the deer and the black bear.

I remember a story current here in old times, about the fate of a gigantic indian named Clouthier—a rather Gallic designation for a pure Algonquin—who was well known to the late "Squire Wright," the original founder of the ancient village of Hull. My story may be true in every particular, for Clouthier was a man of herculean proportions, and almost superhuman strength.

Clouthier was a great hunter, and had a fine field for his prowess and skill in the neighborhood of Hull, which then abounded with bears, deer, moose, wapiti, otters and beaver. In one of his hunting excursions he was attacked and torn to pieces by a large pack of wolves. It was surmised by those who afterwards discovered his bones, and fragments of his clothing, that after he had shot one of his assailants with his single-barrelled flint-lock gun, he had drawn his tomahawk from his belt, and fought desperately for his life.

From the number of skulls and other portions of their bones found at the scene of the tragedy, it was calculated that the indian had killed fourteen of the wolves before he was overpowered. The dead wolves had all been devoured by their fellows, nothing of them being left but their bones. Like his scriptural prototype, the Algonquin Sampson did not fall unavenged.

If this story be correct—and it was considered quite authentic by the old inhabitants of Hull and Bytown—it is the only instance of

which I have heard or read, of wolves having attacked man in this part of Canada. On the contrary, I know of several instances in which one man had taken the carcass of a recently killed deer from as many as four wolves, without meeting with any resistance, although without a weapon of any kind.

In a thickly wooded country like Canada, hunting the wolf is necessarily confined to shooting, trapping and poisoning by means of strychnine. The latter mode of destroying wild animals is altogether unsportsmanlike, and, excepting under very peculiar circumstances, ought to be frowned upon and discouraged by all the sportsmen. Leaving out of the question the danger to domestic animals caused by putting out poison, many of the animals killed by this questionable method, wander off a long distance before they die, suffering extreme torture, and are never found

Wolves are seldom seen in the woods, even by those whose avocations oblige them continually to travel through the most solitary fastnesses. So keen is the eye and the ear, and so acute is the wolf's sense of smelling, that the hunter or bushranger is either seen heard or scented before he has any idea that a wolf has been near. Now and then an accidental shot may be obtained, but even such chances are few and far between.

Six years ago, while deer hunting, I saw an enormous wolf on the Madawaska River. He had been started by another hunter on the top of a mountain, and had rushed down the side of a ravine at the end of which I was watching for him. As he came within range, he jumped up and stood upon a log behind two pine trees growing together, which concealed every part of his body but his nose. As that part of his anatomy is not as vulnerable as the nose of a bear, I waited for him to take another step. This, to my great regret, he did not do, but jumped off the log and disappeared in the thick brush and tall weeds. Thus I lost my chance of obtaining a grand trophy ; and thus by his escape, I feel that many a beautiful deer afterwards lost its life.

Spearing the wolf, on the open prairie, in the manner of "Pig Sticking" in India, is a most exciting kind of sport, although not always unattended by danger, occasioned by badger-holes and prairie dog towns, which are frequently encountered in the chase.

But the grandest sport with the gray, or as he is called on the

prairies, the "timber wolf" may be enjoyed in coursing the animal with strong courageous greyhounds.

Although the grey wolf is an animal of great speed and endurance, he is soon overtaken by those fleet-footed gaze hounds, which, when they overtake him, snap at him and wound him with their sharp teeth and powerful jaws, and by their extreme agility avoid his dangerous attacks, keeping him at bay until the mounted hunter arrives and terminates the chase by a well directed pistol shot. For a time this kind of hunting taxes all the energies of the greyhounds, in consequence of the fleetness and great staying powers of the wolf, a swiftness, however, which may be termed comparatively slow work contrasted with the lightning performances of that telephone of the plains, the "Jack Rabbit," or correctly speaking, the great hare of the prairies.

It has been affirmed by the great naturalists of America, that the aborigines of this country, before the advent of white men, used domesticated wolves instead of dogs. This can readily be credited by any one acquainted with the indian dogs of even the present day. Although smaller in size, a condition superinduced by ages of neglect and starvation, the indian dog of the present is peculiarly and positively wolfish in aspect and characteristics.

It is a notable fact that an irreconcilable antipathy has always existed between the domestic dog and the tamed wolf of the Indians. In their constant quarrels and combats with each other, the former are always the aggressors. The Indian wolf dogs always act upon the defensive; usually trying to avoid a conflict with their more courageous kinsmen.

In other days, when the lordly bison frequented and ornamented the limitless prairies of the great Northwest, when their million-hoofed tramp shook the solid earth, the wolf was ever his sneaking and persistent enemy. He silently tracked the calves, the wounded, the aged and the helpless, until an opportunity presented itself for a safe attack.

A single white arctic wolf will run down a barren ground caribou and by one savage bite in the flank disable the largest buck.

Sir John Richardson, a distinguished arctic explorer, who has contributed many interesting facts to the general fund of natural history, tells us that the wolves of northern America run down and capture

foxes, whenever they find them on the open plains, at a distance from their underground dens. A large wolf is strong enough to carry off an arctic fox in his mouth at a rate of speed far surpassing that of hunters upon snowshoes. They are said frequently to attack and carry off the sleigh dogs of the Indians.

The northern Indians improve the breed of their sleigh dogs by crossing them with wolves. This process adds to their size, speed and strength. The voice of the wolf and that of the Indian dog, to my own personal knowledge, in volume and sound, is precisely similar.

Many years ago I remember having hunted deer with a large sized Indian dog. He was one of the best dogs that I ever turned loose upon a deer track. As he pursued his quarry his tongue was distinctly and unmistakably the howl of of a wolf, loud, clear and prolonged, without a single sharp bark like that of a dog. This dog, true to the instincts of his ancestry, never failed to find a deer, if there was one within reach, and once the game was found, he stuck to the trail like his old progenitors until he tasted blood. I would not mind paying what some of my audience would consider an exorbitant price for such another dog to-day.

When I speak of Indian dogs, I do not mean the miserable diminutive race of singed curs generally found in starving annoyance around an Indian camp to-day. Such attenuated whelps, in my opinion, can trace their origin to the fox ; certainly not to the wolf. I allude to the strong and hardy wolf dogs used by the Indians in the Northwest, and by the Esquimaux as they speed along over the snow under the crackling of the aurora borealis in the Arctic Circle.

The late Sheriff Dickson, of Pakenham, who, during many years of his life was, not only a successful deer hunter, but also an enthusiastic student of geology, in an interesting article on the wolf, published in the Canadian Naturalist and Geologist, gives many entertaining particulars respecting the Canadian wolf. From personal experience he bears testimony to the cowardice and treachery of wolves. When caught in a trap, wounded by a gunshot, or cornered up so that they could not escape he invariably killed them with a club or tomahawk, without ever meeting with any resistance. Wolves, he found, could always be frightened away from the carcass of a deer by firing a shot amongst them.

As their only means of escape, when hunted by wolves, deer make for the nearest water. Should the river or lake be narrow, the deer generally swim either up or down. Seldom straight across; and frequently after making a detour of some distance, land again on the same side from which they had entered the water. By this ruse the wolves are puzzled and put off the scent.

If there are weeds or thick brush growing along the shore, a hunted deer will sometimes sink himself under water in a thick clump, so that no part of his body can be seen above the surface but his head, by which his pursuers are baffled. On glare ice the wolf soon ends the chase. When frightened, the deer falls flat at every bound and is quickly overtaken and killed. Should a deer get into a strong rapid and the wolves attempt to follow, they are generally swept off their feet and carried away. If one should approach close enough, a large buck will often kill his foe with one blow from his sharp hoof. Dogs of the courageous kind are sometimes killed in the same manner.

The great and merciless slaughter of deer, however, occurs in the latter part of winter, when the snow is deep and covered by a crust strong enough to bear wolves or dogs, and not sufficiently so to support a deer. Then it is that the wild wolves of the forest, as well as the human wolves of a yet imperfect civilization, relentlessly murder the poor animals in hundreds.

I have now told you nearly all I know about the wolf, and also much of what I have learned from the valuable writings of standard naturalists concerning the life, habits and habitat of this widely distributed member of the great and interesting family of our north American carnivora.

From personal experience, and careful comparison, I have no hesitation in assigning to the wolf of the Ottawa Valley, if not a pre-eminence in size and weight, at least an equality in magnitude, as well as in all the other amiable characteristics distinguishing the genus *lupus* in any other land.

If I have been fortunate enough to add one original fact to the voluminous records of natural history, if I have imparted one instructive idea, if I have succeeded in amusing or entertaining my critical audience, if I have thrown but a single ray of new light upon the wolf, I shall consider myself specially favoured in having achieved more than I expected to accomplish.

REPORT OF THE ZOOLOGICAL BRANCH OF THE OTTAWA FIELD-NATURALISTS' CLUB FOR THE YEAR ENDING 18TH MARCH, 1890.

In the year which is just closing there have been no mammals observed in the immediate vicinity of Ottawa, which have not hitherto been seen and more or less accurately described. This does not mean, however, that the field is exhausted, as there is no certainty of such being the case, on the contrary, there are reasons for believing that there yet may be found among the smaller mammals species new to this locality, it being only about three years ago since the hairy-tailed mole (*Scapanus breweri*) was first noted as having been seen in this neighborhood

During the past year two specimens of mole shrew (*Blarina brevicauda*) were caught, one by Mr. Lees in the early part of December in the village of Ottawa East, and the other by Mr. Fletcher in Stewarton in January last, both of which were sent to Mr. Whiteaves of the Geological Museum and duly acknowledged. The one caught by Mr. Lees has been prepared and mounted and placed among the other animals in the museum. One specimen of the field mouse (*Arvicola pennsylvanica*) was caught in Mr. Fletcher's house on the 10th February, after having gnawed off about a yard of a lace curtain where it touched the ground. It gnawed its way into the room through the floor. It is well known that the common house mouse will eat starch quite readily, and probably the field mouse, having a similar taste, was attracted by the starchy dressing of the curtain.

A jumping mouse (*Zapus hudsonius*) was caught near Billings Bridge last summer by Mr. Bartlett, of the city post office, who ought to be a member of this club. The mouse is somewhat rare in this vicinity. It is now mounted and placed in the Geological Museum.

It is hardly necessary to mention that Mr. W. P. Lett gave a very nstructive and interesting lecture on the 21st February on the habits and characteristics of the common grey wolf before the members of this club. The animal in question having been very common in this locality thirty or forty years ago, but now never seen.

We think it well to recommend that in future the different mem-

bers of the club should be asked to report as soon as possible to the leaders of this branch, for the time being, if they should observe any animal which might be new to them, as important discoveries may often be lost for want of attention just at the time. They think also that it would be desirable to have printed, a list of all the mammals which have ever been known to frequent this neighborhood. Many of the larger kinds have now completely disappeared.

Respectfully submitted,

Ottawa, March 14, 1890. J. BALLANTYNE, W. P. LETT. } Leaders.

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CORRESPONDENCE.

To the Editor of the Ottawa Naturalist:

SIR,—In the transactions of the O. F. N. C. for 1883-84, the report of the Ornithological Branch notes that one of its members found the Short-billed Marsh Wren, *Cistothorus stellaris*, "very abundant" in a marsh along the Rideau, about twenty miles from the city. As this is a very rare bird in Ontario, and one whose acquaintance I have never made, I made enquiries about the locality, and on the 9th July my brother, F. A. Saunders, and myself took the C. P. Ry. to Osgoode and went from there to Kars, where we were informed the Marsh Wrens were to be found. The marsh was there, with the usual quota of marsh birds, viz: Florida Gallinule, Bittern, Carolina Rail, Virginia Rail, Red-winged Blackbird and Long-billed Marsh Wren, but though we searched diligently we could find no trace of the short-billed species. All we saw at short range were long-billed, and the only one we shot was of the same species, but as neither of us were familiar with the song of the short-billed, we might possibly have heard it without knowing it. The eggs would have provided a ready means of determining the presence of the Short-billed Wrens had they been laid, but though we examined between twenty and thirty nests, some of them almost if not quite completed, none contained eggs and we were again left in the dark. These nests, however, were the ordinary type of the long-bill, whereas the short-bill is said to build among long rush-like grasses,

covering the nest completely on the outside with living blades, so that it is comparatively difficult to find. The nest of the long-bill, placed high in the cat tails, is easily found, in fact the searcher is bewildered by finding three or four nests at one glance, most of which are invariably empty. It would be interesting to know if the authors of this note referred to, took specimens of the bird when the locality was visited before. The Short-billed Wren inhabits a much more restricted region than the other species, and has not, as far as I am aware, been reported as *common* from any other point in Ontario, and as the long-bill is abundant in every suitable locality in Western Ontario, New York State and all adjacent parts south and west, the chances are that the Short-billed Wren if present at Kars at all, is rare. Nevertheless, it is found in its greatest abundance through the States along the Atlantic, and as its numbers gradually diminish the nearer they approach Ontario, it is not impossible that they have been found as stated. I have observed the long-bill species in abundance in the marshes at Toronto, Rondeau, Point Pelee, and Lake St. Clair, and in smaller numbers in little pieces of bulrush marsh through the country, and in all these places they have shown their industry by building several unused nests for every one that is built for breeding purposes, but even then, their numbers are such that the collector has no difficulty in securing all the eggs he may desire. Their song is a medley of unmusical chatter, delivered generally on a short flight into the air, but often while perched on a dead bulrush stalk, and while they are not easily approached if sitting in a conspicuous place, their assurance is such that they will often come fearlessly to within 8 or 10 feet and sing and chatter at the intruder at a great rate, very likely making a big hullabaloo over his approach to the very nest they have decided not to use.

London, Ont. W. E. SAUNDERS.

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EXCURSIONS.

The next general excursion of the Club will be held on Saturday, 9th August, to Eastman's Springs, on the Canada Atlantic Railway. The train will leave Elgin street station at 2 P.M.

The following low rates have been arranged, which should secure a large attendance :—Members of the Club, 25c ; non-members, 30c ; children, 15c. Tickets must be bought from the Club.

September Excursion by vans to Kirk's Ferry on 6th September.

SERPENTINES OF CANADA.

By N. J. Giroux, F.G.S.A., C.E., P.L.S., of the Geological Survey of Canada.

The study of serpentinous rocks and other serpentines is certainly one of much interest and has been followed with great enthusiasm by several of the most eminent geologists.

As serpentines are met with in almost every country where geological work has seriously been taken up, scientists of all schools took part in the great discussions which ensued from their geognosy and geogeny. Such being the case it may be well to enunciate the views of a few of the best known writers on the subject before describing the mode of occurrence of our Canadian serpentines. The divergence of opinion as to the mode of formation and occurrence of serpentine did not originate until the view was expressed that they were of eruptive origin, and this is not so very long ago, as the most distinguished scientists were all of the opinion, at the beginning of this century that serpentines were stratified contemporaneous deposits. In 1826, Maculloch, in his geological classification of rocks, separated the primitive rocks into two groups, stratified and unstratified, and placed the serpentines and granites together in the latter. But subsequent studies led him to announce that like gneiss or mica-schist, the serpentines are stratified rocks. The great objection then, to classing serpentines with the unstratified rocks was that unlike granite and trap, they had not been found to present dykes or ramifying veins. However, De la Bèche, Brongniart, Elie de Beaumont and many others regarded them as an eruptive rock, and Professor Hitchcock, in 1835, speaking of serpentine says :

" Dr. Maculloch considers it as sometimes stratified ; and accordingly enumerates it in both these classes and also as a veinous rock. It occurs in connection with granite, gneiss, micaceous, chloritic and argillaceous schists."

These characters apply to the serpentine of Massachusetts, according to Professor Hitchcock, who places it along with the limestones in the stratified class. Favre and Stapff regard the serpentines as of aqueous and sedimentary origin. Dr. T. Sterry Hunt in 1859 and 1860 speaking of these rocks said they were undoubtedly indigenous

and resulting from the alteration of silico-magnesian sediments, and in many writings since has supported this view of the subject. In the transactions of the Royal Society of Canada, Vol. I, Sec. IV., 1883, is given the geological history of serpentines, including studies of Pre-Cambrian rocks by this author. Very interesting facts and many observations from several European and American geologists are mentioned in this clearly written paper, the most of which are in support of the theory therein advanced. Some of the serpentines that were then declared to be indigenous have been studied more in detail, and facts of recent date, brought to view, tend to show that these are in certain places eruptive.

The serpentines are, as we all know, metamorphic or igneous rocks, and consequently we should not judge of their age from lithological evidence only, for with very few exceptions this criterion is of little value. Since it is generally admitted that metamorphic rocks are not of any particular geological age, so we shall have to consider our serpentines as being also of different ages, for they not only differ in their lithological association but in chemical composition as well.

If we have serpentines that are the altered remains of olivine rocks, we have them derived from some other source as well, for it is impossible to suppose that the banded and slaty serpentines of the Shickshock mountains in Gaspé, and of Long Lake in the Province of Quebec are due to the metamorphism of the same class of stratified beds, the main constituents of which are derived from the trituration of olivine rocks ; for in that case they would occur in some characteristic bands, and this is not the case as far as we know.

There is a magnesian rock says Daubrée that is very closely allied to peridotite and therzolite although it presents a great many peculiarities which are not characteristic of these. Although serpentine is hydrated, infusible and without distinct crystallisation, it occurs with eruptive rocks, and the general view of geologists is that it is derived in many cases from peridotite, since it exhibits very often the characteristic form of crystals of that rock.

By his synthetic studies, Daubrée has discovered that very often serpentine has a tendency to change to a peridotite and he is of the opinion that it is derived from the hydration of olivine rocks. There

are many views expressed as to the genesis of serpentines and an enumeration of them would require more time than we have at our disposal. It can be stated however that in the opinion of some, serpentines are formed (by metasomatosis) from feldspathic rocks, such as diorites, diabases, granulites, &c., &c., or by a complete elimination of alumina and lime and the replacement of these bases by magnesia; others maintain that they are derived from the transformation of silico-magnesian deposits. Again would it not be possible to suppose that they might be formed from the limestones themselves, when we take into consideration the serpentinic structure of the Eozoon Canadense.

It is also mentioned by some that they are due to the hydration of eruptive olivine rocks, while others hold that they were ejected from the earth's interior in a state of aqueous magma or mud. Some of those who maintain their origin from the hydration of olivine rocks suppose such eruptive rocks to have passed into a hydrous state before being ejected.

If we consider all the transformations we can perform, with different temperatures and under different pressures in our laboratories which are so imperfect as compared to the great, wonderful, and unknown laboratory of the whole universe, we are at no loss in finding theories enough as regards the genesis of serpentines, for hypotheses are easily adopted, even by following the strict and well established chemical and physical laws.

This is not the place nor the time to enter into discussion as to the mode of formation of the rocks which will be described in this short notice as it is the intention of the writer to show, in the best way possible, the characters of our serpentines and their association with rocks of very highly scientific as well as of economic interest, without questioning mother Nature too much as to the course followed by her in giving rise to serpentine and the interesting series of minerals associated with it.

Let us then consider the sepentine as it actually is, a rock which enterprising capitalists, most serious chemists and zealous geologists look upon with so much speculating spirit and such contradictory views, without trying to solve the great problem of origin, a thing beyond reach.

Serpentine occurs in many places in this country, from the far west to the extreme east, associated with strata of different ages, and one would be surprised at the area it occupies on our maps although a great extent of the Dominion is still geologically unknown.

Our serpentine may be divided into four groups :—

1st. The Archæan group, or group No. 1, consisting of the Laurentian, Huronian and Pre-Cambrian serpentines ;

2nd. The Palæozoic group, or group No. 2, consisting of the Cambrian and Carboniferous serpentines ;

3rd. The Cenozoic group, or group No. 3, consisting of the Tertiary serpentines.

4th. Group No. 4, consisting of those of doubtful age.

LAURENTIAN SERPENTINES.

This serpentine is found associated with limestone and dolomite' but is most abundant in the limestone. It is frequently disseminated in grains varying in size, occasionally in scattered masses, and sometimes in interstratified beds. Its color varies from light green, greenish-yellow, pale-yellowish or greyish-green. It sometimes presents masses of yellowish-green spotted with crimson or blood-red patches from disseminated peroxyd of iron. It has a lower specific gravity, contains less oxyd of iron and more water than ordinary serpentines. It is very widely spread all over the country, and is found in nearly all the provinces.

Near Pisarinco Cove, New Brunswick, are reported crystalline limestones, grey and beautifully white, alternating with quartzites and diorites, and with occasional bluish argillites. Along with these limestones there are also some thinner beds of yellowish and purplish colours which contain serpentine. At another point apple-green and pinkish limestone is enclosed in a bed of diorite, both rocks being traversed by veins of serpentine holding chrysotile. Again, on the west side of the Narrows of the St. John River, in this same Province, can be seen pale grey and white crystalline limestone with a conglomerate of limestone pebbles in a serpentine paste. What is worthy of mentioning of the St. John River serpentinous limestone is that it contains the Eozoon Canadense.

The next areas of the Laurentian rock, which occur in a westward direction, are found in the township of Grenville, on the Ottawa River, Province of Quebec, where it is massive and nearly pure. Its colour is generally pale-yellowish, wax-yellow, or greyish-green, unless it has been penetrated in parts by red peroxyd of iron. In the serpentine of this township have been found very good specimens of Eozoon Canadense. A white lamellar dolomite from this township contains a large proportion of grains of honey-yellow serpentine.

Serpentine rocks analogous to these last are found in the seigniory of La Petite Nation, which adjoins the Township of Grenville. The serpentinous structure of the Eozoon Canadense is beautifully shown in many places in this seigniory, and the best specimens of that fossil exhibited in our museum were first collected there by Mr. James Lowe, who was for some time attached to the Geological Survey staff. Proceeding westward we find serpentinous rock in the Township of Templeton, where it is associated with the so well known mineral apatite. About 50 miles farther west, at the Calumet Falls, on the Ottawa River, pale green serpentine, associated with brown phlogopite and apatite, in a white crystalline limestone, has been described under the name of loganite. To trace the Laurentian serpentine westward we shall have now to cross the Ottawa River and enter the Province of Ontario, where it is first seen in the Township of Ramsay, Lanark County, and about 30 miles south-west of the Township of Templeton. It appears there sometimes of a beautiful amber-color, and in some parts of the township the mineral occurs entirely as disseminated grains through a pure white carbonate of lime, while in others it is distributed in lumps or patches from the size of a pea to that of a medium sized cannon ball. We find very analogous serpentine in Lanark township, and where this mineral is interstratified with the limestone, it forms a rock of striking beauty. On lots 23 and 24, range 3, Township of Dalhousie, the serpentine is interlaminated with a finely granular and brown-weathering crystalline limestone, which, on its weathered surfaces, shows forms very much resembling Eozoon. Similar limestone, without Eozoon structure, is found on lots 26 and 27, range 2.

In the township of South Sherbrooke, which lies due south of the township of Dalhousie, can be seen spotted serpentine limestones which

resemble very much those of Grenville on the Ottawa. They abound in veins of chrysotile, present a very rough weathered surface, and appear to be devoid of Eozoon.

In North Burgess, which adjoins Dalhousie, is found massive and nearly pure serpentine. Eozoon Canadense has been found in the serpentine limestone of this township, from which are also reported pure dolomites, with grains of steatitic pyroxene and green or yellowish-green serpentine, also accompanied by Eozoom.

About 20 miles farther south, and in the township of Loborough, county of Frontenac, white and coarsely crystalline dolomite is seen on lot 4, range X. This dolomite leaves, when dissolved in acids, a residue of quartz and serpentine, and contains traces of oxyd of iron and of phosphate.

Serpentine of probable Laurentian age is believed to occur on Wollaston or Hatchet Lake, as well as at the head of Reindeer Lake. Dr. Lawson reports having met serpentine in the Keewatin area, on the west side of Clear Water Lake, a tributary of Rainy Lake. This rock is massive and occurs there in a band, immediately followed to the west by hornblende schist and to the east by another band of green hornblendic schists and altered traps. Another mass of serpentine, in very analogous position, is seen on South Bay of Lake Despair, and Dr. Lawson reports this as occurring with some degree of constancy in the middle portion of the Keewatin trough, and thinks these serpentines are the altered remains of olivine rocks. A small boss of this rock has also been examined by the same gentleman at the south-west end of Sucker Lake, coming in with green schist. Dr. Lawson, speaking of the serpentines of the Keewatin area of the Lake of the Woods, says :

"This interesting class of rocks is not of extensive occurrence in this area, but is found irregularly distributed in patches of rather ill-defined character and extent." Of the Wiley Point serpentines he speaks thus :

"The quartz-porphyry occupies the greater portion of a small island two and three-quarters miles south-west of Wiley Point, and is evidently associated with a mass of serpentine which occupies a small island beside the north, and the neighboring point on the main shore a little to the south-west. The serpentine on this point presents no definite relations

to the other rocks, beyond the fact that it is in contact to the west with dark green somewhat chloritic hornblende schists, and that on the east the point is tipped with a nob of hard crystalline dioritic rock. On another point of the shore, one and a-half miles to the north-east of this occurs a second mass of serpentine, under conditions very similar to those just described. It is in contact to the west with green schists as before, and the extremity of the point occupied by the same dioritic rock, but with this difference, that between the dioritic and the serpentine there is a dyke fifteen feet wide of the quartz-porphyry, evidently an off-shoot from the main mass occupying the island off shore a little to the south. The masses of serpentine in these two points, and on the small island in immediate proximity to the quartz-porphyry, are nearly in a line, and also in a line with the general strike of the rocks at this locality ; but whether the serpentine is interbedded with the schists, or was originally intrusive, it is difficult to say from the evidence available in this particular case. The presence of the quartz-porphyry as an intrusion, associated with what appear to be dykes of diorite striking parallel to the dyke of quartz-porphyry, would seem to warrant us in regarding all these rocks —serpentine, diorite and quartz-porphyry—as different manifestations of outflows along a line of fissure, probably at widely-separated intervals, and altered according to the well-known tendency of these rocks, or rather of their original forms." Mr. Bayley has made microscopical examinations of these serpentines, and says that in many of them the forms of the original olivine can be clearly seen, although there is no trace of the mineral left. Dr. Lawson also reports serpentine to be more largely developed on the inland and shore of Shoal Lake Narrows than elsewhere in the region. He mentions also a boss of serpentine projecting through the black hornblende schists in the immediate vicinity of their contact with the gneiss.

Many minerals are associated with the Laurentian serpentine, but very few are found in workable quantity.

Small quantities of chrysotile have been mined for asbestos in lot 2, range 7, Templeton, but the fibre was so coarse and short that these works were soon abandoned.

The magnetic ore formerly smelted at the Marmora iron furnace was obtained from lot 8, range 1, of Belmont. This deposit presented

a succession of beds of ore interstratified with layers of greenish talcoid slate and of crystalline limestone, with which were also met serpentine, chlorite, diallage, and a greenish epidotic rock. Iron of a superior quality was manufactured from this deposit.

Pyrallolite, a mineral similar to steatite in chemical composition, softness, and refractory properties, is often met with in the Laurentian series. A bed of it, associated with serpentine, occurs between the gneiss and the limestone on lot 13, range 5, of Grenville. It may be traced thence into range 6, and appears to be in considerable quantity. The colour of this mineral is generally greenish-white or sea-green; some varieties of it are nearly white and have the translucency of porcelain. Very dark-coloured, nearly black varieties, have been described by Dr. Emmons, who says this mineral is capable of being turned in a lathe and wrought like soapstone, and has been made into small vases, inkstands and similar objects. Much of the figure-stone, or pagodite, of which the Chinese carve various ornaments, appears to be pyrallolite. It was used by the aborigines to make pipes and calumets.

The serpentine of lot 13, range 5, Grenville, and of some parts of the Township of Burgess, is of a pale-green colour, marked with spots of iron, and forms a fine ornamental stone.

The limestones of the Laurentian series are very important, not only on account of their extent, or their association with serpentine and apatite, but from the fact that wherever they occur the Laurentian region presents fine fertile valleys fit for cultivation. The principal settlements found among these rocks are upon the outcrop of the limestone bands. These limestones afford excellent lime as well as good materials.

The Laurentian serpentine on account of being light in colour in many places could be ground, and subsequently impregnated, by a peculiar process, with various mineral and vegetable colour, and then used for the manufacture of cheap and durable paints of various hues.

HURONIAN SERPENTINES.

These are but little known and of very limited extent.

Messrs. Bailey and Matthew report as follows of a series of rocks of Charlotte County, New Brunswick, which they suppose to belong to the Laurentian system :—

" With the ordinary type, however, there occur at two points to the north-east of St. Stephen, rocks of very different aspect. These are the dark grey dioritic rocks containing serpentine, diallage and chromic oxyd. About two miles north of St. Stephen, may be seen ledges of coarse grained, dark grey granitoid diorite, having thin layers of picrolite or fibrous serpentine in the joints as well as serpentinous matter in the body of the rock. In crossing these ledges towards St. Stephen, the rock becomes somewhat darker, and portions are met with exhibiting thin lamination, the laminæ being separated by layers of serpentine about one-eighth of an inch in thickness." There seems to be some doubt as to the age of these serpentinous rocks, and although supposed to be of Laurentian age, they are here placed under the head of Huronian rocks. The presence of chromic oxyd in them and the want of crystalline limestone in their association with other rocks give them quite a different character to those of the Laurentian series of this Province. The first outcrops of these serpentines which we know of, in a north-westward direction from these last mentioned are on Lake Abittibi where they are found to be associated with micaceous, hornblendic, and chloritic schists, fine grained hard quartzites, diorites and dioritic schists. A little island in this lake is composed of strongly magnetic serpentine with splintery fracture, resinous lustre and weathering dull white. An analysis of it was made by Dr. Harrington who found it to contain grains of chromic iron and a very small quantity of nickel besides silica, alumina, protoxyd of iron and magnesia.

According to Dr. Bell there is, in the middle of Pigeon Lake, and at about one mile from the lower end of it, a small island composed of very dark green serpentine, with strings of calcspar and crysotile. It weathers rusty, and Dr. Harrington, on analysis, found it to contain oxyd of chromium, both in the form of small grains and in chemical combination with the rest of the rock.

No mineral of economic importance has yet been found in these serpentines, but perhaps when the country where they are more abundantly met with is settled, some wandering geologist or hard-working *habitant* will discover in them large deposits of asbestos or other valuable mineral.

PRE-CAMBRIAN SERPENTINES.

Of these very little can be said; they seem to be limited to the almost extreme easterly portion of the Dominion. Mr. Hugh Fletcher, who so very carefully studied that section of the country, reports serpentines to occur in three different places :—

First, in Macdonald Brook, Cape Breton Island, where white, pyritous crystalline limestone, lemon-yellow serpentine limestone, and pale-green brown-weathering limestone, and tremolite in small fibrous tufts, occur between bluish-grey and red felsite and bluish-porphyritic felsite. Then on Kelvin Brook, in the same island, a cliff of coarse, reddish felsite, associated with greenish and red, mottled, soft serpentine, is in immediate contact with reddish coarse grit and conglomerate along an irregular line which runs N. 9° E.

On Campbell Brook, eastern Nova Scotia, some white crystalline limestone appears, some beds of which are covered on the surface with large knobs of light-greenish and white serpentine, but the hills are composed mainly of syenite.

These resemble very much the Laurentian serpentines in colour and in their association with crystalline limestones. No minerals of economic value were found in them.

CAMBRIAN SERPENTINES.

The most easterly outcrops of these are found in the Shickshock Mountains, Gaspé Peninsula.

*Mount Albert, which is one of the main peaks, is composed of serpentine. The thickness of this great mass is estimated to be about 1,000 feet The whole of it presents evidence of stratification, in some parts remarkably clear and distinct, in others more obscure. Much of the lower 600 feet is bottle-green in colour, with beds towards the top of a streaked and mottled reddish and greenish brown, much studded with small crystals of diallage. The upper 400 feet display the bedding very beautifully, by difference of colour on the weathered exterior, as well as in freshly exposed surfaces. The weathered surfaces are marked by a set of red and opaque white bands, the white broader than the red, varying from one-eighth of an inch to an inch in thickness, and becoming often interstratified with layers of a brownish fawn colour, which

*From Geology of Canada, 1863, page 266.

vary in breadth. When cut and polished, this serpentine displays dark brown parallel bands, with thin blood-red vein-like lines, running through those which are red on the weathered surface. These red lines are sometimes disposed after the manner of false bedding. Very thin parallel bands of asbestos are found separating the red layers, together with occasional crystals of diallage; both of these, in certain lights, give golden-red reflections. With the red bands, chromic iron ore is associated, which is sometimes diffused in grains along the layers. Occasionally minute faults displace the layers, and where they cross those which contain chromic iron, the fissures connected with the fault are filled with the ore for some distance on each side. Beds of chromic iron, of two and three inches in thickness, are met with in several parts, and somewhat above the well stratified serpentine, the ore occurs on the surface in considerable quantity, in large loose angular blocks, which are traceable on the strike for some distance, showing that workable masses are probably imbedded in the rocks.

Mr. Richardson's explorations during the summer of 1878 have shown that this serpentine is close to important rock-masses of olivine, which have undoubtedly given rise to it. Dr. Harrington made a microscopical examination of a sample collected by Mr. Richardson, and reports on it as follows :

" It shows a few minute black grains, probably of chromite, and rarely a little of a fibrous mineral which resembles enstatite." According to Dr. Harrington the olivine rock from Mount Albert is probably not eruptive.

Speaking of that part of the Notre Dame range, Dr. Ells, in the Geological Survey Report for 1882-83-84, says :

" Among the prominent features of the Shickshock range are the two bare hills of serpentine, the one on the eastern extremity overlooking the forks of the Ste. Anne River, and known as Mount Albert ; the other twelve miles west, on the Salmon branch, and called by Sir Wm. Logan the South Mountain. Of these the former was carefully studied and is described by Mr. A. P. Low, while the latter was the only one accessible to us. The latter presents a bold bluff on the south and west, rising to a height of over 1,200 feet above the Salmon branch, and extends for about two miles and a half east. The surface, like that of

Mount Albert, is either bare rock or is slightly clothed with a scattering growth of stunted spruces from five to twelve feet high, and small ponds with marshy edges occupy the depressions. The width of this mass of serpentine and associated rocks is about three-eighths of a mile. It rests upon the south flank of the hornblende schists, and terminates abruptly on the east bank of the branch, though a spur from its southern flank, of forty yards in width, crosses the stream in close contact with crystalline dolomitic rock.

The serpentine of this mountain apparently lacks the stratification seen in that of Mount Albert, and no traces of asbestos or chromic iron were discovered. On weathered surfaces it is exceedingly rough and ochreous.

Although the serpentines of this area have generally been regarded as an integral portion of the metamorphic series and contemporaneous in age, there are indications, at several places, which point to an eruptive origin. The position of the eastern or Mount Albert mass in particular, breaking, as it does, apparently across strata of Pre-Cambrian and Silurian age, gives it the aspect of an immense dyke, while the exposure noted as crossing the Salmon Branch, much of which is of peculiar character, is also like an intrusive rock.

In the Geological Survey Report for 1882-84, Mr. A. P. Low reports as follows of the olivine and serpentine of the Shickshocks :—

"These rocks are largely developed at the eastern extremity of the Shickshock range, and form the prominent peak of Mount Albert. They extend in a south-westerly course from the west side of Table-top Mountain across the south branch of the Ste. Anne River to Mount Albert, which is about the centre of the mass, and thence to the head water of the east fork of the Salmon Branch of the Cascapedia River, making a total length of twelve miles. The greatest breadth is four miles, on Mount Albert, but the average is not more than two and a half miles.

The rocks are chiefly olivine, more or less changed into a dark green serpentine, associated with patches of mottled brownish-red, the whole overlaid by banded beds. The green serpentine has sometimes a course, fibrous structure (picrolite), but the quantity is small and the quality not fine enough to make it commercially valuable as asbestos.

All the rock seen in Mount Albert was altered into the above serpentine, but on the eastern slopes, along the Ste. Anne River, olivine was found only slightly decomposed upon weathered surfaces.

These rocks all change to a light buff colour where they are exposed to the action of the atmosphere ; and as the soil above them is very poor, supporting little or no vegetation, a dead appearance is given to the scenery.

Banded structure is distinctly seen amongst the serpentine in the mountains, but the direction of the strike of the beds is not continuous nor parallel to that of the surrounding stratified schists, and is supposed to be due to flow structure, as the olivine is undoubtedly of igneous origin. Chromic iron is found associated with the green serpentine, and seems to be confined to certain beds of the rock, as it is found scattered along the strike in loose blocks, some of which are ten inches in diameter. This mineral was observed on the surface near the banded beds of serpentine, at the north-east side of the mountain, and also along a bed about two miles south of the first place. The ore was found to occur in small, widely separated pockets, scattered through the serpentine, and where seen is not in sufficient quantity for profitable mining.

Where the olivine crosses the Ste. Anne River, veins of steatite of a light green colour were observed, but the cost of transportation renders them of no economic value."

Mr. Frank D. Adams made a microscopical examination of a slice of the Mount Albert rock, and gives the following description of it:

"This rock, which is very fresh, is in section seen to be composed of olivine, arranged in very irregular bands of larger and smaller grains, together with a small quantity of an opaque-black iron ore, which, judging from its association with the olivine, is probably iron ore. A few grains of a very light brownish-green fibrous mineral, some of which show parallel extinction, are also present. These are probably enstatite, but none of them are cut so as to enable this to be determined with certainty. An interesting point in connection with this rock is that each grain of iron ore is surrounded by a greenish ring composed of an aggregate of wavy fibres, which in a few cases, where they were sufficiently large for examination were found to have a parallel extinction, and which resemble serpentine. It is an olivine rock."

The next areas of Cambrian Serpentines are those which occur in Eastern Canada, or more generally known as the Eastern Townships serpentines. They are by far the most important ones of the whole Dominion, not only on account of affording rich minerals, but also as being considered by some as an altered metamorphic rock contemporaneous in age with those highly metamorphosed strata which constitute the Quebec group.

Ever since the establishment of the Geological Survey, work has been done almost every year in that part of the Province of Quebec called the Eastern Townships, and very highly interesting facts have been collected by the different gentlemen of the Geological staff who were given this section of the country to work out; but it is not until 1886 that the first geological map of a part of that section of our territory was published to accompany Dr. Ells's report of that same year. Though no map had previously been published, much had been said of the complicated set of rocks of that region, not omitting the famous serpentines which very often form vast masses almost without admixture, and at other times, enclose diallage, actinolite, garnet, and chromic iron, or are intermingled with carbonate of lime, dolomite and sometimes with ferruginous magnesite, forming varieties of ophiolite rock into which talc often enters. They almost always contain small portions of chrome and nickel while these two metals appear to be altogether wanting in the similar rocks of the Laurentian series.

These serpentines which are closely allied to a band of diorite and dioritic rocks, extend from the Township of Potton, on the west side of Lake Memphremagog, and a few miles only north of the International Boundary line, in a north-eastward direction across the St. Francis River, or a stretch of about 115 miles. They appear in irregular but generally well defined masses and bosses, and although showing only here and there, the most of that distance, they do not deviate from the aforesaid direction except in the Townships of Shepton and Cleveland where they were around eastward towards the Township of Ham, whence they follow the general trend of all the formation, which is north-east. Sir Wm. Logan and Dr. T. Sterry Hunt held these serpentines to be of sedimentary origin, but Dr. Selwyn in the Geological Survey report of 1877-78, says :—

" I think there are very few who would agree with Dr. Hunt in the general proposition that the diorites and serpentines of the Quebec group are of sedimentary origin...."

Most of these serpentines however are almost always associated with dioritic rocks of which Dr. Ells reported as follows in 1885 :—

" Dioritic rocks are found at many points throughout the Townships, sometimes in masses of large extent, as in the Big Ham and Little Ham Mountains, and in the peaks along the western side of Lake Memphremagog ; at others, as bosses and dykes. With these are often associated dioritic agglomerates, serpentines and serpentinous breccias."

In places massive serpentines are in immediate contact with black slates, and in others, very much broken and slaty serpentines, different in character, in colour and in touch, are found in what appear to be exactly the same black slates. To say that all the Eastern Township serpentines are or are not intrusive is a question that can be solved only after a long and very careful study of the whole region. There are undoubtedly two very distinct sets of serpentines in this field, but whether their difference is due to age, or origin, or both, is still an unsolved problem.

These serpentines are generally darker coloured, tougher and better fitted for ornamental purposes than those of the Laurentian series. Ophiolites, which are chiefly mixtures of limestone or of dolomite and serpentine, the latter predominating, are found in many places in the Eastern Towships.

Many minerals of great importance are found either associated or in close proximity to serpentine in this region, and in order to show the importance attached to the study of this class of rocks, an idea of the economic value of these will be given.

The old Huntington copper mine, in the Tonship of Bolton, is just in the midst of serpentine and serpentinous rocks ; the Brompton Lake copper mine, in the Township of Orford, is also located in the serpentine. Variegated and vitreous sulphurets of copper disseminated in small masses in a bed of grey tough serpentine rock, four feet in width and flanked by serpentine on each side, occur on lot 28, range 9, Brompton. According to the Crown Land survey, a quartzose chloritic rock near a band of serpentine, in Orford, contains a small amount of

copper pyrites. On lot 9, range A, Orford, and near the junction of the serpentine with a diallagic diorite, six quartz veins occur in the latter rock within a breadth of twenty-five feet. Some of these are ten inches wide, aud they all contain portions of yellow copper ore which is associated with a greenish serpentine-like material. On lot 22, range 1, Garthby, a large mass of iron and copper pyrites is found subordinate to the stratification of the enclosing rock, which is a calcareous serpentine.

Iron ores are also found in many places in the Townships associated with serpentine. Large loose blocks of magnetic ore, sometimes half a ton in weight, are found on the second lot of the tenth range of Leeds. They are near a band of serpentine, and probably not far removed from the parent rock.

An important deposit of magnetite is found on the west side of Nicolet Lake in serpentine.

Of chromic iron, Dr. Ells reports as follows :

"Chromic iron is found in connection with the serpentines at several places in the area under consideration" (the Eastern Townships). "A deposit on the south side of Lake Nicolet, lot 4, range 2, Ham, was open some years ago, and about ten tons extracted, but the indications were not sufficiently favorable to warrant a continuation of the work. Within the last five years, several openings have been made near Bellmina (lot 24, range 3, Wolfestown), on the crest of the serpentine ridge at this locality. The deposits are apparently of the nature of irregular pockets. From the most important of these about twenty tons were extracted from a shaft fifteen feet deep. The vein was five feet wide at the surface, but decreased to three feet at the bottom of the shaft. Two hundred yards east of this spot, a second opening was made, which produced two to three tons in pieces scattered through the serpentine. Other small deposits were also found, and in all about 25 tons were obtained."

An opening has been made by Dr. Reid in chromic iron on lot 16, range 4 of Thetford. The mineral occurs there in pockets and very small irregular veins in an asbestos-bearing serpentine.

In the seigniory of St. Francis Beauce, there is a bed of granular iron ore, forty.five feet wide, in serpentine. This ore is composed of common magnetic oxyd of iron and ilmenite.

As already stated, nickel is seldom or never absent from the serpentine of this area, but rarely forms more than two or three thousandths of the minerals in which it generally appears to be combined as a silicate. With the chrome-garnet of Oxford, the sulphuret of nickel (millerite), occurs in small grains and prismatic crystals, disseminated through the mixture of garnet and calcite in small quantity.

The most important mineral found in the Eastern Township serpentine is chrysotile, generally called asbestus, although the true asbestus is a fibrous tremolite or hornblende.

Of this mineral, which traverses the serpentine in irregular veins, varying in size from mere threads to a thickness of five or six inches, much has been said by Dr. Ells in his two last reports on the Eastern Townships. This mineral, which is undoubtedly a segregated one, is supposed by some to have been formed during the cooling of the mass in which it is found. They compare the cooling surpentine to a mass of cooling molasses, and say that asbestus is formed in the same way as the thin sugar fibres are produced in this substance when it is drawn out in the working. Acccording to this theory the longer asbestus veins would be the finer; but it happens to be the contrary. Moreover, how in this way could the presence of chromic iron, which is sometimes highly magnetic, be explained as occurring in veins in the asbestus veins themselves, cutting the latter very often into two equal parts?

The existence of asbestus in this country was detected by Sir Wm. Logan in 1851; bnt it was only iu 1877 that the first deposit of any commercial value was discovered. A *habitant* by the name of Fecteau was the happy finder.

In 1878 Messrs. Ward, John Johnston, Andrew Johnston and the Honorable George Irvine opened the first asbestus mine.

Asbestus was but little known by the ancient people, who used it only for the manufacture of cloths in which were placed the bodies of the great and distinguished men for cremation. By so doing they could keep their ashes from being mixed with any impurity. This minera was then scarce and very costly; its property of not being consumed by fire made it a wonderful and even a marvellous thing. It used to be then kept as an object of curiosity rather than of commercial value. Even in the seventeenth century asbestus was employed in the manufac-

ture of handkerchiefs and a few garments which were used in scientific lectures and representations of all sorts to illustrate, in a pleasant way, the non-conductibility of this silicate, which serves to-day for the manufacture of paints, cements, putties, wall-papers, mill-boards, parchments and cloths. Mixed with tripoli it is used for packing and insulating steam and other pipes, as well as for lining safes. It is also used in the manufacture of drop-curtains and the sceneries in theatres, of suits for firemen, of safety ladders, of belts used in chemical works, and the last but not the least in the making of pipes.

Soapstone, which is more or less compact talc, is found in many places in the Townships, and is very often associated with serpentine. When pure and compact this mineral is much used as a refractory material for lining furnaces, especially those destined for anthracite. From its softness it is readily cut with knives and saws into the required shape, and it is infusible in any ordinary furnace heat. It is also used in the construction of small portable furnaces, and of open stoves, which are made of plates of it held together by iron bands and rods. Culinary vessels are made of it, and it has also been bored for water-pipes, and for the lining of cisterns for acid and alkaline liquids. When very strongly heated, soapstone looses the small quantity of combined water which it contains, and becomes much harder and susceptible of a polish. It may then be colored by various solutions, and it has been used in this manner for the manufacture of buttons and of some other small articles. Jets for gas-burners are also made of this hardened soapstone, and have the advantage of not being liable to rust or corrode. When reduced to powder its softness and unctuosity have caused it to be used, like plumbago, as a lubricator, and when mixed with a small proportion of white lead it forms a hard cement-like pigment, which is claimed to equal in resistance many of the more expensive fire-proof paints. It is also well adapted for a filer in the manufacture of paper. Slate pencils and tailors' chalk are also made of it.

Among the rocks of the Quebec group, in Eastern Canada, argillites fit for roofing slates occur in many places and have been successfully worked.

In the Township of Melbourne these slates, which are in contact with dark-green serpentine, afford excellent roofing slates, and are

extensively quarried for that purpose by the New Rockland Slate Co.

This serpentine is not only well adapted for interior decorative purposes but can also be used for the manufacture of small articles such as chandeliers, inkstands, paper weights, etc., etc.

In France serpentine is used for the manufacture of sulphate of magnesia or epsom salt. The magnesia which may easily be obtained from this sulphate makes fine hydraulic cements particularly well fitted for constructions exposed to the action of sea-water.

CARBONIFEROUS SERPENTINES.

These constitute the last of group No. 2 or the palæozoic serpentines, and so far as we know, are of very limited extent.

In the Geological Survey report for 1877-78, page 93 B, Dr. Dawson speaking of the rocks of Cache Creek series, British Columbia, says :

"Whatever uncertainty might remain with regard to the region now in question has been set at rest by the discovery of fusuline limestone on the Bonaparte, interbedded with the siliceous and serpentinous rocks. The occurrence of serpentine and other metamorphic rocks of ancient appearance in beds of carboniferous age, is in itself a point of considerable interest. In the place above referred to, it is said that "the limestones holding these fossils are so intimately associated and interbedded with the serpentines and other crystalline rocks above described, as to leave no doubt that they all belong to the same series." This statement I have been able to confirm by the examination of many additional localities. Between Hat Creek and 124 miles past (Mundorf's) numerous exposures in the roadside show the intimate association and interbedding of the cherty siliceous rocks with serpentines pure and impure, and of the latter with volcanic breccias of greenish-grey colour."

Of the serpentines of the Bonaparte River, Dr. Dawson reports as follows :—

"They may often be recognized at a distance by the bluish banks, bare of vegetation, which they produce on weathering. Here the relation between the serpentine and other rocks was most clearly seen. . . There can be little doubt that serpentines in this group of rocks have been igneous materials of some sort, and perhaps owe their conversion

to serpentine to the same hydrothermal or other action which has produced from siliceous sediments, the great mass of cherty quartzite."

CENOZOIC SERPENTINES.

These, also, like the last referred to, occur in British Columbia.

Dr. Harrington reported as follows on them :—

"Olivine has been detected in several of the eruptive rocks of British Columbia. One of these, of Tertiary age, from Kamloops, affords most beautiful examples of the alteration of olivine to serpentine. It is massive, rather fine-grained, and of a very dark olive-green colour. The examination of a slide with the microscope shows that originally the rock must have consisted of crystals and grains of olivine, augite (mostly in crystals), and a small proportion of plagioclase feldspar and magnetite. But while the augite mostly remains fresh, a large part of the olivine, which appears to be the most abundant constituent of the rock, has been altered to serpentine. Most of the olivine crystals and grains retain a nucleus of the unaltered mineral, showing the characteristic rifts, and the outlines of many crystals which are partly or entirely converted into serpentine are still perfectly sharp."

No economic minerals have yet been found in these serpentines, as well as in the carboniferous ones, but future researches and study may lead to some valuable finds in them.

We have now come to the last group or the one in which have been classed the serpentines of doubtful age, and which are found to the north of Lake St. John, Province of Quebec, and in the Yukon district.

Of these north of Lake St. John, Mr. Richardson reported as follows :

"About 200 yards west of the portage road, a cone-shaped hill, which rises over the waters of the narrows about 160 feet, is entirely composed of serpentine. This rock is traced on one side to the portage, and on the other it is supposed to form part of Juggler's Mountain, which is about 400 feet high, and is about two miles distant. On the highest part of the cone referred to, there is a blackish limestone, about one foot thick, interstratified with serpentine."

Dr. Hunt, while examining these rocks, had a portion of the limestone sliced for examination under the microscope, which revealed a structure resembling that of some coral. The serpentines, which are

dark-coloured opaque, and contain much disseminated magnetic iron, yield by analysis considerable portions of chrome and traces of nickel.

Dr. Dawson in his report on the Yukon district says :

" A specimen of asbestus (chrysotile), being part of a small vein of that material about half an inch in thickness, has been brought from the Stewart River, and the occurrence of serpentine in large mass elsewhere tends to show that valuable asbestus deposits may yet be found in the region."

If we now go out of our own Dominion we see that the Cambrian serpentines of the Eastern Townships which extend to Gaspé Peninsula are spoken of as occurring in the island of Newfoundland, and Mr. Alexander Murray, in 1876, speaking of the different ores found in this island, said :

" The more valuable ores hitherto discovered upon this island, notably those of copper, nickel and chromic iron, have usually been found to be closely associated with serpentinous rocks ; and the presence of such rocks has frequently instigated close inspection of the ground, resulting in the discovery of satisfactory metallic indications." In a paper read by Dr. E. D. Peters at the last meeting of the American Institute of Mining Engineers, which was held here last fall, is found the following statement : " The entire world's production of nickel annually is less than 1000 tons, the bulk of this being produced by the New Caledonian nickel mines, which are oxyd deposits situated in serpentine dyke."

In the Urals, platinum associated with chromic iron is found in a rock of serpentinous matrix.

In Science, vol. 8, 1886, is given a very interesting article on the genesis of the diamond, by H. C. Lewis. He refers to the diamonds of Kimberley, South Africa, and on examination of the adamantiferous rock, as well as of the ore which is free from diamonds, he says that :—

" Both are dark, heavy basic rocks, composed essentially of olivine, and belong to the group of peridotites. Both are similar in structure and construction, differing only in the presence or absence of inclusions. The rock consists mainly of olivine crystals lying porphyritically in a serpentinic ground-mass."

Let us, then, hope that our Canadian serpentines, which are proved

to be in many places the altered remains of olivine rock, not only contain asbestus, the mineral of the day, which is not attacked by fire, but that we will find them, in a close future, affording also the mineral which the greatest heat and pressure of our laboratories could not yet produce, the diamond.

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BOOK NOTICE.

ARTIFICIAL KEYS TO THE GENERA AND SPECIES OF MOSSES in Lesquereux and James's Manual of the Mosses of North America ; by Charles R. Barnes ; pp. 72 ; 1890.

Under the above caption Prof. Barnes has published in the Transactions of the Wisconsin Academy of Sciences (and also separately) a most useful article. After the Ferns there is perhaps no order of plants whice is more invariably admired by those who love nature than the Mosses; their study, however, has been almost impossible owing to the want of an intelligible work which could be used by a beginner. In this way many who might have had their attention drawn to the study of botany by these beautiful objects, have been lost to the science. For botanists, unlike poets, need not be born botanists, but can be made by accident or training. By the publication of Prof. Barnes's pamphlet a great obstacle to the study of mosses is removed, and we feel sure that many of our members will now avail themselves of this opportunity. This should be particularly the case with our local members, for we have in Prof. Macoun, who is always courteous and willing to help beginners, the highest Canadian authority upon mosses. The above mentioned pamphlet is well printed, and sewed so as to open flat, and can be obtained through the editor for 50 cents a copy. J. F.

NEW MEMBERS.

Bethune, Rev. C. J. S , *M.A.*, *D.C.L.* (Port Hope).
Campbell, A. M. (Perth, Ont.)
Deeks, W.E., *B.A.*
Macfarlane, T., *M.E.*,*F.R.S.C.*
Meneilly, W. J.
Ripley, C. J.
Ross, Niles G.
Smith, Miss Ethel M.
Smith, Miss Eloise.
Sutherland, Miss Christine F.
Sutherland, J. C. (Richmond, Q.)
Topley, W. J.

MONDAY AFTERNOON POPULAR LECTURES.

ZOOLOGY.

IDEAS ON THE BEGINNING OF LIFE.

By J. Ballantyne.

(*Read February 10, 1890.*)

Organic life, as you all know, is arranged by naturalists into two great divisions, named respectively the vegetable and animal kingdoms, the last named of which being the subject matter of this paper.

To the ordinary observer the difference between plants and animals can be seen at once, as only the higher or more specialised forms are compared, but with the naturalist, who digs down into the lower forms of life, distinctions all but disappear, so that he finds it impossible to fix the point where the diverging lines of life really begin, or to say whether vegetable or animal life had precedence in the order of their beginning in the far distant past. Dr. Andrew Wilson, of Edinburgh, in his work "Chapters on Evolution," says: "In the lowest deeps of plant life we may discover organisms which possess at the best a doubtful title to be regarded as objects of botanical study. In the animal world, likewise, are included lower organisms which may be regarded in certain aspects as possessing true relationship with plants. Modern biology to-day frankly admits its inability to pronounce whether certain lowest forms of life are animals or plants, certain 'monads,' for example, consisting each of a speck of protoplasm provided with microscopic whip-tails, exhibit a highly confusing identity of structure and function which renders their exact nature indeterminable, or at least highly doubtful. Hence we discover that apparently at the lowest confines of the animal and plant realms, we enter a biological 'no man's land,' whereof the included inhabitants may legitimately claim relationship with both kingdoms. They exhibit in this latter respect, in the eyes of biologists, the actual survivals of that early epoch in the history of life's development when the specialized kingdoms of animals and plants were not, and when existence passed placidly along the common lines which were soon to diverge into two great series of living beings that environ our footsteps to-day."

Zoology in its widest sense may aim at a full and complete knowledge of animal life, from the simple cell of the lowest protozoon to that of the most complex or differentiated structure in existence. It may not only be a knowledge of animal life as it now exists, with its almost infinite number of variations and complexities, but it may extend its researches away back for countless ages and inquire into their origin or beginning—inquire from whence they came and whither they are tending. Truly a vast subject.

In the ordinary study of animal life the various kinds are grouped together in a certain order. The number of the different sorts of animals being very great—much greater than that of plants—and the diversity among them also being greater, a division of the same into branches relating to different groups may naturally take place, as without an arrangement of this kind it would be almost impossible to describe an animal in such a way as to enable the student to find very readily any particular animal described. This method of grouping animals together is somewhat as follows: Supposing we take up that branch of zoology which has for its subject bird life, or ornithology—(*ornis* a bird, *logos* a discourse). The first step in classification would be to ascertain some peculiarity common to all animals which go by the name of bird. It would occur to most of us at once that all birds have feathers, and that no other animal is similarly clothed. This one characteristic would be sufficient to determine a bird's place among animals. Having got this far, it would very soon be perceived that structural differences, particularly in the feet, existed among birds, some having three toes, some four, some with three in front and one behind, some with two in front and two behind, others again with three in front only, some with their toes joined together with a thin skinny web, and several other points of difference. It would be quite natural to begin classification by grouping together all the birds having the same kind of feet. We would not think of placing a bird with feet adapted for perching in the same group with those with feet adapted for swimming. We would soon have several large orders of birds arranged by their feet peculiarities; but this grouping would not be sufficiently definite, as many birds with feet somewhat alike are very different in other respects; so that in order to designate any particular bird with certainty

these orders would require to be subdivided a good many times, always selecting those which have most things in common, and grouping them by themselves. By narrowing down in this way it is comparatively easy to find out the name of any bird from the descriptions usually given in works on ornithology. In like manner in all the other divisions into which animal life is arranged, classification is carried out. The necessity for classifying the different sorts of animals into such groups as I have tried to point out must be so apparent to all that there need be nothing further said on the subject.

The study of the various forms of animal life with all their never ending peculiatities, their relations to each other—their habits and instincts, &c., must always be of great interest to man, but that branch of scientific research, which takes for its subject the origin of life, together with the origin of species, opens up fields of speculation of much greater interest, and which bid fair to revolutionize our whole conception of the manner in which man as well as all other organisms came to be as we now find them.

It is my purpose to try and point out as briefly and as clearly as I can some of the views held by leading scientists of the present day on the subject just named. Up to a very recent period the belief was all but universal that all living creatures came from the hands of their creator perfectly formed and perfectly fitted to the surrounding world in which they had their habitation, that a power outside and beyond what we call nature brought life into existence from nothing, and that it was so continued in the same unchanged and unchangable condition throughout all the time of its existence. It was claimed that God had infallibly revealed to man the order and plan of creation, and consequently there was no room for discussing or inquiring into the subject at all. The few people who had the timerity to doubt the finality of the biblical conclusions, as then understood, suffered no little in the way social and physical persecution.

The investigation of nature, principally during the past half century, has not only shaken the belief in the theological explanation of the world and of life, but has given rise to new theories concerning the beginning of life and the causes accounting for all its varied forms.

As the structure and make up of the earth came to be investigated

there were found, as Mr. Billings told us a few evenings ago, the imprint or remains of figures in the rocks which strongly resembled the organic structure of plants and animals. To account for these apparent remnants of life, various conjectures were advanced, the one most generally acceptable among theologians for a time being the great flood of Noah as recorded in the Book of Genesis, which was a sufficient explanation, and the organic remains found in the rocks bore testimony to the fact that such a great deluge had really taken place. As the work of geological investigation proceeded it soon became evident that the generally conceived idea of creation, as found in the Mo-aic records was not in accordance with facts, and that a different interpretation was necessary in order to reconcile the apparently conflicting records, one of the difficulties being the existence of organic remains so deeply embedded in the rocks, that it was utterly impossible to conceive how they could have been placed in such a position in the short period of six days, or how a temporary flood existing less than one year could bring about such tremendous changes in the surface of the earth.

Hugh Miller, the Scotch geologist, in his work entitled the "Testimony of the Rocks," written about forty years ago, makes an attempt to reconcile the geology of the Pentateuch with the geology of nature by the hypothesis, that the days mentioned in the first chapter of the book of Genesis do not represent the actual duration of the successive periods of creation, but only the time occupied by God in unrolling a panoramic vision of these periods before the eyes of Moses on the Mount. Another form of reconciliation advanced and very generally accepted by believers in the scientific accuracy of the Mosaic records, and which it is maintained the original text fully warrants, is that the days mentioned in the book of Genesis were not days of twenty-four hours each, and that the Hebrew word translated into the word day in our common English version of the Bible is used in other places to signify a period of time which might be indefinitely prolonged.

The Hon. W. E. Gladstone very recently undertook to show that the order of creation as recorded by Moses was in complete harmony with the order recorded in the rocks and that there was no conflict between religion and science. He attempts to show that there were four periods of time in which all organic life appeared upon the earth, and

that the order in which geology tells how they came, was in no way different from that told by Moses. The four periods were as follows:— First, a period in which all vegetable life came into being ; second, a period in which aquatic or water-living animals appeared, and third, a period in which fowls of the air and all winged animals began to exist, and fourth, a period in which earth and land animals appeared with man as head over all.

Mr. Thos. Huxley, in reply, maintains that the testimony of the rocks does not warrant a belief in any distinctive periods in which plants and animals first made their appearance, but appears to think that the lower forms of life, whether of plants or of animals, came into existence about the same time. In that school of scientists who have accepted the general theory of evolution as sufficient to account for all the varied and ever changing forms of life, it is held that the beginning of life itself was simply a phase of matter, and was no more mysterious, and no more called for supernatural interference than the chemical combinations continually taking place round about us. I think I cannot do better than give a few quotations from " Evolution and the Origin of Life," by Professor H. C. Bastian, of University College, London, England. He very clearly states the case from an evolutionist point of view, and as clearly gives the reasons why he believes the general theory to be true. I can only give short quotations here and there, which you all know cannot do justice to any writer. In defining what the word implies he says: " Evolution implies continuity and uniformity. It teaches us to look upon events of all kinds as the products of continuously operating causes ; it recognizes no sudden breaks or causeless stoppages in the sequence of natural phenomena. It equally implies that natural events do not vary spontaneously. It seeks to assure us that the properties and tendencies now manifest in our surrounding world of things are in all respects similar to those which existed in the past. Without a basis of this kind Evolution would be a mere idle dream." An examination of the facts of science generally, and of various every day phenomena, teaches us, according to the evolutionist, that matter of different kinds, situated as it is and has been, gradually tends within certain limits to become more and more complex in its internal and external constitution, Coupling this conclusion with various astronomical data,

and with facts derived from the study of past forms of life upon the globe, the evolutionist attempts to penetrate through the long vista of bygone ages till he may rest his speculative gaze upon a vast rotating nebu'ar mass of gaseous matter from which he supposes our universe to have been slowly evolved ; assuming that our planet had a past history of this kind, he must also assume that it rapidly changed from a gaseous to a fluid state before beginning to solidify by the formation of a superficial crust, which gradually thickened as the fervent heat of it radiated into space. Until this stage of the earth's history had been far advanced no living thing could have existed upon its surface. Living things must, however, have appeared upon its surface at some very remote epoch, since their remains are to be found far down in the rocks which at present constitute its crust. How, therefore, it may be asked, is the first appearance of life on this earth to be accounted for ?

We should not invoke an unknown act of creative power unless more ordinary natural causes fail, and it really be found necessary to invent some such a hypothesis. Now, the thorough-going evolutionist repudiates the notion of creation in its ordinary sense. He believes that the operation of natural causes working in their accustomed manner were quite adequate to bring into existence a kind of matter presenting a new order of complexity and displaying the phenomena we call life. Living matter is thus supposed to have come into being by the further operations under new conditions of the same agencies as had previously led to the various inorganic constituents of the earth's crust—such mineral and saline substances as we see around us at the present day, so that in accordance with this view we have no more reason to postulate a miraculous interference or exercise of creative power to account for the evolution of living matter in any suitable portion of the universe, whether on this earth or elsewhere, than to explain the appearance of any other kind of matter. The question might be asked whether life still continues to come into existence from inert or lifeless matter ? Herbert Spencer, the great apostle of evolution, sees no reason why it may not do so. Professor Bastian, and a good many others, maintain that it really does so, as proven by a series of experiments extending over a lengthened period. He contends that all the conditions of matter necessary to the beginnings of life still exist, and that

new life is continually being evolved. Professor Huxley is quite in agreement with Spencer and Bastian as to the beginning of life, but appears to think that existing conditions of matter on the earth's surface are not favorable to new beginnings of life. Dr. A. Wilson sums up the question in the following words : " Although research has not as yet finally placed the puzzle of life and its solution at our feet, our inquiries have at least served to indicate the direction towards which modern scientific faith is slowly but surely tending. The search after a material cause for phenomena formerly regarded as thoroughly occult or supernatural in origin, is not a feature limited to life science alone. Such a characteristic of modern research indicates with sufficient clearness the fact that, as biology and physics become more intimately connected, the explanations of the phenomena of life will rest more and more upon a purely physical and appreciable basis. That life had a distinct beginning upon the earth's surface is proved by astronomical and geological deductions. That life appeared on this world's surface, not in its present fulness, but in an order leading from simple forms to those of an ever increasing complexity, is an inference which geology proves, and which the study of animal and plant development fully supports.

That the first traces of life existed in the form of protoplasmic germs, represented to-day by the lowest of animal and plant forms, or rather by those organisms occupying the debatable territory between the animal and plant worlds, is well nigh as warrantable a supposition as any of the preceding. And last of all, that these first traces of protoplasm were formed by the intercalation of new combinations of the matter and force already and previously existing in the universe is no mere unsupported speculation, but one to which chemistry and physics lend a willing countenance. Living beings depend on the outer world for the means of subsistence to-day. Is it more wonderful or less logical to conceive that at the beginning the living worlds derived their substance and energy wholly from the same source? The common origin of animal and vegetable life, and the further unity of nature involved in the idea that the living worlds are in reality the outcome of the lifeless past, constitute thoughts which leave no break in the harmony of creation."

A few words on the origin of species, as very generally accepted in the scientific world, may not be without interest. I can only give a meagre outline of the general principles :—

"A few great naturalists, previous to the time of Darwin, struck by the very slight differences between many species of animals, and the numerous links existing between the different forms, and also observing that a great many species do vary considerably in their form, color and habits, conceived the idea that they all might be produced one from the other. The most distinguished of these writers was the great French naturalist Lamarck, who published an elaborate work, "Philosophie Zoologique," in which he endeavored to prove that all animals whatever are descended from other species of animals. He attributed the change of species chiefly to the effect of changes in the condition of life, such as climate, food, etc., and especially to the desires and efforts of the animals themselves to improve their condition, leading to a modification of form or size in certain parts, owing to the well-known physiological law that all organs are strengthened by constant use, while they are weakened or completely lost by disuse. The arguments of Lamarck did not, however, satisfy naturalists, although a few adopted the view that closely allied species had descended from each other. The general belief of the educated public was that each species was a "special creation" quite independent of all others, while the great body of naturalists equally held that the change from one species to another, by every known law or cause, was impossible, and that the "origin of species" was an unsolved and probably an insoluble problem.

The only other important work dealing with the question was the celebrated "Vestiges of Creation," written by the late R. Chambers, of the great publishing firm of W. & R. Chambers, of Edinburgh. In this work the action of general laws was traced throughout the universe as a system of growth and development, and it was argued that the various species of plants and animals had been produced in orderly succession from each other by the action of unknown laws of development aided by the action of external conditions. But no great change of opinion was effected among naturalists until after the publication of the "Origin of Species" in 1858 by Charles Darwin. There was then no question of the origin of families, orders and classes, because the

very first step of all was believed to be an insoluble problem. But this is now all changed. The whole scientific and literary world, even the whole educated public, accepts as a matter of common knowledge the origin of species from other allied species by the ordinary process of natural birth, the idea of special creation being all but extinct.

A summary of the Darwinian theory of the origin of species by Alfred Russel Wallace, is as follows :—" The theory of natural selection rests on two main classes of facts which apply to all organized beings without exception, and which thus take rank as fundamental principles or laws. The first is the power of rapid multiplication in a geometrical progression ; the second, that the offspring always vary slightly from their parents, though generally very closely resembling them. From the first fact or law there follows necessarily a constant struggle for existence, because while the offspring always exceed the parents in number, generally to an enormous extent, yet the total number of living organisms in the world does not and cannot increase year by year, consequently every year, on the average, as many die as are born, plants as well as animals ; and the majority die premature deaths. They kill each other in a thousand different ways ; they starve each other by some consuming the food that others want ; they are destroyed largely by the powers of nature—by cold, by heat, by rain and storm, by flood and fire. There is a perpetual struggle among them, which shall live and which shall die ; and this struggle is tremendously severe because so few can possibly remain alive—one in five, one in ten, often only one in a hundred or even a thousand.

" Then comes the question, Why do some live rather than others ? If all the individuals of each species were exactly alike in every respect, we could only say it is a matter of chance. But they are not alike. We find that they vary in many different ways. Some are stronger, some swifter, some hardier in constitution, some more cunning. An obscure color may render concealment more easy for some. Keen sight may enable others to discover prey, or escape from an enemy better than their fellows. Among plants the smallest differences may be useful or the reverse. The earliest and strongest shoots may escape the slug ; their greater vigor may enable them to flower and seed in unfavorable weather ; plants best armed with spines or hairs may escape being

devoured; those whose flowers are most conspicuous may be soonest fertilized by insects. We cannot doubt that, on the whole, any beneficial variation will give the possessors of it a greater probability of living through the tremendous ordeal they have to undergo. There may be something left to what may be called chance, but on the whole "*the fittest will survive.*" Then we have another important fact to consider,—the principle of heredity or transmission of variations. If we grow plants from seed or breed any kind of animals, year after year, consuming or giving away all the increase we do not wish to keep just as they come to our hand, our plants and animals will continue much the same; but if we every year carefully save the best seed to sow, and the finest or brightest colored animals to breed from, we shall soon find that an improvement will take place, and that the average quality of our stock will be raised. This is the way in which all our fine garden fruits and vegetables and flowers have been produced, as well as our splendid breeds of domestic animals; and they have thus become, in many cases, so different from the wild races from which they originally sprung as to be hardly recognizable as the same. It is, therefore, proved that if any particular kind of variation is preserved and bred from, the variation itself goes on increasing in amount to an enormous extent, and the bearing of this on the origin of species is most important; for if in each generation of a given animal or plant the fittest survive to continue the breed, then whatever may be the peculiarity that causes fitness in the particular case that peculiarity will go on increasing and strengthening so long *as it is useful to the species.* But as soon as it has reached its maximum of usefulness, and some other qualification or modification would help in the struggle, then the individuals which vary in the new direction will survive; and thus a species may be gradually modified, first in one direction and then in another, till it differs from the original parent form as much as the greyhound differs from any wild dog or the cauliflower from any wild plant. But animals or plants which thus differ in a state of nature are always classed as distinct species, and thus we see how by the continuous survival of the fittest, or the preservation of favored races in the struggle for life, new species may be originated. Past time has been to all intents and purposes infinite. Hence it is probable that the existent species of animals and plants have

been evolved through natural selection acting through long periods of time from a few primitive and simple forms of life."

It will be observed that Mr. Darwin does not attach much weight to environment as a great agent or factor in the origin or modification of species. Other naturalists of eminence differ from Mr. Darwin in this respect, and maintain that the influence of surrounding physical conditions, as held by Lamarck, is quite as potent a factor as natural selection, in bringing about the changes which are ever taking place in the structure of organic life. It has often been observed that when certain kinds of animals change their habitat, organs that cease to be useful gradually disappear, while new organs or adaptations of already existing ones to changed habitat as surely come about. In the January number of the *Popular Science Monthly* there is published an article by A. S. Packard, whom most of you have heard about, on the effect of cave life on animals, in which he shows most conclusively that gradual loss of the organs of sight occurs to animals so situated, and that modification of other organs takes place, such as the lengthening of the antennæ or feelers, etc.,—that is, the sense of touch becomes greater as the necessities of the conditions demand its use. In such cases as these Dr. Packard thinks there is little room for the operation of natural selection, and that it plays a very subordinate part in the set of causes inducing the origin of these forms. I will not attempt to state the evidences which have been advanced by scientists to prove the relationship and unity of organic life as manifested by embryology, by rudimentary organs found in many animals for which now there is apparently no use, and by the fossil remains of animals now extinct but showing close affinity to those now living, but will only say in conclusion that the longer anatomical and geological investigations continue, the more surely does it appear that all animated beings began their life course in the form of a simple cell, and that by a long process of evolution they have come to be differentiated into the numberless forms in which we now find them, all tied together by an endless chain without even one missing link.

MONDAY AFTERNOON POPULAR LECTURES.

CONCHOLOGY.

By Rev. G. W. Taylor.

(Delivered March 10th, 1890.)

After some preliminary remarks concerning the scope of the study of Conchology and the best way to make a collection of shells, the lecturer proceeded to give an outline sketch of the classification of the Mollusca. He showed that they are divided into four large divisions, in accordance with the form and position of their organs of progression. These divisions are—

I. CEPHALOPODA, as the Nautilus and Squid, which have their feet grouped around the head.

II. GASTEROPODA, or stomach-footed, as the common snail which progresses by the regular movement of the muscles of the ventral surface.

III. SCAPHOPODA, or boat-footed, a very small order containing only the *Dentalia* or Tooth Shells and their allies.

IV. PELECYPODA, or axe-footed Mollusca. This order contains all the bivalves, such as oysters, clams, mussels, etc.

Under each of the heads an account was given of the anatomy, geological age and present distribution of some of the better known species, and attention was drawn to the importance of studying the animal of the different shells.

Before closing his interesting lecture Mr. Taylor went on to speak of the way in which the study of the variations of species in the mollusca brought the conchologist face to face with the great theories of evolution and development. He said:—"A paper on evolution was read before this Club a week or two ago and in the discussion that followed, a remark fell from one of the speakers concerning the *conflict* between evolution and theology. Now, as I know, that there are many of you who would hesitate to accept evolution, if at variance with theology, while there are others, perhaps, who would eagerly throw overboard their theology, if apparently contradicted by evolution. I think that it may be useful to state the opinion on these matters of one who has

studied, and who conscientiously accepts the teachings of both theology and science.

Science, of course, should be primarily an independent study. Scientists have no time and little inclination usually to study theology, and neither have theologians, as a rule, the opportunities to become masters of science. When science has demonstrated a *fact* there can be no gainsaying it; it will over-ride any theological dogma; but a scientific *theory* does nothing of the kind. For instance science has *proved* that our world was not made in six days of 24 hours, as it used to be believed, and theologians accept the *fact* and find it in no way inconsistent with their Bible.

Science has *proved* that evolution has taken place, and is taking place, in both the animal and vegetable world, and theologians accept these facts also.

But science has *not yet proved* that evolution is the cause of *all* the various forms of life we have to-day, and it has *not yet proved*, and I am confident never can prove, that any life can originate *of itself*. Let it prove even the former of these propositions, let it trace back every animal and vegetable to one original speck of protoplasm, and even then science will not do away with the necessity of a creator."

Mr. Taylor went on to explain how Dr. Bastian's theory of abiogenesis had been completely upset by the experiments of Prof. Tyndall, and then said: You will see therefore that there is no necessary conflict between the theory of evolution and theology. Both parties (the theologians and the scientists) are often rather unreasonable. Theologians have sometimes been tempted I know to dogmatise unnecessarily, but on the other hand scientific men are constantly asking them to swallow pounds of theory with every few grains of fact. I for one am ready to accept the facts, and I believe that the principles of evolution have been conclusively proved, but I do not feel called upon to accept at present all the extravagant theories that the more extreme disciples of Darwinism have put forward.

In conclusion, my excuse for introducing this subject into an address on conchology must be the fact that from this science evolutionists have drawn some of their strongest arguments, while in it also they have met with some of their greatest difficulties.

BOOK NOTICES.

Several pamphlets have been sent to the editor, which will be noticed as space and occasion permit. The following will be of interest to fruit-growers :—

"The composition of Apple-tree Leaves" by F. T. Shutt, M.A., F.I.C., F.C.S., Chemist to the Dominion Experimental Farms. The above is the title of a useful paper, the separates of which have just been distributed, that was read by Mr. Shutt before the convention of fruit-growers of the Dominion, held at Ottawa in February last. The work was undertaken with the object of suggesting a rational method for the application of fertilizers to apple orchards. Analyses are given of the leaves of five of the best known varieties, at two different stages of growth—on 25th May when the leaves were just unfolded and on 20th September when they had fully matured. The results are given in tabular form, arranaged under the following heads :—i. Composition of Leaf, showing the percentages of moisture, organic matter and ash. ii. Percentage composition of important constituents in Ash, giving the amount of phosphoric acid, potash, lime, magnesia, oxide of iron and silica. iii. Nitrogen in Organic matter. iv. Weight of Fertilizing Constituents in 1,000 lbs. of Leaves, namely, Nitrogen, Phosphoric Acid and Potash.

From the data in the above table we ascertain the extent to which the soil is exhausted by the apple-tree as regards its leaves. This is valuable knowledge. We are told that Mr. Shutt intends to make a complete series of analyses of the apple tree in which the old and young wood as well as the fruit will be included. We shall then have definite knowledge by which the fruit grower will be able to obtain the best results, and will be able to carry on his operations with precision and without doubt as to the results. Below are Mr. Shutt's conclusions, founded upon his scientific investigation, and it will be seen that they coincide exactly with the results which have been arrived at by practical orchardists after many years of experience and trial, with the important difference that the scientific man knows that his results must be accurate, while the man who has only his practical experience to back him only thinks he is right without knowing the reason why :—

"Phosphoric acid, potash and nitrogen are the three constituents which above all others must be put back into the soil if we are to preserve its fertility. Plants of certain orders require more of one or other of these than plants of other orders. Some soils are specially rich or poor in one or more of the materials, and consequently in the rational mode of application of fertilizers much intelligence and patience must be exercised.

That the leaves of the apple trees draw a large amount of food from the soil annually, has been shown. This must be replaced in excess for the vigourous growth of the tree. The leaves of the tree play no unimportant part—respiration and digestion are their two chief functions—which, if they do not perform well, the tree cannot live and bring to perfection its fruit. Therefore, when we feed the leaves we are indirectly feeding the fruit.

The results of this work seem to point in the direction of mineral fertilizers, and specially of potash, as being more particularly required for the growth of the leaves, and, therefore, for the vigorous development of the tree, including an abundant crop of fruit.

A heavy dressing of wood ashes (which may be procured in many parts of Canada at a very low price) or of kainit or other form of potash is, therefore, to be recommended for orchards.

The value of the leaves composted—a process to be advised as more economical than burning—is also well established by the data afforded by this work."

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LIBRARIAN'S REPORT 1889-90.

To the Council of the Ottawa Field Naturalists' Club :—

GENTLEMEN,—I have the honour to report that, as soon as possible after taking office as your librarian, I collected the books and periodicals forming the library of the Club, as well as the back numbers of the Club publications, from those of my predecessors who still had them in their keeping. Through the kindness of the Custodian of the Ottawa Literary and Scientific Society, I have been able to find storage room for these in the lecture room of the society. This has enabled me, to a certain extent, to classify and arrange them, and to prepare in

rough form a catalogue, which I regret exceedingly lack of time has compelled me to leave in that form, but which, with the permission of my successor, I shall revise and copy before handing it over to him. In making the catalogue I found that almost all the sets of back numbers of exchanges were incomplete, but on receiving authority for that purpose from the Council, I exchanged missing back numbers with such of our exchanges as were willing to do so, and they were nearly all so willing. The result is that, at a slight extra expenditure for postage, the sets are now in most cases complete, as far as the missing numbers can be had in print. Four exchanges have been added to our list during the year, viz. :—*The Royal Swedish Academy of Science*, Stockholm ; *The American Geologist*, Minneapolis, Minn. ; *The Wisconsin Academy of Science*, Madison, Wis. , and *The Nautilus*, Philadelphia, Pa. It is a matter for congratulation that we have been able to appropriate the sum of $8.40 for binding. With this I have have had bound twelve volumes of convenient size, containing in all eighteen volumes of periodicals, as follows :—*The Auk*, 6 Vols. ; *Bulletin of the Torrey Botanical Club*, 8 Vols., bound in 3 ; *Proceedings of the Boston Society of Natural History*, 1 Vol. ; *Transactions of the O. F. N. C.*, 1 Vol. ; *The Ottawa Naturalist*, 2 Vols. bound in 1. The fact that several of these have already been borrowed by members, indicates the desirability of pushing on the work of binding as fast as our resources will from time to time permit. It is also desirable that when we move to other quarters, as I believe we soon must, larger and more suitable accommodation should be provided for our books, many of which are extremely valuable. A list of the publications received as donations and exchanges during the year appears in the number of the NATURALIST issued to-day.

Respectfully submitted,

WM. A. D. LEES, Librarian.

Ottawa, March 14th, 1890.

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WINTER SOIREES.

The Soiree Committee requests such members of the Club as are willing to read papers during the coming winter to send in to the Secretary, as soon as possible, the titles, and at the same time to indicate approximately the date when they prefer to present them.

A BIRD IN THE BUSH.

[By W. A. D. Lees.—Read February 1890.]

The old saw about a bird in the hand, like many another old saw, needs some filing down to make it cut true. Applied literally to birds, it may appeal by its aptness to the sportsman or the working ornithologist, but to one who does not aspire to the honours of either position, but is a simple lover of birds in their native haunts, its truth will not be so apparent. I shall not stop to discuss the question of man's inherent right to slay his fellow-creatures at pleasure, or even of the expediency of so doing for useful purposes, scientific or gastronomic. I merely wish to record, in passing, my humble opinion that there is much unnecessary slaughter of birds by amateur ornithologists and others; and then to show, by a few anecdotes of bird ways from personal observation, that not a little of interest, and perhaps something of value, may be learned of the habits of these interesting creatures, without the aid of a gun. If in so doing I am fortunate enough to enlist in the ranks of the observers one recruit who has hitherto held aloof, through his aversion to killing, I shall be satisfied that I am not altogether on the wrong track. It is just about two years since I began to observe birds with any care, and when I tell you that at that time I knew barely fifty species and of many of these I had very hazy ideas, though I had lived in their midst for twenty-five years, you will be inclined to ask me where I kept my eyes all that time. It is a question I have asked myself a thousand times, but as yet I have received no answer.

One of my first finds was a flock of Pine Siskins, which I surprised feeding in a clump of cedars in February. It was a beautiful still, bright day, an ideal day for a snowshoe tramp, which I had been enjoying to the full, when I reached this bit of cedar swamp and stopped to reconnoitre. I had not waited long when I heard the contented trilling chirp of the feeding birds, and followed the sound till I came upon them busily picking out and devouring the seeds of the cedar, and scattering the husks broadcast upon the snow. I immediately levelled my double-barrelled fowling piece (a field glass) upon them, and as this did not seem to disturb them in the least, I gradually moved towards

them until I was so near that I could easily distinguish the yellow markings of the feathers, and get a pretty fair mental picture of the bird for comparison with the description which, after some research, I found in my "McIlwraith." I have dwelt somewhat at length upon this as being a very fair sample of the way in which I identified the one hundred and twenty species of birds I have now the pleasure of numbering amongst my acquaintances. This number I am aware is a small showing for two years' work, but as yet I have had but little opportunity to visit the haunts of the water birds. Of course I varied my plans to suit the circumstances, and when the birds seemed unwilling to have me go to them, I reversed Mahomet's plan with the mountain and sat down and waited till the birds came to me. If many a time I got tantalizing glimpses for a moment only of some new or rare bird, which tempted me to regret my lack of a gun, there were few instances in which I was not afterwards rewarded by a longer and nearer view of the same bird, which enabled me to identify it, at least to my own satisfaction. Besides, I always consoled myself with the reflection that the noise of a gun would have driven away more birds than its use would have secured. Having thus outlined my plan of campaign, it remains to give you the promised anecdotes of bird ways, though I cannot reasonably hope that my observations will interest you as they did me, to whom everything I saw was a new revelation.

One of the first things that struck me about the birds was a very human quality in many of their actions, and strange to say it was not always the noblest traits of man they chose for imitation. For instance my admiration for the stronger sex was not much increased by watching the actions of a Downy Woodpecker, who would not respond to his wife's frenzied entreaties for help in driving from their door a big, able-bodied tramp of a Flicker who insisted on getting in. There sat Mr. Downy in a neighbouring tree, and would not stir a wing, though his better half even left the door unguarded for a moment, and went to fetch him, but when the intruder was driven away by my rapping on the the trunk of the tree with a stick, he came swaggering home, and took all the credit of it to himself. It was only when he was thus shamelessly boasting of his prowess that I noticed the scarlet fez he wore on the back of his head, and reflected that one could expect no

better of a Turk. This seems to have been a bad neighbourhood to live in, for, a month or so later, when the downies had moved out and rented their cottage to that trim little housewife Jenny Wren, she, too, got into trouble with a couple of marauding English Sparrows, who forced an entrance and destroyed everything eatable in the house. The neighbours all gathered round and chirped their sympathy in loud and distressed voices. There were the gaily dressed Yellow Warblers, and Goldfinches, the Cedar Waxwings in their olive-brown silks with the yellow trimmings, a lone Catbird in his sober slate-coloured coat, and even a tiny Ruby-throat came buzzing along and perched on a dead twig to see what was the matter. All agreed that it was dreadful, but that it really could not be helped, and besides it was none of their business. Even landlord Downy when he arrived could not make up his mind that he would be strictly within his legal rights in using that murderous looking dagger, which he always carries round with him, for the protection of his tenants, or the punishment of their assailants. Turning now to a pleasanter phase of this unconscious imitation of human traits, one of the most striking instances of affection between birds that have come under my notice was that displayed by a pair of Cedar Waxwings, or as they are sometimes called, Cherry-birds. It was at the time when the fruit was beginning to form on the trees, and one of them had picked up an apple about the size of a large pea and perching close beside his mate in an old apple tree, he passed it with a great display of politeness and affection to her, and she with an equally courtly and loving air returned it to him. This operation they repeated several times, till at last they caught sight of two interlopers who had been watching them, and being too bashful to continue their billing in public, they flew away. Burroughs I think cites a similar case with reference to the same bird.

Curiosity is another characteristic, many of the birds have in common with the human race. I remember being interviewed by a Water Thrush, while standing quite still in a swampy piece of woods, watching for another bird. This shy little warbler came hopping along from branch to branch till it was within two feet of my face, looked me full in the eyes, took a careful survey of me from head to foot and then, as if satisfied with the inspection, flew away.

What fixed this somewhat trival occurrence, in my mind, was that on the afternoon of the same day, in another swamp at least three miles from the first one, the very same thing was repeated by another Water Thrush, in almost exactly the same way. At another time one of a little knot of Meadowlarks I was scrutinizing with the glass, thought he would like to see what I looked like behind, so, making a long *detour*, he flew up as near as he dared behind me to have a look. By turning my head I followed his flight, and when he alighted and saw that I was still watching him, he hurried back by the way he came in a great state of excitement, and reported to his comrades that I could look both ways at once with my big goggle eyes. Of course they knewbetter and laughed at him.

Of all the birds, one would think the big blustering bully known as the Crow Blackbird, the least likely to imitate the acrobatic feats of human beings. And yet I was told by a young man, whose veracity up to that time I had had no reason to doubt, that he had a short time before witnessed the spectacle of several of these birds turning somersets on the grass. He further went on to say that one of them was as far superior to the others in acrobatic proficiency as the bespangled king of the circus arena is to the common tumblers in the pink tights. These less favored birds, he averred, made a dismal failure of it, or as he put it "fell all over themselves," whenever they tried to follow the leader in his graceful evolutions. I gravely listened to this touching narrative giving no hint of my mental resolve to enquire the price of yarn at the first opportunity, a resolve I never carried out, for just six days later I surprised two of these Blackbirds sitting on a pasture fence, acting in the double capacity of spectators and sentinels, at a similar acrobatic performance given by half a dozen of their cousins, the Cowbirds. They were not just exactly turning somersets, but their actions were sufficiently unbirdlike, and bore a strong enough resemblance to the tumbling of the circus ring, to make me very glad I had expressed no open doubt of my informant's truthfulness, and when I afterwards saw two Robins playing hide and seek over the shelving edge of a railway cutting, with all the dainty tip-toeing to the edge of the bank, the springing out from the hiding place, the screams, and the laughter, that would have characterized the game had it been played by children, I was still

more ashamed of my unbelief. And now that I too have forfeited all claim to be believed I shall only ask you to listen to a few more of my bird yarns, selecting such as will not lay too great a strain on your imaginative powers.

It often puzzled me how birds did for water in winter when snow and ice covered almost all the available sources of supply, and open water was to be had in but few places. The most natural solution (in more senses than one) of the difficulty did not occur to me till I happened to observe a Goldfinch eating snow in February.

If I am not mistaken the tail, in its capacity of rudder, is generally supposed to be an indispensable part of a birds outfit, and I must confess to a similar opinion, held till August of last year, when I saw in broad daylight, and watched for some time, a Night Hawk so utterly devoid of tail that it seemed as if the after half of the body had been chopped off with it. And yet this bird was hawking for its daily meal of insects, among its brothers, and performing all those graceful aerial evolutions for which the species is noted, with apparently as much ease as any of them. I also read in the last number of the Ornithologist and Oologist, (one of our exchanges), of a Yellow-billed Cuckoo without a tail having been observed on its nest, and the question at once suggested itself, by what kind of accident are birds deprived of this useful appendage, or do these instances merely indicate the beginnings of a new phase of avian evolution, analogous to that by which man has attained his present tailless eminence?

Though birds in general conform more or less strictly to certain rules in the selection of their building materials, we occasionally find an individual who sets these rules at defiance, and displays the originality of a master mind in the selection. For instance a Robin's nest found in this vicinity a year or two ago embodied in its composition art, literature, finance, and the manufactures, art being represented by a skein of colored embroidery silk, literature by a newspaper clipping, finance by a cancelled cheque on the Bank of British North America, and a fragment of a promissory note, and the manufactures by a piece checked cotton shirting. It will be noticed that the builder showed great impartiality except perhaps, as above indicated, an undue preference for checks.

When we reach the last chapter in the life of a bird many perplexing questions arise. One of these is, what becomes of the large numbers of birds that must of necessity die from old age or other natural causes? Is it, as has been suggested, that on the approach of death they instinctively hide themselves from view, and thus concealed await their doom, or is it that they are at once removed from sight by nature's industrious scavengers, the insects and other animals? Whatever be the reason, the fact remains that comparatively few dead birds are found whose deaths cannot be traced to violence or accident. In the latter class of cases the inventions of man play an important part. Lighthouses, railways, and telegraph wires all contribute their quota to the large number of accidental deaths in the bird world. Many instances are reported of birds meeting their deaths by flying against moving railway trains, and last summer a black-billed Cuckoo was brought me which had been found dead upon the cowcatcher of the locomotive, on the arrival of the evening express from Montreal on the Canada Atlantic Railway. This bird was brought me by a bright-eyed and observant boy, who sometimes accompanies me on my tramps, evincing much intelligent interest in bird life. He tells me that last summer, while on an excursion train on the same railway, he saw a Crow fly against a wire fence, and, becoming entangled with one of the barbs, it hung there, struggling and fluttering as long as he could see it from the window of the moving train. Another curious instance was that of a Sparrow Hawk brought me last fall, which had been found in one of the flues of the boiler at Lansdowne Park, just before the Exhibition there last fall. The boiler had not been opened since the year before, and the poor creature had evidently, at some intervening time, flown down the smokestack, and, being unable to fly up again, had starved to death. What little flesh remained on its bones was completely dried up, and the plumage, except for a slight abrasion on the head, was in perfect condition, its colour, however, being slightly darkened with soot. I congratulated myself on having a ready-preserved specimen, but although it had been very dead when I got it, in less than forty-eight hours it was very much alive, and I speedily lost my faith in that method of embalming, and with it my specimen.

These are a few instances, taken somewhat at random, of what may be seen by any one who will use ordinary powers of observation, and if my hasty and imperfect account of them has interested any of you one half as much as the observations themselves interested me, I think you will be inclined to agree with me that, for some purpose at least, a bird in the bush is worth two in the hand.

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A NATURALIST IN THE GOLD RANGE, B. C.

By James M. Macoun.

(*Read March 7, 1890.*)

While the Gold Range proper includes the Selkirk, Purcell, and several other ranges of the Rocky Mountains, the term "Gold Range" is more frequently applied to that part of the system termed by geologists the Columbia Range. Lying between the N. E. arm of Shuswap Lake and the Canadian Pacific Railway is a group of mountains forming a part of this range, but to which no distinguishing name has yet been given; one of the mountains in this group, however, is known as Mount Queest, and I shall restrict myself to a brief account of an expedition made to it last summer in search of Natural History specimens. If my paper assume the form of a personal narrative it is only because I have thought it the best means of conveying impressions of the mountains and what is to be found on them, to those who have never been among them.

I was accompanied by one man, and late in July we left Sicamous, at the mouth of Eagle River, and rowing up the N. E. arm of Shuswap Lake camped, after a long day's pull, at the mouth of a small creek which we were to ascend the following day. Before sunrise we had packed a few pounds of bacon and flour in our blankets, and tying them securely on our backs, set out, my companion carrying a repeating shotgun and I a plant press well filled with papers. It was our intention to follow the creek to its source, and by doing so we hoped to reach a mass of snow almost due south of where we had camped. A well-defined path ran along the creek, and as we had heard that the plateau

which formed the summit of the range was a favorite hunting ground of the Indians, we imagined that by following it we should be able to ascend the mountain with little difficulty. For perhaps a hundred yards the trail was broad and well worn, trees on all sides had been "blazed," and there was every evidence that it had been much used, but we then came suddenly upon an opening in the woods and found that our supposed mountain trail led only to an old camping ground where canoes had been made the previous year. Our disappointment was somewhat lessened by the discovery of a faint trail which still led up the creek, and although in many places it was imperceptible we had always two or three marked trees in sight before us, and had no difficulty in making fair progress, for while there were fallen logs and trees without number, our path wound in and out, over and under them, in such a manner that there were no obstructions to delay us; suddenly all traces of the trail were lost, nor were there markings of any kind upon the trees. After some time spent in a fruitless search for a continuation of the trail we concluded that we had been following an old line of traps; why it should have ended so abruptly we could not understand until having decided that trail or no trail we would push on, we looked about us and saw that the creek valley had been gradually narrowing, so that where we stood the bottom of the valley was not more than thirty yards across; the hills rose steeply on either hand, and on moving forward a short distance and rounding a "shoulder" of a hill that had before prevented us from seeing what was ahead, the reason for the sudden termination of the trail was evident. The valley had grown still narrower, or rather there was no longer any valley at all, the creek flowing through a canyon about half a mile in length, in which distance it fell several hundred feet. As we looked up the gorge we saw something darting in and out of the water, now disappearing behind a log or rock and again coming into view twenty or thirty yards off, it was a dipper, or water-ouzel (*Cinclus Mexicanus*). A pair at least of these wonderful little birds is to be found somewhere on every stream in the Gold Range, and yet it is nowhere common. Until mated it leads a life which, did the bird not always appear to be active and happy, would seem the essence of loneliness, for two of them are never seen together except in the breeding season. The splashing of swiftly-running water

against logs and stones, or its roar as in little cascades it falls over obstructions to its course, is all the company the dipper asks, and all day long never resting, never wearying, it moves from place to place. It walks under water as if on dry land, and seems almost as much at home there as anywhere else; it knows of but one way of getting behind the waterfall, where perhaps it has built its nest, and that is to go straight through it. Its song is described as "exquisitely sweet and melodious," but although I have seen many of them I have never heard one sing.

We decided that we could follow the creek no further, and after a short rest began the ascent of the shoulder. As we left the low, dark woods of the creek valley a mountain chipmunk (*Tamias Asiaticus var. borealis*), the smallest of the squirrel family in America, ran chattering across a ledge of rock above us. This tiny animal possesses to the full the characteristic activity of its family and is seldom at rest; it is to be found everywhere in these mountains, and one soon grows to feel lonely when none happen to be near enough to make their presence known by their merry chatter. No more industrious animal is to be found anywhere; all through the last weeks of summer and the short autumnal days, before the first heavy fall of snow drives him into winter quarters, he is employed in gathering and storing away roots and seeds for use during the winter. With his fore feet he fills the pouches with which nature has provided him—one on either side of his mouth—and returning to his snug little home beneath some stump or fallen tree, packs his harvest away in his store-room, for not satisfied with making the chamber he is to occupy warm and comfortable with moss and leaves he stores his food in another apartment than that in which he is to doze and dream away the long winter.

After leaving the creek we forced our way through a dense growth of small fir trees and underbrush until we were out of the creek valley and about 500 feet above the water. We were now between two creeks and on a ridge that seemed to extend to the summit, and up this we toiled for three hours. The whole mountain side had a few years before this been burned over, and the second growth timber was as yet very small; the dense undergrowth effectually concealed the burnt logs with which the ground was strewn, and which could seldom be seen

before they were stumbled against. Not a trace of water had been seen since we had forsaken the creek, and dinner without it was out of the question. We had seen no berries yet, but a little higher up found *Vaccinium parvifolium* in abundance. Its fruit, although refreshing, could be eaten in small quantities only, as at this altitude it was hardly ripe yet and far from sweet. By three o'clock we were both pretty tired, as we had not only been climbing steadily, but all our strength had to be exerted a great deal of the time to enable us to force our way through thickets of balsam or alder; and now we decided that water must be had even at the cost of losing some of the ground we had gained. We had been moving parallel to the creek, but had risen much more quickly than it, so that we were now nearly a thousand feet above it. Turning almost a right angle we began the descent, but so thickly grew the underbrush, and so many detours had to be made to avoid precipices, that it was five o'clock before we reached the water and found that we were just at the head of the canyon, half a mile from where we had been in the morning; supper was soon ready, and before dark we were quite rested. The canyon was now behind us, and we resolved that come what might we would not again leave the creek, nor did we, and although the road was far from smooth and there were rocks and logs in abundance to climb over, shortly after noon the following day we saw the snow glistening through the trees, and knew that we had not much further to go. A few rods higher the woods ended abruptly, and before us was a meadow (if a meadow may be formed of flowers instead of grass) reaching to the foot of the mountain two hundred yards away. This little flat is about one-fourth of a mile wide and two hundred yards deep at the centre, the hills rising from it in the form of a semi-circle, so that the meadow made an arc of a circle, a veritable amphi theatre. Just at the edge of the woods our packs were thrown down, and we hurried across the intervening level ground to the foot of the last steep incline that led up to the snow, and had hardly begun to ascend it when we were startled by a sharp, clear whistle not unlike that used by yardmen about a railway station. Almost instantly it was answered from all sides, and we saw scampering toward an immense pile of rocks at the foot of a cliff, a dozen or more Hoary Marmots, or "whistlers," as they are generally called, (*Arctomys caligatus.*) Arrived

at their own quarters, and imagining themselves in safety, they soon recovered from their surprise and fright, and as we climbed the hill we saw here and there above a rock a head apparently watching us. Soon the animals themselves appeared, and by degrees returned to the agreeable occupation of fattening themselves for the long hibernation of the coming winter. The whistling went on at intervals, but the note of fear was changed to one that savored ever so slightly of impudence. Our minds were now at rest. Here was food in plenty, and although we discovered afterwards that the flesh of the whistler is neither very tender nor very palatable, it was easily procured and furnished us with several good meals when nothing better had been shot; but at no other time did we attempt to take them. Only a few days before, the surrounding hills had been entirely covered with snow, but on many exposed places it had melted away and we ran up a grassy slope dotted with spring flowers. There was the beautiful Erythonium giganteum, a larger and much more handsome species than its brother the familiar Adder's Tongue or Dog-toothed Violet of our Ottawa woods, beside it grew Anemone occidentalis, the western mountain Anemone, a far larger and more attractive flower than any of our eastern forms of this genus. The little arctic buttercup Ranunculus Eschscholtzii was everywhere in profusion, and in the little rivulets running from the snow Epilobium alpinum grew in dense clumps, its delicate pink flowers massed together to attract attention. Claytonia Caroliniana, var. sessilifolia, was abundant too, but is not nearly so pretty as our Spring Beauty, of which it is a variety. Merely glancing at these as a foretaste of what was in store for us, we lost no time in climbing to the summit of the hill, which we soon reached, and from which we had a magnificent view of the surrounding country. Due north of us lay Shuswap Lake, and it was not difficult to trace with the eye the course of the creek from our feet to where it entered it. Far to the north and northeast were snow-capped mountains, and one glacier could be seen glittering in the sun. Towards the south the prospect was brighter. A mountain prairie, about three miles across, stretched from where we stood to a higher mountain. Further inland, a few groves of trees and frequent dashes of brilliant color, where the flowers of one species predominated, gave the whole an appearance of an im-

mense park, the innumerable rivulets and brooks defined by the deeper green of the grass that grew along them, appearing to be so many intersecting paths and heightening the effect of artificiality.

There seemed to be a great many species of flowers growing on this prairie, but a closer examination the next day showed that after all there were but three conspicuous species, the red blue and yellow blossoms of which blended in so many different ways and formed such novel combinations that it seemed incredible that there should not be at least a dozen species represented. Others indeed there were, but not such as formed noticeable patches of color, but the three colors in some form or other were everywhere. In one place could be seen many yards covered with Lupinus Nootkatensis, a common British Columbia lupine, but one could never tire of its spikes of beautiful blue flowers, which exhibit all the varying shades between the lightest caerulean and the deepest smalt blue. Again, it would be mixed with the bright scarlet flowers of Castilleia miniata, or those of the yellow Arnica. As a rule, however, while all three flowers were present one was generally sufficiently in excess of the others to give the impression that it alone was to be seen, but on turning the eyes a little to one side some other color filled them. As we turned to descend the hill a porcupine was seen walking slowly towards us along its crest, and my companion could not refrain from picking up a stick and giving chase. Beyond a slight increase in his speed, as he turned away, the animal gave no evidence of being in the least frightened or even aware of our presence. A blow from the stick ruffled his equanimity a little, but before he could show fight a second had fractured his skull and he was hauled in triumph down the hill to camp, for we had decided to camp just where we had left our packs, and at once set about making ourselves comfortable. A level spot was soon found; Bryanthus empetriformis, the nearest approach to heather we have in Canada, grew everywhere, and enough of it was soon pulled to make a bed. There was dry wood in abundance; the pot was soon boiling, and after a cup of tea we felt quite at home. We did not ascend to the summit again that night, but in the immediate vicinity of the camp forty species of plants were collected before dark; many of them were small and of little nterest to any but a botanist, but there were among them flowers that

would have added to the beauty of any garden, Mimulus Lewisii, the Western monkey-flower, being one of the most conspicuous. To my mind none of the species in ordinary cultivation are at all to be compared with it. On a ledge of rock grew a solitary clump of Epilobium latifolium, but its dwarf habit and larger flowers make it much more attractive than its weed-like brother E. spicatum which grew near it. Beside and in every rivulet grew Caltha leptosepala, in general appearance not at all like Caltha palustris, the marsh marigold or cowslip of the East; the flowers are bluish-white instead of yellow, and the whole plant is much smaller than Caltha palustris. The porcupine was the largest animal seen while we were on this mountain, although there must have been caribou, bear, deer and mountain goats in considerable numbers, as fresh tracks were seen every day, but we never caught a glimpse of the animals themselves.

Besides the locality near our camp which I have mentioned, colonies of the Hoary Marmot were found in many other places; with them were frequently Parry's Spermophile *(Spermophylus empetra)* and the Little Chief Hare *(Lagomys princeps)*, although the spermophile preferred more open ground in which it could burrow easily. It is one of the largest of the ground squirrels, and was our principal food while on the mountain; we found its flesh to be delicate in flavour, tender, and much to be preferred to that of the marmot. The Little Chief Hare is an exceedingly interesting animal, and much has yet to be learned of its habits. Very little larger than the common rat, it is a typical hare in appearance as well as structure, with many of the habits of the common hare of Eastern Canada. Small and much the colour of the rocks which it frequents, it is seldom seen except when it attracts attention by its sharp whistle, and as the whistle is generally given just as it dives into a safe place among the rocks, specimens are not as a rule easy to procure. They are said to hibernate in nests made of moss, dried leaves and similar material, but it is hard to believe that so much time is spent in the careful cutting and drying of leaves that are to be used in the composition of a nest and not for food, when everywhere about are dried leaves of all sorts and sizes, and in sufficient quantity to furnish homes for all the animals that frequent the place; but it is said that they eat nothing when in winter quarters.

Certain it is that in early autumn the industrious little creature sets to work, and much of its time is spent in cutting and piling up leaves which it conveys to some hole among broken rocks, that has been chosen for the winter.

Three species of trees grew about our camp, all conifers : a spruce, Picea Engelmani ; a hemlock, Tsuga Mertensiana ; and a balsam, Abies sub-alpina ; none of them were of large size, but although we were camped within a few hundred feet of the snow, they were almost as large as the same species had been a thousand feet below. No fruit of any kind was found at the altitude of our camp, but about a mile lower down the mountain Vaccinium myrtilloides and Vaccinium ovalifolium formed in many places the principal undergrowth ; the berries of the latter resemble our common blueberries in appearance, but are much more acid, and not valued highly when other fruit is to be had. Vaccinium myrtilloides is unequalled among Canadian wild fruits ; its berries are large, about half the size of the cultivated black cherry, which it exactly resembles in colour, the flavour is exquisite, and it possesses the rare quality of leaving no feeling of satiety, no matter how many of them may be eaten.

Of small birds there were about a dozen species on the mountain, several of them forms of common occurrence in Eastern Canada ; the pine siskin *(Spinus pinus)* and white-winged cross-bill *(Loxia leucoptera)* were flocking together, the rasping note of the red breasted nuthatch and the assertive call of the kinglet *(Regulus calendulus)* were frequently heard, several little winter wrens sang continually behind our camp, and a family of mountain blue-birds *(Sialia arctica)* occupied a hollow tree near us. Although we were camped at an altitude of more than 6000 feet the rufous-backed humming bird *(Trochilus rufus)* was almost as common as it had been at the coast. Of game birds but two species were shot, the blue or sooty grouse *(Dendragopus obscurus fuliginosus)* and the rock ptarmigan *(Lagopus rupestris)* ; the former is a common bird throughout Western British Columbia, and we had counted upon shooting as many of them as we should need for food ; the ptarmigan is found only on the summits of high mountains, generally near the snow.

The descent of the mountain was not so difficult as disagreeable,

for we now knew the best way to go and did not leave the creek valley except at the canyon, and there by climbing a few hundred feet the steep rocks were avoided; the great trouble was to move slowly enough, for in four hours after we had left our camp on the mountain, scratched and torn we had reached our boat at the lake.

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EXCURSIONS.

The excursions held by the Club during the past season have been remarkably successful in every way. In addition to the general excursions sub-excursions have also been made under the guidance of the leaders upon the Saturday afternoons throughout the summer. These will be mentioned in the Annual Reports of the Branches.

Excursion No. 1.—May 31, 1890.—A most successful field-day was held to Butternut Grove, in the Chelsea Mountains, as the first General Excursion of the Club. The locality was a new one, and proved to be all that could be desired. The members and their friends, to the number of 130 availed themselves of this opportunity to spend a pleasant and instructive day in the woods. The weather was simply perfect, and the interest shewn by all was a guarantee of the thorough enjoyment which everyone shared. At 4 o'clock the genial and popular President, Dr. R. W. Ells, having called the party together beneath the refreshing shade of a grove of beech trees, congratulated all present upon the complete success of the day; he then asked the leaders to speak of the various treasures collected in their several branches during the Excursion. Mr. Fletcher was first called upon; he spoke of the rarer and more interesting plants. Mr. Kingston, who followed him with observations upon birds seen during the day, found an attentive and eager audience. Mr. T. J. MacLaughlin, when speaking of the insects which had been taken, made an eloquent addresss and touched upon some of the points of the theory of development as illustrated in the insect world. Mr. H. M. Ami explained concisely the geological formation of the district, and was followed on the same subject by Prof. Bailey, F.R.S.C., of the University of New Brunswick, and also a member of the Club, who expressed his pleasure at being able to attend one of the excursions of the Club, of which he had often read accounts. At the invitation of the President, Mr. Horace T. Martin, of the Montreal Natural History Society, addressed the meeting. He spoke in high terms of the systematic manner in which

the Excursion had been arranged, and the way in which the work was divided up under the leadership of specialists in the different branches of Natural History. He had enjoyed his day with the Ottawa Field Naturalists' Club very much indeed, and hoped that at the annual excursion of the Montreal Natural History Society, which was to be held the next Saturday at Lachute, he might have the pleasure of meeting many of those present. Miss E. Bolton, a member of the Council of the Club, spoke a few words, at the request of the President, upon the benefits of the Club as an educational institution. She spoke in a most encouraging way of the good the Club was doing amongst the young at the public schools of the city by drawing their attention to the good and beautiful.

The benefit to the Club of having ladies on the Council was plainly seen at this and subsequent excursions during the summer.

Excursion to Lachute.—June 7.—In response to an invitation from the Montreal Natural History Society, 17 members of the Club, including the President and several ladies, attended the excursion of that Society at Lachute. The Ottawa contingent arrived first, and received the Montreal club at the station on their arrival. A pleasant day was spent, and many interesting Natural History specimens were collected. Mr. Ami was asked to act as judge of the geological collections and Mr. Fletcher performed the same office for the botanical collections. The President, Dr. Ells, expressed the pleasure that he and his companions from Ottawa had experienced in meeting their Montreal friends, and trusted that there might be frequent similar joint excursions in the future. Mr. Whiteaves being asked to speak of the geology, said that Lachute was classic ground to the geologist, and told how Sir William Logan visited the place at a very early period of his career as Canadian Geologist, in a canoe, attended by four Caughnawaga Indians. How he had noticed the exposures of the calciferous and Potsdam formations in the neighbourhood of the Laurentian; and how he found the band of white crystalline limestone and traced it so many miles across the country. Short addresses were also given by Dean Carmichael, the Mayor of Lachute, and Professor Penhallow, who announced that in answer to the invitation of the Natural History Society, the Royal Society of Canada would hold their next meeting at Montreal. Votes of thanks were passed unanimously to the Mayor and people of Lachute, and cheers were given for the gentlemen who had addressed them and for the party from Ottawa. The company were invited to board the cars, where refreshments were provided through the kindness of the Canadian Pacific Railway Co.

WINTER SOIREES.

All members who wish to read papers or short notes for publication during the winter should send in the titles of their papers without further delay, as the programme for the winter is now being drawn up.

THE ENGLISH SPARROW.

By J. Ballantyne.

(*Read February 21st*, 1890.)

You are all aware that it is but a short time since the bird known by the name of "The English Sparrow" was introduced into North America, yet, notwithstanding this fact, it has increased in numbers so fast that it has now spread over nearly a third of the whole continent and is extending its area at the rate of about 275,000 square miles annually. It is highly probable that there are more of these sparrows at the present time in North America than of any single species of native bird. The presence of so many of them has become a question of such economic importance that the United States Department of Agriculture has issued a bulletin containing upwards of 400 closely printed pages relating wholly to the English Sparrow in North America, especially in its relation to agriculture. Attention to this bulletin has already been called in the last number of the Ottawa Naturalist. It deals with the whole question in a most exhaustive manner, entering fully into details concerning its introduction and diffusion, rate of increase and checks on the same. It also gives the replies from hundreds of observers from all parts of the country relating to the good and bad effects of sparrows on vegetation. Subsequently it points out the relation of sparrows to native birds, showing clearly that many of our insect-eating birds have been completely routed by the invaders. The conclusions arrived at by an overwhelming majority of observers are, that sparrows are more or less injurious to nearly all growing crops, including all our common fruits as well as grain and vegetables. and what little good they do would have been better done by our native birds had they not been driven away. The bulletin also gives an account of various methods which have been tried, in different localities, to destroy the sparrows, such as poisoning, trapping, shooting, etc. The methods most approved are pulling down their nests when this can be done, and persistent shooting. They become so wary that it is difficult to either trap or poison them.

Perhaps it may not be generally known that a great many colonies

of sparrows have been introduced into the United States and Canada a considerable number direct from Europe, and a much greater number from their progeny in this country. The places and dates of the first importations, so far as known, are as follows :—

Brooklyn, N.Y., 1851-52 ; Portland, Maine, 1854-58 ; Peace Dale, Rhode Island, 1858 ; Boston, 1858-1868 ; New York City, 1860 ; Philadelphia, 1869, and not long afterwards into nearly every State of the Union. In Canada they were first introduced at Quebec in 1864, Montreal 1870, Ottawa the same year, Hamilton 1872, Toronto 1875, Halifax 1875-76.

The English or House Sparrow (*Passer domesticus*) is common over nearly the whole of Europe, the northern parts of Africa, and a large part of Asia. It has also been introduced into New Zealand and Australia, and has become, like the rabbits, a great pest in those countries. It is known to have been quite common in eastern countries before the beginning of the Christian era. Aristotle mentions it as being a common bird in Greece in his day. Dr. Charles Pickering, of Boston, states that in hieroglyphic times the picture of a sparrow indicated an enemy or one ready to fight. I think most of you who are at all familiar with the habits and disposition of their latter day descendants will agree with me that they are no unworthy sons of their ancient pugnacious sires. In an old and highly venerated book, which some of you may occasionally see, it is stated that the current price of sparrows some two thousand years ago or thereabouts was two for one farthing, a pretty sure indication that sparrows were either very plentiful at that time and place or that farthings had a higher commercial value than they now have.

As has already been stated the consensus of opinion among observers, regarding the habits and food of sparrows, is unmistakably against them so far as agricultural pursuits are concerned, and the verdict has gone forth that it would be better if they were made to go. Accepting this dictum as final, the question naturally enough arises, can they be made to obey ? It has been said by some that they could "call spirits from the vasty deep," but the reply to the question, "Will they come ?" has never been satisfactorily answered ; so it may be with our little fellow-emigrants. The question of their going may not be very

easily answered. It seems to me that the advent of the people of Europe on this continent is almost a complete parallel to that of the sparrows. When they first came to this country they were heartily welcomed by the then occupiers of the land, but it was not long before the avarice, greed and cruelty of the strangers caused them to change their minds, and the word went forth among the dusky nations that the white man must go. We all know where he is now to be found, but where is the red man? So it may be with the sparrow. It came, or rather was brought, as the welcome ally of the husbandman. It has outlived the welcome, but it is still here in ever-increasing numbers, and, like its human prototype, it has probably come to stay.

One of England's greatest men in the world of science, but recently deceased, makes the statement that the power of adaptation to surroundings, means the survival and extension of both plants and animals so conditioned. The proofs of the truth of this statement are abundantly manifest, and perhaps no more striking instance can be given than the rapid increase and spread of the House Sparrow in this country. It appears to be possessed of the power of accommodating itself to climatic conditions in a higher degree than most of our native birds, and the varied range of food on which it can subsist and thrive fits it in an eminent degree to become a citizen of the world.

The sparrow, in providing for the rearing of its young, takes great precautions in the way of securing dry and warm quarters for them; from the care exercised in this respect there are reasons for believing that an unusually large proportion of their eggs produce young. It may also account in some manner for their great fecundity. The drain on the system incident to maternity being reduced to a minimum on account of their nests being always thickly lined with feathers and non-conducting materials, so that the time required to keep the eggs constantly warm during the period of incubation, must be shorter than it would be when the construction of the nest was of a different character. The fact that sparrows have from three to six broods in a season, varying from five to seven in each brood, while very few of our native birds have more than two broods, varying from four to seven in each, would confirm the belief that the drain on the vitality of the mother sparrow is less than it is with many of our native birds. Another

proof that maternal duties do not affect the vitality of sparrows in a very great degree is the fact that occasionally there will be found in their nests, at one and the same time, new-laid eggs, eggs half hatched, and young birds. I have not seen this myself, but my friend, Mr. W. A. D. Lees, on the 30th May, 1883, took from a nest in the top of a young hemlock tree, built on the remains of an old robin's nest, two young birds just out, one half-hatched egg, and another fresh and good, apparently new laid. Whether a continuous succession of eggs and young birds ever extend over a whole breeding season remains, so far as I know, yet to be found out.

During the past fall, after the breeding season was over, several members of the club observed sparrows carrying feathers and other light materials to the nests occupied in summer, with the evident purpose of making them warm and better adapted to resist the severity of winter weather. In fact, it did not seem to be nest-building at all, but rather house-building, much after the same manner as a man might build a house and occupy it. This habit, I believe, is common in other cool climates. I was not aware of the fact until a few days ago, when Mr. Lees called my attention to an article on "Winter Birds" in the December number of *Blackwood's Magazine*, 1889. I will give the quotation: "In times of severity he seeks the innermost eaves and holes of thatches, gnarled ivy roots and interior of barns, being a lover of warmth to no inconsiderable degree. Certain it is that at times, when nesting cannot possibly occupy his mind, he may be seen dragging feathers about which evidently are to warm the nest last used in summer." It was gratifying to learn that observations in Canada were in such complete harmony with those made in England on this peculiar habit of the sparrow. It would be a reasonable conclusion to arrive at, that it was a case of adaptation to climatic conditions.

Sparrows begin nest-building very early in the year, and it is certain that occasionally they hatch young in February. I was informed by Mr. Fletcher a few days ago that he saw sparrows carrying hay and other materials to a nest on Metcalf street in the last week of last January, also that a warm new-laid egg was found in Mr. A. McIntyre's porch on the 18th day of the same month. Mr. Armstrong, M.P. for one of the ridings of Middlesex, tells me that he saw fall from

a sparrow's nest in this city, in the last week of February, three or four years ago, a half-fledged sparrow ; there were probably others in the nest. Notwithstanding the above, there are reasons, however, for believing that the breeding season does not fairly begin until the latter part of April or the beginning of May.

It may be owing to the fact that sparrows have been brought so much into contact with man that they have attained to such a high degree of intelligence. There is little doubt but that they exercise a greater degree of cunning, it may be called, in self-preservation and applying means to ends than do most of our native birds. A case illustrative of this fact I saw in one of the papers a short time ago. It is as follows: A gentleman in one of the neighboring States having been greatly pestered with sparrows undertook to destroy them. To do so he soaked wheat in a solution of arsenic and water for some time, and then had it thoroughly dried. This he scattered about in places convenient for the sparrows to get. In a yard close by he had a lot of chickens which he was in the habit of feeding with the same kind of grain, unpoisoned of course, and where the sparrows were in the habit of congregating and eating the wheat along with the chickens. At first the sparrows readily ate the poisoned grain, but, soon experiencing the disagreeable effects of eating grain otherwise than in the company of the chickens, refused to eat wheat at all, whether poisoned or not, unless the chickens would eat it also. They knew that it was safest to eat in good company, and acted accordingly. This may be a case of exaggeration and not quite in accordance with facts, but there are so many well authenticated accounts of their sagacity as to leave no room to doubt the statements made concerning their wonderful cunning.

Sparrows are largely used as food in Europe, as well as in this country ; even in this city I have been informed that many of them are shot with noiseless guns and used in this manner, and are said to be quite as good as rice-birds or snow-birds. It might have an appearance of cruelty to destroy the pugnacious and self-maintaining little scavenger. I confess I like to see the sparrows hopping about the streets in winter when all the other birds are gone; but when it comes to be a choice between our native songsters and the foreigner my patriotism wells out n unmistakeable accents. Canada for Canadians, and if for love of our

country we must wage war, perhaps we cannot do better in the way of showing love to our enemies than by converting them into a savory mess and surrounding them with our own dear selves.

I might have said something about the effect of sparrows on our native birds, as observed at our own place ; but as my ten-minute limit has fully expired, I will only say that the number of native birds nesting with us grows fewer year by year, some of them having disappeared altogether.

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EXCURSIONS.

Excursion No. 2.—On 21st June an excursion attended by 110 ladies and gentlemen was held to Casselman on the Canada Atlantic Railway. Notwithstanding the intense heat and the enormous nummers of mosquitoes, which kept in constant attendance on the visitors throughout the day, the excursion was a most enjoyable one. Rare and interesting specimens rewarded the collectors in all branches. As soon as the Nation River was reached, the leaders made up their parties ; some crossed the the river to examine the beds of fossiliferous limestones and to look for Indian relics ; some took boats and amused themselves fishing or collecting aquatic plants or animals, while others went off in different directions through the woods and fields culling the treasures which everywhere presented themselves. As evening drew on the party reassembled at the railway station and, after an hour pleasantly spent in discussing the discoveries of the day, as well as the contents of the luncheon baskets, the usual addresses were delivered by the leaders. In the absence of the President, Mr. Robert Whyte congratulated those present on the successful and enjoyable excursion they had all taken part in. The thanks of the Club are due to Mr. Ebbs, of the Canada Atlantic Ry. Co., for the exceptionally low rate charged for the transportation which had made it possible for so many to attend.

Mr. Fletcher spoke of the insects collected and explained the uses of stings amongst the hymenoptera.

Mr. W. Scott, the botanical leader, drew attention to some of the rarer plants he had found. Botanically Casselman is a most interesting locality, several plants found here, not having been detected in any other place near Ottawa. Of these mention may be made of *Saururus cernuus, Phlox divaricata, Hypericum Ascyron, Thaspium aureum* and *Rudbeckia laciniata.*

Mr. W. A. D. Lees gave a good account of the birds seen by his party during the afternoon and spoke of their habits.

Mr. H. M. Ami spoke in his usual earnest manner and explained the rock and clay formations seen on the way to Casselman and there exhibited.

Excursion No. 3.— On the 19th of July a most successful excursion was held to Montebello by steamer "Empress." The weather was fine and a large number attended. On arriving at Montebello some visited the famous mansion and grounds, others explored the beautiful mountain from which the place takes its name, while a fortunate few, of the geological branch, were very kindly taken by the Hon. Mr. Papineau some distance up the river in his steam yacht to inspect certain tracks of marine animals there exposed in the rock. They were afterwards most hospitably entertained to luncheon at the Papineau mansion, for all of which, as for many like kindnesses in the past, the club is deeply indebted to Mr. Papineau. While returning by boat addresses were given: By Mr. Ami on the interesting marine tracks mentioned above; by Mr. Whyte on the plants collected, many of which were rare, and by Mr. Lees on the more noteworthy birds observed during the day.

Excursion No. 4, August 9th.—A trip to the Mer Bleu, in August, when the blueberries are ripe, has long been talked of by members of the Ottawa Field-Naturalists' Club, but it was not until this year that it could be arranged.

Upon the above date, however, a large party left by the C. A. R. 1 p.m. train, and found that the pleasures anticipated in such an excursion were in no way over-estimated.

On arriving at Eastman's Springs Station, Mr. R. B. Whyte acting as President announced the programme for the afternoon. The

party then examined the mineral baths and wells in the vicinity of the hotel, and some regaled themselves on the celebrated saline waters. Mr. Whyte then led the way to the vast peat bog known as the Mer Bleue. Some time was spent in visiting the gas spring and lighting the bubbles of gas as they rose to the surface of the water. The bog itself was very attractive; blueberries (*Vaccinium corymbosum* and its var. *atrococcum* with black berries) were very abundant, and in even greater profusion were the not unpleasant berries of the Choke-berry (*Pyrus arbutifolia* var. *melanocarpa*). The most conspicuous object was the beautiful ruddy Cotton Rush *Eriophorum Virginicum*), with here and there a patch of the white variety. The lovely White-fringed Orchis (*Habenaria blephariglottis*) was found in quantities, as well as many other peat-loving plants.

On reassembling at the railway station Mr. Whyte addressed those present in the happy and entertaining style now so well known to the members of the Club. He spoke of the plants gathered during the excursion. He was followed by Messrs. Fletcher and Kingston, who delivered addresses respectively upon insects and birds. Mr. Kingston's remarks upon the Chimney-swift were listened to with great interest.

Excursion No. 5, to Kirk's Ferry.—The last excursion of the season was to the above favourite locality and was well attended. At 9.30 on Saturday morning 6th September six large vans carried off a merry party of over 100 to the grand old Laurentian hills, now magnificent in their glorious autumn array of purple, green, bronze, and gold. The weather was all that could possibly be desired, clear, bright and hot; but tempered by a gentle breeze. A most enjoyable day was spent by all. Those who did not care to follow the energetic leaders sought out shady nooks amongst the rocks by the rapids or strolled quietly through the mountain woods. Prof. Macoun who had just returned from the Rocky Mountains was heartily welcomed by the members of the club.

An hour was well spent, before leaving for home, in listening to the leaders' addresses.

The acting President, Mr. R. B. Whyte, first called upon Prof. Macoun, who gave two most instructive addresses, the first upon the classification of Fungi and the way to distinguish between edible and

poisonous varieties. At the request of the leaders in Ornithology, he also spoke at some length upon some western birds which were representative of eastern species.

Mr. R. B. Whyte spoke upon general botany as leader of the botanical section. One plant new to the locality, viz., *Monotropa hypopitys* had been found by Mr. T. J. MacLaughlin.

Mr. H. M. Ami in speaking of the Laurentian rocks amongst which the day had been spent, showed specimens which he had collected during the excursion and mentioned the economic minerals contained therein.

Mr. Fletcher as leader in Entomology spoke of galls and in a general way of the instinct of insects.

The party reached home at 8 o'clock thoroughly satisfied with the last outing of the most successful series of excursions ever held by the club.

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SUB-EXCURSIONS TO THE MUSEUM OF THE GEOLOGICAL SURVEY DEPARTMENT.

Through the kindness of the Director and officers of the Geological Survey, the Excursion Committee of the club has been able to arrange a series of sub-excursions to the Museum on Sussex street. These excursions will be held at 2:30 p.m. on the second and fourth Saturdays in each month throughout the winter.

Three of these meetings have already been held, and were most successful. The first of them was of the Ornithological branch to the bird room.

They were met by Mr. J. F. Whiteaves, Palæontologist and Zoologist to the Survey, who delivered an instructive address upon the habits and noteworthy peculiarities of the birds exhibited as mounted specimens in the cases. Prof. Macoun also assisted in showing the specimens to the visitors, and afterwards took the party to the "long room," where he had arranged a large series of skins of western birds with their eastern representatives, he pointed out the gradual variation

which was shown by species obtained at the exreme limits of their habitats.

The second sub-excursion was of the Zoological branch. The club was again indebted to the kindness of Mr. Whiteaves for a most pleasant afternoon. The collection of stuffed animals was made the subject for a most entertaining object lesson.

The third sub-excursion was of the Botanical branch. Prof. Macoun met the party at the door with characteristic geniality and led them to the "long room," where he had laid out a large number of mounted specimens of Canadian plants and upon which he delivered an address which was eagerly listened to and highly appreciated. Some time was also spent in examining and comparing the specimens exhibited. Great interest was shown in the complete and handsome collection of Canadian woods, the economic values and distribution of which were described.

The next meeting will be held on Dec. 13th, when Dr. G. M. Dawson will give a description of some of the more interesting objects contained in the exsensive collection of Indian relics and curiosities, in the gathering together of which he has taken such an active part. The subjects to be explained at their meetings in the Museum will be announced from time to time in the OTTAWA NATURALIST. Mr. Ferrier has promised two lectures upon Mineralogy and Lithology. The Director, Dr. Selwyn, and other officers of the Survey Staff will take charge of the other meetings of the course.

The thanks of the Club are due to the Director and Staff of the Geological Survey for this opportunity of examining the collections in the National Museum under these very advantageous circumstances, and we trust that the sub-excursions will be largely attended.

Those who had the good fortune to attend the three first meetings are very grateful for the courtesy shown them on those occasions by Mr. Whiteaves and Prof. Macoun.

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BOOK NOTICES.

MANUAL OF INJURIOUS INSECTS AND METHODS OF PREVENTION. By Miss E. A. Ormerod. Second edition.

We have just received from our highly esteemed corresponding member, Miss Ormerod, copies of a much enlarged and thoroughly revised edition of her well-known Manual of Injurious Insects. Economic Entomology has made great progress since the appearance of the first edition in 1881, and this progress is largely due to the unceasing efforts of this talented authoress. Her Annual Reports are eagerly looked for by thousands of farmers in England and other parts of the world. There is no writer upon the science of combating the ravages of insects which attack crops, in Australia, India, South Africa, the United States or Canada, who does not quote her opinion as the highest authority upon those subjects which she has studied, and the present remarkable work is just what might have been expected from such a writer. "Insect Life," issued from the Department of Agriculture of the United States, and edited by the highest living authorities upon Economic Entomology, contains the following complimentary notice of this work :—"On account of its convenient size, admirable arrangement, plain language, and abundant illustration, it is almost a model of what such a work should be."—"Miss Ormerod's work cannot be too highly commended."

The merits enumerated above render this work intelligible—nay, indispensable, to every farmer, gardener and fruit-grower who wishes to carry on his work in the most successful manner. Nor is this the case in England alone where the work was written, for so many of the insects mentioned are common to both Europe and America that it will be found of interest to all of our readers. Moreover, from the fact that most of our injurious species have been imported from Europe, we know not at what moment any of the others mentioned in this work may not appear amongst us as a serious tax upon our cultivated crops. The different kinds of attacks are arranged alphabetically under the three headings, Food Crops, Forest Trees, and Fruit. Some new attacks not mentioned in the first edition, and which occurred subsequently to

the appearance of that volume, are here treated of at considerable length, *e. g.*, the Hessian Fly, Stem Eel-worms, and the Wheat-bulb Fly. In all cases much additional information is given; but particularly with regard to Wire-worms, Turnip-Flea and Hop Aphis. In the treatment of insects injurious to fruit trees a most important addition is that of the use of the arsenical poisons. The use of these poisons, now so well understood in this country, but which were until quite recently unknown in England as insecticides, has been wisely and boldly advocated by Miss Ormerod during the past two years, and the results have been most satisfactory.

As an appendix to the Manual is given a short and copiously illustrated "Introduction to Entomology," where, in the plainest possible language, the structure and changes of insects are described, and illustrations and definitions of the various natural orders into which they are classified are given, so as to "enable the observer of a crop attack to tell at least what kind of insect is before him," and also "in the list of the orders of insects, notes are given of the most observable of the characteristic points by which the insects composing these different orders may be distinguished from each other."

A glossary of terms and a full index render this work very complete. It contains 410 pages, and is illustrated with 155 excellent figures, many of them from the authoress's own pencil. It is well printed, neatly bound in cloth, and the small price at which it is published ($1.25) brings it within the reach of all.

Revision of the Species of the Genus Agrotis. By John B. Smith, 8vo. Washington, pp. 237, 1890.

This important work forms Bulletin No. 38 of the United States National Museum. It was begun when Prof. Smith was associated with Prof. Riley at Washington; but was subsequently handed over to the present author for completion, on account of pressure of other work upon the time of the United States Entomologist. Prof. Smith has made a special study of this difficult genus for many years and the present monograph will be gladly welcomed by all students of the noctuidæ. There is no doubt but that the publication will give an impetus to the study of these injurious insects, which was seriously

hindered by the lack of such a source of reference. There are five plates, four of sexual and other characters and one of an ideal agrotid, showing the normal maculation and habitus, with the proper names for the different constant markings, which will be of great service to students.

CATALOGUE OF INSECTS FOUND IN NEW JERSEY, 8vo. Trenton, pp. 486, 1890. By John B. Smith.

The above catalogue is issued by the Geological Survey of New Jersey and is a publication of much interest. Local lists are of great value when carefully prepared and Prof. Smith seems to have used the facilities he possessed to great advantage. Being well acquainted with all the leading Entomologists, both from the public positions he has held, and also as editor of *Entomologica Americana* he has been able to avail himself of the assistance of specialists in all the different orders. This catalogue is a valuable contribution to the Science of Entomology in North America, and we trust that ere long many others of the States will follow the good example set by New Jersey. 6,098 species are recorded as occurring in the State.

PLANT LICE AND HOW TO DEAL WITH THEM, by John B. Smith.

This is Bulletin No. 72 of the New Jersey Agricultural College Experiment Station. It is a pamphlet of 27 pages and is illustrated with 16 exceptionally good illustrations, all of which are original. The insects treated of are the Wheat Aphis, which, as well as its parasites, is fully described, the Cabbage Aphis, the Black Peach Aphis, the Cherry Aphis and the Melon Aphis. In all cases the best remedies are given and the method of their application is described. For such plant-lice as attack vegetation above the ground, Kerosene Emulsion and Whale-oil Soap are recommended, and for those species which attack the roots, periodical dressings of Kainit of Potash were found effective This substance not only acts as an efficient fertilizer, but also destroys many of the plant-lice. The application should be made just before a rain, if possible, so that the salts can be at once dissolved and carried into the ground.

This bulletin will be read by many with great interest, and from the language in which it is couched it can be understood by every one.

We take much pleasure in congratulating our esteemed corresponding member for having produced one of ehe very best bulletins ever yet sent out from any of the United States Experiment Stations. The language is plain, the matter is well arranged, and the illustrations are good ; merits which cannot but commend it to agriculturists, the people for whom it is prepared.

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CORRESPONDENCE.

To the Editor of the Ottawa Naturalist :

Sir,—In answer to the letter of Mr. W. E. Saunders in the Ottawa Naturalist for August, I beg to say that when I visited the marshes near Kars in 1883, I, unfortunately, was not in a position to secure any specimens of the birds I took to be Short-billed Marsh Wrens (*Cistothorus stellaris*). As my visit took place seven years ago, my recollection of what occurred is not very distinct, but I remember seeing a large number of what I believed to be Short-billed Marsh Wrens, and getting quite close to a few of them. I was not, however, familiar with the species, nor was I then aware of its limited range. I had no doubt at the time of the correctness of the identification, but would have made an effort to further verify it before placing it on record had it not been for the fact that one of my co-leaders in Ornithology, Mr. Geo R. White, reported the capture of a female of the species near the Rideau on the 22nd of June of the same year. (See "Transactions" 1883-4, p. 141). This, I concl uded, settled the matter. I have never seen the skin taken by Mr. White, but I preume it must still be in his collection.

Yours truly,

Ottawa, August 5, 1890. W. L. Scott.

Note.—The above note was sent to me by Mr. Scott immediately after the appearance of Mr. Saunders's letter, but was accidentally mislaid. The delay, therefore, in its appearance must be attributed to the Editor.—J. F.

The following interesting letter has been handed to us for publication by Prof. Macoun :

265 Yonge St., Toronto, Nov. 23rd.

To the Naturalist of the Geological Survey, Ottawa.

A few days since, I received for monnting, a very uncommon bird which proved to be a hybrid between a Pintail Duck and a Mallard.

It is a male with a beautiful blending of the plumage of both parent birds, In shape and length, it resembles the Pintail, measuring 25$\frac{3}{8}$ in. : tail 5$\frac{3}{8}$, culmen 2$\frac{1}{8}$, wing 11$\frac{1}{4}$, tarsus 1$\frac{3}{4}$, toe without nail 2, as against the measurement of a fresh Mallard I got for comparison : Length 23$\frac{3}{4}$, wing 11, tail 3$\frac{7}{8}$, culmen 2$\frac{1}{8}$, tarsus 1$\frac{7}{8}$, toe 2$\frac{1}{8}$. The bright green head of the Mallard is toned down to a brownish green, and the ring runs up behind towards the top of the head, as in the Pintail, while below it extends and fades into brown or chestnut. The wing contains green instead of the deep violet or purple of the Mallard. The wings are the same as in the Pintail, having the pencilling much heavier than the Mallard. It is a very interesting and fine looking specimen.

In Mammalogy too, I have just received a curious specimen; a red Deer, half white. Although a heavy buck, it is not nearly as tall as an ordinary one. The white extends from the belly to half way up to the back, on sides of face, top of neck, shoulders, front leg and hind quarters. It was killed on Cove Island, Lake Huron. When I have it completed I intend to have it photographed.

W. CROSS,
(Taxidermist and Naturalist)

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THE WINTER LECTURES.

Throtgh the kindness of Dr. J. A. MacCabe, Principal of the Ottawa Normal School, the winter courses of lectures will be held in the commodious and comfortable Lecture room of that institution. This is a great advantage, and one which we feel sure will be appreciated by all our members. The programmes for the two series of lectures are presented herewith, and will be found to contain papers of great interest. The soiree committee, in drawing up the programmes, particularly endeavoured to obtain papers which would be of interest to the general public as well as to naturalists.

The educational aims of the Ottawa Field-Naturalists' Club have been kept prominently in view, and to further this end it has been decided by the Council to make admission to all the lectures in both courses free to any who may wish to attend.

With the object of making the lectures as entertaining and instructive as possible, where practicable specimens will be exhibited illustrative of the subject discussed.

The chair will upon all occasions be taken promptly,—for the evening lectures at 8 o'clock, and for the Monday afternoon popular science lectures at 4.15 p.m. These afternoon lectures will last for 45 minutes, and 15 minutes will be given for discussion.

1890. Ottawa Field-Naturalists' Club. 1891.

EVENING LECTURES 8 P.M.

1890.

Dec. 11.—Science as an Aid to General Education.....Dr. MacCabe.
President's Inaugural Address.....Dr. Ells.

1891.

Jan. 15.—Report of the Zoological Branch.
The Beaver.....Mr. Lett.
29.—Report of the Ornithological Branch.
The Chimney Swift.....Mr. Kingston.
Canadian Gems.....Mr. Willimott.

Feb. 12.—Report of the Botanical Branch.
The Development of Cultivated Fruits from Wild Varieties.....Mr. John Craig.
26.—Report of the Conchological Branch.
Some new species of Chazy Fossils.....Mr. Sowter.
A Botanist among the Glaciers.....Prof. Macoun.

Mar. 3.—Report of the Geological Branch.
Asbestus.....Dr. Ells.
12.—Report of the Entomological Branch.
Mineral Phosphates.....Mr. Lainson Wills.

MONDAY AFTERNOON LECTURES 4.15 P.M.

Jan. 12.—The Study of Natural History.....Miss M. A. Mills.
19.—The Geographical distribution of Plants.....Prof. Macoun.
26.—The Educational value of Botanic Gardens...Mr. Fletcher.

Feb. 2.—The Physiology of Plants.....Mr. W. Scott.
9.—The Migration of Birds.....Mr. Lees.
16.—The True Bugs.....Mr. Harrington.
23.—The Chemistry of Food (1).....Mr. Shutt.

Mar. 2.—The Chemistry of Food (2).....Mr. Shutt.
9.—Beneficial Birds.....Mr. Kingston.

N.B.—All the above lectures will be delivered in the Lecture Room of the Normal School. Admission free. Anyone wishing to attend will be welcome.

EVENING LECTURES.

The Opening Address, delivered Dec. 11, 1890.

The first meeting of the course of Thursday Evening Lectures, arranged to take place during the winter, was held in the Normal School on the above date, at the advertised time. Dr. J. A. MacCabe, the Principal of the Normal School, opened the meeting by delivering an Address of Welcome. He stated that owing to the fact that they were in the midst of the closing examinations it had been quite impossible for him to prepare the address he had proposed. He had two objects in view in granting the use of the Normal School Lecture room for these Free Popular Lectures, which he was certain could not but be of great value to the students attending the school and to the citizens of Ottawa. The first object was to show, as expressed in the title, that "Science" was given on the programme for his address " an aid to general education," the second was a very easy and pleasant one, namely, to extend to the members of the Ottawa Field-Naturalists' Club and their friends a very hearty welcome.

Speaking of the educational value of science he drew attention to the fact that no one was too old to learn—the time never came to anyone when he could say he had finished his education. A person's education was always progressing, and was influenced by every person or object with which he came into contact. Taking this into consideration, he said we all must appreciate that the great fountain and source of knowledge lies outside the class-room, and is not found in text books alone, but must be sought in the great world of Nature. Teachers are frequently told to study Nature's methods; he would go further and say: Study Nature herself.

Speaking of the good work which had been already done by the club, Dr. MacCabe foresaw great advantages from the present course of lectures, not only to the Normal School and the city of Ottawa, but to the whole district.

He concluded by wishing the club every success, and then introduced Dr. Ells, the president of the club, who delivered the following:—

PRESIDENT'S INAUGURAL ADDRESS—1890.

Ladies and Gentlemen,—In opening the lecture course of the Ottawa Field-Naturalists' Club for the present season, I feel that there are several things which call for a word of general remark before we enter upon the discussion of the several scientific subjects which, as you will see by reference to your programmes, the Soiree Committee have so liberally provided for our entertainment. And, first of all, I think this society has great cause for rejoicing, in the fact that we have had placed at our disposal, through the kindness of the authorities in charge of the Normal School building, and more particularly through the courtesy of Dr. MacCabe, the Principal, the large and commodious rooms of this institution in which to hold our lecture courses; a change, I am sure, that all will appreciate, not only those whose place it is to speak to you but those who may listen; for there is no denying the fact that much of the pleasure and profit derivable from any lecture course is dependent upon comfortable and attractive surroundings. On behalf of the Club, therefore, I would desire to tender our thanks, through Dr. MacCabe, for the privileges which have been hereby conferred upon our society, more especially since, through this courtesy on their part, we are enabled to extend very considerably the aims of this club, in that we are now in a position to tender a cordial invitation to the large classes of students who attend the Normal School to be present at all our lectures and soirees, a thing impracticable heretofore owing to the limited lecture room at our disposal. In this way, I say, the original purpose of the club's work, viz., that of Education, will be very greatly facilitated.

I must, in the second place, congratulate the club as a whole on its rapidly increasing membership, which now reaches nearly 300 persons, as well as upon the fact that many of our new members are persons of influence at points remote from Ottawa, and among whom are represented the several provinces from the Atlantic to the Pacific; a feature which, I take it, is largely due to the change in the policy of the club two years ago, when the scope of its work and transactions was extended. In this extended membership I see a very great element of strength, so much so that I feel, if we can keep up the

interest in the society at its headquarters by continuing to furnish such excellent programmes for our evening and afternoon lecture courses, this interest will gradually spread to the remotest limit, till presently we shall find the little society in Ottawa a gathering centre for information from all parts of the Dominion, concerning which aspect of the question I may have something further to say presently. Though I regret that owing to absence I was unable to be present at but two of your excursions, I am glad to know that throughout the season they were markedly successful, both in the numbers attending them and in the greatly increased interest manifested in the several scientific branches which were discussed. I think, therefore, on the whole, the club has great cause to be proud of the work already accomplished, and, judging from the progress of the last two years, it can safely be predicted that before the next decade, at the present rate of growth, this society will be the largest and most influential scientific body on the American continent. To some this may seem a far-fetched notion, but, I think, if we look at the composition of the club as it is to-day, with its long list of names, among which are those of many men distinguished for scientific attainments in every branch of Natural History, both at home and abroad, you will all agree with me that the realization of this ambition lies entirely within ourselves. And why should it not be realized? Why should not Ottawa, the centre of legislative and political influence, the most important city in many respects in the Dominion, the seat also of the largest purely scientific staff in the country, as well as of the Royal Society, with its several important institutions of learning, be also the headquarters of the largest and most important scientific society in Canada as well? I firmly believe, if we pursue the proper methods to this end and do not allow our zeal to flag, we shall see this aim accomplished. By enlarged membership we secure enlarged means, and with increased means greater facilities for publication and extended influence. I do not know of any society or scientific institution anywhere, either in this or the adjacent great country of the United States, which, for the small sum of one dollar a year, provides such an amount of valuable information, both in its lecture courses and in its publications, as the Ottawa Field-Naturalists' Club.

I trust I have said sufficient to indicate the future possibilities of this club, and to some of us the time appears to be drawing nigh when even a yet larger field of operations than any heretofore contemplated may be safely entered upon—that is to say, the establishment, not of an international but an inter-provincial science association, which, having its headquarters here in the Ottawa Field-Naturalists' Society, may, by means of its widely extended branches, gather together scientific information from every quarter, with many things of great value, which can be here arranged and placed on record. For, though the club has no museum of its own, the museum of the Geological Survey Department will always be only too glad to be the curator of valuable specimens in the several kingdoms of Natural History, and should be the natural receptacle for them. The present museum space is none too great, but some of us as members of the Geological Survey, and all of us as citizens of Ottawa, do not despair of the coming of the time when, upon some one of the beautiful spots in this city, there shall arise the magnificent proportions of a national museum within whose walls shall be gathered together and properly arranged the large and exceedingly valuable collections which are now found in the old building on Sussex street, a building which it is no sacrilege to say, is utterly unworthy of the treasures therein placed, exposed every day as it is to the risk of destruction by fire owing to the character of its surroundings. In this museum of the Geological Department are to be found specimens, not only illustrative of the geological formations and of the mineral wealth of the Dominion, but extensive collections in the branches of ethnology, botany, ornithology, entomology, conchology, etc., collections more extensive by far than the capacity of the building will even now accommodate, and many of which are, as a consequence, laid away in drawers and out-of-the-way places simply for the reason that there is no available space for their display. These collections, moreover, are increasing at a wonderfully rapid rate, as may easily be imagined, from the fact that of the large field staff that go forth every spring each one forwards annually whatever is found illustrative of the field which he is working, so that, of sheer necessity, the erection of a new museum, or the very considerable enlargement of the present one,

must be undertaken at no very distant date. In such an event, with a national museum erected, it is easy to see what a power for good scientific work such a scheme as that now proposed would be, in the contributions not only of wonderful and valuable materials to every branch of Natural History, but in the great collections of important scientific data that constantly accrue. Throughout all the provinces of this Dominion which I have visited, many persons interested in some one of the various branches of Natural History will be found. Botany, ornithology, entomology, etc., all have their students among persons whose tastes incline them to the study of the many objects of interest which are common to every one of Nature's fields. These observations are, however, checked or hindered by the fact that there are no local societies in most of these places where assistance in determining the specimens can be found, unless, indeed, at considerable expense; and also by a lack of opportunity for presenting the facts obtained, many of which are of very great importance to the scientific world, and by means of which the results can be made known to the host of persons interested in such pursuits. To all such workers the methods of the Ottawa Field-Naturalists' Club must commend themselves heartily, since in the work of this club there is an honest effort made to acquire as well as to impart information in nearly all the branches of Natural History. I can see, therefore, no reason why this society, having already shaken off the local trammels which once bound it according to the terms of its original constitution, should not go on still further and enlarge the scope of its operations to an indefinite extent by incorporating in its ranks the best talent found in our High Schools and other educational centres throughout the length and breadth of our country, as well as all those whose tastes incline them to the study of the natural sciences.

To this it may be objected by some that local societies are already in existence in the several provinces, and therefore there is no field left for extending the scope of our own society in this direction. It is true that such societies exist in cities like Halifax, St. John, Quebec, Toronto, Ottawa and Winnipeg, but of many, and in fact most of these, the work is of a different character to that contemplated by the

Field-Naturalists' Club. Some of these societies dealwith literary and historical subjects only ; others confine their observations largely to but one branch of Natural History ; while of others, again, owing to the very doubtful policy of leaving the management in the hands of men who, from business engagements or advancing years, do not possess the necessary animus to keep the societies' aims prominently to the front, or, in fact, to keep the society itself alive in its fullest sense, it is to be feared they have fallen rapidly into the background and are not conspicuous for the amount of scientific work done. In none of these, probably, or at least in very few, is there any attempt at obtaining a membership outside of the city in which the society is located ; and it is in this particular respect, if in no other, that this society has already secured a prominent place in the fact, that our membership even now embraces persons from Nova Scotia to British Columbia.

At the last meeting of the Royal Socicty of Canada a scheme was suggested for the acquisition and arrangement of various scientific data, such, for instance, as the arrival and departure of our birds, the first flowering of plants, the putting forth of the leaves on the various kinds of forest trees, and other kindred subjects, work which has been done locally by the members of this society ever since its organization. By many of us, however, I think it will be admitted that, while the Royal Society, from its elevated position as the leading literary and scientific society of Canada, stands in a particularly favorable position in regard to its smaller, and I think we may allow the expression, sister societies in literature, science and art, to lend the support of its great influence to all those which, as working organizations, must ever be the great gatherers and collaborateurs as regards the material from which scientific conclusions may be derived, the work itself must and can only be done by persons laboring actively in the out-door realms of Nature, and in actual contact with the things which surround us, whether in the hard and puzzling problems of geology, in the pleasant and instructive study of botany, or the delightful study of our birds, insects and shells, or in some of the more minute forms of animal and plant life. The materials thus obtained by these working societies, like the Field-Naturalists' Club, and the quantity of these should, in a short time, reach large proportions, can then be discussed, and the conclusions

arrived at arranged and presented at the winter sessions, after which the final results can be presented to the Royal Society of Canada in a series of papers which would form a most valuable contribution to our store of scientific knowledge, and which would be, by this society, put on record, and in case of doubtful points, could there be further discussed and the points in dispute carefully considered and settled. The question, then, of extending our membership in the way just indicated is one which I feel should be earnestly and speedily considered, and I am convinced that such a course will be conducive to the highest possible gain to our club as a whole and to the furtherance of scientific investigation throughout the Dominion.

I have had considerable difficulty in arriving at any conclusion as to what would be most profitable to present to the Club's consideration to-night in this opening address; for I think it will be unnecessary to designate the few remarks I may have to make by the title of lecture. You will see by reference to the programme of our winter courses, both for the evening and afternoon lectures, that there is an unusually good variety of material, embracing the Animal, Vegetable and Mineral Kingdoms. Among the latter we shall, I trust, have the pleasure of learning about the mode of occurrence, peculiarities and distribution of that important substance, mineral phosphate, concerning which Mr. Lainson Wills has kindly promised to give us some information, while in the department of Canadian gems we may also expect a treat in the contemplation of really beautiful things; for although Canada cannot as yet produce the diamond, the ruby or the emerald, she can furnish exquisite gems for personal ornament or for interior decoration, as you will be enabled to testify after seeing the exhibit which will, doubtless, be made on that occasion. The mode of occurrence and characteristics of that very peculiar mineral asbestus, are also to be described. In the department of Natural History you will hear our ever-welcome friend, Mr. Lett, who will tell us of the habits and peculiarities of the beaver, an animal now unfortunately rapidly becoming extinct in Eastern Canada owing to the fact that it is hunted very often without regard to proper observance of close seasons; while botany, in the more familiar form to many of garden decoration, will be discussed by one of the staff of the Central Experimental Farm. In

the afternoon lectures, which are supposed to be of a somewhat more elementary nature, botany will also take a somewhat prominent place, while the chemistry of food, a somewhat new branch in connection with the work of this club, but one of very great practical importance, will also be ably discussed. It may, therefore, be safely predicted that both the evening and afternoon courses of lectures for the coming winter will equal in every respect any which the management of this society has ever yet been able to provide, and will amply repay any who may be able to attend them for the amount of time and effort therein involved.

I must not omit in this connection to call the attention of the members to a new departure in the matter of sub-excursions for the coming winter. In former years these sub-excursions, as you all know, were supposed to terminate in October or with the coming on of cold weather, but this year, owing to the courtesy of the Director and staff of the Geological Survey Department, it has been arranged that these excursions will be continued on the alternate Saturday afternoons of each month during the winter to the museum on Sussex street, and some one of the branches of Natural History as there displayed will be discussed and illustrated by one of the officers in charge. Several of these gentlemen have already expressed their readiness to explain the leading features in the several collections, and it may be safely stated that the hour or two there spent will not be wasted.

While I do not propose to-night to go into any elaborate discussion on the comparative merits of any of the sciences, I think it is only fair to point out, in a working society like this, some of the great benefits that may be derived from the study of some one of the various branches of Natural History, more particularly since it has always been the aim of this club to keep prominently before the general public the higher education along these lines. And just here it is fitting to remark that it would seem that our present location in the buildings of the Normal School is one particularly adapted to forward our aims in this direction. Here we have annually a large number of students from many portions of the country, young men and women, who may be supposed to represent the more progressive elements in either sex, and who have arrived at that stage of life when, as instructors of youth, they are supposed to have a very fair idea of what constitutes the best and most useful

part of a liberal education, and to know the best means of imparting the same to those with whom they are brought in contact. To all such, both of those who are here to attend the winter session, and those who are present during the earlier part of the year, we can say most confidently that an attendance at the regular lectures of the winter courses, or at the regular outings of the summer and autumn, which may be said to extend from the 1st May to the 1st of November, will be time most profitably spent, and be productive, in most cases, of far better and higher results to those engaged in the work of teaching than the same time devoted to the study of some prosy text book. In this way, too, by opening some hitherto unexplored pathway among Nature's choicest treasures, and by awakening in the mind some new and hitherto unexpressed desire for a further and broader acquaintance with some of the more varied forms of matter, such a plan will, it is safe to say, tend to kindle the higher and nobler part of our natures and enhance our capacities for enjoyment tenfold. True it is that all dispositions do not regard the study of the natural sciences with the same feeling of delight. To some there is, unfortunately, no enjoyment in the contemplation of the beauty presented in the unfolding rose, or in the flight of the delicately tinted butterfly. To some, also, the study of the fossils embedded in the rock, or the contemplation of the wonders seen on every hand, does not raise the mind to the consideration of the grandeur and condescension of that Master designer of the universe that has fashioned all things with such wondrous art, and created for man's enjoyment such wondrously beautiful things. But in so far as the teaching portion of our community is concerned, I believe there is no way by which those so engaged can exercise so beneficent an influence on those entrusted to their care as by frequent short excursions over the neighboring fields; by unfolding to them the beauties of structure displayed in every opening flower, by showing the wonderful convolutions of the many dainty shells which, though more rare than the flower, can also be easily obtained, the increased necessity for closer search, serving often but to enhance the pleasure of the discovery. What, for instance, can be more interesting than to study the habits of some of our most common insects, to watch the various evolutions of our common ants, to note the gorgeous colors and graceful flight of som

of our moths and beetles? All these things appeal most strongly to the sense of the beautiful which will be found implanted in the breast of by far the greater number of our youth, and which in many cases requires but the smallest encouragement to spring up and develop into what may make of its happy possessor a painter, a sculptor, a naturalist, who may be conspicuous among his fellow men for the power of depicting whatever is great and beautiful in the domain of his chosen art. How many an Audubon, Cuvier, Darwin, or Linnæus, may we have in our very midst, to whom the divine spark which is necessary to kindle into flame the slumbering forces of these youthful minds may be imparted by a chance word of encouragement or of sympathy, and to whom a chance excursion into the domain of Natural History may prove the starting point upon a career which will bring renown, not only upon himself personally, but upon our country as well? If, indeed, no such prominence is reached, the habits of observation thus engendered will prove to be such that the powers of mind will be strengthened very materially, for, whatever pursuit in life may be adopted, it will be found, without a doubt, that the study of Nature in some one of her many forms will tend to make life easier and happier, and will cultivate and refine our ideas; and not only this, but this study will tend directly to impart breadth and solidity to all our conceptions, to lift us out of the narrow rut into which one is far too prone to be drawn; to extend the scope of our possibilities, and to make gladder the whole pathway of life. When one thinks of the privileges enjoyed by the instructors of our youth at the present day, in the acquisition of knowledge concerning Nature in all her forms, not only through the medium of the lecture room, but through the agency of text-books, which have increased so rapidly and obtained such an excellence that one finds it almost an impossibility to keep in line with them, we can but hope that those to whom are entrusted the moulding of the minds of our nation will carry out their work on the broadest and noblest plan, and make full use of all the best and choicest methods at their disposal The study of all these things carries us at once into the broad domain of science, and a knowledge of the anatomy of the beetle, or of the habits and life history of one of our most ordinary insects, things which can be picked up anywhere by hundreds, are as

pregnant with importance, in so far as we know, as the most abstruse problems of the astronomer or the physicist, who endeavors to ascertain the composition and life-history of the remotest of our planets, or with the studies of the geologist who strives to decipher and to map out the life history of our own planet. In fact, the former often presents problems of the greatest practical scientific importance, since by the study of the common living things around us, and by the determination of their habits and modes of existence, the greatest benefits to the human race accrue.

The practical application of science in some one of its many forms is at the present day so universal that we have long since ceased to consider it as entering into the doings of our everyday life. Yet, when we allow ourselves to glance for a moment at the various processes going on around us, we are brought at once face to face with the fac that, even in the simplest and most ordinary avocations, its influence is everywhere visible. The word science is derived from the Latin word *scio*, meaning to *know*. There is, therefore, no mystery about the word itself in its general or ordinary acceptation, and it simply may be used as another term for knowledge in its highest and truest form. Science has been defined as, knowledge, certain and evident in itself, and the basis of all science as, the immutability of the laws of Nature and of events. The varieties of scientific knowledge are almost endless. Thus we have the science even of Mathematics, which deals with abstract truths, of Jurisprudence, of Logic, Chemistry, Astronomy, Geology, Rhetoric, Grammar, and a hundred others, including the more abstruse sciences of Metaphysics and Theology. Some of these may be regarded as speculative sciences; others deal with the material alone, and whatever theories arise are supposed to be founded entirely upon the facts which are ascertained during the processes of investigation. In this latter class may be placed those which deal with the phenomena of Nature, with which we more particularly have to do.

With many the idea appears to prevail that science is a thing of comparatively recent date, and in their egotism these suppose that the citizens of the nineteenth century should almost be permitted to claim for themselves a monopoly of the honors arising from the unravelling of Nature's secrets. While, without a doubt, the growth of knowledge

in all its branches has, within the present century, proceeded at an exceedingly rapid rate, we must not as a consequence infer that our ancestors of a thousand, or even of five thousand years ago, were destitute of inventive genius, the faculty of reason, or the ability to put their common sense to a profitable use, or that their craniums were not furnished with as good a quality of brain matter as those of the present day. The magnificent ruins of fifty, or even possibly a hundred centuries ago, since no real date can be assigned to many of these monuments of a long extinct people, which are found both in the new and old worlds, show at least that the sciences of architecture, of sculpture, and of the highest of the mechanical arts, must have reached a very advanced state of perfection even at that early time; while among the very earliest remains of our race, viz., those who dwelt in caves and were contemporaries of monstrous beasts which have long since become extinct, such as the mastodon, or the cave bear, when the ice of the glacial period was even yet descending from our mountain sides, we find that the genius of sculpture, and to a certain extent the knowledge of it existed, though probably without having reached any very great degree of excellence. The magnificent sculptured forms and architectural wonders of Egypt are familiar to you all, and show that in this country, one of the great centres of the human race, knowledge of these arts had also become very highly developed, according to the most recent and reliable investigations at least 6,000 years ago; while on our own continent, in the curious remains left by the mound-builders and the cliff-dwellers, races so far removed that their origins have never yet been satisfactorily explained, but which evidently have preceded the present races by an unknown and lengthy period of time, many of the lines of decorative work have also been cultivated to a very considerable degree. In fact, the present race is very often confronted with the accuracy of the statement that "there is nothing new under the sun," and it may probably be accepted as a sober truth that, making all due allowance for cultivation, the human nature and the intellect of the present day, differs very little, and that not in kind, from that which prevailed among the earliest settlers of the globe. It may even be said that, with many of the so-called startling discoveries of modern

science, it is known of some at least that these are but the re-discoveries of arts which perished with the records of a former people.

It has been already suggested that science in some of its forms enters very largely into our most ordinary pursuits. As an illustration of the complexity of the subject, and the mutual interdependence of one science upon another, let us glance for a moment at even so apparently simple a thing as the making of our daily bread. Here we should probably, first of all, obtain a knowledge of the conditions of climate which are most favorable to the growth of cereals, and this opens to us at once the great domain of the sciences of climatology and meteorology. The conditions of soil, again, also a question of great importance, brings us to the study of chemistry, physics and geology, while the sowing, harvesting and grinding of our grain introduces us into the wonderful field of applied mechanics, the skill of whose students is so largely devoted to the invention and perfecting of the best and most labor-saving appliances by which these operations can be most satisfactorily effected.

In the second stage of the industry, chemistry again comes into play in the laboratory of our kitchens and in the production of the best materials for producing the finest varieties of bread from the prepared grain, and in this connection also several sister sciences are invoked in the invention and building of our ranges and other appliances for the cooking of the materials after they are ready for that process. If we follow up our illustration to its legitimate conclusion we shall have to go back still farther and bring in the aid of several other important assistants. Thus we must have the science of geology to determine the presence of the coal-beds from which we derive the necessary fuel to supply our ranges. Then we have the sciences of palæontology and palæo-botany to determine the age of the coal plants which accompany these coal beds, and the science of mining engineering, by which the coal, and even the iron ores from which our implements and ranges are manufactured, can be extracted and brought into useful shape, in which process, also, we have the aid of the sister science of metallurgy, and so we might pursue our illustration almost indefinitely and show that in every department of our life's work there is an exceedingly close relationship everywhere existing between the various branches of scientific knowledge.

While, therefore, the study of the sciences should be of the greatest practical value to all, there are certain forms of thought or study which are by many supposed to be possessed of more elevating tendencies as regards the development of the mind than others. Yet it seems scarcely fair to make any such invidious distinction in the value of scientific knowledge itself, but if any such peculiar tendency is apparent among the mass of mankind in general, to attribute such peculiarity rather to the particular bias of the individual himself, since it is a well recognized fact that the tendency of the human mind in different individuals is exceedingly diverse, so that to some the study of the most intricate problems pertaining to the sciences of pure mathematics or metaphysics is capable of affording the highest type of mental delectation, while to others such studies are conducive only of weariness and even of disgust itself.

It is evident, I trust, from what has already been said, that there is nothing in the study of the natural sciences which is not of a character to elevate both the physical and moral condition of mankind, and yet, in regard to some of these, there is a certain feeling of hostility displayed which occasionally finds expression, but which is due apparently rather to a lack of conception of the principles involved in their study than to any other cause; so hard is it even among those who are generally considered as enjoying the advantages of a liberal education to cut entirely free from the old leaven of mediæval superstition, belief in which very often proves stronger than the exercise of the strongest common sense. As an illustration I may merely mention the fact that, not many years ago, one of the most popular lecturers of this city, at that time, assured me that he had read everything which he thought had a bearing upon the subject of the creation of the world and on the doctrine of evolution, and yet retained the impression that all the phenomena which have taken place since the period of chaos down to the beginning of the seventh day, could be easily included within the space of six literal days of twenty-four hours each, from which we may realize in what exceedingly narrow grooves some minds, excellent in other respects, are cast. We may be disposed to regard this as a somewhat exceptional case, and wonder how any one, possessed of even a moderate share of common sense, can prefer to cling to the exploded and

antiquated ideas of the middle ages rather than to allow his belief to be influenced by the light afforded through modern research ; yet the fact is still evident that the old views concerning some of the now well proved and generally accepted truths of science to some extent yet prevail. To the earnest student of Nature, however, there is nothing more certain than that broader and truer views of the harmony and fitness of all things pertaining to the material world will be presented as knowledge of these things increases, and that a grander and more correct conception will be afforded of the great Author by whom all things have been brought into existence and by whom they are harmoniously controlled.

There is yet one aspect of the scientific question which to us, as students of Nature in all her forms, need have no direct practical interes', but which, owing to certain circumstances, has assumed such a phase at the present day as to merit a word of explanation. To many of us the expression, "conflict of religion and science," is familiar enough, but to some at least I fancy the phrase is, to a very large extent, nearly meaningless. The aims of scientific investigation are, or should be, the acquisition of truth itself concerning the phenomena of Nature, and its conclusions are based upon the examination of the material things around us. The aims of religion are also associated with the ascertainment of truth in its highest form, but these have an entirely different bearing, and are not confined to the material, but rather deal with the immaterial or immortal portion of mankind. In certain points these two lines of investigation tend to converge, and in such cases, owing to imperfect interpretation on one side or the other, or possibly on both, there is an apparent clash of opinion.

It is plain, however, that science, that is, natural science, was not intended as a hand-book to each religion, except, possibly by induction and in its broadest sense ; and it is equally plain that there is no reason why religion should be so twisted out of her natural sphere as to cause any direct interference with the teachings of science, seeing that the two proceed in such entirely different lines.

Any apparent discrepancies which may exist in the interpretation of the two books which have been given us, viz., that of Revelation which we call the Bible, and that often styled the unwritten page

around us, the Book of Nature, and yet which, in truth, is a book written in plainest lines in every page, should, since they both have come from the same great source, be rather attributed to a lack of skill in those who attempt to read them ; since if we accept the statement that the Bible is the word of God, and the other statement, which is equally true, that there is an overruling force which controls the phenomena of Nature, in accordance with certain fixed and, in some cases at least, well known laws, the interpretation of such phenomena should, if correct, agree in their essentials even though viewed from different standpoints.

The term Agnostic, which now-a-days one frequently hears, has of late years assumed considerable prominence, and possibly more than it really deserves. The derivation of the word is from the Greek, and literally means one without knowledge. In its ordinary acceptation, however, it is held to signify one without definite knowledge of the Creator or God, or of the plan of creation. If we take the word in the broad and natural sense it has no meaning at all as applied to mankind, since every one is supposed to possess at least a certain amount of information, while no one is held to be perfect in every branch of knowledge.

If, on the other hand, we limit its meaning to those who have a lack of knowledge of the fundamental truths of theology, we, as Christians, must also, even from our own standpoint, to say nothing of that of the scientist, properly so called, acknowledge ourselves worthy the title in certain respects, since many of the accepted tenets of Christian belief are articles of faith only, and are not susceptible of actual demonstration. Though we may claim we have a clear conception of the plan of Creation according to the scheme laid down in Genesis, the exceeding terseness of the scheme as there presented is such that we know that it cannot be taken in its literal sense, and the theologian is indebted to the scientist for the presentation of more light upon a question which has produced much unnecessary, and often unseemly, controversy. When such uncertainty exists, therefore, it does not, to many, seem the wisest course that anyone should dogmatically assert any particular line of doctrine, and claim for himself infallibility in its interpretation, especially when the data given are confessedly so imperfect. It is, therefore, easily seen that this term *agnostic* is one exceed-

ingly hard to define clearly, and in the heat of controvery is very apt to be used so loosely that the results are frequently as damaging to one party as the other.

But it is not very clear to many why the word should be used at all in the sense as generally understood. With its broader meaning, doubtless, it would find scope in the realm of metaphysics, but as applied to the investigator after scientific truth, dealing only with material things, it should certainly have no place. As for any man's personal belief, that is an entirely different matter and one entirely beyond the range of scientific investigation.

The distinction between the terms *agnostic* and *atheist*, if these terms must be retained, while it should be sharply drawn, is apt to be confounded. An atheist, pure and simple, by which one understands a person without belief in God, or in any supreme overruling power, is a very rare being to encounter. Certainly they are very rarely found in the ranks of the earnest workers in the field of Natural Science. The greatest writers and students on these subjects do not hesitate when necessary to express their belief in the existence of a first great cause through which life was first introduced on the globe, and by whom all things are controlled—known, indeed, under different names, such as the Creator, the Infinite, Nature, the Power behind the veil, all of which terms in point of fact resolve themselves into the same meaning. From the fact, however, that scientific problems are supposed to be worked out by the aid of natural surroundings alone, and to be capable of actual demonstration, this portion of their belief is not brought prominently into notice, since there is no absolute occasion for its intrusion, but its influence is everywhere apparent in the lives of our most illustrious scientists.

For many hundreds of years the expression *Gnothi seauton*, know thyself, has been familiar to the human race. Generation after generation has been studying the problem this presented with somewhat indifferent success, and no one will to-day, I think, be so presumptuous as to say, that even in the study of the human frame, and of the phenomena which take place in the human body, have we yet arrived at the perfection of knowledge. How much more presumptuous, then, would it be to say that in any of the great fields of science, art

or theology, the expression *Gnothi seauton* has been fully worked out, or that we know but little beyond the merest rudiments of the boundless stores of knowledge which lie therein concealed. To many of us it will, therefore, seem much more fitting that the two great sister civilizers, science and religion, should go forward, hand in hand, intent on the ascertaining of truth itself and the amelioration of the condition of the human race, rather than through the errors of man's judgment or the imperfection of his knowledge, the least semblance of conflict should be apparent.

Theories there are without end in every department of life's work but theories are not always the essential things to which we should pin our faith. It does not follow that the school-boy, when he has reached man's estate, should continue to abide by the dictum of his early preceptor. Had Galileo been content to accept the doctrine of his so-called superiors that the world did not move, but that the heavenly bodies, by their revolutions around the earth, gave rise to the phenomena of day and night, and had the successors of Galileo been content to have followed the same blind path, it is very possible that the science of astronomy, and, in fact, human knowledge in general, would have made much slower progress than it has done since that date. The mere dictum of any man, or of any body of men, will not at the present day, and should not, carry more than its proper weight in the face of an array of indisputable facts to the contrary. The great thing to guard carefully against is the rash putting forth of unsubstantiated theories as theories only ; and what is even worse, when such a theory has been advanced, is the deliberate distortion of facts to its support when its weakness becomes apparent or its falsity is clear. This unfortunate condition of things is occasionally found in all the sciences. Thus in the science of geology we have had the fierce warfare of the school of the Neptunists, who hold that all the phenomena of the earth's surface were produced by the agency of water, against that of the Plutonists, who invoked the agency of fire alone as the solver of all the difficulties in the creative problem. Later, we have had the men who contended for the great continental ice sheet extending over the entire northern half of our land, against the advocates of iceberg action and local glaciation only, and so on throughout the chapter. People looking on from

a safe distance often wonder how such diverse opinions can prevail on such subjects if the facts are the same in every case. The fault does not lie with the facts but in the peculiar bias of each individual's mind in regard to the interpretation of these facts. The principle sometimes laid down, that the conclusions of those who have preceded us, both in the domain of science and theology, must ever be regarded as infallible, has not only been opposed in large measure to the intellectual advancement of the race, bnt, if blindly persisted in, would tend to prove a very serious obstacle to any kind of improvement whatever.

True it is there are extremists on either side, and the great factors in the world's advancement, science and religion, should not be held in any way responsible for the foolish utterances of those ill-adjusted intellects which are constantly seeking opportunities to run a muck against any theory or individual that may chance to oppose the peculiar whim of the moment which they may desire to advocate. Truth is great and will prevail, and the differences between the two great schools will in the end be found to be more fancied than real.

The spectacle of the theologian bitterly assailing his co-worker in the cause of truth is not, to the general onlooker at least, a very edifying one. Disputes and misinterpretations will, doubtless, continue to arise, and owing to the imperfection of man's nature, and the lack of completeness of his knowledge, will furnish in the future, as in the past, abundant material for angry recrimination. Not until the final change comes to each of us will the mists be entirely dispelled, and then with clearer vision we shall see and understand all these mysteries, for then we shall see face to face.

At the conclusion of the President's address a vote of thanks was eloquently proposed by Sir James Grant, K.C.M.G., F.R.S.C. He spoke of the good work being done by the club, and particularly by the President and his colleagues in the Geological Survey. He had watched with great interest the rapid progress of scientific studies during the last 20 years, particularly in the Ottawa district and in response to the efforts of the Ottawa Field-Naturalists' Club. He suggested the appropriateness of the club erecting a monument to the late Elkanah Billings, a native of this city, who had done so much for the honour of the Dominion.

Prof. Macoun, in seconding the vote of thanks, spoke in high terms of the Inaugural Address and also of the Address of Welcome delivered by Dr. MacCabe. He showed the value of originality of thought, and deprecated students sticking to the letter of the text-book. Anyone who would succeed in life must study text-books closely at first, and then strike out boldly for himself. He was pleased to be able to agree so fully with what the Principal of the Normal School had said in his address

The vote of thanks was unanimously carried.

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EDITORIAL NOTES.

Sub-Excursions to the Geological Museum.

On Saturday, 10th January, there will be a sub-excursion to the Geological Museum, when the party will be addressed by Mr. H. M. Ami upon Palaeontology.

On Saturday, 24th, another of these excursions will be held and Mr. Willmott will deliver an address on some mineralogical subject.

PROGRAMME.

Members are requested to pin up the loose programme enclosed herewith in a conspicuous place, so that they may not forget the various lecture days as they come round.

THURSDAY EVENING LECTURES.

During the present month two lectures of great interest are to be delivered. Jan. 15th, Mr. W. P. Lett will read a paper upon the Beaver and the Report of the Zoological Branch will also be read.

For Jan. 29, there is a very full programme. The report of the Ornithological Branch will be read by Mr. W. A. D. Lees. Mr. A. J. Kingston will read a paper on the Chimney Swift, and Mr. Willimott of the Geological Survey Department will deliver a lecture upon Canadian Gems. This will be fully illustrated by an exhibit of native gems, cut and uncut.

MONDAY AFTERNOON LECTURES.

The inaugural lecture of the Monday afternoon series is to be delivered on January 12, when Miss Margaret A. Mills will speak on the Value of the study of Natural History. Knowing Miss Mills's ability to treat this subject, we can promise a most pleasant afternoon to all who avail themselves of this opportunity of hearing Miss Mills speak, and we trust that not only this but all the lectures in these free lecture courses may be largely attended. On the following Mandays in this month, lectures will be delivered upon Botanical subjects ; on January 19th on "The Geographical Distribution of Plants," by Prof. J. Macoun, and on January 26th on "The Educational Value of Botanic Gardens," by Mr. J. Fletcher.

MONDAY AFTERNOON LECTURE.—No. 1.

THE STUDY OF NATURAL HISTORY.

By Miss Margaret A. Mills.

(Read Jan. 12, 1891.)

The term Natural History, should be used to include the study of all natural objects whether they are possessed of life, or, give no evidence of vitality. The phenomena of the inorganic world are the special concern of the geologist and mineralogist. The phenomena of the nature and relations of all bodies which exhibit life, are known as the science of biology, which is subdivided into two main classes—botany which deals with plants, and zoology which treats of animals. This general application of the term is often narrowed so that Natural History includes zoology alone. The science of Botany includes everything relating to the vegetable kingdom whether in a living or fossil state. It takes a comprehensive view of all plants, from the minutest microscopic growth to the vast productions of the tropics. From earliest times this study has been much more rationally treated than zoology. It has always been understood as embracing not only the study of the external form of plants, their systematic classification and their geographical distribution, but also that of their minute structure and the processes of nutrition and reproduction. The botanist has studied from his garden of living specimens, and from his hot-house, in which could be reared under the proper conditions necessary for their development, plants from the seeds obtained from foreign lands.

On the contrary, the zoologist had no such aid, and for centuries had to limit his researches and observations to the skeletons and dried skins of birds and animals, or the collections of the traveller or sportsman. It was only in the past century that a knowledge of the preservation of the entire specimen in alcohol was learned. Thence its development and progress has been delayed, not from any lack of interest in the subject, but from a dearth of the facilities and aids which had so assisted the sister science—botany.

A history of zoology and botany must take account of the growth of the various kinds of information acquired in past ages through the

labors of a long series of enthusiastic and ardent lovers of nature who, in succeeding periods, carefully noted and accurately arranged and tested their observations, until we inherit as their descendants, the rich legacy of the accumulated lore of ages.

The infancy of Natural History was the recognition of surrounding objects, and the eager, childish desire to understand their relationships to God and man. Stories of animals from deep seas or foreign lands were treasured with wonder and delight, and this age of universal credulity known as the "legendary," was succeeded by that of the collectors and travellers who were able to refute or confirm, by their own observations, so much that was doubtful.

The great instinctive desire of the heathen and savage to worship the natural in his surroundings, who saw his deity in the sun or in the mighty rushing waters, or seemed to feel the supernatural in some living creature, must have been an evidence of God working in him for his development.

A knowledge of botany has existed from the earliest times, for the plants that so beautify the globe must have ever attracted mankind's notice. The wise Solomon "spake of trees," and the Egyptians and Greeks are known to have been the early cultivators of plants for their medicinal virtues. Aristotle, the great mind of Greece and the leader in all intellectual culture of his time, was especially a Naturalist, and his work on Natural History is not only a record of his own investigations but of all preceding knowledge in this department. He refers his readers to illustrations in anatomical text-books which seem to have been in familiar and general use 2,000 years ago. Pliny, of the Romans, added scarcely a fact to Aristotle's store.

A history of plants was written by Theophrastus, 300 years before Christ, but Dr. Brunfels, of Berne, restored the science to Europe in the 16th century in his "History of Plants."

The 16th century, which saw the occupation of the New World and a general impetus given to learning, is rightly regarded as the starting point of the modern knowledge of natural causes and of the natural sciences. The three following centuries have made great progress in developing the truths of Natural History.

The 16th century awakening of Western Europe led to active

research by means of observations and experiments, the home of which, naturally, was the universities, so at this early date the Italian universities conducted comparative anatomical inquiry into the animals next to man in the scale.

In the 17th century these experimenters began to band themselves into societies for mutual support and intercourse, and academies were founded whose philosophical spirit soon spread from such centres to the nation. At Naples, in 1650, was founded the first of such academies, which still survives and retains its name, "Academia Naturæ Curiosorum."

In 1662, "The Royal Society," of London, England, was incorporated by royal charter. A little later Louis XIV. founded "The Academy of Sciences of Paris."

The dogma of the isolated student of science was restrained, and dogmatic views were rapidly dispelled by argument and the agreement to admit as *truth* only that which was the result of observation or mathematical calculation.

The influence of these great academies in bringing together the collectors, the museum men, and the systematic anatomists, was soon felt in the field of progress of Zoology, and placed it now, for the first time, on a plane nearer the rational one from which botany had been viewed.

By an examination of the early records of the Royal Society it is noticed that marvellous relations were not permitted at its meetings, but solely demonstrable experiments or the exhibition of the actual specimen. Under the light and influence of such strict inquiry, witchcraft, alchemy, and other mediæval relics of superstition disappeared and vanished from public belief like snow before a July sun. But a host of new wonders had accumulated which were substituted, being truth demonstrable by accurate observation.

The progress of the 18th century perhaps culminated in the great Swedish Naturalist, Linnaeus, while such men as John Hunter and Ray undertook the task of examining the anatomical structure of the whole animal kingdom and classifying its members by the results of such profound study.

The invention and perfecting of the microscope in the 19th century

were to the naturalist what the mariner's compass was to the navigator. It came to the aid of the comparative anatomist, when his need was the sorest and as a most potent factor in the development of the science of histology. By the use of this instrument cell-structure and the great cell theory, as propounded and advanced by Schwann and Darwin, became comprehensible.

Buffon's Natural History claims the merit of having been the first work to collect the isolated and apparently disconnected facts of this study and present them in a popular and generally intelligible form.

An important revolution in Natural History took place from the institution of Botanic gardens, from the results of the extension of geographical knowledge, from the various scientific expeditions which were sent over the globe under such scientific spirits as Humboldt, Hooker and Darwin. A botanic garden of the Royal Dublin Society at Glasnevin was opened in 1796. Glasgow had one in 1818, and the Park and Garden at Kew were instituted in 1730. At the end of the 18th century, 1,600 botanic gardens were to be found in Europe. The most important researches in physiological botany had been made by French and German scientists, as their schools afforded facilities not found to the same extent in Great Britain.

The great Linnaeus taught zoology and botany as branches of knowledge to be studied for their own intrinsic interest. He is known to have been a judicious reformer rather than a discoverer. His influence imbued his students with ardor and enthusiasm, and they went forth to all parts of the world to try to contribute to the richness of their loved master's lore and to extend his knowledge.

Linnaeus was the first to attempt the classification of animals according to certain structural characters, and although this proved very defective, it led to much criticism, and stimulated naturalists to comprehend the important principle that internal structure, not external appearance, must determine the limits of groups or classes. The great principle of classification as now generally accepted, was first originated by the genius of the great Frenchman, Baron Cuvier (1769-1832), who made a notable advance on his predecessors, and the world owes to him the first systematic application of comparative anatomy to the study of

the bones of fossil animals. Eminent as an administrator, it is as a naturalist that his memory is and will be preserved.

Linnaeus also devised a simple system of naming the objects of Natural History, by the use of a common scientific language. Each name was to consist of two parts, one to name the whole genus, the other to distinguish the species. Both he and Cuvier showed great skill in the selection of simple, significant names.

The astronomical theories of Kant and La Place, of the development of the solar system from a gaseous condition to its present form, re-acted at once on men's ideas, evolving the notion of spontaneous development in all nature, which idea, although held by the Greeks, was now to be considered under the light and knowledge of the facts gained during the past three centuries. Such men as Cuvier and Agassiz caused to spring up the science of Geology. Lyell explained the history of the earth's crust by the slow development of still existing forces.

To Darwin must be accredited the work of having abolished mysticism from the science of life, and of raising Zoology to be a science which seeks to explain all its phenomena by the application of the laws of physics and chemistry. From his life-work, one gleans that his theory of organic evolution has been based on actual mechanical force and demonstrable fact. He used the knowledge of the unscientific (the farmer and the fancier), who for centuries for practical purposes had used many biological laws. This he formulated as the laws of variation and heredity, and originated thremmatology. He also clearly propounded the theory of the survival of the fittest by showing that numbers are limited by the food supply, and in the struggle for this, a necessary selection is enforced. He also deduced the following :— That every organ,part, color and peculiarity of any organism, must either be of benefit to its possessor or have been useful to its ancestors. And finally he brought the simplest living matter known as protoplasm before the mental vision as the starting point from which all highest forms have been evolved. This principle is generally known to most people only in its sarcastic application to man's descent from the ape.

After paying the tribute of honor by naming Von Baer, Milne-Edwards, Leuckart, Hæckel, Wallace, Von Haller, Audubon, Dawson, Wilson, Huxley, Tyndall and Muller, all bright stars in the

firmament of Natural History, we must leave this historic review to present some other aspects of our subject. Before dismissing them let us remember their toils along a tedious road, along which they had glimmerings of light and hope from that glorious prospect and clearer mental atmosphere which their efforts opened up for our gratification, our intellectual enjoyment and general welfare. Let us be grateful and worthy our inheritance.

Now, scientific truth is not the property of the few, for it is a part of the woof of common life, and all await the solution of the problem and mystery of existence. Since all science is tending this way it must be generally diffused, and this can be done in no better way than by making it a part of the intellectual culture afforded by our common educational systems.

There will be, as there always have been, those with particular aptitudes for the study of Nature, who will pursue it with the noble interest that its truths inspire rather than for the sake of its usefulness to humanity, but their labors are woven into the practical resources of our life. Other abilities, other qualities are required by those who use the truths and principles evolved by the scientist in their practical adaptations to man's material wants and daily uses. One is the researcher, who communes with Nature to allure from her secrets and laws which the mechanical genius readily seizes upon and incorporates in his inventions. The world is most appreciative of the latter, and showers upon him her praises and emoluments, while man in his short-sighted selfishness is too prone to forget and neglect the scientist, who is thus kept behind the scenes of the world's stage. However, such minds are recompensed by the pleasures they find in the discoveries of Nature's truths and in the assured feeling that they are bettering the condition of the masses. Those who pursue science for its own sake rather than from a utilitarian point of view should be fostered and encouraged by the Government of the land and by society's most influential classes. It is from the prevailing tendency of our age to be material and practical that more assistance is not given to naturalists, and the study made more a part of the curriculum of our Public School systems. To be sure, the students of our universities have opportunities to develop scientific tastes, but they form a very small fractio..

of the community. We must reach the children, the young children whose minds are receptive and plastic, and whose habits are being formed. This important work can be commenced in every home, and in every school, if parents and teachers feel their responsibilities in directing aright the latent energies of those entrusted to their care.

Children are busy observers of natural objects and have many questions to ask. This is but indicative of a healthy natural state in them. Are not their inquiries often repressed instead of being encouraged and guided? Why? one asks. And must it not be answered that those in charge of the education of children, as well as parents, do not possess the information necessary to answer simply and intelligently the questions prompted by an awakening intellect. At school and at the fireside how irrationally children have been treated. They have been shut in from nature and compelled to read, write and learn much in abstractions; while Nature, the skilful teacher, awaited them abroad in her domains to give lessons in the pleasantest, easiest form, through the senses. But "a good time is coming, boys;" it has dawned upon us, and our little human buds open in and bloom in the "Kindergarten"—the child garden, where they hear and imitate the songs and movements of birds; where God and love make all things bright and happy; where the flowers, the ants, the bees, the winds, the rain, "Jack Frost" and the stars are the playmates of the children of men. But alas! too soon there comes "a biting, chilling frost" and nips or delays such an all-round development as is desired for our blossoms. It will be only when this natural, rational culture is continued through our entire school course that a right and rational method will be followed, and be productive of good results.

The moral, mental and physical are harmoniously developed under skilful guidance, for in our rambles abroad, eyes, ears and brain are busy in noting and wondering at God's greatness, His love, and His myriad wonders of Creation. The activities of youth must be directed aright, or soon a lazy, listless humor will take possession of many, and if indulged in will be productive of idle day dreams; or, worse still, the same activities and latent energies may lead into wrong and dangerous channels, where shipwreck and disaster may ruin the staunch craft

which gave such bright promises when launched upon life's journey under favouring breezes.

What responsibilities devolve upon us! Do we know them, realize them, feel them—and feeling, act; "Act in the living present"?

If mankind would awake to an examination of self; if we could throw off that sauntering humor, which as a habit lets a great part of each day, of each life, run carelessly away without either business or recreation, we might acquire much skill in many things and ways, quite apart from our proper business or vocation.

Without much knowledge of Natural Science, and without any of its technicalities, much can be done by any one, by encouraging observations and affording or presenting opportunities for the observance of many facts and phenomena, that can be easily and simply explained. The wonders of Nature are ever with us—in all seasons—in all lands, and not only delight and gratify the senses, but lead us up "through nature to Nature's God in worshipful humility, to feel the boundless power and wisdom of our Creator." The rich coats of animals, their graceful forms and movements; the beautiful variegated plumage of birds, and their sweet songs, all delight the senses; but the elevation of the intellect must follow when their wonderful construction, their uses and the part each plays in Nature's great drama, are observed and comprehended. It can never be too strongly impressed upon minds anxious for the acquisition of knowledge that the commonest surrounding objects are worthy of minute and careful attention. That man has been studying them from earliest times, and recording his interpretations of the Creator's plans, only serve to show how little has been done by comparison with what has yet to be accomplished.

Sleep, the pulsations of our heart, and such puzzling mysteries of our existence are not yet satisfactorily solved, and these problems of paramount importance to nobly endowed man, the crowning work of God on earth (standing at the top of the animal creation), have engrossed man's attention for centuries, and will continue to do so. Then think of thousands of creatures of which little is known, but that they exist, and see what a field of work is before those who may devote themselves exclusively to the facinating employment of determining their

relations to their surroundings and the part they play in the economy of Nature.

Be convinced, then, there is work for all. No field is yet exhausted; no man, however great, can say I know all; no lifetime, however well spent, is long enough to solve the questions of a single subject. Many must contribute each his little store, that the genius may glean and sift new truths from the cumulation which he skilfully lays upon the foundation at that point where his predecessors left the uncompleted work when their summons came to go hence to "join the great majority."

All can help—man, woman and child—whether as the individual or as a society. For those who employ only their leisure hours, the hours of relaxation from the worries or toils of business and busy life, there is this thought, that they are aiding in the great work, and though the contribution be but a single new or rare specimen, the record of an accurate observation, the relation of some true anecdote, or a new psychological inference, he may be furnishing a missing link in some complex chain, some thought that may be crystallized into, and vitalized anew along with the life-long labors of some genius, or he may be furnishing the keystone to some uncompleted structure. Pursued at home, or when visiting foreign countries, who can tell the result? Some strange bright bird may serve to fill an unoccupied space in the web of Nature; a fossil bone may reveal the existence of previous unknown monsters; a broken branch may disclose invaluable material for future mansions or navies; a mineral fragment may reveal a rich mine, or a geological observation may point out a new locality for coal, that indispensible aid to commerce and industry.

Business must be attended to, and some one has aptly said: "The intervals of business must be attended to." Though a man's leisure is his own, yet for his sake, as well as that of the community, it ought to be one of occupation. His pleasures and recreations ought to bear a contrasting character to his business or profession, in order to cultivate those powers of the mind that are dwarfed or unemployed during work With Natural History as a recreation of leisure hours, ennui disappears, and every step becomes enchanted ground, and a walk with an aim in view is not exercise for the body alone, but patience, minuteness

and accuracy of observation, cautiousness in drawing conclusions, and in generalization, qualities most desirable in business life, are exercised, and become valuable mental discipline. Then, too, there is that forgetfulness of self, our natural selfishness is forgotten or laid aside when our thoughts are carried upward, and we become wiser and better.

The study of Nature tends to make us more social, in bringing together the different ranks and uniting them by a bond of common interest. Nature makes brotherhoods, and when banded to fish, to hunt, or in some common pursuit, men become fellows; caste and society's distinctions are ignored—man becomes the genus man; snobbery has no encouragement from Nature.

The right impressions of Nature and a cultivation of a taste for some branch of Natural History, may be made a recreation of childhood before life's more serious duties engross the energies and turn the mental, as well as the physical eye from our natural surroundings. Entomology, or the study of insects, proves particularly fascinating to the opening curiosity of children. Too often, children are taught to treat all insects as dangerous or horrible, and meriting avoidance or destruction. The sensible mother can, by her own demeanor and influence, avoid giving any such prejudice against harmless insects and easily explain why the hurtful kinds must be avoided. What ideas of beauty, of form, of coloring, of skill, of speed, of industry, and of character, can be developed from our common insects. The common fly which walks on the smooth ceiling by means of tiny suckers upon its feet; the household spider with its silken snares; the earthworm of our pavements and gardens, which turns over the soil and enriches it for man's use; the ants, many of which oppose barriers to the progress of civilization in some parts of the tropical regions, and the termites which have destroyed the written history of some provinces of South America; again the lovely butterfly that so gracefully flits about our gardens and fields—all furnish topics delightfully novel and attractive for our little ones, when wearied limbs bring them to our knee for mental refreshment. Make such a true story from Nature's fairyland of wonders, and the kindling, interested eyes, which regard you with so much pleasure, will soon make the discoveries necessary to verify your lessons,

and before many years pass, their owner may repay and delight you by an extended knowledge and original work.

Books, papers and periodicals are now aiding the good work, and works on entomology, botany, ornithology, etc., are to be obtained, wherein is given in a pleasing, popular form talks on such topics without the difficult technical terms which alarm so many at the outset of these studies. Names must be learned in due time, being absolutely necessary if we are to discuss or impart our knowledge. Like money, names are but a medium of exchange. When there is the demand, the supply is soon found, and such books are on the increase. Parents will aid by placing these in the hands of the children and instructors of youth. The boys and girls can help by noticing the habits of birds, the flowering of plants, the homes and nests of insects, and in remembering to be kindly with all God's creatures, who have feelings and suffer in some degree like us, though unable to speak to us in our language, to tell the wrongs they suffer, yet their plaintive calls or agonized cries should find commiseration in our hearts. The one who inflicts torture on his inferior is a tyrant and a coward ; but to the one who prevents and alleviates suffering, the noble title of hero belongs.

Boys and girls with quick eyes and active feet can gather specimens where their elders, less nimble, fearless and active, would fail.

The young ladies, too, can help the ornithologist, who rightly grieves over the destruction of thousands of birds whose happy existence is sacrificed at the altar of fashion for the sake of their plumage, which is worn upon ladies' hats and bonnets. Would they deem it an adornment if they thought of the slaughter of the gay, pretty creatures, which people the groves and forests and make them ring with their happy songs and bright existence? No! we answer. Ladies are kind but thoughtless on this point, and perhaps reason that it is no harm to wear the bird or a part of its plumage when it is dead, not thinking that they are fostering the trade in bird life and pandering to a cruel whim of dame Fashion. Quite a different thing is the taking of the lives of a few of these for scientific studies, and it is quite proper that the Government of the country should assist Natural History, by equipping and opening to the public, museums, suitable as receptacles for the collections which have been brought together and which are yearly increasing.

Such museums are direct public educators. Strict laws might be framed, and are in most countries, to prevent cruelty and control the avarice of man from carrying on the wholesale slaughter of birds and animals, where there is fear of the extermination of some species, or the destruction of our entire forests. They can assist, equip and encourage our devoted naturalists, whose sole aim is the amelioration of the world.

From a diversity of tastes and mental faculties, all subjects of Natural History receive due attention; each department has its own particular value, and any advance in one does not re-act to the detriment of any other.

We find some taking great pleasure in the study of Conchology, and claiming that shells and their animal inhabitants, when compared with the other orders of creation, are inferior to none, showing in external appearance as beautiful forms or contour, as exquisite and varied tints and shades of color; and as harmoniously developed a structure and fitness for its surroundings in the animal inhabitant as are to be found in the more complicated higher classes of animals.

And Botany has always had particular charms, and our plants and flowers that so beautify and adorn the brown earth, lend their fragrant odors to delight our sense of smell, and themselves to adorn not only the body but to cultivate the æsthetic in our nature, as well as the most desirable qualities of mind. They always have ministered to our sufferings, in furnishing medicines and remedies to the healer's art. Many there are who find plants too passive to suit their mental trend, and find, in the study of ornithology that life, that sympathy which satisfies their nature, and in our country they have much new work before them, and may find inspiration from a perusal of the life of Audubon, who pursued his extensive studies under such difficulties and discouragements, yet who raised the greatest monument that Art ever gave to Nature, in his great work, "The Birds of America."

The Field-Naturalists' Club has for its composition not only scientists and naturalists, in the fullest meaning of these terms, but many who devote their leisure alone to such pleasing studies, and who imbibe much love and inspiration for the work, as well as much valuable information from the efforts of those so capable of leading and directing others on the borders of such an extensive study.

These enthusiastic leaders, whose unselfish interest in their work and untiring zeal in trying to cause others to enter upon this field of work, should be rewarded by noble *results* and a deep *feeling of gratitude* from those who have enjoyed the opportunities of listening to their lucid discourses in our winter gatherings, or to the familiar talks upon the finds of the day, when we gathered on some shady slope or grassy knoll, after a day's ramble amongst the birds and insects in our flowery fields. We are given so much knowledge—knowledge that has been attested, proved and reduced to a concise, definite form, and which we could not have gained by our own isolated efforts without the labor of reading more than one book on the subjects of botany, entomology, geology and ornithology.

In closing this feeble effort to show that the study of Natural History offers to all opportunities for its promotion as a *science*, some of the more direct advantages of its bearing on man's corporeal wants, as well as upon his mental and moral state, have been briefly noticed as being an important part with which most of us can effectively deal, and a part in which the human tendencies for a love of the marvellous, merely superficial and somewhat credulous may be influenced and directed to a healthy mental development and invigoration, by a selection of the proper mental food.

For a better treatment of the subject, I must refer you to the inaugural address by our worthy President, Dr. Ells, which you have in a printed form in the January number of the "Ottawa Naturalist," which records the transactions of "The Ottawa Field Naturalists' Club."

I've done my little for the club in this paper from a deep sense of gratitude for the great pleasure and profit I've derived from the meetings of this society and from social intercourse with its members.

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REPORT OF THE ZOOLOGICAL BRANCH, 1890.

(*Read Jan.* 15, 1891.)

To the President and Council of the Ottawa Field-Naturalists' Club :—

In making a report of the work of the Club for the past year in that branch of natural history which relates principally to the mammalia found to exist in the neighborhood of Ottawa, we cannot say that any discoveries of particular importance have been made. Many of the larger animals which were at one time quite common have completely disappeared with the cutting down of the forests and the occupation of the land by man, whilst several others are seen only at rare intervals, and these are likely also to disappear at no very distant date. Of the smaller animals, many are yet to be found, and, if new varieties are discovered at all, it will most likely be among the moles, the shrews and the little rodents.

The following is a summary of captures, etc., which have been reported :—

Mr. Evarts, of this city, caught in his house in an ordinary mouse-trap a White-footed Mouse (*Hesperomys leucopus*) in November last, and sent it to Mr. W. A. D. Lees, who in turn sent it to Mr. Whiteaves, of the Geological Survey, who had the specimen mounted. It is now to be seen in the Museum. Several mice of the same sort have been seen during the year in and about dwellings. The mouse itself is common ; but we are not aware of its having been previously reported as having taken up its abode in such places.

Mr. F. A. Saunders reports having caught in a trap in Dow's swamp, in November last, three specimens of the Red-backed Mouse (*Evotomys rutilus*), the traps being placed under a fallen tree and baited with apple.

He also reports having seen a Red Fox in June and another one in October, besides Rabbits, Chipmunks, Red Squirrels, Musk Rats, Field and White-footed Mice, and one Flying Squirrel in July last. He further reports that he and his brother, Mr. W. E. Saunders, shot several Bats in the early part of July, among which were the Hoary Bat, the Brown and Silver-haired, and some others which they had not

at the time identified. It may be said that the Hoary Bat is not very common, the other two named are abundant.

Miss Harmer reports that in October last a Black Squirrel was caught near Britannia. This Squirrel was never very numerous in this locality its habitat being more to the south and west. No report has reached us of any having been seen for several years in this neighborhood.

At the Club's excursion to Butternut Grove in early summer a Common Garter Snake was seen in the act of swallowing a goodish sized frog—the frog was at least three times the size of the snake's head. It looked like a big undertaking to persuade a frog of that size to go down head foremost into such a small hole. The reptile was left with its work half accomplished. It seemed rather cruel to leave the frog in such a horrible plight; but we justified ourselves in doing so with the thought, that if we liberated the prisoner his snakeship would only catch another one if he was not prevented from doing so. We did not want to kill the snake and were not inclined to stay and watch him and keep him from exercising the might which constitutes right in the domain of snakes and frogs, and which perhaps is sometimes claimed by animals of a sort which are supposed to occupy a higher place in the natural world.

While no important discoveries have been made during the year, an active interest has been taken by many of the members in finding out more about the habits and peculiarities of the animals common to this and other localities. There are reasons for believing that the club is doing much good in the community by the encouragement and opportunities it affords to its members, and the people generally, for becoming better acquainted with the work in which they occupy themselves, and its never ending sources of interest and enjoyment.

Respectfully submitted,

J. BALLANTYNE,
W. P. LETT. } *Leaders.*

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SUB-EXCURSIONS TO THE GEOLOGICAL SURVEY.

No. 4.—December 13th, 1890, under the direction of Dr. George M. Dawson. A large party of ladies and gentlemen availed themselves of the opportunity of examining the collection of Indian curiosities, under the able guidance of Dr. Dawson. As a high authority on this subject, Dr. Dawson has a world-wide reputation, and in his case, the prophet is not without honour in his own country. The afternoon in the Museum was most enjoyable, and all appreciated the courtesy and patience with which all questions were answered, and the uses of the different curious objects explained.

Nos. 5 and 6.—January 10th and 24th, 1891, under the direction of H. M. Ami. The subject treated of at both of these lectures was Palæontology. At the first of these meetings, Mr. Ami gave a brief description of the fossils in the Museum from the Laurentian to the Carboniferous systems; and at the second meeting, completed the description from the Carboniferous to the Post-Tertiary. The meeting on the 24th was very largely attended, and great interest was manifested in the subject. Mr. Ami treated his subject in an able and pleasing manner and the interest was well sustained.

THURSDAY EVENING LECTURES.

On January 15th Dr. Ells delivered a most elaborate and careful paper on Asbestus. This will be published in full in a future number of The Ottawa Naturalist. A very extensive and valuable collection of specimens from Canadian and foreign mines was exhibited, as well as a great variety of manufactured articles illustrative of the uses to which this valuable mineral is applied.

MONDAY AFTERNOON LECTURES.

On January 12th, the first of this series of popular lectures was inaugurated by the excellent paper by Miss Margaret A. Mills, which is printed in this number. The report of the Zoological Branch was also read. The audiences at all the lectures have been most encouraging and the council is fully satisfied that its decision to hold the lectures in the Normal School has been justified by the great increase in the attendance.

The following meetings will be held during February:—
Mondays—2nd, 9th, 16th and 23rd, at 4.15 p.m., Nomal School.
Thursdays—12th and 26th, 8.00 " "
Saturdays—14th and 28th, at 2.00 p.m., Geological Museum.

Members who have not paid their subscriptions for the current year will kindly forward them to the Treasurer, without waiting to receive personal notices from him.

ASBESTUS; ITS HISTORY, MODE OF OCCURRENCE AND USES.

(By R. W. Ells, LL.D., F.G.S.A.)

(Delivered January 15th, 1891.)

The asbestus mines of the province of Quebec are, at the present day, of special interest to the mining and industrial world, from the fact that in so far as now known they practically represent the only deposits where this mineral, of a quality adapted for spinning and for the finer purposes of manufacture, can be profitably obtained. So great are the advantages which these mines possess, particularly as regards their accessibility and the ease with which the asbestus is extracted, that unless fields as yet unknown and as easy of access can be discovered, this province will doubtless long enjoy the position of being the principal source of supply for this peculiar and important substance.

The rocks with which the asbestus veins are associated in Quebec constitute a somewhat distinct series, which have, for the last thirty years, been known under the name of the "Quebec group." They comprise an extensive and important development of both sedimentary and eruptive rocks, which extend throughout the eastern part of the province, from the Vermont boundary to the extremity of the Gaspé peninsula. They are not recognized in their entirety in any other part of Canada, though certain portions of the group are found in their extension southward into the United States. Crossing the Gulf of St. Lawrence they, however, form a very extensive belt in the island of Newfoundland, where, more particularly at certain points on the west coast, the same series of slates, sandstones, diorites and serpentines occur, the whole presenting features both from geological and mineralogical standpoints, very similar to what are seen in this portion of Canada. While these rocks in Newfoundland have, to a certain extent, been traced out, in so far at least as the entirely unsettled and unopened character of that section of the country permitted, no systematic search for asbestus has as yet been made, though, that the mineral occurs there at a number of points and in a variety of forms is clearly indicated by the specimens which have from time to time been obtained in the course of the general geological exploration of the

Island. Some of these specimens belong to the group of actinolitic minerals like the deposits found in Potton and Bolton, but among others observed from that country, were samples of vein asbestus, equalling in quality any obtained at Thetford, and having a fibre from two to three inches in length. Little attention has, however, been paid to these deposits by the people of the island, and their extent is entirely as yet, unknown. It cannot, however, be expected that this seeming indifference will long continue, in view of the rapidly increasing demand and consequent advance in prices. And it is probable that the time is not far distant when Quebec's greatest rival as a source of supply for asbestus will here be found.

While the mode of occurrence of asbestus, and, to a limited extent, its uses as well, have been known to a few, probably for the past twenty centuries, the discovery of its true economic value and of its great commercial importance are matters of quite recent date. Under the general term "asbestus," we find included several varieties of minerals, or of rock matter, some of which present startling and somewhat anomalous features. For instance, rocks as a rule, or the ingredients of mineral veins are generally regarded as possessing a weight or density several times greater than water, yet in one form, at least, of this mineral, we have a substance so light that it will float readily upon water, and has in consequence received the name of *mountain cork*. To most people, also, in speaking of rocks, minerals, or ores generally, the impression is conveyed that these are dense, heavy bodies, which can be crushed to powder with the proper application of sufficient force, yet here we have a mineral which can be pulled apart with comparative ease, teased out into fibre, and which thereupon presents the characteristic appearance of fine floss silk or cotton, so much so that in certain places this material is familiarly known by the name of cotton rock—or as the French call it, *pierre du coton*.

We have therefore here a substance which in some respects presents features belonging to both the mineral and vegetable kingdoms.

While, however, asbestus in all its forms must be styled a true mineral it possesses certain properties which distinguish it very clearly from many others. Among these presumably the most important is that of non-conductivity or its power of resisting the action of heat,

in which respect it possesses some of the properties of wood, which also is in one sense a slow conductor, though in much greater perfection; since wood under the action of sufficient friction rapidly becomes charred and even ignited, whereas friction apparently exercises very little influence upon asbestus, no matter how long it may be applied. This property of non-conductivity, or of resistance to fire or heat, is one of the principal reasons for its extensive application in certain lines at the present day.

The term *asbestus* is derived from the Greek and signifies literally *inextinguishable*, while the other term frequently applied to the same mineral, viz., *amianthus*, is also of Greek origin and signifies *undefiled*, from the property possessed by the mineral of being purified by the application of flame without injury to the substance i self. This was a property well recognized by the ancients, since we read in several of the earliest authors that the custom prevailed of wrapping the dead bodies of their important personages in an incombustible cloth by which the ashes resulting from their cremation were retained intact. The process of weaving this cloth from the fibres of amianthus shews that considerable scientific skill in the textile arts had been acquired by those people, judging from the difficulty which has been experienced, even in modern applications of the art, and it is supposed that the requisite degree of tenacity was imparted by the admixture of threads of flax or silk, which could afterwards, if necessary, be removed by burning. The wicks of the lamps in the early heathen temples, which were supposed never to be extinguished, were also held to have been made of this material.

The resistant action of the asbestus fibre, or of the cloth woven from this fibre, to heat, is one of its most wonderful properties. Temperatures of 2000° to 3000° are easily withstood, while with some varieties a temperature of 5000° Fahr. has apparently produced no visible effect. Its property also of successfully resisting the action of acids is one of great value, and these properties render this substance of great importance in certain chemical operations, so much so that its use in this direction is rapidly increasing.

In addition to the cloth used by the ancients in the process of cremation, napkins were also woven and specimens of these are preserved

in the museums of several of the cities in Italy. The old story of the table cloth of Charlemagne is doubtless familiar to many of you, in which it is stated that he used to draw this cloth from the table, all soiled with the *debris* of his feasts, and in the presence of his guests throw it upon the blazing fire, from which it was soon taken, cleansed from all impurity. This peculiarity, however, probably applies to a cloth made from the true abestus and not from the chrysotile, the difference in which will be pointed out as we proceed, but which varies from the other somewhat in composition. To the former variety, also, probably belongs the garment described in the story so quaintly given in the book by Montpetit, concerning the French *habitant*, in which he relates that at a certain lumber camp in one of our great northern forests, one of the men, newly engaged, upon his return from his day's work in the soft melting snow, when the rest of the crew were gathered about the stove, coolly proceeded to remove his boots, and then his socks which he dashed into the open fire. He, however, speedily extricated his foot gear, now cleansed to immaculate whiteness, and proceeded to dress his feet as if nothing unusual had occurred, a proceeding which, it is needless to say, among a group of people unaccustomed to witness such marvels, resulted in something stronger even than amazement, and with a sudden accession of terror at the presence of a man who could thus perform such miracles with apparently flaming garments, they incontinently fled and left the uncanny stranger undisputed master of the situation, under the impression that he could be no other than the evil one himself. Explanation was of no avail, and the men refused to return to work until the foreman had discharged absolutely the unfortunate wearer of asbestus socks.

Somewhat analogous to this is the story related to me by one of the local managers of an asbestus mine in Coleraine township. This gentleman, also, was the fortunate possessor of a pair of asbestus mittens and under the impression that these were indestructible by fire, and desirous of astonishing the crowd which was gathered around the stove in a country store proceeded to throw one of them into the flames within. The success of the wished for miracle was not, however, equal to his expectation, since upon withdrawing his mitten from the flames, after a short interval, it was found

that the action of the fire had rendered the fibre so brittle that its tenacity was almost entirely destroyed, and the mitten was of no further use. In order to explain then the seeming inconsistency between the two cases, it may be stated that what is known as the Quebec asbestus of commerce, and the true asbestus, are two distinct substances, and belong to two distinct groups of minerals. Thus asbestus proper belongs to what is known as the pyroxene or hornblende group, while that obtained from the Quebec mines belongs to the talc or serpentine group. The former is classed among the igneous rocks proper, such as syenites, granites, syenites, porphyries, etc., and embraces among other varieties augite, diallage, hornblende, etc. Some asbestiform minerals are augitic, but the greater number belong to the hornblende family, and are known by several names, such as amianthus, asbestus, byssolite, tremolite, actinolite. In the variety known as pilolite, which is also a division of the hornblende group, several curious forms of asbestus occur, such as mountain paper and mountain leather, in which the fibres have become felted together in a somewhat uniform consistency, and are in the form of thin sheets; mountain or rock cork, which is a more massive form, and in which the specific gravity ranges from .68 to 1.34, and mountain wood, the name of which is derivable from its ligniform or woody aspect. The chemical composition of these several asbestiform minerals varies considerably, but for the most part they may be classed as silicates of alumina and magnesia, with varying proportions of lime and iron and occasionally a little water. The varieties known as mountain cork and leather contain a considerable proportion of water, amounting sometimes to 23 per cent.

A peculiar bluish variety known as crocidolite, and found in South Africa, Norway, and at several other points, contains a very considerable proportion of iron protoxide, sometimes as much as 35 per cent., in addition to silica, magnesia, and soda, and contains also a small percentage of water. This mineral is more properly a silicate of iron, and has great tensile strength as compared with the ordinary form of asbestus, though deficient in fire-resisting properties.

These minerals occur for the most part in serpentinous rocks in the oldest formations. In Canada, the variety known as actinolite occurs

in large masses in the Laurentian rocks of Ontario, in the townships of Elzevir, Lake and Tweed.

It is also found in Norway and Sweden where rocks similar in age and character occur. The finer varieties of amianthus and asbestus occur most abundantly in the Alps of Savoy, near the boundary of Switzerland and Italy, and in the island of Corsica, at which places beautifully white silky fibre is found in considerable quantity along with much of the coarser varieties.

The variety known as tremolite is found in several countries, generally in the old Laurentian rocks, in connection with limestone. It consists of long prismatic crystals of white, grey and green colors, but has not the fine fibrous texture of amianthus or chrysolite, and it frequently graduates into actinolitic forms. It occurs in the Laurentians of Canada and New York where it has been mined for some years to a limited extent. Cork,, leather, &c., are also found in rocks of the same horizon, and beautiful specimens of the former are obtained from the township of Buckingham, in Quebec. The preceding minerals belong to what is styled the group of the anhydrous silicates in which water is supposed, for the most part, to be wanting.

Of the other varieties, belonging to the talc and serpentine group we find water entering into their composition to a very appreciable extent, and they are therefore placed in the group of the hydrous silicates of magnesia. These include talc, soapstone, or stearite, potstone serpentine and a number of other kinds, somewhat similar but not economically important. The composition of all these may be generally stated to be silica, magnesia and water, with occasionally a little alumina and iron, the percentage of water, ranging from $2\frac{1}{2}$ to 5, in talc, to $12\frac{1}{2}$ and 15 in serpentine, so that the distinction between the two groups, the hydrous and the anhydrous, is, in this way, clearly marked. While the composition of talc, soapstone and serpentine is to a great extent the same, or with the ingredients in slightly varying proportions, the mineral which we call asbestus in Quebec, but whose true name is chrysolite, is confined almost entirely to the latter. The serpentine itself is frequently of varying colors, being green, grey, red, yellow and brown, having a hardness of about 3 to $3\frac{1}{2}$, and a specific gravity of 2.5 to 2.7. It is generally massive, but some-

times presents a banded structure and is occasionally quite slaty, being frequently marked with spots, veinings and stripes of various colors. The coarser fibrous varieties are known as picrolite and baltimorite; the fibres themselves being devoid of the soft silky character and lustre which is a peculiarity of the better kinds of the variety known as chrysolite or the asbestus of commerce.

Asbestus is therefore seen to present a great variety of forms, and in some one or more of these it is found at various places over the greater part of the surface of the globe. Among these may be mentioned in Europe, small deposits in England, Scotland and Ireland; in France to a limited extent, except in the extreme southeast in Savoy, more abundantly in Italy and Portugal, and on the island of Corsica, where the beautifully silky variety, amianthus, is quite abundant. In Germany, Bavaria, the Pyernees, Russia, Norway and Sweden deposits of greater or less extent have been found.

In South Africa the peculiar bluish variety, crocidolite, has already been referred to, and recent reports state that extensive deposits of asbestus occur in the serpentine belts of Kimberley, in which the diamond diggings also are situated. Asbestus has also been found in South America, in Brazil, in Australia, and in Asia Minor. In several parts of Newfoundland, excellent fibre, more particularly of the variety known as chrysotile, is known to occur, and in the United States it is also found in connection with the serpentinous rock of the eastern mountain range in nearly every State from Maine to Georgia On the west coast also it is reported in considerable quantity from California and British Columbia, and as far north as Alaska, while its presence in the rocks of Ontario and Quebec has been recognized for many years. With such a widely extended distribution, therefore, it would seem natural that the supply of the material should be practically unlimited. Such, however, does not appear to be the case; since in many of these places the quantity is so small as not to be available for general use, and in others the quality is such as to be economically valuable only for the inferior purposes of manufacture; while in others again the difficulties of access preclude all possibility of successful mining, for years to come at least. Prior to 1880, the greater part of the fine fibre adapted for spinning came from the mines of Italy and

Corsica, and owing to the difficulty with which it was obtained and its exceptionally fine quality commanded a very high price in the market, reaching as much as $250 to $300 per ton; but the discovery of the chrysotile deposits in the province of Quebec, of a quality equally well adapted for spinning as that of Italy, taken in connection with the fact that these were situated directly along a line of railway within short haulage of a shipping port, almost immediately revolutionized the industry, and has lately nearly closed the Italian mines.

Much of the so-called asbestus of these mines, however, is not adapted for spinning, and is used for the manufacture of mill-board, cements, paints, etc., as is also the output from such mines in the United States as have been working more or less constantly for the last twenty years. The output of the Quebec mines has even already had such an effect upon these that their present output is probably scarcely a tenth of what it reached ten years ago.

In Ontario, also, a large quantity of the variety known as actinolite is mined and ground at Bridgewater in Hastings county. This is used for cement roofing being mixed for that purpose with tar, the fibrous texture of the material being sufficient to allow of its felting sufficiently, but not for spinning.

The non-conducting substances available in the process of manufacture in addition to asbestus are not numerous. Among the most important probably may be mentioned *infusorial earth*, which is generally found as a white or grayish white earthy material occupying the beds of certain lakes, or under peat bogs and in deposits frequently of very large extent. In composition this earth is almost a pure silica and is composed of the siliceous shells or crusts of diatomaceous plants, spicules of sponges, &c. It is also known as tripolite and under the name of *Tripoli*, or polishing powder, is familiar to most housekeepers. The localities where infusorial earth occurs most abundantly in the States are in Virginia, where an immense bed, many feet thick, underlies the city of Richmond; and in California, where a deposit of fifty feet in depth occurs near Monterey. In Germany large deposits also are known under the name *kieoelguhr*, and much of this material used in the United States comes from that country. Numerous lake bottoms filled with this substance occur in the provinces of Nova Scotia and New

Brunswick, generally of much greater purity than the American or German earth, and it is also found to some extent in the province of Quebec.

It is extensively used for the manufacture of water-glass or soluble silica, and for the coverings of boilers and steam pipes for which purposes, owing to its great non-conductive properties, it is especially adapted. As a polishing powder it is also extensively employed, and for some years was an ingredient in the manufacture of dynamite, as an absorbent of the nitro-glycerine which enters into the manufacture of this explosive. For this purpose, however, wood-pulp has now to a large extent superseded it. In the lining of safes and for the protection of exposed portions of buildings, it is also largely used, but it can never compete with asbestus fibre in the peculiar processes to which that product is now applied.

Another non-conducting material which enters largely into competition, both with asbestus and infusorial earth, is the substance known as *mineral wool*. This is an entirely artificial preparation, and its discovery was doubtless due to the fact that a somewhat similar substance occurs in a state of nature in connection with certain volcanic eruptions, more especially in those of the Sandwich Islands, where the slaggy volcanic liquefied matter is acted upon by blasts of air and blown out into long silky fibres, which have received the name of "Pele's Hair." Mineral wool, or slag wool, is formed artificially in a somewhat similar way, viz., by subjecting a stream of molten slag from a blast furnace to a jet of steam or compressed air, by which means the slag is broken up into minute particles, generally with a small fibrous end or tail, which accumulate as they fall and resemble masses of roughly teased out cotton. The solid particles which form the head of each minute atom are subsequently detached and the finer fibres carried over into a separate chamber, when they are ready for use. This material possesses wonderful properties as a non-conductor of heat or sound, has great lightness, and is absolutely fireproof. It is extensively employed as a material for covering boilers, steam-pipes, and for lining buildings to render them fire, sound and vermin proof. While, therefore, it competes very successfully in many points with asbestus as a non-conducting substance, like infusorial earth it has not the property

of being spun, and has also several objectionable features besides which interfere somewhat seriously with its universal application.

Steatite or soapstone is an excellent resistant of heat, and as an ingredient in fire-proof paint is probably quite as valuable as asbestus, while as linings for stoves, furnaces, etc., it has long enjoyed a well deserved reputation. It also enters into competition with asbestus as a loader or filler of paper stock, and for several other purposes to which the lowest grades of the asbestus waste were formerly applied, but its special use at the present day would appear to be the manufacture of a non-corrosive and fire-proof paint.

As non-conductors of heat and sound several other preparations have been invented, among which may be mentioned *wood-pulp* and *terra-cotta lumber*, the latter being principally a mixture of clay and sawdust, made into bricks like ordinary clay. This mixture possesses great lightness, especially fitting it for interior work, such as dividing walls in buildings, being both fire and sound proof, but can scarcely be said to be a rival or competitor of asbestus in many respects.

Having thus briefly reviewed the several asbestiform and other non-conducting substances, we can now proceed to the consideration of the asbestus or chrysotile deposits as they occur in Canada, and more particularly in the province of Quebec, since it is in this province that the most important developments in this mineral have taken place.

The workable asbestus of Quebec is, in so far as at present known, confined to the serpentine areas of the mountainous belt which extends through the Eastern Townships from the boundary of Vermont to the extremity of Gaspé peninsula, with the exception of certain peculiar deposits which are found in connection with the serpentinous limestones of Templeton and the Gatineau valley in the Laurentian rocks north of the Ottawa. Concerning these latter deposits sufficient development work has not yet been done to determine definitely their economic value, but the quality of fibre obtained from some of the asbestus veins of this district is remarkable for its purity or freedom from foreign substances. The serpentines of the Townships form a series of disconnected masses, generally of small extent, surrounded by igneous rock, principally dioritic, but occasionally rising through great outcrops of slates or schists. At times these serpentinous masses assume such pro-

portions as to rank almost as mountain ridges, as can be seen in Wolfestown and Coleraine, and in Gaspé in certain parts of the Shickshock range. As pointed out last year in an excellent paper "on the serpentines of Canada," contributed by Mr. N. J. Giroux, of the Geological Survey to this club, these peculiar rocks are found in formations of different ages from the Laurentian to the Tertiary. To the latter period some of those found in British Columbia are supposed by Dr. G. M. Dawson to belong, while others are there associated with rocks of Carboniferous age. It is evident, therefore, that they have a very wide geological range; and this is seen, also, in the province of Quebec, where the serpentinous limestones north of the Ottawa are of Laurentian age, while the serpentine east of the St. Lawrence is associated with rocks of Huronian, Cambrian, and possibly even newer systems. Whether this difference in the age of the serpentine formations may have any influence on the question as to the presence or otherwise of asbestus in workable quantity is a question not yet fully ascertained, but there is some reason to suppose that the serpentines of a certain age are more productive of chrysotile in paying quantity, than that of more recent date in this country, in the same way that the quartz veins of the Cambrian rocks appear to be the seat of more productive gold mines than those found in newer formations.

The serpentinous rocks of New Brunswick have not as yet yielded asbestus except as mere thread like veinings. These are found to belong to the Laurentian system. In Nova Scotia it has not yet been recognized, but recent investigations in northern Ontario, according to the report of the Royal Mining Commission for that province lately published, indicate the presence of fibrous asbestus in the vicinity of Lake Temogami, according to the statement of Mr. E. Haycock, in veins of considerable length. This is in rock also supposed to be of Huronian age.

The serpentine areas of the Eastern Townships may be divided into three portions, viz.: 1st, a southern, embracing the masses in Potton, Sutton, Bolton, Orford, Melbourne and Shipton, which terminates not far from the Shipton Pinnacle, south of the village of Danville, though occasional detached outcrops appear above the surface for a few miles further north; 2nd, a central portion beginning with Big

Ham mountain and extending through the townships of Ham, Coleraine, Thetford, &c., to and beyond the Chaudiere River, in which the most conspicuous and important masses are in Thetford and Coleraine; and 3rd, an eastern area which is found in the Shickshock range of Gaspé and of which the most eastern outcrop is in Mount Serpentine, on the Dartmouth River, about ten miles from Gaspé Basin.

While all serpentine rocks present certain leading features which enable them to be readily recognized by anyone familiar with their general aspect; there are in the serpentine of these three areas several marked peculiarities which serve to distinguish them quite easily. Thus the rocks of the southern area are frequently, though not always, slaty, and occur sometimes with much soapstone, or potstone, and sometimes with dolomite, and have frequently a greasy smooth aspect on the slaty surface. About Brompton Lake they are associated with great hills of dioritic rock as well as with slate, and contain masses of white garnet. Mining has been attempted at several places in these rocks, more particularly for ores of copper, which has produced some very fine hand samples, but in so far as yet worked, not in quantity to be remunerative. Veins of asbestus are seen occasionally, but these are as a rule of short fibre, either soft and pasty, or harsh and stiff, while in extent they are mostly short and gashy, and do not possess the well defined vein character of those seen in Thetford and vicinity. Near Danville, however, in a peculiar knoll-like mound of serpentine the veins of asbestus are well developed, and fibre of very fine quality and of suitable length for spinning is found in abundance. The occurrence of this mass of serpentine, rich in asbestus, in a belt which is well developed a short distance to the south, but which is there, in so far as yet prospected, almost deficient in asbestus fibre of any length, is peculiar, and serves to indicate that, even in most unlikely places, exceptional development of conditions may give place to a favorable change in the rock which may lead to the establishment of a profitable mining area.

In so far, however, as experience has determined the conditions for profitable mining, the serpentine of this southern area does not yield indications favorable to successful development; and the same remark will apparently apply to much of the serpentine found in the adjoining

State of Vermont. It is possible that much of this serpentine may be the result of alteration from dolomitic rock, or from slates which contain dolomite; whereas it is clear that much of that found in Thetford and Coleraine is an alterative product of dioritic eruptive rock, rich in olivine or some allied mineral.

The rocks of the central or Coleraine area differ as a whole from those just described in being, as a rule, much more massive, and occurring in large areas. They have associated with them deposits of chromic iron and of magnetite, as well as of asbestus. Large areas of steatite or soapstone occur also about Ham Lake, and mining for nickel was carried on in this vicinity many years ago, the quantity of this mineral obtained being, however, but small. The country occupied by these rocks is generally rough and uninviting from the agricultural standpoint, and the whole area from Ham Mountain to the northern terminus of the main belt in Thetford or at the Bull Mountain in Adstock is of this description. In character of rock the serpentine presents several varieties. Portions are hard, reddish brown weathering and very siliceous, as seen in much of that in the townships of Wolfestown and Ireland, and even in the Coleraine ridge south of Black Lake and about Lakes Caribou and Little St. Francis. In this hard siliceous serpentine, asbestus very rarely occurs, and when present is mostly of imperfectly developed fibre in short and gashy veins. Occasionally, however, seamy partings are found which at first glance and at a distance present somewhat the aspect of asbestus veins, but on closer examination reveal the existence possibly of a small parting of fibre, or sometimes only of a seam of serpentine. In certain portions of the belt these seamy partings are quite numerous, and by some prospectors are supposed to indicate the presence of workable veins, on the general principle held by many practical miners, that a vein of mineral matter always becomes larger as it is followed downward, a principle of such peculiar application that its absurdity should be apparent to anyone who has ever thought a moment on the subject.

Passing beyond or to the north-east of the great masses of serpentine in Thetford and Coleraine, detached masses, knolls, and sometimes bands of this rock crop out at intervals. These are well seen near the Chaudiere River, both in the Bras de Sud Ouest and in the Des Plants

streams; but though these outcrops have been carefully prospected, nothing more than small gash veins have been found. Further to the north-east on the south side of the great dioritic mass called Moose Mountain in Cranbourne, a small outcrop of serpentine, on the bank of the Etchemin River, shows small veins of one quarter to possibly half an inch of fibre, and this is the most northerly outcrop of asbestus-bearing serpentine yet known in this belt.

The most easterly area, viz., that of the Shickshocks, is largely made up of serpentine, different in character from the rock of Thetford which we may take as our typical locality; the southwestern portion being very hard and siliceous, in contact with black hornblende schists on the north; while the eastern or Mount Albert serpentine, which is the principal area in this direction. is frequently banded with shades of reddish brown and green. In these rocks only small veins of imperfect fibre have yet been found, and the generally hard and siliceous character of much of the rock is against the presence of large deposits of the fibrous variety. In the most easterly exposure, on the Dartmouth, the serpentine is very much of the same nature as in the Shickshocks, associated with hornblende schists and containing small veins of one-quarter inch fibre of but little economic value.

It is easily seen, therefore, that the character of serpentine which is really asbestus-bearing to an extent which can be profitably worked, is confined to a comparatively limited area, and more particularly to contain portions of the townships of Thetford, Ireland, Coleraine and Wolfestown, in which localities successful mining operations have been carried on for some years. But even in these favored districts there are large portions of the serpentine belts which, in so far as yet proved, have disclosed no asbestus in quantity to be economically available. The rock carrying the merchantable asbestus is generally a greyish weathering serpentine of some shade of green on fresh fracture, generally a greyish green, in which are contained numerous small particles of iron, both magnetic and chromic, more generally the former. Serpentines that have a black, hard, chippy aspect do not apparently promise well, nor does the rock which weathers a dirty reddish brown. In the asbestus-bearing rock proper the veins of asbestus are seen without any special arrangement, intersecting the mass of the rock

generally in every direction, but for the most part at a considerable angle both to the perpendicular and horizontal. Certain peculiar arrangements of these veins are, however, noted in certain areas, as at the King Bros.' mine in Ireland, where the serpentine appears to be regularly stratified almost in the manner of sandstone or quartzite in layers dipping to the northwest, and the veins of asbestus apparently follow what, in sedimentary rocks, would be regarded as the bedding planes. In several other places the veins, few in number, cut the rock in an almost horizontal position, and when found in a knoll can be traced across from one side of the hill to the other nearly on the same plane, but as a rule the veins are irregularly placed. In size they range from mere threads up to a thickness of five or six inches, though the most of the workable veins in the principal mines do not, or but rarely, exceed two and a half inches in width or length of fibre, and such veins, where the asbestus is of good quality and unbroken by partings of iron, are regarded as extra No. 1 material. There are, however, generally more small veins of one inch or less than of the larger size. Serpentines associated with talc or with soapstone, where the latter is in quantity, rarely appear to carry veins of asbestus to any extent, and such steatitic rock is not usually considered good mining ground. The Broughton mine may possibly be cited as an exception to this principle, since at this place a vein of large size of very fine fibre was found lying between serpentine and soapstone walls. As the soapstone became more abundant, however, the size of the vein rapidly became less and finally split up into small strings and became useless, and it is a fact worthy of note that at the great and profitable mines in Thetford and at Black Lake soapstone is absent from the rock mass.

As for the origin of these veins in the serpentine several theories have been advanced. In composition the vein matter is, as already mentioned, apparently the same as the containing rock, and the chrysotile is simply a fibrous serpentine. Some have supposed the veins to be formed when the mass of the rock was in a pasty state and exposed to sundry strains or twistings which produced the fibrous nature of certain portions. That the rocks have been exposed to such violent action is very evident from their present faulted character.

Others have supposed the cracks to have been formed by the cooling and shrinking of the mass from a heated and pasty state by which cracks have been formed, which subsequently became filled with asbestiform matter from below. In whatever way the fissures were caused, and it is very probable that they have been formed by the great processes of metamorphism to which the rocks were exposed in the change from dioritic matter to serpentine, the vein asbestus appears more naturally to have been produced by a process of segregation of serpentinous matter from the sides of the fissure, very much as ordinary quartz in many mineral veins is known to have been produced, the segregated or infiltrated matter gradually filling the original fissure, and meeting at or near the centre, in proof of which the presence of a comb of particles of iron is very often found occupying the centre of the vein, and quite frequently these iron grains assume sufficient size as to form a regular parting of iron ore in the fibre. In this respect asbestus veins resemble very closely mineral veins with quartz or calcite which frequently contain alternate layers of ore on either side of a central comb of crystals. The arrangement also of the fibre at right angles to the sides of the containing fissure, except where the rock has been disturbed, is confirmatory evidence in the same direction.

In some of the mines fibre of exceptional length is observed. Sometimes there are veins caught along lines of fracture and drawn out of their natural position. At other times this long fibre is, to some extent at least, due to the friction of the rock walls by the displacement of a fault. In this way the long woody fibred material, known as hornblende to the miners, but which is rather a form of picrolite, is probably produced. In the same position also, and due probably to the same cause, are the long well fibred strips of asbestus seen in some of the mines, and which at first sight might almost be taken for vein matter of exceptional length. A very peculiar form of asbestus is found on an island in Lake Nicolet, where also the coarse picrolitic variety is well seen, which consists of small concretionary pellets of asbestus containing a nucleus of serpentine and enclosed in a steatitic rock. This peculiar development was first pointed out by Mr. C. W. Willmott, and has not been recognized at any of the other mines,

at least to a noticeable extent. But a still more peculiar form is that seen at the Megantic mine in Colerain, where the serpentine wall for the distance of several feet is laced with minute veins of not more than a twentieth of an inch in thickness, and presents the appearance, on fresh surfaces, of a rock regularly and evenly striped with greyish white paint. The same mode of occurrence of small veins is seen at King Bros.' mine in Ireland, and at Bellmina, and occasionally some of these smaller veins there come together and form one of workable size. This peculiarity is also conspicuous in the serpentine asbestus deposits of Templeton and the Gatineau district, although the character and age of the containing rocks are entirely distinct from those of the eastern area. In this latter place the small veins of asbestus have a thickness generally of an eighth to a fourth of an inch, with partings of light greyish serpentine of about the same thickness. These occur throughout a space sometimes of a foot or even possibly more, and enclose roughly lenticular masses of limestone, which are often of large size. Sometimes several of these detached veins coalesce and produce a large vein having a thickness of two inches of wonderfully clear fibre, which continues for a short distance and then splits up again. The same peculiarity is seen in the lower part of the large vein at the Broughton mine in eastern Quebec, where the hanging wall is soapstone.

While, therefore, indications of asbestus or chrysotile may be found at most places where serpentine rocks occur, it is, I think, very clearly established by the work of prospectors, as well as by that of the staff of the Geological Survey, that very many areas do not contain, nor are likely ever to produce, asbestus in workable quantities; and while the greatly enhanced price of the mineral renders operative, areas which a few years ago could only be worked at a loss, it must be borne in mind that the great profit is made in the output of first-class material, rather than in third-rate asbestus. To any persons, therefore, contemplating investment in such mining areas, it is plain that the first thing to be attended to is a careful examination of the property by one not personally interested in the matter, and one, further, who has a good knowledge of the different kinds of serpentine, as well as of the conditions which should govern the occurrence of asbestus in sufficient quantity to repay the money invested. Unfortu-

nately prospectors as a class, not only of asbestus properties but of other minerals as well, are not sufficiently well informed as to such conditions. Many are led by what they have observed in connection with mines in certain other areas, such as for instance in the case of the Cornish miner, who measures everything in a Cornish half bushel. Whereas the truth is that the profitable or economical development of minerals very frequently depends upon the presence of local phenomena or conditions which have affected certain limited areas only of the earth's surface or crust. Just what the conditions have been in the past by which the serpentine areas of Thetford and Black Lake have become so impregnated with asbestus veins of great purity and large size, while the areas a short distance to the east or west should be almost devoid of asbestiform mineral, cannot yet be conclusively settled. It is possible that the presence of the large intrusive masses of granulite, which are of more recent date than the serpentine, may have had some effect in this direction, but in that case we should expect to find at Black Lake, where these granitic masses are the most abundant, the richest deposits of asbestus. On the contrary, however, it is found that the largest and most important veins are found at Thetford where the granitic masses are comparatively small and generally confined to narrow dykes; for while the serpentine of this area is, according to the best testimony on the subject, due to an alteration of igneous or dioritic rocks, we can scarcely suppose that the asbestus itself is of igneous origin. While, therefore, the reason why the Thetford areas are the most productive of fine asbestus fibre has not yet been satisfactorily ascertained, we have been able to learn some facts from the study of these Thetford mines, which are of value to guide the prospector or the scientific explorer in the search for other deposits.

Since the asbestus veins occur throughout the mass of the rock and come directly to the surface where exposed, as in the hill at Thetford mines and the great escarpment to the south east of Black Lake station, the mining of the mineral does not follow the methods which are usually employed in the working of other mines, viz., by underground slopes and levels connected with the surface by shafts, but is simply open quarry work, the entire rock being removed, broken up and the veins of asbestus separated by hand cobbing, in so far as the size of the

veins will warrant the expenditure of labor for this purpose. The bulk of the barren serpentine necessary to be removed in order to obtain a ton of fibre is consequently very great, and while no exact data are to hand by which the relative proportion of asbestus and serpentine can be determined, it has been estimated to range in the ratio of 25 to 1 in very prolific ground, to 50 to 1 in ordinary mining. Of course in such a great quantity of waste rock, under the present system of working, many small veins or portions of veins are not removed, owing to the expense and difficulty attending such operations by hand labor only—and the great heaps of waste material have accumulated till they now occupy large areas of valuable ground. As in the case of the drilling and hoisting, however, where hand labor has been obliged to give place to steam and compressed air, so, also, very shortly the breaking and cobbing must also be done by machinery, and with proper appliances, with a great saving of expense, as has resulted in the case of the drilling and other operations; since with a properly equipped mine the cost of production can be reduced from 50 to 75 per cent. from the expense due to the laborious system of hand labor.

The history of asbestus mining presents some points of interest in view of the rapid growth of the industry. Comparatively little importance was attached to the mineral, from the economic standpoint, in the early days of the Geological Survey's operations, and this combined with the fact that, although asbestus had been known before 1850 in the serpentines of the Eastern Townships, the quantity seen at the places where discovered was very limited, and led to the result that but little heed was paid to its occurrence. In 1877, owing to the burning off of the forest in Thetford and Coleraine townships, the hills of serpentine became laid bare and the weathering speedily produced the peculiar felting of the asbestus fibre on the surface wherever veins occurred. This was observed by a French Canadian named Fecteau, it is stated, and the importance of the new material was soon ascertained, which resulted in the establishment of mining operations on a small scale in the summer of the following year, by the Johnston Asbestus Mining Company, although the credit of the first attempt at working should probably be given to the Ward Brothers. The areas in the immediate vicinity were speedily secured and new mines located, since

which time the growth of the industry has been constant and rapid, the output increasing from 50 tons only in 1878 to probably not far from 8,000 tons in 1890, while the prices have also advanced within the last year or two at a like wonderful rate, till now No. 1 Quebec asbestus commands probably as good a price in the market as the best Italian, while No. 3 brings nearly as much as was obtained for No. 1 six years ago.

According to the Ontario Commission's Report, actinolite mining in that province was commenced in 1881, since which time about 3,000 tons have been extracted. This material, however, does not command the price of the Thetford mineral, selling at about the same figure as the waste or No. 4 from that locality, it being used almost entirely for asbestus roofing, for which purpose it is mixed with tar, as already stated, and then applied in a coating of about half an inch in thickness. The waste from the mines of the Eastern Townships, and formerly the output graded No. 3, was at one time quite extensively used for the same purpose.

The asbestus of Templeton was probably first mined in 1883, but the industry has never proved very remunerative, owing to the limited nature of the deposit and the smallness of the veins, so that for some years mining was entirely abandoned. During the last season, however, operations have been started anew, and some very excellent fibre taken out, it is claimed at a profit. The conditions under which the asbestus occurs in this district are distinct from those which are found both at Kaladar in Ontario and in the serpentine areas of the Eastern Townships, the serpentine in which the asbestus veins occur being intimately associated with crystalline limestone, and in many places the latter is highly serpentinous. The fibre of the asbestus is distinguished from that of Thetford in having a marked pearly and wavy lustre, in being generally lighter colored, and by an entire absence of impurities in the form of iron grains. Sufficient study of these peculiar rocks has not yet been made to pronounce definitely upon their probable importance, but when the deposits are made more accessible considerable mining will be done, as these appear to be quite extensive.

As for the uses of asbestus, these have multiplied with exceeding rapidity. The early history has been briefly stated, in so much that

sufficient acquaintance with its peculiarities had been learned many centuries ago to enable it to be woven into cloths often of considerable size. At the present day the finer grades and longest fibres are still somewhat extensively used for weaving into cloths, from which drop curtains for theatres, suits of clothing for firemen, and various other articles, are made, among which are asbestus mail bags for railway transit. So important is the matter of fire protection in theatres now regarded in the leading cities of Europe and in the United States, that special legislation has decided that asbestus curtains of a size sufficient to completely shut off the stage from the body of the house must be a part of the stage furniture. As an instance of what can be woven from this material, it may be mentioned that the curtain of the Academy of Music, Philadelphia, by which the stage is separated from the body of the house in case of fire, is 54 feet wide and 53 feet high, and is made almost entirely of pure asbestus, only 3 per cent. cotton being employed, presumably to facilitate the weaving.

As a protection for firemen asbestus clothing has been proved to be of the greatest advantage. By its aid they have been able to enter burning buildings and approach so closely to the flames as to extinguish them in a much more speedy manner than by the old plan of fighting them at a distance. Of a somewhat similar character are the fire shields, also made of asbestus, which are placed between the burning building and those who are fighting the flames, thus protecting them largely both from the great heat and from the dense volumes of smoke as well. As for the great heat which can be endured when clad in these garments, the story of the extinguishing of the Coste gas well in western Ontario only last year is quite fresh in our memories. Here the huge jet of gas which issued from the stand-pipe of the well became ignited, and the screw-cap which closed the pipe having received some injury could not be adjusted so as to effectually close the orifice. Several expedients were resorted to in order to arrange the cap successfully, till at last, under promise of a heavy reward, some one, clad in an asbestus suit, boldly approached the flame itself, a thing absolutely impossible without the protection thus afforded, adjusted the cap properly, screwed it on and extinguished the ignited gas. But while the use of this material for the purpose of clothing has steadily increased within

the last ten years, so many other needs have arisen to which it appears especially adapted, that the manufacture of clothing is forced to take a comparatively unimportant place. Thus in chemical laboratories fine asbestus cloth, or even finely teased out asbestus fibre, is now used very extensively for filtering various solutions for which no other material yet discovered has been found so well adapted, especially for strong acids and alkalies which would quickly destroy the ordinary filtering paper. The advantages of the asbestus filter are also apparent in the fact it can be ignited without being consumed. It is also rapidly coming into use in sugar refineries for filtering the saccharine juices, and as a filter for water it has been found to possess very superior qualities over most of the substances in use, and will doubtless, before very long, become an important agent in the purification of our supply of water in large cities.

Its value as an ingredient in the manufacture of fire-proof paint has already been alluded to slightly, in which respect it ranks with steatite. Applied to woodwork it is capable of successfully withstanding a very considerable volume of flame and so confining the fire to a limited space. As a material for fire-escapes also, owing to its very considerable tensile strength, it is largely made into rope, the fibres of which are sometimes strengthened by the addition of brass or copper wires, from which ladders are then made, which are practically indestructible. More recently, also, its properties as a non-conductor of electricity have been discovered and a great demand has sprung up for it in the construction of dynamos, and other portions of electrical apparatus requiring insulation. Wall paper, also, printed in ornamental colored patterns, which when applied to the walls of a room reduce the risk of conflagration to the least possible degree, are manufactured even now in considerable quantity, and even writing and fine printing papers are made which have the property of resisting destruction by fire, and though becoming altered to some extent, even then preserve the writing or printing which has been made on them. A great difficulty, however, in the former case is to give the paper a sufficiently hard and smooth glossy surface over which the pen can glide freely; but this defect will doubtless be remedied in time, and with a fire proof ink the preservation of deeds and important papers can thus be readily effected.

To those affected with cold feet a stocking or insole of asbestus cloth, which is easily made, is a sure preventive of discomfort. This article has already been manufactured by an enterprising firm and a patent taken out theron, while a thin strip, used as a cork sole, will be found highly efficacious in keeping one's feet comfortable. While, however, the uses to which this peculiar mineral appears to be adapted are manifold, possibly the most important and valuable is that to which it is now so generally applied, viz., as packings for cylinder pistons in steam engines, and for joints in gas, steam and hot air pipes. In the manufacturing of steam packing good fibre is required capable of spinning. The mineral as it comes out of the rock in vein form is first pulled apart and the fibre teased out into a woolly or silky mass. Then, by specially prepared machinery, the gritty and iron particles are carefully eliminated, since their presence would be productive of injury to the rapidly moving polished piston rods, and the resulting product, a fine fluffy substance, is then carded and spun into yarn or woven into cloth. If the former, the yarn is treated after the manner of manilla and manufactured into ropes of various sizes and shapes, as required for the different varieties of packing into which it is to be made. In order to adapt the mineral to special uses the fibres of the asbestus are frequently intermixed with fine wires of copper or brass or associated with rubber. In some varieties also finely divided graphite enters into the composition, presumably to impart greater lubricity to the material. The great value of this packing arises from the fact that it is unacted upon by steam or heat, and consequently retains its elastic properties for a very long time in comparison with the old style of hemp or rubber packings; so that now, especially since the late improvements in engines of the marine type where enormous power is developed, such satisfactory results could not probably be obtained by any other known substance.

As a covering for steam pipes and boilers it has also come into very general use, the saving in fuel and power from its application far more than repaying the cost of the material, and is estimated to be not less than 30 per cent. of the energy developed.

But it would be practically impossible in a paper of this kind to enumerate the uses to which this wonderful material is now being ap-

plied, and concerning the adaptability of which fresh discoveries are being made almost daily. The great importance attached to the deposit in the province of Quebec is seen in the fact that several of the largest companies interested in the manufacture of asbestus products have found it to their interest to secure mines of their own in this district, among which may be mentioned the Bell Asbestus Co. and the United Asbestus Co., of London, Eng., and the great German firm of the Wertheims, of Frankfort, while American firms are also largely interested in several of the mines. In spite, therefore, of the wide geographical distribution of the mineral, it is evident that the asbestus of this country has, from its excellent qualities and from the ease with which it is obtained, risen to this prominent place, and in view of the fact that the sources of supply appear to be limited, it is doubly important that in all mining operations the minimum of waste should be permitted by the employment of the most improved machinery applicable to the purposes of mining and dressing, consistent with its economical and profitable output. This view of the case is now rapidly engaging the attention of those who possess the keenest insight into the great possibilities of this industry, and rapid strides have taken place in this direction during the last two years.

I trust that sufficient has been said in this paper to show that in asbestus we have a substance which is almost unique in the mineral kingdom—a substance of such ready adaptation to such a variety of uses that its neglect for so many years seems wonderful to those who have but superficially glanced at the subject. Doubtless, however, the great expense attendant upon its use prior to the discovery of the deposits of Thetford and Coleraine, in Quebec, is largely accountable for this state of things, and as in the case of many other substances when once they have come into general use, one wonders how the manufacturing and commercial world ever got along without them. It is possible that within the capacious bosom of mother earth there are stored up other treasures of the mineral kingdom, whose uses are also unknown at the present day, but which await the fortunate coming of some clever genius to show their great importance. A very striking case in point is seen in the enormous nickel deposits of Sudbury, and, to go a little further back, in the great petroleum wells and the reservoirs

of natural gas of Canada and the United States. In fact nature seems to delight in astonishing us at intervals with the production of some new material which almost revolutionizes the existing methods of work; yet it is equally certain that, just as soon as these substances are discovered, the inventive genius of man proceeds to find out some process by which they can be utilized. It will not do, however, to conclude absolutely that, because asbestus at the present day appears to fill a want which is apparently incapable of being filled by any other known material, this condition of things will continue forever or even for any very great length of time. Scientific investigation in the various branches of manufactures and arts is progressing at so wonderful a pace that one ceases almost to be astonished at each successive and brilliant discovery. It is gratifying to know, however, that all such discoveries, whether in the domain of medicine, electricity or in any of the branches of applied science tend to the increased welfare, comfort and advancement of the human race, and to those engaged in the solution of the problems which are constantly being presented in the different fields of scientific research, the thanks of all men are due as to do the world's greatest benefactors.

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THE ANNUAL MEETING.

Members are reminded that the ANNUAL MEETING will be held on the afternoon of the third Tuesday in March (17th). It will be held in the Normal School lecture room at 4.15 p.m. The importance of every one attending the annual meeting is manifest, as matters of vital interest always turn up and the Council is most anxious that every member should consider that he has a voice in directing the management of the Club.

SUBSCRIPTIONS.

The Treasurer begs to request that all members who have not already done so will pay their subscriptions before the annual meeting.

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