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OF

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NEW BRUNSWICK.

ARTICLE I.

THE MARSH AND LAKE REGION AT THE HEAD OF CHIGNECTO BAY.

By George J. Trueman, M. A.

Read April 2, 1896.

CONTENTS.

Geographical Description.—The Isthmus of Chignecto is about fifteen miles wide at its narrowest part. Its western shore is washed by the head waters of the Bay of Fundy. This Bay, running up toward the north-east, tapers into Chignecto Bay, which divides into Shepody Bay on the north and into Cumberland Basin, between Cumberland in Nova Scotia and Westmorland in New Brunswick. These two arms of Chignecto Bay are separated by a somewhat boot-shaped piece of land, known as the Meranguin Peninsula.

Shepody Bay receives the waters of the Petitcodiac and Memramcook, while the Tantramar, Aulac, Missiguash, La Planche and River Hebert, with the Nappan and Maccan Rivers, flow into Cumberland Basin.

All these streams have areas of marsh or bog lands along the greater part of their courses. The largest bodies now in cultivation are along the Tantramar, the most northerly of the group. The relative position of the rivers can be best seen from the accompanying map, but a few words of description are necessary for those who are not familiar with the country.

The Tantramar and Aulac flow into the Basin by one mouth. Some three miles up the Tantramar is the village of Sackville. The river, with its numerous windings is about twenty miles long. Some eight miles from the mouth the stream divides, one branch coming from Cookville on the north, and the other flowing down the marsh from the north-east.

The Aulac is not separated from the Tantramar by a ridge of highland, as is usually the case with the marsh rivers. About five miles from the mouth, the Aulac branches, one branch, La Coup, flowing down from the Jolicure Lakes to the north of Jolicure, the other branch coming down between Jolicure Point and the Aulac ridge.

The Missiguash River flows almost parallel with the Aulac, from which it is separated by a high ridge of millstone grit, called the Aulac or Point de Bute Ridge. This river is not more than twelve miles long, and the upper part of its course is lost in a maze of lakes and bog. Along its lower course it forms the boundary between the two provinces, New Brunswick and Nova Scotia.

At the same mouth by which the Missiguash enters the Basin, the La Planche finds its way to the sea. The lower courses of the rivers are separated by Fort Lawrence Ridge. This ridge is not so high as that on the north of the Missiguash, and it is overlaid with Permo-Carboniferous rocks. The lakes and bogs of these two streams unite at their sources. The town of Amherst is south-east of the mouth of the La Planche, beyond this the Basin takes a sudden turn to the south, and terminates in the mouth of the River Hebert.

Surface Geology.—The Isthmus is overlaid with Permo-Carboniferous rocks, with the exception of the Aulac Ridge with its continuation across the mouth of the Aulac and the Tantramar to Westcock. This strip is Millstone Grit.

The marsh mud is from one to one hundred and fifty feet deep, and is underlaid with Permo-Carboniferous shales and sandstones. These shales are covered in many places with heavy red clay similar to that found on the Aulac and Fort Lawrence ridges. The marsh

mud and underlying soil are perfectly distinct, and there is every evidence that the mud has been laid down in recent geological times; certainly since the Glacial period. Off Fowler's Hill, on the Aulac Ridge, the descent is very rapid, and one-third of a mile from the shore borings have shown the mud to be one hundred and fifty feet thick. At the same distance from the Sackville shore, where the hills slope more gradually, there is not more than sixty feet of mud.

Formation of the Marsh.—As to how this marsh was formed one not thoroughly conversant with the geology of the region can do little else than speculate. There have evidently been many changes in the level of the southern shore of New Brunswick in known geological times. Dr. G. F. Matthew considers that the Isthmus was far above its present level in the Glacial period. At that time Chignecto Bay would be a valley and the Bay of Fundy dry land. Glacial action would have eroded the surface and moved the loose incoherent material to lower levels. The depression of the land that followed the glacial period would have allowed the accumulation of marine clays such as are now found on the Aulac Ridge and adjoining elevations. A subsequent re-elevation would permit the accumulation of forest mould and soil on these ridges and the contiguous valleys.

In 1892, when excavations for the marine dock were being made near the mouth of the Missiguash River, numerous trunks of trees were found about at low tide level. Sir Wm. Dawson, some years ago, found a stump there showing over one hundred rings of growth. (Acadian Geol. p. 28-29). Some of these trees were white pine, others beech; neither variety attain such a size on damp land. Evidently the land where these trees were growing was much above its present level. The trees were found rooted in a rich loamy soil resting on a bed of red clay. To be above the reach of high tides the region would have to be from sixty to eighty feet above the present level.

On the Baie Verte side of the Isthmus abundant evidence is found of recent depression. Mr. E. P. Goodwin, C. E., of Baie Verte, while digging mud for fertilizing purposes, found oak leaves and spruce cones in the solid mud twelve feet below the surface, and there was every evidence that they had fallen on what was then the ground surface.

The subsidence was probably gradual, and on the Bay of Fundy has practically ceased, as the dykes have not been made perceptibly higher in the last 100 years.

When the regions first settled below high tide level, the salt water would creep around the sturdy beeches and pines, and while depositing the food for plants yet to grow, would kill off the old and hardy race of trees. Ice would break off the tops of these trees, and the water bear them away, or the elements would rot the tops down, and only the lower part, encased in the solid mud, would remain to tell the story of the old upland valleys now under the marsh. The land nearest the Basin would at first be submerged, but as the depression went on the salt water would make its way further and further up the valleys. It would seem from an examination of these regions that neither moss nor grass made any perceptible growth until the subsidence ceased. At points down the Bay there is evidence of different surface soils of the marsh that were formed in the process of settlement. On Cobequid Bay near Onslow several turfs are plainly seen, each separated by a foot or more of deposited mud. A canal, fifteen feet deep at the mouth with a grade of two feet to the mile, is now being dug up the Point de Bute marsh, and in no place throughout the three miles already dug is there any evidence of vegetable remains below the present surface. In the marsh soil vegetable remains would be very readily detected by the presence of the surrounding blue mud. The same absence of blue turf or peaty surfaces is seen wherever canals have been dug in the marsh soil.

The marsh rivers are constantly changing their beds. After the depression first occurred they may have kept their channels for some time, but by the rush of mud-laden water every curve becomes greater, as the stream rushes against the opposite bank one side wears off and the other builds on.

In the memory of men now living, marked changed have been made in the position and direction of some of the rivers. Off Prospect Farm at Point de Bute, the Aulac has, in the last two hundred years moved some three hundred feet nearer to Sunken Island. This change is clearly proven by the old dykes. When it is remembered that the Aulac has been abandoned for sixty years, it will be seen how rapidly these changes are made.

Marsh Improvements—Nature did much to make this a fertile region, but it was necessary for man to make some exertion that he might reap the harvest. The French, settling here in the seventeenth century, dyked the rivers and raised crops on the marshes. There are records of their damming up the smaller streams in the first half of

the eighteenth century. Father LaLoutre used the men and money for this purpose that were sent him to be used in putting Fort Beausejour in a state of defense, but not until the English came to this country were large aboideaus built.

In 1827 the Aulac was aboideaued four miles from its mouth, and in 1840 an aboideau was thrown across less than two miles further down.

Eighty years ago these lands presented a very different appearance from what they do now. The Aulac was much larger, at least in its upper course, than the Tantramar. The bridge across the Tantramar, where the upper bridge now stands, was just eighteen feet wide, as stated in an old contract. Above this point the whole region was covered with moss, and the water oozed rather than flowed into a very crooked, lazy stream. A mile north-east of the bridge, in the bog, Goose Lake was situated. Its waters flowed north-east to Gravelly-beach Lake, and then in about the same course to Big Lake. Big Lake drained into the Aulac through La Coup. A large part of the land in the lower course of the rivers was also bog.

About 1815 Tolar Thompson started a canal between the Tantramar and Goose Lake. This man, a farmer, had made a careful study of the lake region, and was convinced that the lakes could be drained and made into marsh. Before this canal was finished in 1820, one was dug in a northerly direction toward Log Lake. The old river course and the canals can be seen on the accompanying map. The new canal took a straight course. Tolar's Island and the old river bed with its many curves, filled up level with Bay of Fundy mud. This canal was cut through about ten feet of moss, but did not go into the underlying mud. The moss was cut in large junks and floated down the stream by the receding tide, hence the name "Floating Canal" which it still bears.

In recent years, this canal has been extended five miles beyond the Upper Bridge, and hundreds of acres of good marsh are to be seen in the place of lake and moss. The lakes were from four to seven feet deep, and they were allowed to fill with mud before the surrounding moss was covered with the deposit. Several small lakes on this branch are still unreclaimed, but they are gradually filling with the mud from the canal. Blue or red mud underlies all the lake and bog areas, and is found in the valley eight or ten miles above the upper bridge. The greater part of the low moss has been made up, but hundreds of acres of high moss are still growing "hard hacks" and small trees.

The floating canal has greatly increased in size since it was dug and has worn into the mud from two to four feet. On the more southerly branch of the Tantramar, at Goose Lake, hay has been cut for seventy years. Moss is again growing on this lake and surrounding lands, and large tracts are having their fertility ruined. The more energetic farmers are digging wide ditches and using the rich marsh soil thus obtained as a fertilizer. Good results are in this way secured.

The Aulac river has not been so well handled. The Trueman and Etter aboideaus have much reduced the size of the river. The system of lakes at the head of LaCoup stream is shut off from the tide. The rail and carriage roads cross the river on the Etter Aboideau. Only at a great cost could the river be again opened and the natural fertilizers carried to the Point de Bute marshes. Not only this, but some of the lakes on La Coup have been turned down the Tantramar, and even were the stream opened, the basin above into which it might throw its waters would be much reduced.

Formation of Lake and Bog.—One naturally wonders how all these lakes were formed, and what led to the tremendous growth of moss. The building up of the lakes has given a clue to their formation. When the water is first let into a lake the greatest depth of mud is deposited at its mouth. where the tidal waters enter. If the season is rainy the outflowing fresh water may prevent any deposit, but if the time is dry eighteen inches of mud may be laid down at a lake entrance in a single set of spring tides. The reason for this is evident. The water, running up the canal with great force, loses its speed as it spreads over the lake, and the larger part of the sediment settles at once. As the water runs slowly up the river in the neap tides, much sediment is deposited in the river bed. When the spring tides come on, especially those in the late summer when it is usually dry, this sediment is lifted and carried into the lakes above. Thus the water at the head of the stream is often more heavily laden with mud than that further down.

Red or blue mud underlies both lake and bog, its depth varying as the underlying soil rises or falls. Under the whole upper section the mud is about the same level. Owing to the gathering of silt the lake bottoms are often higher than the mud below the surrounding bog. Evidently the tide once flowed through the whole valley without being hampered by lake or bog. Before the marsh reached its present state of depression, lake basins were formed by the water damming itself in

as before explained. These lakes and ponds may have been many times drained by the water breaking out in a weaker place. The same thing now takes place in draining the lakes. After the tide has entered, unless the self-erected barrier is dug through, the receding tide, swelled by the fresh water coming down will break out of the lake at some weaker point, and find its way to the river by the path that offers least resistance.

A lake basin once strongly formed would be made stronger by each tide. As the moss gradually settled the barrier would become higher and the lake deeper. One would expect a heavy flow of fresh water to keep the barrier worn down, therefore the largest lakes should be where there is the least flow of fresh water. This is just what is found. Sunken Island, one of the largest lakes, has no stream of any size flowing into it. At the head of Morice's Mill Pond, Sackville, before the dam was put in, there was a small lake reaching from W. W. Fawcett's to the mouth of Beech Hill Stream. Mud extends all over the pond bottom and up the stream to the foot of Beech Hill. The lake is dammed off with marsh mud. The history is evident. The mud has shut off the lake as before described, and the rush of fresh water down Beech Hill Stream has kept the stream open below. When the subsidence of the marsh areas become almost *nil* the lands that had kept their drainage open in course of time became covered with salt grasses. The growth of these grasses had been largely checked by the salt water, while the marsh was settling. Now only the highest tides would cover the drained marsh, and the lakes would be practically freed from any incursions of salt water. Moss then sprang up around these fresh water lakes. Year after year this moss reached out and grew higher. Most of these moss plants are of the genus Sphagnum, and growing one upon another they kept above the level of the water, and grew out over it. This moss was always full of water and exposed such a breadth of surface to the air that the greater part of the water was carried off by evaporation. The moss itself, at least in the older lakes, formed an additional barrier against the tide. In digging the Floating Canal many trees of small size were found buried in the moss. When once started the moss grows over a lake very rapidly. Many of the lakes on the Tantramar have become markedly smaller in the memory of men now living.

Sunken Island is a great lake overgrown with moss, and in this moss are heaths, etc., and stunted trees. Many of these trees are from 15 to 25 feet high, 10 inches in diameter, and show 60 or more

rings of growth. Few of the lake bogs have such large trees on them, and few have become so filled with moss. There is every evidence that this lake was one of the earliest to be dammed off. In the first place it is several miles nearer the mouth of the river than the other lakes, and its position between the Aulac and Tantramar would make it liable to damming from both sides. The small amount of fresh water running out of it would make this easily possible. One or two small open lakes of less than an acre in extent alone remain of the original lake which probably covered nearly one thousand acres. There are about seven feet of water in these lakes, and the depth is about as great close to the shore as farther out. The moss projects over the water in such a manner as to make it dangerous to approach the margin. When examined last by the writer there were several large pieces of detached moss floating in the centre. The moss is now intergrown with heaths, bullrushes, coarse grass, cranberry vines, pitcher plants, etc., so that the "hackmatacks" (larches) find a fair amount of soil in the rotting vegetable matter.

A good deal of money has been spent in Sunken Island with little or no results. The moss is so high that a great deal of salt water will be needed to kill it, and a long time will pass before it will be properly settled. In fact since the aboideaus were blown out and the tide allowed to flow in unhindered on the "Big Marsh," the water has not risen high enough to enter this island at all.

The digging of a canal into the Jolicure Lakes has been agitated for some time. The owners of the Sunken Island body hope the route selected may be through the island. Should the canal take that course the bog could be made into marsh, and probably pay a dividend to the investors.

North-east of Cole's Island the Tantramar curves out, then doubles back on itself, leaving a point of land joined to the mainland by a narrow neck sixty feet wide. High tides swept over this and rendered the point unfit for cultivation. The water going up the river kept its old bed, but no sooner would it get around to the upper side of the neck than it would rush back over the neck to return again by the way of the main river. This gives one an idea of the rapidity with which the water rises as it runs up the river. This neck was cut off in 1893 by two of Sackville's enterprising farmers, and in 1894 there were twenty feet of mud deposited in the old channel. Several acres of marsh will be made from the reclaimed point and the old river bed.

If a canal were cut through the Ram-pasture neck, a similar curve further down, a much larger piece of marsh would be given to the country. Unfortunately the wharves are situated on the curve, and such a change would necessitate their being moved to another part of the river. So great is the rush of water back over this neck when the tide is flowing in, that several hundreds of dollars have been spent by the government to prevent the neck from wearing out of itself.

The work that has been done in building up the marsh soil is but small in comparison with what can be done. At the head of the Missiguash and La Planche rivers the lake and bog areas are extensive. With proper handling, thousands of acres of marsh can be made. The work is being agitated, but the large immediate outlay required, and the prospect of slow returns, deter capitalists from hastening into what at first sight appears to be a fine investment.

Since writing the above paragraph a company has been formed for the purpose of draining the areas at the sources of these rivers. They have had a surveyor on the ground for the past year, and at present have dug two miles in a canal intended to tap all the lakes on the marsh. At present a steam dredge is working about five miles above the mouth of the Missiguash. They began to dig three miles from the mouth, and have made a canal fifteen feet deep by thirty wide, decreasing in depth at the rate of two feet per mile as it approaches the lakes. At Round Lake, which is six miles above the mouth of the canal it should be six feet deep. A number of smaller lakes will be drained before Goose Lake at the head of the marsh is reached. In all there are about ten thousand acres at the head of the two rivers. Near the mouths of these rivers there are already valuable marsh areas. Surveys made in connection with the projected ship canal and marine road, have given abundant material in regard to levels, etc., on this bog. From a study of the levels used by the Missiguash Marsh Company the following data have been obtained: Taking a line one hundred feet below the Saxby tide as a basis, the ground surface at the mouth of the Missiguash is ninety-two feet above datum. The bog surface ten miles up the marsh at Round Lake is ninety-five feet above datum. The average spring tide is ninety-six feet above, while the Saxby tide was one hundred feet above. As the bottom of the lakes is scarcely ninety feet above datum, there will be a good fall from a high tide in the river into the lakes; these should therefore fill with mud and come quickly into grass. The bog begins about six miles from the mouth of the river, and the whole area above that is floating

bog and lake. That the bog is actually floating on mud and water, there can be no doubt. There are from two to three feet of moss and below that as much more rotted moss and water, forming a semi-fluid substance. It does not seem possible that the lakes are held in by this moss; on the other hand the water in places run under the moss. and acts in some ways as a lake with a thin layer of ice on its surface.

E. P. Goodwin, C. E., who has been engineer for the company for the last year, thinks that this moss can be cut in large squares and floated out the canal when the barrier of mud is cut away. It would seem as if the canal being dug is too small when the very slight fall is considered, and the area of the submerged lands.

Borings are to be made this winter all over the bog by Mr. Goodwin, and in the spring new light may be thrown on the history of these regions. So far the canal has not cut through to the bottom of the marsh mud in one instance, nor has it come in contact with one stick or other sign of vegetable remains.

The Marsh Soil.—The sediment floated up by the water is formed from the wearing away of carboniferous sandstone and shales. As the water is comparatively clear at the entrance to Cumberland Basin, the rocks which yield the deposit must be situated above this. At South Joggins nearly two feet of rock are worn away each year, and no doubt the wash is carried up the bay to make marsh soil.

The mud is of an exceedingly fine texture. While very little grit can be detected by the fingers or teeth, it nevertheless contains a large amount of sand as seen in an analysis. Tools that are used in working it soon become blunted. A heavy bolt was worn through on the steam dredge in a few weeks from friction with the soil in shovelling. When wet it seems almost soluble, and is very sticky. After being quickly dried by the sun a harrow has little effect on marsh mud, it being almost as hard as brick. In many cases seed is thrown on the plowed land and the rain causing the soil to run buries it with little or no harrowing.

The marsh soil is naturally of a red color, and this red soil constitutes the valuable marsh. Hay has been cut from this for 100 years and more without materially impairing its fruitfulness. Large quantities of red mud are annually carted on the highlands, and, as a fertilizer, for many soils it is considered equal to barnyard manure. No analysis that has yet been made will explain its marvellous fertility. Sir Wm. Dawson (Acad. Geol. p. 23) thinks it may in a part be due to the presence of fish bones and vegetable remains which do not appear in

an analysis. This seems very doubtful. May one cause not be the extreme fineness of the soil which enables the plant to get its food readily? One reason that so much land is not fertile is that the necessary ingredients are not in a state available for plant food. This soil is in such a fine state of division that it must present a great deal of surface to any dissolving agent. That it is rich there is no doubt, as land that has been cutting heavy crops of hay for nearly two centuries will give a rank growth of timothy when turned up by the plow, and that without one bit of fertilizer during all this time.

Fertility is only insured by a thorough system of drainage. If allowed to lie in the water the red soil changes to blue, and the growth of moss and coarse grasses gives the soil a corky texture. The blue mud covers all the low marshes, but usually has red mud under it at no great depth. This quality of marsh is much less valuable than the red, as it will produce coarse grasses and sedges only. When plowed and drained a good crop of oats can be obtained, but even the native grasses refuse to grow the following year.

This change from red to blue is an interesting one. The red mud derives its color from peroxide of iron In the blue mud the iron is in a state of a sulphuret. The change is brought about by the decay of vegetable matter. The salt water contains salts of lime and magnesia. The vegetable matter excluded from the air unites with these two sulphates of lime and magnesia, liberating the sulphur as hydric sulphide and retaining the oxygen. The sulphide can be detected on any low marsh by means of its unpleasant odor. This gas now unites with the oxide of iron in the mud, producing iron sulphide which gives the marsh its blue or gray color. When the water is drained off, the iron of sulphide unites with the oxygen of the air, forming iron sulphate, a substance poisonous to most crops. This shows why blue mud when drained refuses to grow even the native grasses. When heated the iron sulphate is changed to a brown powder, an oxide of iron similar to the ore, limonite. It is this oxide hydrated that is seen in the bottom and sides of so many marsh ditches. (Acad Geol.)

Analyses of several Bay of Fundy marsh soils made at the Central Experimental Farm, are given below for the sake of comparison :—

Unclaimed Marsh near Amherst, 1897—

Moisture	3.78
Organic and Volatile	5.86
Coarse Sand	16.60
Fine Sand and Clay	58.73
Nitrogen	.137

Sackville Marsh, 1897—

Potash	.16
Phosphoric Acid	.16
Nitrogen	.131
Lime	.13
Loss on Ignition	5.83

Unclaimed Marsh at Quaco, 1897—

Air dried sample.

Moisture	7.66
Organic and Volatile	7.61
Insoluble Mineral Matter, Sand and Clay	71.96
Mineral Matter soluble in acid	12.77
Lime	.42
Nitrogen	.24
Common Salt	1.4

Mud from Five Islands, N. S.—

Nitrogen	.079
Organic and Volatile	5.23
Sand and Clay	76.73
Mineral Matter soluble in acid	15.9
Water	2.85

Gaspereau River, N. S.

Nitrogen	.084
Water	11.11
Clay and Sand	74.28
Organic Matter	3.35
Oxide of Iron and Al	8.08
Lime	.54
Potash	.40
Phosphoric Acid	.12

ARTICLE II.

THE "DIP" OF THE MAGNETIC NEEDLE IN NEW BRUNSWICK.

By Prof. A. Wilmer Duff.

Read December 6, 1898.

Nearly everyone knows the use of a magnetic needle for finding the direction of North. Those who are more familiar with the use of such a compass know that the needle does not point to the true North, but only approximately so; that, in fact, the difference between the true North, and the magnetic north as indicated by the compass, differs by an angle which surveyors call the "variation" of the needle. The angle is different at different places, and even at any one place it is always gradually changing, although the change is a very slow one and requires months to be perceptible, unless the measurements be made with very great accuracy.

A casual glance at a compass needle is sufficient to show anyone that the needle is only free to swing in a horizontal plane, owing to the fact that the point of support of the needle is higher than its centre of gravity. Now what would happen if the needle was supported so exactly at its centre of gravity that it could swing in a vertical plane as well as in a horizontal plane? It would be found to come to rest at an inclination to the horizontal. The angle it would then make with the horizontal is called the "dip" of the magnetic needle, or, briefly, "the magnetic dip." The dip, like the variation, is different at different places, and if measured some months apart at any one place it would be found to have changed appreciably.

The importance of the "variation" is so great in surveying and navigation that it is frequently determined, and is pretty closely known by any one who is in the habit of using the compass professionally; but, so far as I am aware, the "dip" has not been accurately determined anywhere in New Brunswick. If, however, I am mistaken, any member of the Natural History Society who can find the record of any past determinations of the dip, will find it interesting to compare those determinations with the readings recorded in the remainder of this paper and note the change time has produced. Before giving the readings I have made, it may be noted that, while observations of the dip have, at the present time, no direct practical importance, they are of interest in assisting toward the formation of a true theory of the nature and cause of the earth's magnetism. Moreover, very remarkable differences, in both dip and variation, within the range of a very few miles have been discovered in several countries, especially in Russia, but also in France and England, and these have attracted great interest as shedding some light on the constitution of parts of the earth situated too far below the surface for direct examination. Whether similar anomalous areas occur in New Brunswick must at present be a matter of mere conjecture; but their discovery, if existant, would be a matter of considerable scientific interest. While the few determinations I have made are insufficient to shed any light on such questions as the above, they will yet be of some interest to anyone who may happen to repeat them a few years hence at the same places.

The following observations were made with a very accurate portable dipping needle, made by Elliott Brothers, of London. It is the property of Purdue University, and was brought east by me during a summer holiday in 1898. A minute description of the instrument, and the method of using it, is not called for here, further than the statement that it was provided with means for careful levelling, reversing the magnetism of the needle, and eliminating the effects of lack of symmetry in the needle or exactness in position of support. Each reading given below is the mean of eight separate readings; and the angles, given in degrees and minutes, are the angles between a horizontal line and the dipping needle, the north pole of the needle dipping downward. Thus, it will be observed, that the needle pointed more nearly vertically than horizontally. Many more observations were made than those recorded below, but they were in the neighbor-

hood of the places mentioned, and (with one doubtful exception, which I hope to examine hereafter) showed no marked local peculiarities.

Station of Observation.	Dip. *in August 1898.*
St. John (Fort Howe)	74° 35′
St. Andrews	74° 57′
Oak Point (St. John River)	75° 3′
The Point (Bellisle Bay)	75° 15′
Fredericton	75° 44′
Indian Village (above Fredericton)	75° 50′

Thus, in general, the dip increases as we go north, the change between St. John and Fredericton being somewhat over a degree.

I may add, that in addition to the variation and the dip, a third quantity has to be measured, if we wish a complete account of the magnetic condition at any point. This is the strength of the magnetic force at the point; but its measurement involves the use of a very elaborate, heavy and expensive set of apparatus, called a Kew Magnetometer, and this, together with the care and experience required for its use, accounts for no determination having hitherto been made in New Brunswick (or probably the neighboring provinces).

ARTICLE III.

NOTES OF A WILD GARDEN.

By G. U. Hay.

(Read before the Society, December 7th, 1897.)

About ten years ago the idea occurred to me of planting a wild garden in which should be shown, as far as the conditions would warrant, the peculiarities and extent of the flora of New Brunswick. The garden plot covers an extent of nearly two acres and is well adapted for the purpose intended. It is situated about eleven miles from the city, on a broken piece of ground overlooking the St. John river. In one corner is a meadow, made up of alluvial deposit brought from the neighboring hills, and adapted for plants usually found on intervales. Through this meadow flows a small stream fed by springs on the hills which lie to the westward. The idea of planting a native arboretum was first suggested by finding in this meadow a group of small trees and shrubs eight in number, forming a pretty little arbor on the bank of the curving stream. The plants consisted of the cedar, the white and yellow birch, American ash or rowan-tree, water alder, mountain maple, balsam fir and black spruce. One could stand in the centre of this arbor and touch one-tenth of all our forest trees and shrubs. When nature had made such a beginning it was surely a broad hint for me to do the rest.

When the remainder of the two acre plot came to be explored, possibilities were found to exist for something more than an arboretum; and the idea of a wild garden gradually came, which might include most of our flowering plants, all our native ferns, and perhaps in time a representative gathering of our mosses, lichens and fungi. Rising from the meadow toward the south, within the bounds of the plot, is a hill whose slope is covered with a young but quite ample growth of spruce, fir, birch, maple, etc., the deciduous trees largely prevailing, and giving to the soil each year an abundant supply of leaf mould. Half way up this hill, in the centre of the grove, is a depression which

catches the drainage of the slopes around it. The moist ground, cool shade, and northern exposure of this basin, forms an ideal spot for a fernery.

Thus there were provided a meadow and a grove, two very neces sary adjuncts of a wild garden.

Crossing an intervening open space toward the south after leaving the grove, the top of the hill is reached. Here stands an aged white pine, the only survivor of a fire which swept over the place some years before. The blackened trunk, and upper branches extended imploringly, tell of its struggle for life On this knoll the soil is dry and poor, covered with a growth of small trees and heath plants. This is called Heath Hill. On the continuation of this knoll to the east stands a small summer cottage overlooking the St. John river and the Nerepis hills to the north. Sloping from the cottage toward the river is a cultivated field in which and along its borders may be placed those plants requiring full exposure to sunlight.

In this garden there have been about five hundred native species of flowering plants and ferns, many of which were *in situ*, while others have been planted during the last ten years; of these about ten per cent. have disappeared, or failed to grow through lack of proper conditions or the perils incident to long transportation, as the transfer of plants has been made chiefly in the summer months; so that not quite one-half of the flowering plants of the province can be seen in this space of nearly two acres. But little progress has been made in planting the grasses, sedges, rushes, and aquatic plants. The results in regard to the latter are especially disappointing, although considerable labor has been expended on them. The (at times) turbulent little stream has shown no disposition to be led into quiet ponds or stretches of pool. It has even carried away—root, stem and branch—the plants placed too confidingly within the limits of its bed, and all attempts to secure its co-operation, or at least a passive non-resistance in the scheme, have resulted in failure.

There is a larger representation of ferns in the garden than any other class of plants. Nearly all of the forty species and varieties found within the limits of the province were living and flourishing during the past summer. The trees and shrubs are also very well represented. Out of the eighty species found in the province, more than sixty are growing and in good condition, and in a short time I hope to have a complete representation of our forest trees and shrubs

Four years ago, Dr. Saunders, of the Experimental Farm, sent me over one hundred plants representing, chiefly, the trees and shrubs of Western Canada and a few northern European species. These have been planted on the borders of the cleared spaces of the garden and are kept quite distinct from the native species. They, with a number of others, sent from Point Pleasant Park, Halifax, including the Heather *(Calluna vulgaris)* have grown very well, although but little care has been given them. These will serve for comparison with similar native species as well as to illustrate the effect of our climate upon them.

Little or no attempt has been made to put plants in rows or beds according to their classification, the chief aim being to provide a natural habitat and surroundings as far as possible. The only exception to this was the treatment of weeds, a colony of which, for prudential reasons, I placed in a row beyond the pale of other plants. With a perversity characteristic of their tribe, they spurned such treatment and refused to grow.

Another family which does not take kindly to cultivation is the Orchids. Many of these, of which we have so many beautiful native species, affect a solitary habit and are found in bogs. Others love the rich mould of deep sheltered woods. Others such as the Calypso, are rare or local in their occurrence.

In the future, I hope to present to the Society at the close of each season, a few notes embodying the results of observations, especially on the rarer species and those less susceptible of "cultivation," together with the time of coming into leaf, flower or fruit of certain species of plants, which on account of their commonness have been generally accepted as the basis of observation. In making such observations, there is a great value in watching for results on the same spot of ground or the same plant, or one quite near it, from year to year. This I have endeavored to do after being assured that the plant has adapted itself to its changed conditions, and had been long enough in the garden to be relied on to furnish correct data. In the results recorded below, I have not hesitated to go outside the garden to make observations on plants more favorably situated for coming into leaf or bloom early, always choosing the same locality, and, in the case of perennials, the same plants from year to year.

The observations recorded below have extended over a period of ten years, from 1889 to 1898, inclusive. They are not so complete as

I would wish, as my visits were generally confined to one day each week (Saturday) in the months of April and May. I give the results here, however, as they may be useful for comparison with those to be made later, which I hope will be fuller and extending through whole seasons.

Observations in Wild Garden and Adjacent Fields, Ingleside, Kings Co., N. B.

1889.

May 4. Plants in bloom: Adder's-tongue (Erythronium Americanum), Mayflower (Epigæa repens), White Violet (Viola blanda), Gold-thread (Coptis trifolia), Bellwort (Oakesia sessilifolia).

May 11. Purple Trillium (Trillium purpureum), Painted Trillium (T. erythrocarpum), Grove Anemone (A. nemorosa), Spring-beauty (Claytonia Virginica), Hobble-bush (Viburnum lantanoides), Blue Violet (Viola cucullata), June-berry (Amelanchier Canadensis), Strawberry (Fragaria Virginiana).

May 17-20. Rhodora (Rhodora Canadensis), Blueberry (Vaccinium Pennsylvanicum), Painted Trillium, Hobble-bush, Red Cherry (Prunus Pennsylvanicum), Shad-bush (Amelanchier botryapium).

(Hereafter the common names of plants alone will be given except where species different from those above are named.)

1890.

May 3. Mayflower (blooming beside the snow banks on the barrens), Adder's-tongue (just beginning to open).

May 17. Adder's-tongue (in full bloom), Bellwort, Purple and Painted Trilliums, Blue and White Violets, Gold-thread, Red Maple (Acer rubrum.) Mayflowers still abundant on barrens.

May 23-26. Adder's-tongue, Blue and White Violets, still abundant. June-berry, its pure white petals making a beautiful contrast with the delicate green of the unfolding leaves of surrounding trees; Service-berry, Strawberry, Hobble-bush, Grove Anemone.

1891.

May 2. Mayflower, Adder's-tongue. (A few in bloom).

May 9. Adder's-tongue (in full bloom), White Violet, one Blue Violet.

May 15. Trees still leafless. Weather dry. Cold and backward.

May 23. Trees (White Birch, Poplars and Maples) just coming into leaf, and fully expanding in the next two days under the influence of warmer weather. In bloom—Strawberry, Blue Violet, Red-berried Elder (Sambucus racemosa), Gold-thread.

1892.

April 2. No signs of leaves or flowers unfolding. Plenty of snow in hollows, but day warm and bright.

April 18. Willow and Alder catkins beginning to shed pollen, Adder's-tongue leaves above ground. Very cold north winds.

April 30. Mayflowers in full bloom on barrens. Cold north winds continue.

May 7. Adder's-tongue (in full bloom), White Violet, Mayflower, Sweet Coltsfoot (Petasites palmata).

May 14. Bellwort, Grove Anemone, Blue and White Violets.

1893.

April 29. Hepatica triloba (planted the previous year) beginning to bloom beside a snow bank.

May 13. Mayflower, White Violet, Adder's-tongue, Selkirk's Violet (Viola Selkirkii , Hepatica, Red Maple.

May 20. Blue Violet, Grove Anemone, Bluets (Houstonia cærulea), Spring-beauty, Gold-thread, Bellwort, Blossoms of Red Maple falling, White Birch and Poplar trees unfolding their leaves.

1894.

April 28. Hepatica (in bloom), Alder and Willow catkins elongated and beginning to shed pollen. Patches of snow still visible in clearings and hollows. Adder's-tongue leaves above ground; a few flower buds visible. Mayflower has been in bloom for ten days in exposed places on the barrens. Strawberry (a few scattered blossoms).

May 12. Bloodroot (Sanguinaria Canadensis), Blue flowers of Hepatica falling with white in full bloom. The Purple and Painted Trilliums, White and Blue Violets, Bellwort, Star-flower (Trientalis Americana), Red Maple, Dandelion, Strawberry, in full bloom. Flower buds of June-berry and leaf buds of Red Cherry and White Birch ready to open. Frost out of ground and gardening commenced.

1895.

April 20. Weather warm and sun bright, with south-west wind. Catkins of Alder shedding pollen. Leaves of Adder's-tongue above ground. (No further observations this year on account of absence.)

1896.

April 24. Season dry with cold winds from March, continuing to the middle of May. Flowers of Alder shedding pollen.

May 1. White Violet, Hepatica, and Red Maple, in bloom, with a few flowers of Adder's-tongue.

May 8–11. Adder's-tongue, Blue Violet, Dandelion, Strawberry, Bellwort, Ground Ivy (Nepeta glechoma), Grove Anemone.

May 15. June-berry, Blueberry, Purple and Painted Trilliums, Hobble-bush, Blue Violet, Dandelion, Marsh Marigold (Caltha palustris), Bluets

May 22. Red Cherry, Elder, Starflower, small flowered Crowfoot (Ranunculus abortivus).

1897.

May 7–10. Weather for first three weeks cold, with east winds and rain, with an occasional warm day. Hepatica, Adder's-tongue (only a few in flower), White Violet, Red Maple, Hazel (Corylus rostrata), Alders, Willows, Poplars, in full flower in shaded places,—in exposed places fading, with pollen shed; Butterwort (Pinguicula vulgaris) with leaves extended in rosettes. This plant, with such northern ferns as Woodsia hyperborea, W. glabella, Pellæa gracilis, and others, were brought from the Restigouche, 200 miles farther north, the previous season, and were among the first in the garden to unfold their leaves and fronds.

May 14–19. Adder's-tongue (in full bloom), Painted Trillium (a few), White Violet (abundant), Blue Violet (a few), Grove Anemone, Bellwort, Gold-thread, Strawberry (beginning to flower), Mayflower (in shade), Marsh Marigold.

May 21–25. Bluets, Hobble-bush, June-berry, Purple Trillium, Dandelion, Ground Ivy.

May 30. Nodding Trillium (Trillium cernuum), False Mitrewort (Tiarella cordifolia), Rhodora, Red Cherry, Elder, Dandelion, Strawberry.

1898.

April 23. Season cold and backward, although the fine weather of February and March promised an early spring. Frost still in ground and cold east winds prevail. Mayflower (in bloom), Adder's Tongue with leaves above ground.

May 7. Hepatica and Red Maple (in full bloom), Alder and Poplar catkins shedding pollen, a few Adder's-tongue, Blue and White Violets (in bloom).

May 14. All the flowers named above in full bloom, with Bellwort, Grove Anemone, Bloodroot, Leatherwood (Dirca palustris).

May 20. Purple and Painted Trilliums, June-berry, Service-berry, Ground Ivy, Gold-thread, Spring-beauty, Marsh Marigold, Blue Cohosh (Caulophyllon thalictroides), Hobble-bush. Trees just leaved out: White Birch, Amelanchier, Poplars, Red Maple, Lilac, Mountain Ash, Red and Black Cherry. Buds just breaking: Horse Chestnut, Black Ash.

May 24. First Red Cherry blossoms, Gray Birch (Betula populifolia) just coming into leaf, Red Oak, Linden, (Tilia Americana), Elm, Sumach (Rhus typhina) bursting their buds.

ARTICLE IV.

THE BUTTERFLIES OF NEW BRUNSWICK.

By William McIntosh.

(Read December 6th, 1898.)

This list of New Brunswick Butterflies can only be considered a preliminary one, as very little collecting has been done in this province. There can be no doubt that with a more extended knowledge of the insect life of New Brunswick this list will be found incomplete.

In the past collections have been made by officers of the army and navy, but we have no detailed record of their captures. Among the early collectors whose specimens have remained in the province the following are perhaps worthy of mention.

A collection of Lepidoptera captured on the Ketchum estate, Fredericton, by Capt. Moody, A. D. C. to Governor Gordon. This collection is in the University of New Brunswick at Fredericton.

A collection of miscellaneous insects taken in the vicinity of St. John, by Mrs. C. E. Heustis. Mrs. Heustis was for a number of years a contributor to the *Canadian Entomologist*, and may be considered the pioneer entomologist of the Natural History Society of New Brunswick.

A collection of miscellaneous insects captured in St. John County, by Mr. H. E. Goold. This collection contains a number of very interesting species.

A number of insects, principally Coleoptera and Lepidoptera, collected in Kings County, N. B., by Mr. Gibson Williamson, of Oak Point.

These three collections are in the museum of the Natural History Society of New Brunswick. At the present time these combined collections contain less than a thousand specimens, and so represent but a fraction of the species indigenous to this section of Eastern Canada.

During the past two years much interest has been evinced in this branch of nature study, and during the present year a number of collectors have been working, over 3,500 specimens having been taken

in the vicinity of St. John and Fredericton during the past season. It is to be hoped that this interest will continue, so that in the near future something may be added to the meagre knowledge of the insect life of New Brunswick.

The remarks on the species in this list are based mainly on the writer's personal observations during the past three years.

No doubt upon more extended research not only will many additional species become known, but a number of those considered not common will be found to be more abundant in other localities.

In the preparation of this list I am indebted to Dr. James Fletcher for the identification of doubtful species, and to Miss Edith Darling for a list of species found at Sussex, and to Mr. Geo. W. Bailey for a list of Fredericton butterflies with notes, and also for procuring a list of species taken by Mr. R. McL. Vanwart. Mr. Bailey also sent me a catalogue of Capt. Moody's collection. From the above lists all references to Sussex and Fredericton species have been taken.

I have followed Rev. C. J. S. Bethune ("The Butterflies of the Eastern Provinces of Canada") in adding in brackets "Mr. Scudder's name for the species whenever it differs from the name employed."

LEPIDOPTERA.

RHOPALOCERA.

Family NYMPHALIDÆ.

Sub-family EUPLOEINÆ.

Danias archippus, Fabr.

(ANOSIA PLEXIPPUS.)

This beautiful butterfly is usually rare in the vicinity of St. John and Fredericton, but it is occasionally seen in considerable numbers. Flies in July and August.

Argynnis idalia, Drury.

Very rare, only four specimens are known to have been taken in New Brunswick. Two of these, captured by H. E. Goold, are at present in the collection of the Natural History Society.

Argynnis cybele, Fabr.

This species is rare in the southern sections of the Province, and probably not abundant in any part of New Brunswick.

Argynnis aphrodite, Fabr.

This butterfly is common throughout the Province. It is frequently mistaken for A. cybele which it very much resembles, but may be separated from that species by its smaller size. Flies in July and August.

Argynnis atlantis, Edw.

Common at St. John, Fredericton, Sussex, Belleisle, Moncton and Chipman. This butterfly is more abundant than A. aphrodite, frequenting the same localities and flying in company with that species.

Argynnis myrina, Cram.

(BRENTHIS MYRINA.)

Abundant throughout New Brunswick. This is our most common Argynnis, flying from the latter part of June to the last of August.

Argynnis bellona, Fabr.

(BRENTHIS BELLONA.)

This species is rare in St. John County, and does not appear to be numerous in any part of New Brunswick.

Melitæa phæton, Drury.

(EUPHYDRYAS PHÆTON.)

Rare; a few specimens have been captured near St. John. On June 18th of the present year, Mr. Geo. W. Bailey captured a specimen at Springhill, York County.

Melitæa harrisii, Scud.

(CINCLIDIA HARRISII.)

A specimen of this species was taken near St. John by Philip J. R. McIntosh during the summer of 1897. Rev. C. J. S. Bethune (The Butterflies of the Eastern Provinces of Canada) gives New Brunswick as a locality for this rare Canadian butterfly.

Phyciodes tharos, Drury.

Abundant from early in July to September. The form MARCIA, Edw. being taken in the earlier part of the season, and the form MORPHEUS, Fabr. later. It is found in open meadows and fields during June, July and August.

Grapta interrogationis, Fabr.

(POLYGONIA INTERROGATIONIS.)

Forms UMBROSA, Lint. MORPHEUS, Fabr.

Rare in the vicinityof St. John, and probably not common in any part of New Brunswick.

Grapta comma, Harris.

(POLYGONIA COMMA.)

Forms DRYAS, Edw. HARRISII, Edw.

This butterfly is not uncommon at St. John and Fredericton. Also reported as occurring at Dalhousie, by Rev. C. J. S. Bethune (The Butterflies of the Eastern Provinces of Canada.)

Grapta faunus, Edw.

(POLYGONIA FAUNUS.)

This species is not so abundant as G. comma in this locality, and is reported as not common at Fredericton and Sussex.

Grapta progne, Cram.

(POLYGONIA PROGNE.)

Common throughout the Province, flying from May to October.

Grapta gracilis, Grote and Rob.

(POLYGONIA GRACILIS.)

Evidently rare. Mr. R. McL. Vanwart reports this butterfly from Fredericton. If the specimens have been correctly identified it will be an interesting addition to our New Brunswick list.

Grapta j-album, Boisd, Lec.

(EUGONIA J-ALBUM.)

This species does not appear to be common in the southern section of the Province, only two or three specimens have been taken in St. John County during the past three years.

Vanessa antiopa, Linn.

(EUVANESSA ANTIOPA.)

Abundant throughout the Province. Flying from April to October, but most plentiful during the latter part of August.

Vanessa milberti, Godt.

(AGLAIS MILBERTI.)

This species is not common in St. John County, but it is apparently more numerous in the interior of the Province.

Pyrameis atalanta, Linn.

(VANESSA ATALANTA.)

Common at St. John, Fredericton and Sussex, and probably abundant throughout the entire Province. Flies, from June to the latter part of September. This species was unusually numerous from the 16th to the 25th of June of the present year.

Pyrameis cardui, Linn.

(VANESSA CARDUI.)

This butterfly is usually abundant, but during the past three years has been rare in this neighborhood, although quite abundant twenty miles inland. Flies during June, July and August.

Pyrameis huntera, Fabr.

(VANESSA HUNTERA.)

This species is occasionally abundant, and is generally found flying with P. cardui.

Limenitis arthemis, Drury.

(BASILARCHIA ARTHEMIS.)

Not uncommon at St. John, Rothesay, Hampton, Belleisle, Fredericton, and probably throughout the entire province. Flying from June to the latter part of August.

Limenitis disippus, Godt.

(BASILARCHIA ARCHIPPUS.)

This interesting species is not very common. Specimens have been taken at St. John, Fredericton, Belleisle and Grand Lake. Flies in June, July and August.

Sub-family SATYRINÆ.

Neonympha canthus, Boisd Lec.

(SATYRODES EURYDICE, Linn.)

NEONYMPHA BOISDUVALLII, Harris.

This butterfly is not uncommon on the Belleisle and at Fredericton and Sackville.

Satyrus nephele, Kirby.

(CERCYONIS NEPHELE.)

EREBIA NEPHELE.

Abundant throughout the province. Flying in July and August. Frequenting swampy meadows and fields bordered by woods.

Satyrus alope, Fabr.

(CERCYONIS ALOPE.)

HIPPARCHIA ALOPE.

This species is reported from Fredericton, but appears to be rare in the northern sections of the province. It is very common in the vicinity of St. John. Frequenting the same localities and flying in company with S. nephele.

Satyrus alope nephele, Scud.

This butterfly, apparently a hybrid between alope and nephele, is sometimes taken at St. John.

Family LYCÆNIDÆ.

Sub-family LYCÆNINÆ.

Thecla augustus, Kirby.

(INCISALIA AUGUSTUS.)

Not uncommon, but difficult to capture, owing to its small size, dark color, and the shrubby localities which it frequents. Flies in May.

Chrysophanus epixanthe, Boisd Lec.

(EPIDEMIA EPIXANTHE.)

This little butterfly is not uncommon in two or three localities near St. John, but it appears to be very local in its habits, frequenting the same places (sometimes only a few yards in extent) year after year. Flies in July and possibly into August.

Chrysophanus hypophlæas, Boisd.

CHRYSOPHANUS AMERICANA, D'Urban.

(HEODES HYPOPHLAEAS.)

Common at St. John, Fredericton, Sussex and Grand Lake, from June to September. This species is no doubt abundant in every part of New Brunswick.

Lycæna pseudargiolus, Boisd Lec.

(CYANIRIS PSEUDARGIOLUS.)

This butterfly is very common throughout the province. The forms VIOLACEA, Edw., being very abundant in May and June, and the form NEGLECTA, Edw., less common, in June, July and August.

Family PAPILIONIDAE.

Sub-family PIERINÆ.

Pieris napi, Esper.

(PIERIS OLERACEA, Harris.)

A number of specimens have been taken at St. John, Fredericton, and on the Belleisle, but this species is no doubt uncommon throughout the province.

Pieris rapæ, Linn.

This species is an importation from Europe, and is our most common butterfly in New Brunswick. Flying from May to October.

Colias philodice, Godt.

(EURYMUS PHILODICE.)

Very common throughout the province. Flying from May to September, and during the present year as late as October 23rd.

Colias interior, Scud.

(EURYMUS INTERIOR.)

Usually not very common, but during the present year this species was unusually abundant, being much more numerous than C. philodice. Flying from July 9th to late in August.

Sub-family PAPILIONINÆ.

Papilio turnus, Linn.

(JASONIADES GLAUCUS, Scud.)

This species is common in every part of New Brunswick, and occasionally very numerous. Flying in June and July.

Papilio cresphontes, Cram.

PAPILIO THOAS, Boisd.

(HERACLIDES CRESPHONTES.)

Rev. C. J. S. Bethune, in his list of the "Butterflies of the Eastern Provinces of Canada," gives St. John, N. B., as a locality for this species. None of our local collectors have met with it. It is a southern insect and no doubt rarely occurs in this province.

Papilio brevicauda, Saunders.

At present we have no local record of the capture of this species, but Rev. C. J. S. Bethune, in his list of the "Butterflies of the Eastern Provinces of Canada," mentions it as having been taken in Dalhousie, N. B. When the insects of the northern sections of New Brunswick become better known, this butterfly will no doubt be found among them.

Papilio asterias, Fabr.

(PAPILIO POLYXENES.)

This species is usually abundant, but during the past two years it has been very rare in the vicinity of St. John. Not uncommon on the Belleisle and at Fredericton.

Family HESPERIDÆ.

Carterocephalus mandan, Edw.

This species is not uncommon in two or three localities near St. John, but it appears to be extremely local in its habits frequenting wood roads and open grassy places in woods. Flies in June and July.

Pamphila zabulon, Boisd-Lec.

(ATRYTONE ZABULON.)

The form HOBOMOK, Harris, is common throughout the Province, flying in June and July.

Pamphila leonardus, Harris.

(ANTHOMASTER LEONARDUS.)

This species is rare in this vicinity, only two specimens having been taken, and at present it is not reported from any other locality in New Brunswick.

Pamphila peckius, Kirby.

(POLITES PECKIUS.)

PAMPHILA WAMSUTTA, Harris.

The most common Pamphila in this locality, frequenting meadows and oat fields, found in every part of New Brunswick, flying in June and July.

Pamphila mystic, Scud.

(THYMELICUS MYSTIC.)

This species is found in the same localities as the preceding, but it is not nearly so abundant. Flies in July and August.

Pamphila cernes, Boisd-Lec.

(LIMOCHORES TAUMAS, Fabr.)

PAMPHILA AHATON, Harris.

Common at St. John, Fredericton, Hampton, and also abundant in Victoria County. Flies in June and July.

Nisionades brizo, Boisd-Lec.

(THANOS BRIZO.)

Rare in the vicinity of St. John, only two specimens having been taken.

Nisionades icelus, Lint.

(THANAOS ICELUS.)

Taken at St. John and Fredericton. This species is quite abundant in the vicinity of St. John, frequenting wood roads and pathways bordered by low shrubbery.

ARTICLE V.

NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong, Ph. D.

14.—On the Lack and Cost of a Topographical Survey of New Brunswick.

(Read October 4th, 1898.)

It is of course known to the members of this Society that no unified topographical survey of New Brunswick has ever been made, and no complete topographical map of the province exists. The entire coast line has been surveyed by the British Admiralty which has employed triangulation checked by frequent observations for latitude and longitude, and the results are contained on the well-known admiralty charts. The United States coast survey has made some triangulation about Passamaquoddy Bay, and its results may be found in their charts and reports. In 1841–1843 Captain W. F. W. Owen made a fine traverse and triangulation of the St. John from its mouth to Springhill, but his excellent contour maps were never published, though there is a copy of them in the Crown Land Office at Fredericton. Aside from these, there has been no proper topographical surveying in New Brunswick, though some determinations of latitude and longitude have been made. Our latest maps, of course, embody all these data; but for the rest of the Province, they are made up of pieced-together surveys of the most diverse age scale and authority, and hence the best of them are incomplete and inaccurate in many places. Passing from horizontal to vertical topography, the data for the latter are so scanty that our best maps make scarcely an attempt to represent it at all, and show but an occasional hachure star for some very marked height, or, as in the Surface Geology maps by Mr. Chalmers, a limited use of hachures for local elevations. It is true the hachure system has been used on several maps to show special

ranges of highlands, etc., as on Baillie & Kendall's map of 1832. Featherstonhaugh & Mudge's of 1839 (followed on Saunders of 1842), but in these the data were most scanty and the results very erroneous. The hachure topography of the coast line of the admiralty charts is of course accurate, but is too narrow a strip to be of much service. At the present time the best maps elsewhere represent vertical topography by contour lines; for New Brunswick absolutely the only published maps using contour lines are the following: first, a very crude folder issued by a steamboat company showing the St. John below Fredericton, with neighboring heights, taken from Captain Owen's maps already referred to; second, some of the surface geology maps, which show a 200 or 220 feet contour line; third, the United States coast survey chart, No. 300, which shows a detailed and accurate survey with contour lines of a strip of our coast from the Waweig to above St. Stephen, the peninsula below the Ledge being thus the most completely and accurately mapped part of New Brunswick. A proper contour as well as an accurate outline map of the province can be based only upon a unified topographical survey.*

Naturally questions of first interest in this connection are the value and cost of such a survey. Two publications which give details on this subject are the following: "The Mother Maps of the United States," by Henry Gannett (in National Geographical Magazine, IV., 101, 1892), and "Topographical Surveys, their Method and Value," by J. L. VanOrnum (in Bulletin of the University of Wisconsin, Engineering Series, I., 331, 1896). From these works I gather the following facts: Accurate maps representing to the eye the vertical as well as the horizontal topography have these values—First for military operations; second, as a basis for property boundaries; third, for study of water powers, drainage, etc; fourth, for the building of railroads, saving immense sums in preliminary surveys; fifth for selecting the best routes for highways; sixth, for municipal improvements, water supply, etc; seventh, as a basis for geological and other special maps. Most civilized countries possess such maps of their territory. Some, but far from all of the United States possess them. The cost of the surveys preliminary to these maps varies immensely with local conditions, scale, accuracy, etc. One of the greatest and best in the

* If the reader is interested to see a splendid model of modern mapmaking, which is at the same time an illustration of the remarkable liberality of the United States government to education, he should examine "Physiographic Types," by Henry Gannett, in "Topographic Atlas of the United States" It may be obtained for 25 cents from the Director of the United States Geological Survey, Washington, D. C.

world, the Ordnance Survey of the British Isles, cost about $200 per square mile, though many special areas cost far more. Such a survey of New Brunswick, with its area of 27,000 square miles, would cost $5,400,000. Of more practical interest is the cost in one of the American States. That of Massachusetts, with its excellent contour maps, cost $13 per square mile, which for New Brunswick would amount to $351,000, but it would really be more than this because of the unsettled state of the country and the more scanty data to start with, and would probably reach $500,000. If a survey of the Province were made according to the recommendations of the topographical commission which met at Washington in 1892, on a scale of one to thirty thousand (half a mile to one inch), with contour intervals of 20 feet, it would cost at least $25 per square mile, or in all $675,000. It is plain that we must wait long for a complete topographical map of New Brunswick.

15.—Upon Natural Pavements and Their Possible Misinterpretation in Archæology.

(Read November 1st, 1898.)

On the Nepisiguit River, just above the Narrows, on the left bank, the beach is formed of flat stones fitted together so regularly and set so nearly upon the same level as to suggest an artificial pavement. Indeed many a city of western Europe has pavements less perfect. The beach slopes gently towards the water and is underlaid by soft clay full of small springs. The stones are water-worn boulders of diverse composition, size and shape, but all have flat or nearly flat surfaces uppermost, and there are no considerable gaps between them. I think I have seen such pavements elsewhere, though never before such regular ones, but probably they are well enough known to students of surface geology. Any artificial agency in their production in this wilderness is out of the question, and they are probably formed by the action of the ice in the spring, which, grinding along the shore, would tend to press the boulders into the soft and yielding beach and to work and turn projecting angles about until a flat surface comes uppermost. If the river's course were to become changed, so that the pavement were no longer on a beach it would be a most puzzling structure and almost certain to be referred to an artificial origin. References to pavements occur not infrequently in local archæological

writings, and are sometimes taken to indicate the existence of early settlements. From the above it would seem possible that such pavements may sometimes be of purely natural origin, especially when on river banks and underlaid by yielding bottoms.

16.—On Attempts at Oyster Culture in Passamaquoddy Bay.

(Read November 1st, 1898.)

The distribution of the oyster in New Brunswick waters is peculiar. Along with several other distinctively southern molluscs, it is found abundantly upon our north coast, but not at all upon our southern shore, which is occupied entirely by sub-arctic forms. The causes of this seemingly anomalous condition are in the main well known, and are discussed fully in a paper in the Transactions of the Royal Society of Canada, vol. viii., section iv., page 167, and by Upham in American Journal of Science, third series, vol. xliii., page 203. The evidence seems to show that the oyster did once live all along the coast from the Gulf of St. Lawrence to south of Cape Cod, and hence also in the Bay of Fundy, but that it has been exterminated in the latter by the entrance of cold currents allowed by geological changes of the coast line. Hence upon theoretical grounds, any attempts to artificially grow oysters in Bay of Fundy waters may be expected to fail. I have been told that many years ago live oysters were placed in Oak Bay, a branch of Passamaquoddy Bay, but they did not live. Possibly, however, it was in this way the southern starfish *Asterias Forbesii*, was introduced into the Bay (noted in the Bulletin of this Society, No. IX., page 54), though it may be a relic of the former southern colony. In the fall of 1896, Mr. G. W. Ganong, M. P., placed in one or two fathoms of water on a good beach, near his cottage on the south side of Oak Bay, some seven or eight barrels of dead oyster shells and two barrels of live oysters from the Gulf of St. Lawrence. In 1897 some of the oysters were washed ashore attached to kelp, and were still alive, showing they had survived the winter. In 1898, however, none of those thus washed ashore were alive, though the attachment of the two valves to one another, and the fresh condition of the hinge, showed that some of the shells were those of oysters placed in the water alive. In September, I dredged several times over the place, but brought up only dead shells, though some of them

obviously belonged, by the test just mentioned, to those placed alive in the water. Neither the dead shells nor the seaweed showed the least trace of any young.

There seems to me no likelihood that oyster planting would succeed in this bay. Not only is the summer temperature too low for breeding, but huge starfishes, the oyster's worst enemies, are very abundant, and the wash of the heavy tides must at times cover the living molluscs with silt very deleterious to their growth.

It is to be hoped that the presence of these shells in Oak Bay will not be taken by some future naturalist as evidence of recent natural occurrence of oysters in the bay; and it is partly to prevent such an error that the present note is placed on record. There is a tradition that oyster shells were once found in an old Indian shell-heap at Oak Point, between this bay and the St. Croix river, but I think this very doubtful. The statement by A. Leith Adams in his "Field and Forest Rambles" (page 35) that quahog and oyster shells are abundant in shell-heaps in this region, is, of course, altogether an error.

17.—On the Nature of the Mud in Our Many "Mud Lakes."

[Read December 6th, 1898.]

The best maps of New Brunswick show a branch of the lowermost Nepisiguit Lake running as a cul-de-sac half a mile or more to the southward. Last summer I went into this branch in a canoe, and found it nowhere more than a few inches deep, while in many places the bottom came above the surface. This bottom consisted everywhere of soft, grayish, flocculent mud, from which, as the canoe was forced with difficulty through it, arose in large bubbles an abundance of a gas smelling like hydrogen sulphide. A pole thrust several feet into it touched no hard bottom except near the shore, and the mud brought up by it from depths greater than a foot or two was of a reddish rather than a grayish color. I collected abundant samples, and a microscopic examination has shown that it consists almost entirely of minute Plants, Desmids, Diatoms and other unicellular and filamentous Algae, alive on the surface grayish layer and dead in the deeper reddish layers. The members of the Society will recognize these forms as among the most varied and beautiful in form and sculpturing of all living organisms. This mud then is all alive on the surface, and grows where it is found, thus filling up the lake; as the individuals die,

their siliceous shells gradually sink and become compacted, thus forming the valuable siliceous deposits (infusorial earth) often dredged from lakes for economic use under the name of "Fossil Flour." It is thus no doubt the great beds of diatomaceous earth were formed in past geological periods.

Another lake of this kind appears to be the Fifth Green River Lake, which according to J. W. Bailey ("The Saint John River," page 53) is "very shallow with a soft bottom of white mud, which the men call 'paint,' from its quality of sticking to the canoe-poles, like white lead." Of course there are plenty of others, and the question at once arises, whether the brown mud which gives the name "Mud Lake" to dozens of small shallow lakes in Maine and New Brunswick may not be of essentially the same nature, the different color resulting from admixture of peaty matters or other impurities. In any case it is a problem to determine what favors the growth of these organisms in some lakes and not others, and why they are so much purer in some than in others. Here is a good place for the student of the freshwater Algae of New Brunswick to begin his labors upon the most attractive group of Plants yet unstudied in our Flora.

To the unaided vision, nothing could be more unattractive than the muddy bottoms of these lakes; but with the microscope to aid, they become replete with a beauty of form hardly to be matched elsewhere in Nature.

18.—Preliminary Outline of a Plan for a Study of the Precise Factors determining the Features of New Brunswick Vegetation.

[Read December 6th, 1898.]

The most marked tendency of botanical investigation at the present day is towards the elucidation of the dynamical factors determining structure and distribution in Plants. In the study of local Floras, it is taking the form of an attempt to find out the exact factors which place each plant where it is, and make it the size, form, color and texture it is, a discipline known as Ecological Plant-geography. Though a new study, many valuable contributions to it have already appeared in Europe and this country, and a great extension of the

bounds of knowledge in this direction may confidently be looked for in the near future. Much of this rapid progress is due to the stimulus given by the appearance of Warming's great work on this subject, a work likely to be viewed in the future as one of the classics of Botanical Science.* To the members of this Society, eager for the advancement of Science and scientific education in New Brunswick, this new phase of Botany must be of especial interest, and some formulation of it for this province will therefore be acceptable.

A complete treatment of the Ecological Plant-geography of New Brunswick will involve three parts, as follows :

PART. I. THE ELEMENTS COMPOSING THE NEW BRUNSWICK FLORA—An account of the species actually occurring in the Province and their habits here; a systematic list of all the species, with the situations they occupy, and the variations in their structure in the different situations. So far as concerns the listing of the species, much work has already been done by our local botanists, but the study of the other phases has hardly been attempted. The great difficulty in this study of habits is the lack of accessible guides in which its principles are distinctly formulated.

PART II. THE GEOGRAPHIC ORIGIN OF THE ELEMENTS OF THE NEW BRUNSWICK FLORA—

A. Present provincial and world distribution of the species.

B. Past History and Changes now in progression, including occurrence of Colonies, and Migrations.

This part is capable of, and needs, thorough statistical study, upon which suggestions will later be offered. It has already received some investigation by Dr. Matthew, Professor Fowler and others.

PART III. THE ECOLOGICAL COMPOSITION OF THE NEW BRUNSWICK FLORA.—The vegetation of no very large region is homogeneous as to its adaptations, but segregates itself into Groups including plants, most diverse in their systematic relationships, brought together by their common adaptations to a particular set of external conditions. These groups as they occur in New Brunswick may tentatively be classified as follows.

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* The original is in Danish, but the German translation is most used. It is entitled "Lehrbuch der Oekologischen Pflanzengeographie," Berlin, 1896. An English translation is said to be in preparation.

A Preliminary Ecologic-geographic Classification of the Vegetation of New Brunswick.

(Primary Divisions in part after Warming.)

SECTION 1. Groups in adaptation to other organisms—Includes Climbers, Epiphytes, Saprophytes, Parasites, Symbionts, Insectivora Myrmecophila, etc. All of these groups are of minor importance in our vegetation.

SECTION 2. Groups in adaptation to external physical conditions.

I. *Xerophytes* (*Desert-Plants*)—Typical forms entirely wanting in our Flora; represented only by xerophytic characters in species living where transpiration normally exceeds supply, either because water drains off quickly or for other reasons is available in but small quantity.

- A. Rocky hills, etc.
- B. Sea-cliffs.
- C. Sand-dunes.
- D. Dry Barrens.
  [See also some features in L.]

II. *Halophytes* (*Strand Plants*)—But a few herbaceous species in our Flora; some inland colonies.

- E. Gravel and Sand Beaches.
- F. Salt Marshes.
  [See also T.]

III. *Hydrophytes* (*Water-plants*)—Very well developed in our Flora.

- G. Plankton.
- H. Algae, { *a* Marine. *b* Fresh water.
- I. Immersed Phanerogams.
- J. Stream and Lake margin.
- K. Fresh water marshes.
- L. Sphagnum Bogs, { *a* Flat *b* Raised

IV. *Mesophytes* (*Normal Plants*)—Comprises the great bulk of the vegetation of this section of America.

1. Original Vegetation.
   - M. Coniferous Forest.
   - N. Deciduous Forest.
   - O. Mixed Forest.
   - P. Intervales.
   - Q. Flood-bank and Bar.
     [See also J.]
   - R. Swamps.

2. Effects of Cultivation.
   - S. Common Crops.
   - T. Reclaimed Salt marshes.
   - U. Abandoned Lands.
   - V. Burnt Lands.
   - W. Roadsides and Dooryards.

The only one of these groups which has yet received study of this kind in New Brunswick is, *Lb* Raised Peat-Bogs, on which there is a memoir, far from adequate, in the latest volume of the Transactions of the Royal Society of Canada. I have done some work upon F and T, which I hope soon to bring to completion. But this is not a task for one student, but for many.

19.—On a Current Error as to the Location of (Nictor) Bald Mountain, Tobique.

[Read January 3rd, 1899.]

In discussions upon the still unsettled question of the location of the highest land in New Brunswick, Bald Mountain near Nictor Lake is often mentioned. Yet curiously enough most visitors to Nictor Lake have identified the wrong mountain as Bald Mountain, and our two best maps of the Province, Loggie's and the Geological Survey, are also in error on this point. Rising abruptly from the shore of Nictor Lake is a splendid mountain, or rather, ridge, densely wooded to and over the top. This mountain was named in 1863 by Governor Gordon, Mount Sagamook, Maliseet for "Mount of Chiefs," ("Wilderness Journeys," 54). Professor Bailey in the same year climbed it and considered it Bald Mountain (Canadian Naturalist, April, 1864), and speaks of the error of the maps in placing it away from the shore of the lake. Chalmers also (Geological Report, 1885, GG, 11) considered Sagamook and Bald Mountain as identical, and the Geological Map names Sagamook "Bald or Sagamook Mountain." By all of these writers, and others, Sagamook has been considered the highest land in that vicinity, if not in New Brunswick. Yet Sagamook is not the same as Bald Mountain, nor is it the highest land in the vicinity. The real Bald Mountain, whose position is correctly shown on Wilkinson's map of 1859, is about three miles to the south-west of Sagamook, markedly higher, and has a perfectly bald conical top. It is this mountain which can be seen from far down the Nepisiguit, and which from the upper stretches of that river and from the Nepisiguit Lakes shows a bare top crowned by a wart-like projection. The reason for the failure of different explorers to see it seems plain. Sagamook is the mountain naturally climbed by all visitors, but its top is so densely wooded a view cannot be obtained from it, but only from some bare bosses of rock near the summit on the northern side, and it is only

from one of the most westerly, smaller, and probably least visited of these, that Bald Mountain can be seen. Otherwise one can see it only by climbing a tree on the southern edge of the summit of Sagamook, and it was from this position Bald Mountain rose before my astonished eyes, distinctly higher than Sagamook, on a fair day last August. If Mr. Chalmers' height of 2,537 feet, given to Sagamook, proves correct, then Bald Mountain may well be the highest land in New Brunswick.

20.—Upon Biological Opportunity in New Brunswick.

[Read January 3rd, 1899.]

Specialization in biological investigation is rapidly reaching such a point that in some lines, such as anatomy, morphology, physiology, embryology, it is becoming impossible to make discoveries away from the great centres in which extensive libraries, abundant appliances and considerable leisure are available. While therefore the local student is cut off from making contributions to knowledge in those lines, there are nevertheless other directions in which large possibilities for usefulness are open to him, namely in the study of *Occurrences*, *Distribution*, *Habits* and *Adaptations to External Conditions* of the organisms inhabiting his district. In such study the local student is liable at present to little interference from the specialists, for the latter are largely engrossed in laboratory problems.

Local Natural History is studied most of all by teachers, and next to them, by men of other professions and of business, who make of it a recreation or a hobby. If it were more widely realized what great and pure pleasure may be derived from the outdoor study of Nature, and how great an advantage it is to have some healthful engrossing subject to which one can turn for relief from the too pressing cares of life, the ranks of local naturalists would be overflowing. One must however possess the right temperament,—a love of outdoors, a fair measure of the collecting instinct, and a liking for one's own society, and one should begin young, and command some leisure. But for such persons there is no part of New Brunswick that does not offer ample scope for Natural History study with assurance of much personal profit and possibility of making some contribution to Science as well. But he who would enter upon such pursuits should not cover too wide a field, but, selecting that phase which most interests him, should devote himself to that. He should make careful collections for

himself, for his local Natural History Society, with which he should keep in close touch, and for specialists to whom he must turn for advice in all difficulties. He should gather books and papers relating to his subject, enter into correspondence with other students of it and publish accounts of his discoveries. Naturally he will explore first the region nearest about his home, then later in his holidays extend his journeys to other parts of the county or province he tries to cover. Thus gradually will he rise in his specialty until he comes to feel the joy of accomplishment, the charm of authority, and the satisfaction of having done something whose value is permanent.

The first and most important problem of local Natural History is that of *occurrences*—exactly what species occur within the given area and in what abundance. In New Brunswick, study of this kind has been made for the few groups that will be mentioned below. Its results are expressed in lists whose value is in direct proportion to their accuracy, which should be secured by asking the advice of specialists upon all doubtful points. Such lists are the very foundation of local Natural History study.

Second of local problems is that of *geographical distribution*, the precise range of species, not only in this Province, but also in relation to their distribution generally. Involved with this is the occurrence of colonies and the position of the lines of migration of species into the Province, and the proportion of the species that are derived from different directions, etc. Practically this could, I think, be best worked out by aid of simple small outline maps of the Province and of the World, on which the range of species could be shown in color, and new facts added as gained. I have no doubt that these maps, appealing to the eye, would suggest facts, principles, and clues for further study that the mere printing of localities in lists or tables would not. No such study of distribution has yet been made for any group of animals or plants in New Brunswick.

Third of local problems is that of *habits* of Animals and Plants. Surprisingly little is known accurately of the habits of organisms in a state of nature, and accurate records of fact in this line are most valuable.

Fourth of local problems is *adaptation of organisms to external conditions*, how their forms and sizes and colors are related to their habits and to outside influences, and especially how all these vary with the external conditions. It is true this division of local study is at present very difficult because of the lack of good books which can be

used as guides, books showing what facts are already known and what principles may best be used in further study. Such books are the great need of local Natural History study to-day, and they will prove as great a stimulus to it when supplied, as Gray's Manual, for example, has been to the study of classification of the flowering plants.

To these problems may be added another of no small importance, the *local and aboriginal names and uses* and *folk-lore* of plants and animals, and other *historic associations*, including their relation to the early settlement or progress of the country.

The groups of New Brunswick Animals and Plants, with the work already done in listing them, is as follows. In cases where there is more than one list, only the later is cited.

Plants.

Flowering Plants. Fully listed for Occurrences in Fowler's List in Bulletin IV, with many additions in later Bulletins. Distribution, Habits and Adaptations yet to be studied.

Ferns, Lycopods and *Equisetums.* Listed with the Flowering Plants.

Mosses. Partly listed by Fowler Rep. Secretary of Agriculture of N. B., 1878), and in Moser's List in Bulletin XVI.

Liverworts. Preliminary List (very incomplete) by Fowler in 1878.

Lichens. Preliminary List (very incomplete) by Fowler in 1878.

Fungi. Preliminary List (very incomplete) by Fowler in 1878.

Algae. Marine : List by Hay in Trans. Royal Soc. Canada, 1887.
Fresh-water : Not at all studied ; a most attractive group.

Animals.

Mammalia. List by Chamberlain in Bulletins III and X.

Birds. List by Chamberlain in Bulletin I.

Reptilia. No published list.

Amphibia. List by Cox in Bulletin XVI.

Fishes. List by Cox in Bulletin XIII.

Insects. List of Butterflies in this Bulletin ; others to follow.

Crustacea. No published lists.

Worms. No published lists.

Mollusca. Marine : List by Ganong in Bulletin VI.
Land and Fresh-water : No published lists.

Echinodermata. Attempt at a Natural History of this group by Ganong in Bulletin VII.

Coelenterata. No published lists.

Protozoa. No published lists.

From the above it will appear that even preliminary lists have been made of but a part of our groups, and that hardly any study at all has been made of Distribution, Habits, or Adaptations. Here is scope enough for many students for a long time to come.

The logical end of all local studies in Natural History is the preparation of a complete Natural History of the Province. The characteristics of such a work I have elsewhere tried to sketch (in *Educational Review*, v, 141).

21.— Bibliography of the Freshwater Pearl Fishery in New Brunswick.

(Read February 7th, 1899.)

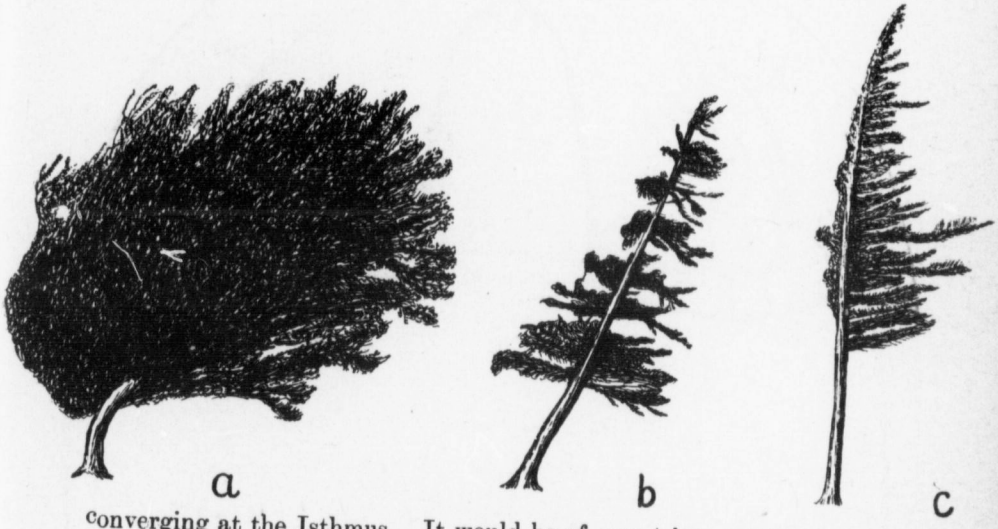
Pearls of considerable, and often great, value are occasionally found in the freshwater clams or mussels occurring abundantly in the brooks and rivers of North America, and there are periodical revivals of interest in the search for them. The latest Bulletin of the United States Fish Commission (Vol. XVII) contains a most valuable article upon this subject by George F. Kunz, entitled "The Freshwater Pearls and Pearl Fisheries of the United States," and to this the future pearl fisher will do well to turn. The work contains, however, but a single reference (on page 395) to New Brunswick. Additional data for this province are to be found in this Society's Bulletin, No. VIII, page 85, and in the St John *Sun* for October 26, 1889, and for November 2, 1889. Of some interest, too, is an article "On the Pearl," by J. Hunter Duvar, in Transactions of the Nova Scotian Institute, II, 86, 87, and a brief despatch probably exaggerated in the St. John *Telegraph* for November 15, 1898.

22.—Wind—Effects on Vegetation on the Isthmus of Chignecto.

(Read February 7th, 1899.)

Every field botanist is familiar with the effects produced upon plants by winds blowing much in one direction, but these phenomena are shown upon an unusually large scale and in extreme degree upon the Isthmus of Chignecto. As one travels along the ridges in that district, he observes the trees bent strongly to the northeast with their branches trailing off in the same direction. This is of course best seen in the most exposed places, but is also well marked in many orchards; and where the wind has a clear sweep over a wide marsh, as at Sunken Island, the effects are particularly plain. Three examples, well marked though not extreme cases, are shown on the accompanying cuts, which are exactly traced from photographs taken along the Fort Cumberland Ridge between Point de Bute and Baie Verte. Of the three *a* is a yellow birch, *b* is a spruce, and *c* a hackmatack.

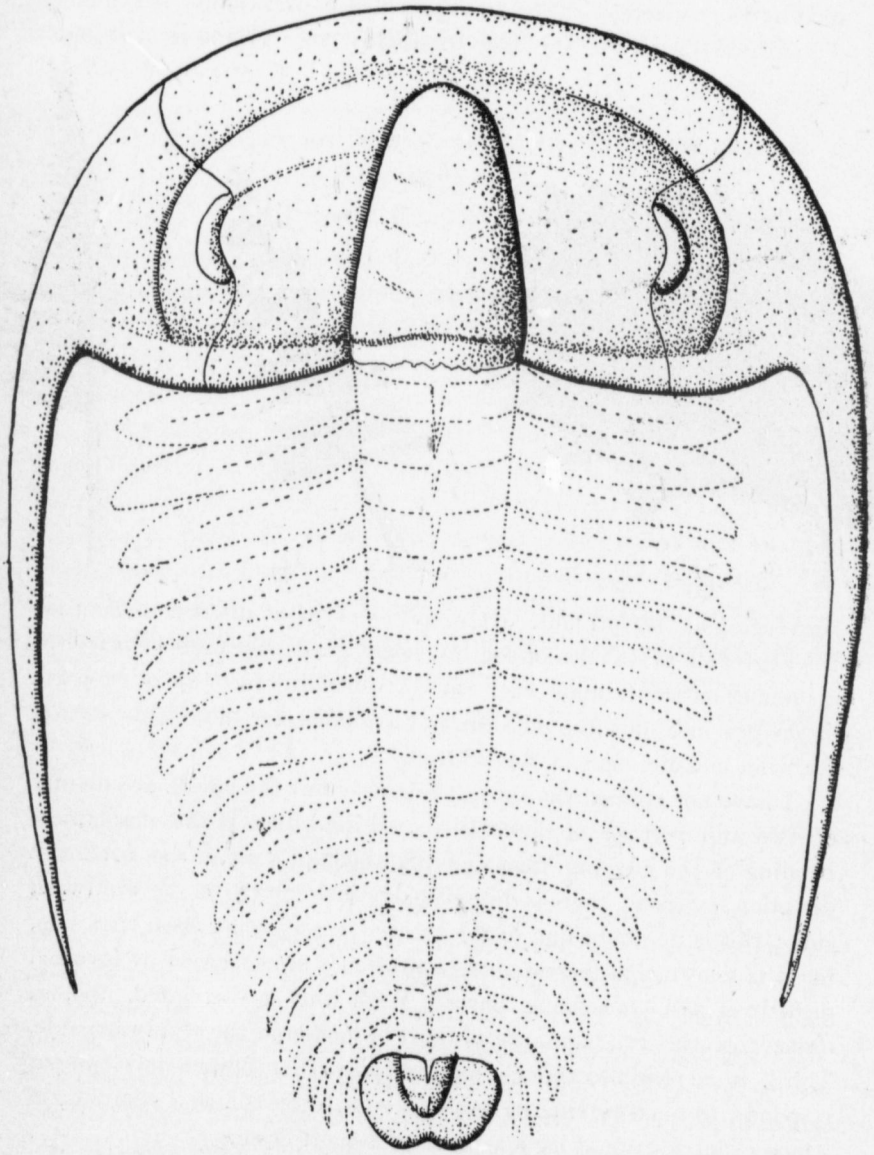
The cause producing these effects is perfectly obvious and agreed upon by all residents, *i. e.*, the great prevalence, particularly in summer, of southwest winds. The Bay of Fundy acts as a sort of funnel converging at the Isthmus. It would be of great interest to compare the aggregate prevalence of southwesterly winds and their velocity for a summer on the Isthmus with the corresponding facts for other parts of the province, but the data are not available, for there is no station for wind measurement in this district.



I have not studied the subject minutely but the effects are plainly of two and perhaps of three kinds. First, there is the mechanical bending of the growing shoots giving them all a set in the northeast direction. Second, there is diminished branch growth on the windward side ; this is no doubt due to the greater transpiration upon that side, for it is known that increased transpiration is accompanied by lessened growth of the transpiring parts. With this is correlated, too, an observable greater abundance of dead branches on the windward side. Third, it is possible, though not probable, that branch-development responds, to some extent, irritably to wind direction as a stimulus, in which event we would have a phase of Rheotropism.

One naturally looks in such a case as this for wind effects on other objects, but the only ones I have seen are occasional inclined telegraph poles, which on the Eddy road almost all lean strongly to the northeast, and the blowdowns in the burnt woods along the Ship Railway which are almost invariably in the same direction. More minute observation may show effects on the small lakes of the marshes and even also in some of the details of tidal movements.

PLATE III.



METADOXIDES MAGNIFICUS, n. sp.

Restored—Reduced $\frac{2}{3}$.

ARTICLE V.

A NEW CAMBRIAN TRILOBITE.

By G. F. Matthew, M. A., D.Sc., LL.D.

(Read February 7th, 1899.)

ERRATA.

"Article V."—A New Cambrian Trilobite, read, Article VI.

we proceed to describe under the name

Metadoxides magnificus, n. sp.,

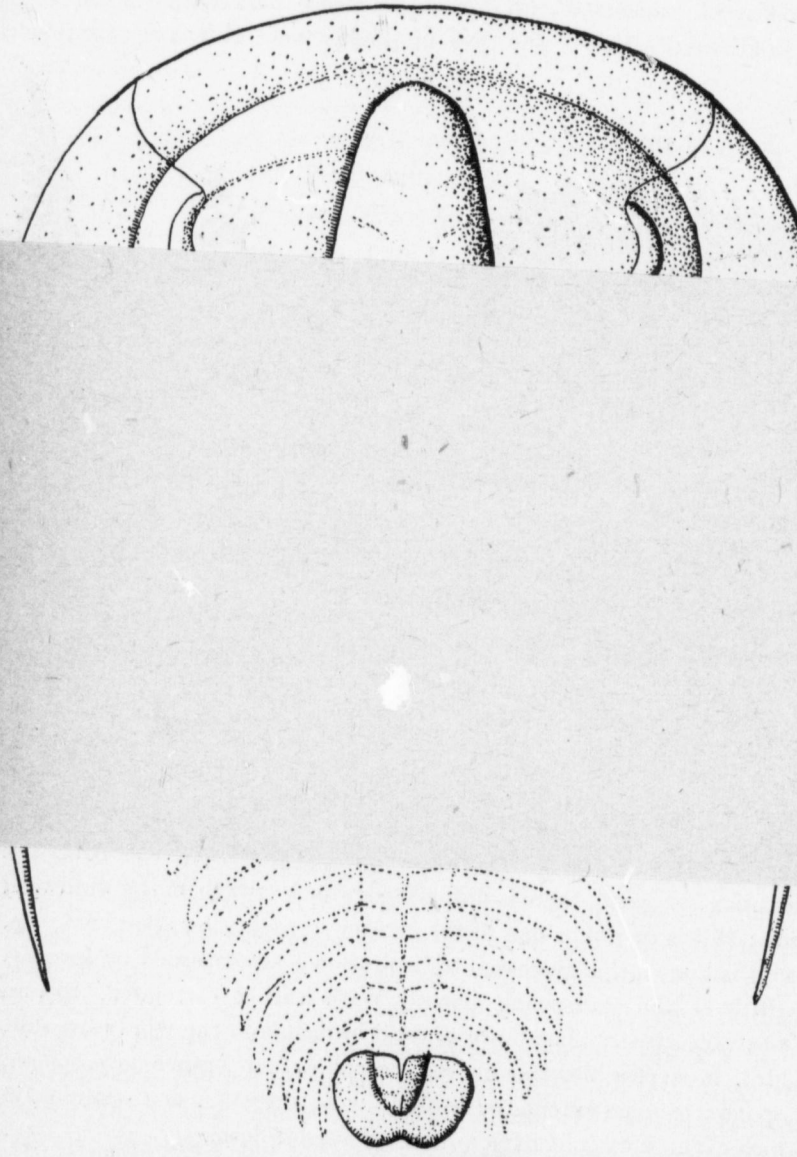
a species of the Lower Cambrian beds in Newfoundland.

A large species with wide, semicircular head-shield, and long genal spines. Middle piece of the head subquadrate. Front broadly arched; anterior marginal fold flat, and scarcely distinguished from the front area of the cheeks (in the flattened tests); the two together in front,

* "Fauna Cambriana-Trilobiti," Memoirs Geolog. Commis. Italy, vol. iii, pt. 2nd. It would be more correct to say that Meneghini described two of the species of which he had only the thoraces under Paradoxides, and the third under Olenus. Bornemann having known heads and thoraces for all three, described them under his new genus.

† Die Versteinerungen des Cambrischen Schichtensystems der Insel Sardinien, von Dr. Joh. Georg Bornemann. Halle. 1891.

PLATE III.



METADOXIDES MAGNIFICUS, n. sp.

Restored—Reduced $\frac{2}{3}$.

ARTICLE V.

A NEW CAMBRIAN TRILOBITE.

By G. F. Matthew, M. A., D.Sc., LL.D.

(Read February 7th, 1899.)

During my visit last summer to Newfoundland I had the good fortune to discover a new link between the Cambrian of Europe and that of America.

In 1888 Meneghini described some trilobites which had been discovered in Sardinia under the genus Paradoxides,* but which are different from the types of that genus as known in the north and west of Europe. Subsequently, J. G. Bornemann redescribed these fossils under a new generic name, *Metadoxides*.† Bornemann found a decided difference between this genus and Paradoxides in the form of the glabella; this part of the head-shield in the latter genus is club-shaped, whereas in Metadoxides it is conical. Now, as the glabella is the most important part of the head-shield, and a part which exhibits prospectively in the larval form, its shape in the adult, it is important in generic classification, and it appears to me that Bornemann was quite right in dividing off his genus from Paradoxides.

Regarding the forms with conical glabella as a separate genus—

METADOXIDES, Bornemann,

we proceed to describe under the name

METADOXIDES MAGNIFICUS, n. sp.,

a species of the Lower Cambrian beds in Newfoundland.

A large species with wide, semicircular head-shield, and long genal spines. Middle piece of the head subquadrate. Front broadly arched; anterior marginal fold flat, and scarcely distinguished from the front area of the cheeks (in the flattened tests); the two together in front,

* "Fauna Cambriana-Trilobiti," Memoirs Geolog. Commis. Italy, vol. iii, pt. 2nd. It would be more correct to say that Meneghini described two of the species of which he had only the thoraces under Paradoxides, and the third under Olenus. Bornemann having known heads and thoraces for all three, described them under his new genus.

† Die Versteinerungen des Cambrischen Schichtensystems der Insel Sardinien, von Dr. Joh. Georg Bornemann. Halle. 1891.

nearly half as wide as the glabella, both widen on each side of the glabella, so that at the facial suture they are as wide as three quarters of the width of the glabella, the marginal fold being the wider of the two. Glabella conical, bluntly pointed in the anterior quarter. The glabella and occipital ring together are about as long as half of the space between the facial sutures in front. The glabella has three pairs of furrows plainly shown, and a fourth pair faintly indicated. The furrows do not connect across ths axis. The occipital furrow and ring are not well preserved in the specimens known, but the furrow appears to extend quite across the back of the glabella. The fixed cheek is broad and flat, with a strongly arched eyelobe, about halfway between the side of the glabella and the edge of the head-shield.

The movable cheek is wide and strongly arched in the anterior part, becoming straighter behind. The area is about half of the width of the marginal fold in front, but less than that at the eyelobe. The posterior margin is sinuate, having a strong sinus near the genal spine; and the furrow and fold are broad and weak. The genal spine is narrow, and more than twice as long as the movable cheek. The facial suture along the eyelobe is somewhat shorter (?) than behind it, and not quite so long as the anterior extension of the suture. This goes forward from the eyes with a sigmoid curve, to the nearest part of the anterior margin. The posterior extension of the suture is obscure in all the specimens obtained, but a detached free cheek appears to indicate that it was nearly direct to the posterior margin.

Only detached segments of the thorax are known; they have a narrow rachis and short pleura; the latter is traversed by a strong furrow, which in some (the anterior) run along the centre of the pleura, but in others begins towards the front side, and is more oblique; the pleura are bluntly pointed.

In the restoration of the thorax given in *Plate III* the anterior pleuræ are longer than some examples would indicate, and the thorax wider; the number of segments is not known, but it may be assumed that they were numerous. In some pleuræ the ring has a tubercle or fractured base of a spine, on the posterior edge; it is supposed that there was a slender axial spine at the back edge of each thoracic ring, as such spines are found on the joints of the pygidium.

The pygidium is elongate semi-circular with a rather flat axis extending two-thirds of its length; three joints are present in the axis, of which the middle one bears a slender spine at the back; an ap-

pressed spine, which extends across the anterior joint, appears to belong to the posterior joint of the thorax. The side lobes are convex, and are of nearly equal width except at the back. The margin is entire, except that it is notched behind at the axial line.

Fragments of the hypostome have been found, but are not sufficient for description.

Sculpture. The surface of the marginal fold of the movable cheek is marked by widely spread, anastomosing, raised lines; along the front margin of the shield, close to the edge, a few of these lines appear, but are closely crowded, both on the free cheek, and on the middle piece of the head shield; along the genal spine the raised lines run diagonally downward from the outer to the inner margin; along the posterior border of the head shield there are crowded raised lines, as along the anterior border. On the doubleur the lines are crowded and more distinct. The edges of the ring of the rachis show similar crowded wrinkles; on some pleuræ there is a narrow band, or transverse wrinkling on each side of the pleural groove; in others the wrinkled band covers the whole under surface, and the wrinkles or raised lines become gradually drawn out in V-shaped lines along the pleura, so that towards its extremity they become parallel to the axis of the pleura. On the pygidium there are raised lines, but finer and more crowded, and parallel to the posterior border.

Size. Length of the middle piece of the head about 70 mm. Width in front 110 mm.; at the eyelobe 95 mm. at the posterior angle about 90 mm. Length of the cord of the anterior extension of the facial suture 25 mm.; of the eyelobe 17 mm.; of the posterior extension about 20 mm. Length of glabella and occipital ring about 55 mm. width at third furrow 25 mm. at the first furrow 32 mm. Length of movable cheek 60 mm. and with general spine about 175 mm., width at the front 25 mm., at the back of the eyelobe 37 mm., at the posterior margin about 35 mm. Length of the pygidium about 20. mm.; width 27 mm.

Horizon and locality. Occurs in a very fine, greenish-grey shale, resting on volcanic ash rock, seen in a railway cutting at Manuel's Station, Conception Bay, Newfoundland. What appears to be the original surface of the ash rock in Cambrian time was uneven, and the fine mud of the shale settled into the inequalities of the surface. Almost directly upon the old rock surface, there is a layer of a few inches of shale abounding with the detached parts of this trilobite; the tests are confusedly crowded together, flattened and somewhat distorted in the shale, and are accompanied by a large Hyolithes.

On comparison with Mr. Walcott's section on Manuel's Brook, (a short distance to the north)‡ I find no volcanic rock mentioned, hence I suppose the rock on which the bed of shale rests that contains *M. magnificus*, belongs to the older Intermediate, or Huronian system. To the east of the ash rock are Nos. 3 and 4 of Mr. Walcott's section, hence it is presumed that No. 5 corresponds in position to the volcanic ridge, as a shore deposit, and that the bed of shale with *M. magnificus* will be at the bottom or near the bottom of No. 6 of Walcott's section. Here, it is stated, the head of an Olenellus was found.

This fine species shows many points of resemblance in a general way to *Holmia Broggeri*, Walc., but there can be no doubt it is distinct, if only by the fact that it has movable cheeks. The genal spines and pygidium differ also from those ascribed to that species by Walcott. It differs from all the Paradoxides in its conical glabella, as well as in the details of the ornamentation of the surface. *Solenopleura* (?) *Harveyi*, Walcott, resembles this species in some respects, but is much smaller, and belongs to a lower horizon (No 2) of Walcott's section.

In this species we have a good example of the Sardinian genus Metadoxides, and apparently the most primitive example of the genus known. *M. torosus*, Menegh., has just such a thorax and pygidium, but has evidence of more advanced development in the head-shield; this is chiefly in the shorter eyelobe, closer to the glabella, the more spreading course of the posterior extension of the dorsal suture, and the condensation of the head in front of the glabella. The meaning of these differences is apparent when we study the development of Paradoxides. *P. Acadicus*, for instance, shows a much wider extension of the marginal area of the head-shield in the larval, than in the adult stage. The withdrawal of the eyelobe from the vicinity of the margin toward the glabella, is seen to be one of the progressive changes that occurred during the growth of the Ptychoparinæ of the Paradoxides Beds at St. John. The short posterior extension of the dorsal suture is an almost universal characteristic of the trilobites of the Protolenus Fauna. Here, then, are three criteria from which we may infer the Newfoundland species to be an older type of Metadoxides than those of Sardinia.

Another species of Sardinian Metadoxides (*M. Bornemanni*) does not show such primitive characters as *M. torosus*, for not only is the whole head more compact, but the condensed pygidium with its

‡ U. S. Geol. Surv. Bull. 81, pp. 260, 261.

costate side lobes, introduces a feature quite at variance with the usual appearance of the pygidium in Paradoxides, and more like that in Conocoryphe; if this species may be retained with *M. torosus* in Metadoxides, there is greater reason for referring to this genus the new species from Newfoundland.

We have already called attention to the fact that the species described by Meneghini under the name of *Olenus Zoppii*, and now referred by Bornemann to his new genus *Olenopsis*, bears a close genetic relation to the genus Protolenus. In fact we may easily infer from the development of the individuals in certain species of Paradoxides that *O. Zoppii* is merely an advanced stage in the development of a Protolenus, in which those advanced characters have become fixed. Bornemann's representation of the development of *O. Zoppii* (in which, however, the figures appear to be somewhat conventional) will readily bear out the relation of this genus to Paradoxides, and justify our reference of Protolenus to the same rootstock.

And this leads us to remark that one of the fossils collected in Newfoundland last summer was a Micmacca, which by its somewhat shortened eyelobe showed an advance in development beyond the species found in the St. John Basin in New Brunswick. Another trilobite, an Avalonia, from the Newfoundland Protolenus Beds has a decidedly shortened eyelobe. It thus appears that one of the criteria of the Protolenus Fauna as found in New Brunswick, *i. e.* that the trilobites as far as known have continuous eyelobes, partially fails in Newfoundland; and in so far as it does so, would indicate that the Protolenus Fauna in Newfoundland (at least its middle and upper part) is of a somewhat later date than in New Brunswick. So far then, as opinion may be based on such data, the Protolenus Fauna in New Brunswick is one of the oldest assemblage of trilobites hitherto discovered, and that the migration of this colony has probably been through Newfoundland to Southern Europe. If the Sardinian species had come from the eastward we might reasonably have expected to find with them Olenellus, Dorypyge, or some other genus that has been elaborated in the region of the Pacific Ocean.

Reference to Plate III—*Metadoxides magnificus*, n. sp.—Reduced $\frac{2}{3}$. In this figure the different parts of the head-shield and the pygidium are placed in position. The thorax is restored from loose pleuræ which in the restoration should be shorter and blunter; number of segments unknown.

POSTSCRIPT.

Since writing the above, it has seemed to the author desirable to make a broader distinction between the Sardinian and American species of Metadoxides than that given above. He has heretofore depended upon the view of the Sardinian succession given by Barrande and Meneghini, from which one may infer the presence of two Cambrian faunas in Sardinia, the lower containing Olenopsis, Metadoxides, Paradoxides, etc., and the upper Giordanella (Asaphus, Menegh.) Neseuretus, etc.

Bornemann, however, seems to throw doubt upon the entire separateness of these faunas, when he says that remains of *Giordanella* are found with *Metadoxides armatus.** If this is the case it will carry the whole Sardinian Cambrian fauna to a higher plane, and imply the separation of these by a wider space of time from the Newfoundland species described above.

Meneghini's view would admit of the following arrangement of the Sardinian as compared with the Atlantic North American Cambrian faunas.

	ATLANTIC NORTH AMERICA.	SARDINIA.
Upper Cambrian.	Dictyonema Fauna. Peltura Fauua. Olenus Fauna.	Giordanella Fauna.
		Olenopsis Fauna.
Lower Cambrian.	Paradoxides Fauna. Newfoundland species described in this article Protolenus Fauna.	

In this view the lower fauna of Sardinia might be regarded as intermediate homotaxically, between the Paradoxides and Olenus faunas. If, however, Bornemann's observation is to be relied upon, it seems to me that the whole fauna must be carried to the Upper Cambrian, notwithstanding the presence of a Paradoxides. It is therefore desirable to emphasize the point in which the Newfoundland species differs from the later, and supposed derived forms of Metadoxides, found in Sardinia, and apply to them sub-generic names, beginning with the most primitive.

1. Species having a widely expanded front to the cephalic shield; somewhat prolonged eyelobes; short posterior extension of the dorsal suture. No costæ on the side lobes of the pygidium. CATADOXIDES n. subgen. Example *C. magnificus.*

2. Species having a compacted front to the cephalic shield, short eyelobes, prolonged posterior extension of the dorsal suture.

a. No costæ on the sides lobes of the pygidium. METADOXIDES, sens. strict. —Ex *M. torosus.*

b. One or more pairs of costæ one the side lobes of the pygidium. ANADOXIDES n. sub. gen. Ex. *A. armatus, A. Bornemanni (A. arenosus ?)*

*Versteinerungen des cambrischen Schichtensystem der Insel Sardinien, p. 465, Halle, 1891.

ARTICLE VII.

ON ARTESIAN AND FISSURE WELLS IN NEW BRUNSWICK.

By G. F. Matthew and S. W. Kain.

Read March 7th, 1899.

One of the authors of this paper has for several years been engaged in gathering information in reference to deep wells, bored in New Brunswick, and in the following pages the writers have endeavored to compare these borings, with a view to deduce practical results, that may be of general interest.

To show the full range of possibility in the origin and mode of flow of such wells, we have included some of less than 100 feet, which are often true artesian wells, penetrating only the surface deposits of the country.

With such inclusions we may divide the wells, referred to in this paper, into two principal classes. 1st. Those penetrating the surface deposits only, and those bored in the Carboniferous and Lower Carboniferous rocks, in which the sandstones, especially those of the Coal Measures, are porous, and so afford sources for artesian flows.—2nd. Those which penetrate the deeply buried Lower Carboniferous rocks, and those bored in the still older rocks which have suffered more or less metamorphic change, and in which the sandstones have been made impervious to water by the calcareous or silicious cement which has been deposited between the grains of the rock. From these latter rocks it is clear we cannot have true artesian flows, and must depend upon such water to supply the wells as may penetrate through fissures of the rock. In many of these wells there is usually no spontaneous flow, but the water has to be obtained by pumping.

Wells of the first class have not received the notice they deserve, for in many localities in the lower levels of the province, from sea level to two hundred feet above it, there are extensive plains and valleys of clay land, from beneath which the purest and best water for household and farm use may be obtained.

The artesian wells have been grouped into three sets, each of which has peculiar characters. Of these the first are those which penetrate the surface deposits only; the second are bored in the soft yielding sandstones of the Coal Measures; and the third penetrate Lower Carboniferous rocks of more varied nature, some of which have saline waters of marine origin, now held in soft red and brown shales, and sandstones.

The three wells of the first group are typical of the varieties of deposit which are likely to be met with in shallower wells. In Dr. Berryman's well we have the full series of the surface deposits which it is necessary to penetrate in order to reach the porous stratum containing pure water. The upper deposit here is the mud of a salt marsh forming an impervious covering to a porous stratum of sand, etc., of a seashore or estuary origin (Macoma sand), and therefore likely to give a decidedly brackish water. Beneath these sands there is a heavy bed of clay "brick clay" (Leda clay), which serves to hold in the water of the lower level; this water is contained in a porous stratum of sand and gravel beneath the clay. At this well the gravels are thought by the owner to rest on the rock, so that a still older part of the surface deposits, consisting of a confused mixture of clay, sand, and stones ("Boulder clay"), usually cemented into a hard, compact mass, is probably wanting at this particular spot, having been washed away by the current that laid down the gravel.

Of the well at St. Stephen we have less special knowledge; it is said to be situated on a ridge of land between two streams and penetrates only the brick clay. To have obtained water, however, the porous gravels below must have been reached.

Ready's well, in Fairville, is driven through a still more limited range of the surface deposits, for at this point the lower gravels swell out into a great ridge, with the brick clays resting on either flank, but not covering it. This well is driven in the gravels only (unless it may strike Boulder clay in its lower part) and the supply of water is drawn from the gravels alone, by direct gravitation, and does not necessarily come from a distance.

The second group of wells may also be regarded as artesian; they are bored in the sandstones of the coal measures which are "freestone"* and occasionally alternate with beds of shale, which would serve as an impervious covering to the several masses of sandstone. In

* Sandstones that are easily cut with the chisel.

a less degree the sandstones of the Lower Carboniferous series in which the wells of the third group are bored, are capable of transmitting water; their grains are frequently held together by a cement of calcite, which to some extent closes the openings between the grains.

As the second class of wells have largely been made in rock that is practically non-porous, the supply of water which such wells yield must come from joint or fissures in the rocks, and for good practical results it is obviously desirable that the positions in which such fissures are likely to be numerous should be known, and also whether there are chances that such fissures will be open, or fast closed by pressure.

Proofs that there is a pressure in a horizontal direction approximately from the southeast, have been observed at Monson, Mass., by W. H. Niles,* at New York by Prof. J. F. Kemp,† and at St. John, N. B., by one of the writers.‡ Such pressure would have a tendency to close fissures that were at right angles to it, especially where they occur in yielding rocks like slates and soft schist, but would not interfere with those that are horizontal, or run in the direction of the the pressure. Hence joints with a low hade to the southwest, or joints with a northwest course are in this region more likely to carry water, than others.

Dr. W. O. Crosby, of Boston, has marshalled evidence to show that joints do not extend to very great depths,§ and are most numerous in the rocks toward the surface of the earth, hence in going down on these fissures one may expect to find a level where the water is held by the cessation of the fault or joint. Under these conditions where these joints or fissures are numerous, they act as reservoirs to hold fresh water that has been transmitted through them from the surface of the earth, to the lower levels.

Nordenskjold‖ from observations made on the coast of Finland and Norway, has drawn the conclusion that at a certain depth in metamorphic and crystalline rocks, *horizontal* fissures have been formed by expansion and contraction of the rocks, due to the difference in temperature of the rocks down to a certain depth in the summer, as contrasted with the winter. The rocks down to the point where they have a uniform temperature at all seasons, would contract in winter and expand in summer. The theory requires that at this level of

* American Journal of Science, March, 1872. † Trans. N. Y. Acad., August, 1895, p., 275.
‡ Bulletin of this Society, No. XII, pp, 39, 1894.
§ Geol. Mag., London, Sept. 1881, p. 316.
‖ Journal Royal Geographical Society, Vol. X, No. 5, pp. 465-469, Nov. 1897.

uniform temperature, horizontal fissures should be formed, that would serve as reservoirs for water from the surface, and a means of transmitting the water from place to place horizontally.

So far we have no support for this theory from the phenomena of the deep wells sunk near St. John, unless the horizontal fissures are deeper than Nordenskjold found them to be in Finland. Of the wells near St. John that have given a generous supply of water, two, to the north of the harbor, draw their supply from a depth of 270 feet, and three to the east, from nearly four hundred feet in depth. It is true that owing to the greater extremes of winter and summer temperature, the anticipated horizontal fissures might be looked for at a somewhat greater depth here, than in Europe, but certainly not at such a depth as the water veins in the rocks near St. John are found to be. It is probable, therefore, that some other cause has been active in permitting the water to sink to these greater depths.

Explanation of the Tabular List of Wells.

Nos. 1 to 3 are entirely in the surface deposits. Nos. 4 to 8 are in the Carboniferous basin along the Gulf of St. Lawrence. Nos. 9 to 13 are in the Lower Carboniferous rocks of the Kennebecasis valley. Nos. 14 to 16 are deep wells; the first two are bored in Lower Carboniferous rocks, and, except No. 16, are supposed to penetrate such rocks only. Nos. 17 to 28 are fissure wells; except the first three they are all in the vicinity of St. John, or in the city itself.

"Date," refers to the year in which the well was bored.

"Depth," that of the well, in feet.

"Bore," diameter of the main portion, in inches.

"Pressure," indicates the height of the water in the well, in feet; the minus mark (—) indicates that it is below the surface, the plus mark (+) that it rises above it.

"Flow," indicates the number of gallons discharged by the well per hour.

"Temperature," was taken with the Fahrenheit thermometer.

"Water veins," the figures indicate the level in feet below the surface where the water enters the well.

"Height," this is in feet above sea level at high tide, except Sussex Vale, where it is reckoned from mean tide level.

"Kind of rock," the thicknesses are in feet, and the upper layers are mentioned first.

13	" Mrs. Jas. Lamb	'95	210	.5	+4	150	4	65 feet above sea. 170 ft. brown sandstone, 25 coarse sandstone, 200 hard limestone [?] with quartz. 100 ft. brown sandy shale.

ARTESIAN WELLS

Bored in New Brunswick, referred to in this Article

No.	Location.	Date.	Depth.	Bore.	Pressure.	Flow.	Temperature.	Water Veins.	Height.	Kind of rock penetrated.
1	The Marsh Road, Dr. Berryman,		93	.1½	−1½	ample		40, 92	Sea level.	60 ft. marsh mud, 18 beach sand, 38 brick clay, 1 coarse gravel.
2	St. Stephen, H. Graham		40		−16			39	Clay ridge.	30 ft. brick clay, 1 ft. gravel.
3	Fairville, Jas. Ready		104	.6	−24	ample	45°	103	95 ft. above sea level.	Gravel, sand and boulders.
4	Westmorland, C. Tormentine, average of several,		100		+3			75, 100	25 ft. above sea level.	Grey sandstone.
5	Newcastle, Public Square	'88	120	.3	+6		45°	120	Near sea level.	15 ft. surface deposits, 11 ft. freestone, 94 ft thin, hard sandstone, with conglomerate and blue shale.
6	" R. H. Greenly	'93	125	.4	−10				On a ridge.	25 ft. superficial deposit, 100 ft. sandstone.
7	" P. Hennessey	'98	140		+10				Near sea level.	Grey sandstone.
8	Chatham, Bank of Montreal		180	.3	+7				do.	Grey sandstone.
9	Millidgeville, Jewett's Mill		147	.6		small		22	About 10 ft abv sea level.	Red sandstone, etc.
10	Sussex, S. H. White		243	.6	+25	1666 ?	42°			221 ft. soft micaceous rock.
11	" G. S. Moore	'95	185	.5	+3	slow 15		3	Sussex Vale is 65 feet above sea.	160 ft. " " "
12	" Gordon Mills	'98	400	.5	+3	50		4		170 ft. brown sandstone, 25 coarse sandstone, 200 hard limestone [?] with quartz.
13	" Mrs. Jas. Lamb	'95	210	.5	+4	150				100 ft. brown sandy shale.

FISSURE AND DEEP WELLS

Bored in New Brunswick, referred to in this Article.

No.	Location.	Date.	Depth.	Bore.	Pressure.	Flow.	Temperature.	Water Veins.	Height.	Kind of rock penetrated.
14	Albert Co., Albert...............	'98	345	.6	....	... ...	....	345	Near sea level.	Grey sandstone, gypsum, red sandstone.
15	Sussex, Geo. D. Slipp	'95	998	.5	—24	......	....	200 and below.	About 65 ft abv sea level.	60 ft. of clay to the rock, then 893 brown sandstone, 35 very soft sandstone, 10 hard sandstone.
16	Chatham, Pulp Mill	......	1400	......	....	....	.....	100 & 1000	... .	Grey sandstone, etc.
17	Campbelltown, "Hotel Dieu". ..	'90	100	.....	....	....	....	....	....	
18	Milltown, Cotton Mill...........	'84	200	.....	....	....	....	....	....	100 ft. in solid rock.
19	Kings Co., Hatfield's Point......	'97	282	.6	—25	ample	....	24, 80	Near sea level.	[Pyritous slates?] sulphurous water.
20	Brookville. W. Wheeler............	......	130	.5½	—15	100	.. ...	60, 130	do.	75 ft. sand, 10 clay, 297 hard rock.
21	Simonds, Alms House	'97	760	.4	—13	15	Jan. 45°	404	do.	60 ft. limestone, 3 ft. quartzite, 67 ft. "whinn."
22	(470 ft. W.)	'97	550	.4	—2½	2000	Dec. 43°	28, 40, 406	About 30 ft abv sea level.	758 ft. black slate, 2 ft. quartzite.
23	Union Street, St. John, S. Jones,	'96	885	.4	....	1000	Feb. 45°	382	About 10 ft abv sea level.	Slates and flagstones.
24	Portland Rolling Mill............	'80	275	.3	....	ample	Feb. 46¼°	....	+58 feet.	52 ft. clay, 9 gravel, 317 black slate, 68 sandstone.
25	Carleton, Lunatic Asylum.......	'98	515	.3	—140	1000	....	....	15 ft. above sea level.	Slates and hard sandstone.
26	Fairville, Pleasant Point	......	640	.4	....	small	....	at intervals	+124 feet.	Slate and limestone.
27	Mt. Pleasant Av., Convent Sch..	'94	521	.4	....	40	....	245	Sea level.	Granite.
28	Adelaide Road, Ropewalk.......	'88	278	.3	0	ample	....	....	+219 feet.	Limestone, etc.
									+60 feet.	Limestone, etc.

Additional Notes.

Information in regard to the above wells has been had from the following sources :

No. 1. Dr. John Berryman.
No. 2. Mr. J. Vroom.
No. 3. Mr. Jas. Ready.
No. 4. Mr. A. W. Dobson.
No. 5, 6, 7. Dr. R. Nicholson.
No. 8. Dr. J. Baxter and Dr. R. Nicholson.
No. 9. Mr. L. Jewett.
No. 10-13. Messrs. D. P. Kent and W. N. Biggar.
No. 14. Mr. F. G. Moore.
No. 15. W. N. Biggar and D. P. Kent.
No. 16. Dr. P. Cox.
No. 17. Rev. E. P. Wallace.
No. 18. Mr. Jas. Vroom.
No. 19. Mr. W. Perkins.
No. 20. Mr. D. P. Kent.
No. 21, 22. Mr. E. C. Woods.
No. 23. Mr. R. Keltie Jones.
No. 24. Mr. James C. Robertson.
No. 25. Dr. Geo. A. Hetherington.
No. 26. Mr. F. Stetson.
No. 27. Messrs. John Kelly, W. Murdoch, C. E. and Count deBury.
No. 28. Mr. R. W. Connor.

Nos. 5–7, Newcastle. In reference to Ritchie's well, Dr. Nicholson states that the interior of the pipe became clogged with a deposit of blue clay, but was removed by passing a hard substance up and down.

No. 8, Chatham. The same authority states that the well near the public wharf at Chatham, though 200 feet from the shore and above tide level, is affected by the rise and fall of the tide in Miramichi river, rising to the surface of the ground when the tide is full. Dr. J. Baxter records four wells that are 100 feet or more in depth, two of which throw the water above the surface of the ground two and seven feet.

Nos. 10–13, Sussex. D. P. Kent, the well borer, gives the following as the succession of surface deposits at Sussex : At the top one foot of loam, then thirty feet sand and gravel, then twelve feet clay of a light grey color, then — gravel and boulders (clean and smooth), finally ten feet of boulder clay.

As Sussex has no system of sewerage, water supplied from ordinary surface wells must be very liable to contamination. Prudence would suggest the use of water for potable purposes from deep wells for this and similarly situated communities.

No. 16, Chatham. Maritime Sulphite Fibre Co. ("Pulp Mill"). Dr. P. Cox says water was struck at 100 feet from the surface, there was only a small flow, which in boring deeper was lost. At the depth

of 1,000 feet an ample flow was met which rose nearly to the surface; the water proved to be saline.

No. 19, Hatfield's Point. Mr. W. S. Perkins says the height of the water in this well is not affected by the rising and falling of the St. John River.

Analyses.

No. 24. Mr. W. H. Mowatt has made a preliminary test of the water from the well at Portland Rolling Mills and found considerable chloride of calcium, and some sulphate of calcium. The water does not appear to contain sodium, potassium or iron.

No. 23. The following analysis of the water at S. Jones' was made some years ago by Mr. Alfred E. Macintyre, a chemist, now at Morrin College, Quebec. The water is pure and free from sediment.

	Parts in 10,000		Parts in 10,000
Sodium Chloride	0.517	Magnesium Sulphate	0.735
Calcium Sulphate	0.127	Aluminium Phosphate	0.015
Magnesium Chloride	0.013	Sodium Hydrogen-Carbonate	0.003
Calcium Carbonate	0.826	Potassium Sulphate	0.042
Iron Carbonate	0.082	Calcium Chloride	0.778
Silicon Dioxide	0.118		
Total solid constituents			3.256

(Signed) Alfred E. McIntyre.

The absence of bacteria, and low temperature of this water, make it of great value to the proprietors for brewing purposes.

No. 10, Sussex ("Mineral Spring.") The following information is furnished by W. N. Biggar. Analysis: Each Imperial gallon of this water contains:

Chloride of Potassium	0.21 grains.
Chloride of Sodium	2.10 "
Sulphate of Soda	1.47 "
Carbonate of Soda	25.35 "
Carbonate of Lime	0.35 "
Silica	1.05 "

The water contains quite a percentage of sulphuretted hydrogen and also carbonic acid gas.

Experience derived from the boring of wells in the Cambrian slates and sandstones at St. John seem to point to certain conditions that are favorable to obtaining water, and others the reverse.

The Jones' well was started in black, fine slates of Division 3 of the St. John group, and no water was obtained until flagstones or

sandstones, presumably of Division 2, were struck. As the dip of the rocks would indicate a great depth of slates at this point, it is to be presumed that these slates have been overthrust on the sandstones by pressure from the southwest in past ages. Depending on this factor as the displacing force here, the water supply of this well would come from the rain-fall on the exposed ridges of Division 2 flags in the city of St. John.

While Mr. S. Jones obtained an ample supply of pure water by boring in the black slates, the Alms House Commissioners had a different experience on boring in similar black slates on the east side of Courtney Bay, parish of Simonds. There though they bored a well twice as deep as Jones' well, they struck no water vein of any consequence. At the suggestion of a member of this Society they bored another well 470 feet further to the north, near the margin of a ridge of Division 2 flags and sandstones, and from this well they obtained a supply of water quite sufficient for their needs. The dip of the Division 2 flags would bring them to the lower levels in this well.

Another well where a fairly good flow of water was obtained, was at the Portland Rolling Mill, Strait Shore, near the Falls. This well is also driven in Cambrian flagstones and slates, though its lower part may penetrate an outlier of Laurentian limestone which appears in the hill near by. The strata along this shore are effected by profound faults, and greatly displaced; these displacements would give additional facilities for the storage and transmission of water.

Some wells bored in the vicinity of St. John have not given such good results. That driven some years ago at Pleasant Point opposite Indiantown was wholly in granite and the yield of water was small. This may be accounted for by the fact that the granite hill at Pleasant Point is enclosed by more yielding strata (limestones and slates) and joints or fissures due to pressure and disturbance, would be found in the more yielding strata, while the hard granite would be comparatively free from them.

Another well which was carried down to quite a considerable depth, was that at the Convent School on Mount Pleasant Avenue. A well was sunk at this place some years ago by the late Mr. Robert Reid, and as the supply which he obtained was too small for the use of a large school, a deep boring was undertaken. The boring was carried down 300 feet below tide level and a moderate supply of water was obtained at a depth of 245 feet, or about the sea level.

Better success, however, attended the boring of a well at Connor's ropewalk, on the Adelaide road, which lies in a limestone valley between two granite ridges about a mile to the northwest of the Convent well. Here an ample supply of water was obtained.

Where we have ascertained the level at which the water stands in wells driven near the harbor or river, it would seem that the level is affected by that of the river ; thus in both the Asylum well and that of Mr. Ready the water surface in the well is about the level of low water. At the Alms House, on the contrary, where the flow is unusually heavy, it rises considerablyabove high tide level.

The following may be suggested as working hypotheses to govern the search for water by deep boring in compacted sedimentary and in igneous rocks, to be proved or disproved by further exploration.

1. Water veins are most likely to exist in bands of such rocks that abound in joints or faults, rather than in bands where such joints are scarce ; hence more likely to be found in valleys than on ridges.

2. In a complex of soft slates and sandstones the water veins may be looked for in the sandstones, not in the slates.

3. The water will stand in the wells approximately at the drainage level of the district, and not be lifted by artesian pressure as in wells of the first class.

In conclusion we may here call attention to the advantage of the comparatively inexpensive boring of wells in the surface deposits, to the porous stratum below the brick clays, from which in many flat and low-laying tracts in the province, pure and copious supplies of water may be obtained.

APPENDIX.

THE PRESIDENT'S ADDRESS.

A WILDERNESS JOURNEY — WITH SUGGESTIONS.

By G. U. Hay.

Read at the Annual Meeting, January 17th, 1899.

To-night I shall depart, to some extent, from the usual order of an annual address and first take you with me in imagination on a canoe trip one hundred miles across northern New Brunswick—from the Baie de Chaleur to the St. John River. I would like to impart to you some of the pleasures of that trip,—the exhilaration that comes from poling a canoe up a rocky and swift stream and then dashing down long stretches of rapids, breathing the free air and taking in the glorious scenery of our northern woodlands. But no description of mine, I fear, can give any adequate idea of the reality of such a trip through the entire length of two of our most beautiful rivers—the Nipisiguit and Tobique—rivers whose windings among leafy woods bring into view at every turn such matchless scenery that I shall always feel my blood move more quickly at the recollection of that journey, with its pleasures as well as its trials.

No country of the world, perhaps, presents a greater variety and beauty of river-scenery than New Brunswick. From the tidal streams of Westmorland and Albert rushing in from the Bay of Fundy with impetuous haste to cover up muddy flats, on past the stretches of the lower St. John and Kennebecasis winding smoothly among green fields and meadows, we come to our northern rivers—the Miramichi, Nipisiguit, Tobique and Restigouche, leaping down from their mountain homes and running races with each other to the sea. Every river and stream has numberless tributaries, cradled among forests of pine and spruce and maple, rushing down the mountain sides, resting occasionally in quiet lakes, and gathering strength and volume from other tributaries as they sweep onward toward the sea. These streams

form a network over the whole province,—the delight of the canoe-man now as they were in former times of his brother, the dusky savage.

In the summer of 1896 I accompanied Dr. Ganong down the Restigouche, an account of which trip was published in Bulletin XIV of the Society's proceedings. As we passed the mouth of the Upsalquitch we formed a plan to ascend that stream in the summer of '98, make our way from its headwaters to the Nipisiguit, reach the sources of that stream, and thence descend the Tobique to the St. John. Owing to difficulties in the way, chiefly the lowness of the water in the Upsalquitch, we decided to ascend the whole length of the Nipisiguit. The course for canoe trips is usually up the Tobique from Andover, and down the Nipisiguit to Bathurst. The reason of this is obvious; the Nipisiguit is the more difficult river to ascend, having a rise of 996 feet from Bathurst harbor to Big Nipisiguit Lake at its source, a distance of 80 miles, while the Tobique from the St. John river to Lake Nictor rises 625 in a length of 95 miles.

On the eighth of August we started from Bathurst with a canoe, camping outfit and a four weeks' supply of provisions, and were carried by team to Grand Falls, 21 miles up the river. A few miles beyond Bathurst we left the last settlement and soon the last house. Our intended course stretched through a wilderness, which for over one hundred miles contains no sign of a human habitation except a fishing lodge at the Grand Falls. The lower Nipisiguit is rougher than the upper portion, which some of its enthusiastic admirers told us was "full of quiet pools and every pool full of fish." I well remember my first canoe trip many years ago from Bathurst to Grand Falls and return. Everywhere the scenery is strikingly wild and picturesque, and the river tossed into foam by numerous rapids and small cataracts, or whirling round huge granite boulders which lies scattered everywhere in the bed of the stream. The names "Rough Waters," "Chain of Rocks," "Moorhead's Rocks," "Pabineau Falls," and "Round Rocks," are suggestive of some of the perils of navigation on the lower Nipisiguit. The occasional glimpses obtained of the river as we lumbered along over the rough wagon road, gave it a great fascination when compared with dreary stretches of burnt lands with blackened dead trunks and branches along the road. The Pabineau Falls, about twelve miles from Bathurst, is a wild and beautiful spot, the river tumbling and breaking over a granite ledge into a deep chasm beneath—a choice spot for salmon fishers. On the adjacent

rocks was found the rare plant *Aster linariifolius*, this being the only known locality for it in the province.

Our first camping ground was on the border of a thickly wooded terrace near the head of the Falls, not far from the deserted "farm" of "Bear" Walsh, a once mighty hunter, who gained the name from his many contests with bears. His favorite plan was to dress in a bear-skin, amble on all-fours through the woods, and come upon the unsuspecting bruin, whom he invariably knocked out in the first round.

The Grand Falls of the Nipisiguit are less impressive than the Grand Falls of the St. John, although the scenery is wilder. The chasm through which the water pours by a series of pitches and rapids is very narrow. The first pitch is about fifty feet high and a second about twenty feet. After these plunges the dark waters pour swiftly through a narrow gorge, three-fourths of a mile in length, with perpendicular walls of rock on each side. So narrow is the space between these opposing walls that in times of freshet it is said sometimes to be completely filled, and the gorge becomes one long rapid of seething tumultuous waters.

The *Woodsia Ilvensis* was the fern most thoroughly established on the rocks about the falls, with a few patches of *Polypodium vulgare*. The blue flowers of *Campanula rotundifolia* filled crevices wherever its roots could secure a foothold. A few Habenarias and other orchids, the Wild Onion *(Allium Schœnoprasum)*, the yellow flowers of Utricularia, Ranunculus, and others were found on the shores of the stream above the falls.

From Grand Falls to Indian Falls, thirty miles further up, the river is very rough, and we had hired two guides to take us over this part. Next morning we began the ascent in a large dug-out, in which we were placed with our baggage, and our bark canoe was towed alongside. A horse was attached to the dug-out with the driver on his back. The other guide stood in the bow of the dug-out with a long pole in his hand to fend off the vessels from the rocks. By such conveyance as this it is possible to carry a large party and their baggage up the river. As many as five or six dug-outs may be placed side by side, and one horse, with skilful guiding to avoid shoals and rocks, may pull the whole fleet up stream. But it is a very matter-of-fact, even miserable, way to get up a stream. The water was pretty low, the dug-out scraped on the rocks, and our course was slow, giving abundant opportunity to observe the shores and the character of the river.

The Nipisiguit river deserves its name, (*Win-peg-y-a-wik*, angry waters). It is a succession of rapids, with a few falls making a "carry" round them a necessity. The river is comparatively wide and shallow, but with sufficient water to float light canoes in the dryest season. The rocky bed presents a good many obstacles to the canoeman, who has to be constantly on the watch to prevent "scraping." As our canoe had been somewhat battered on the Restigouche trip, and had not been improved by two years' storing in a dry place, we had to be especially careful to keep ourselves and it from parting company on the trip.

The Nipisiguit is like the Restigouche in some respects, but very different in others. There are no salmon above Grand Falls, the falls presenting an obstacle which they are not able to surmount. One rarely meets with the deep pools so common on the Restigouche, but the shallower pools are the abode of trout innumerable, and casts at any place on the river reward the angler with catches of fine specimens weighing from one to four pounds. The bed of the river is an interminable succession of rocks and shingle, while the bed of the Restigouche is almost everywhere overlaid with gravel. There are few terraces on the Nipisiguit, whilst these are picturesque features of the Restigouche, especially where they are crowned with fishing lodges, the abode of sportsmen. The flora of the Nipisiguit is less interesting and varied than that of the Restigouche, and affords fewer rare specimens, especially in ferns and those boreal species brought down by its branches from the hills and mountains of Quebec. The Restigouche has comparatively low land along its upper course, the land rising gradually into mountains along the lower stretches. In the portions of the Nipisiguit toward the mouth, especially above Grand Falls, the hills are low, the land gradually rising as the river is ascended until altitudes of from 1,000 to over 2,000 feet above sea-level are met with along its upper waters. The tributaries of the Nipisiguit are much less in size and volume than those of the Restigouche, except the southwest branch, which is nearly the size—even broader at the mouth—than the main stream. Many islands are met with in the Nipisiguit river, a few clothed with grass but many more covered with a growth of trees, some of considerable size. There are more wild animals—bears, moose, deer, caribou, along the Nipisiguit, the country being wilder and less frequented by sportsmen.

The monotony of our second days' voyage by the novel (to us) "horse and dug-out team" was destined to be rudely interrupted, and

the interruption came about in this way. After we had gone about four and a half miles we came to the "Narrows," a gorge with walls of nearly precipitous rock and dangerous water. Most of the baggage was carried round, and the remainder was entrusted to the guides who undertook to pole the dug-out through the rapids, with the result that it became a total wreck, and our supplies went to the bottom or floated down stream. Hurrying to the spot in our canoe we rescued from the greedy waters ham, butter, pork, fishing tackle, etc. But there were some things dear to our hearts that the angry waters would not yield up, and these were baked beans and the aluminum outfit, containing cooking utensils and dishes.

Guides are a necessity. They are also an encumbrance if not of the right kind. We decided to dispense with ours. The generous sportsman at the fishing lodge below Grand Falls improvised for us a cooking outfit. In the meantime our own had been recovered from the depths of a pool. Left to our own resources we pictured the delights of making our way unaided through the wilderness ahead of us, taking our own time, and examining whatever we chose,—a free life indeed, with a prospect of abundant ingenuity and exercise in overcoming the obstacles that lay strewn in our pathway.

About four o'clock on Saturday afternoon, August 13th, we reached Indian Falls, fifty miles from Bathurst, having poled our own canoe for three days without any mishap, covering in that time over twenty miles of very bad water. But we rejoiced in the prospect of a Sunday's rest in one of the wildest and most picturesque spots on the river, and the opportunity to review the events of the past week, estimate our resources of strength and provisions, and to form plans to reach the second haven of rest—the Nipisiguit lakes, thirty miles beyond Indian Falls. We had devoted ourselves almost exclusively during the past three days to the task of getting our canoe up through the rapids and over rocks that strewed our pathway "thick as autumn leaves in Vallambrosa." The last two or three miles of our journey to Indian Falls was the tug-of-war of the trip. Rocks and huge boulders filled the river, and there seemed at times not passage way enough for the canoe in the swirling waters as they eddied from rock to rock. When the rapids were too strong and the rocks made the poling of the canoe too dangerous, we towed it up by means of ropes.

The hills on each side of the river became higher and gradually drew nearer the banks as we ascended, occasionally forming overhanging precipices as on the Restigouche. Cool springs and gurgling

rivulets of ice-cold water were refreshingly near us all the way up from Grand Falls. Droseras and Utricularias were busy capturing insects in their cool mossy retreats on the borders of these springs. *Arethusa bulbosa* and other orchids, such as the purple fringed Habenaria, the *Habenaria dilatata* and *H. hyperborea, Arnica mollis* and other plants loving cool moist habitats were found in great abundance. Some fine straight specimens of scrub pine *(Pinus Banksiana)* were seen along the higher ground overlooking the river; some of these towering to the height of sixty or seventy feet forming ample groves. White birch, black and white spruce, fir, maples, black ash, cedars of large size, were the chief trees met with, while alder, mountain maple, cherry, mountain ash and other shrubs drooped over the water with clematis and bed-straw twining everywhere over their stems; the purple Joe Pye-weed seemed to crowd all the vacant spots, forming a tangle of vegetation most delightful to look upon, but very hard to get through, especially when it is remembered that the sweep of the freshet and ice in the spring causes every shrub and small tree trunk within its reach to point down stream. It is to the thicket entanglements of these shores that I owe what little skill I possess in poling a canoe up a rapid stream. When this trip was first planned, Dr. Ganong, with a generosity that overcame all my scruples, since I was not accustomed to pole a canoe up stream, offered to "do all the work' and leave me free to botanize along shore. I scrambled along that rock-strewn and tangled shore for the greater part of two days. On the third I got on board the canoe and seized the bow pole with a determination to stick to the ship at all hazards.

What a charm there was about that camping-ground at Indian Falls, with the pale light of the full moon coming to us over the dark hills of spruce and pine beyond our tent. There was no sound except the rushing of the waters, which was continually in our ears. We had a feeling that the roughest part of the river was past; for was not the assurance given us that the upper part of the river is a series of quiet stretches, "full of pools and every pool full of fish." A spirit of contentment is in the air. The coffee never gave out a more delightful aroma. The flapjacks as they were deftly turned in the air came down in the right place in the fryingpan and lay sizzling contentedly with a well-browned surface, done to a charm. We enjoyed with all the high spirits of boyhood the charm of outdoor life in the woods. We talked of everything under the sun: why a bountiful providence has given us the means of knowing when a flapjack is done on the one

side but has left us in the dark about the other side. Again, how many persons ought to compose a camping party. This was discussed with some warmth as each strove to outdo the other in deftly turning a flapjack, or win the palm in producing the richest brown surface. The question of number could not be definitely settled. *Four* and *three* were suggested, but these numbers were rejected as furnishing too great a variety of interests which would possibly clash. *Two* was a favorite number, but this was objected to also, the disagreement turning on the point: if one of the two should tumble from the canoe and go sprawling upon the flood, should the other laugh or maintain a proper gravity under such trying circumstances. Thus we whiled away the hours until sleep closed our eyelids on the fragrant fir boughs, with the murmur of the waters growing fainter and fainter.

The next day—Sunday—was bright and beautiful. The series of rapids known as Indian Falls extends up the river until a turn hides the waters from view. Here, as the level rays of the setting sun shone over the foaming waters and black boulders, there was a strange fascination in watching the effects of sunlight and shadow, the crinkling lines of sunlight playing around the huge boulders looking like monsters disporting themselves in a sea of gold.

On Monday morning we made a portage of about half a mile to get round these rapids, of which Indian Falls forms the eastern end. These portages are among the delightful troubles of a journey in the wilderness. One wished at such a time that the camping party consisted of four instead of two to share the toil. But it is to be done and we might as well do it cheerfully. We take it as a pleasure, and in two or three hours it is accomplished, over a pretty woodland pathway, well tramped for centuries by voyageurs through the wilderness. First, we take the canoe, binding our coats on the benches nearest the bow and stern, raising and turning it over at the same time so that it is carried bottom upward, with the benches resting on our shoulders — Indian style. Next the baggage is taken, carrying it as far as we can, putting it down and resting as we walk back for more, — after the fashion of Klondikers.

Then we launched our canoe, rejoicing in the prospect of the "quiet stretches" beyond; but the rocks and rapids are ever present. We meet with a few pools "full of fish," but the fish are probably suckers, the trout hiding themselves at the foot of rapids or beneath overhanging banks. But finally the rocks and boulders which have

strewn our pathway for four or five miles become fewer, and we have a few gravelly stretches to our great relief, although they are soon succeeded by rocky ledges and shallower water.

The country has become more mountainous and the mountains are close to us on both sides of the river. Bald Mountain has been in sight since Saturday, and on Monday afternoon, at three o'clock we land at the point nearest to it and pitch our tent, intending to climb at early dawn on the following morning. Near us was situated a "bear camp," where the lumbermen store supplies of flour and salt pork for use the following winter. They are made very strong, to resist the attacks of bears, who frequently, however, get into them by tearing off portions of the roof. We had been authorized before leaving Bathurst to get into this one, bear fashion, and help ourselves if we ran short of supplies, but fortunately we were not in need.

Here was noticed *Euphrasia officinalis* and other foreign plants which had followed the lumbermen up from the coast. I had not noticed this plant at the camping sites on the Restigouche, while of the introduced plant *Silene inflata*, noticed in such abundance on that river, not a vestige was to be seen on the Nipisiguit. Such are some of the vagaries of that vagrant class of plants known as weeds!

We started at 5.20 next morning to climb Bald Mountain, and in about an hour reached the summit without any difficulty. From the top a beautiful panorama was presented to the view. We could trace the outline of the Nipisiguit from Grand Falls to its source in the Nipisiguit lakes, near which lay a number of high peaks, among them Bald Mountain of the Tobique rising from Lake Nictor. To the south stretched hills and mountains, descending to the eastward in ranges of low hills. The height of the Nipisiguit Bald Mountain above the Bay de Chaleur is given by Mr. Ells in the Geological Report as 1922 feet. There is a mountain to the north, on the opposite side of the river, with a bare summit nearly if not quite as high as this. The air on the top was bleak and cold, and even with our coats on we were glad at times to seek the shelter of an overhanging rock, although the day in the valley below was warm, even sultry. I found the vegetation rather interesting, with several boreal plants and the trees and shrubs all of stunted growth. The following is a list of the plants observed: *Vaccinium uliginosum* (its first recorded appearance in this province), *V. Pennsylvanicum*, *V. vitis-Idæa*, *Nemopanthes Canadensis*, *Pinus Strobus*, *P. resinosa*, *P. Banksiana*, *Larix Americana* (first place that I had seen it on this river), *Picea rubra*, *P. alba*, *Abies balsamea*, *Kalmia*

angustifolia, *Rhodora Canadensis*, *Empetrum nigrum*, *Betula papyracea*, *Populus tremuloides*, *Melampyrum Americanum*, *Aralia nudicaulis*, *Pyrus Americana*, *Pteris aquilina*, *Aspidium filix-fœmina* (the only ferns observed) *Diervilla trifida*, *Viburnum cassinoides*, *Solidago latifolia*, one willow, two or three lycopodiums, a growth of lichens that covered the rocks in every direction, chiefly the Iceland Moss (*Cetraria islandica*). These plants were collected within a radius of 25 yards of the summit.

It seems rather odd that in the reports of the Dominion Natural History Survey there are so few records of the plant and animal life of the province, when the surface geology is reported with so much care and minuteness. Here, for instance, was found a plant (*Vaccinium uliginosum*), the most conspicuous one on the summit of Bald Mountain, which has not been detected in any other part of the province so far as I am aware.

The scenery along the Nipisiguit, from Bald Mountain to the lakes, is grand and picturesque. Lofty mountains, whose rounded or dome-shaped tops form fine positions for extended and uninterrupted views, were constantly in sight, presenting great temptations to climb. Storms of rain, accompanied with thunder and lightning, were of frequent occurrence and added to the grandeur of the scene. Just after one of these down-pours, and while the hills were reverberating with the distant thunder, we rounded a turn in the river and came upon a Virginia deer and her fawn bathing in a sheltered nook—a pretty woodland picture. Islands become more numerous as we ascend the river, and low meadows on which were growing elms, maples and butternuts. The tall grasses and ostrich ferns, from four to six feet in height, gave evidence of a rich soil, while the asters and Joe Pye-weed contrasted with the vivid green of the rich vegetation around. Passing Southwest Branch, which comes in almost at right angles to the main stream, we reached in a short time after Portage Brook, whose source is near the Upsalquitch Lake. We congratulated ourselves that we had not come by that route, as the water was too low to float our canoe. Islands now become more frequent, dividing the diminished water of the river, and making our course tedious and laborious.

About three o'clock one afternoon we came to a stream, probably the Little Forks of the Nipisiguit, and here we obtained one of the finest views on the river. Just behind us was a high mountain, not less, we supposed, than 1000 feet above the river, and forming an

abrupt ending to the straight piece of river we had just traversed. The top was a perfect dome in shape, bare on the summit, reflecting from its bronzed surface the afternoon sun in a thousand matchless colors.

As we approached the Nipisiguit Lakes the water became less rapid, but more shoal, with low grassy stretches along the river, in which were seen the tracks of moose and red deer. *Viburnum Opulus* and *Viburnum pauciflorum* were abundant on the low banks, with the royal fern in large clumps.

On Friday, August 19th, at 1.45 we reached a haven in the first Nipisiguit Lake, seventy-seven miles from Bathurst Harbor, on the twelfth day of our journey, and pitched camp Number Ten on a piece of low ground at the source of the river. Since leaving our guides at the Narrows we had made an average of six and one-half miles each day.

Next morning we started bright and early to explore the Nipisiguit lakes, four in number, connected by short thoroughfares. Nature smiled on us, for never was there a clearer or brighter morning. We enjoyed the rare luxury of sitting down and paddling our canoe. That was a red-letter day in our calendar. A moose was sighted, three plants new to the province were found, and a stream was discovered not laid down on the maps. Of course the moose was not captured, as moose hunting was out of season. The three plants found were *Ranunculus circinatus, myriophyllum alterniflorum*, and *Carex utriculata*, var. *minor*. The three Nipisiguit Lakes lying to the east are only ponds of little depth and with soft muddy bottom, each not more than from a half mile to a mile in length. Big Nipisiquit Lake is a fine sheet of water, over two miles long, very irregular in shape, especially on its northern side, where there are several islands, with a long ridge (moraine) extending into the lake and covered with a fine growth of red pine (*Pinus resinosa*), and flanked on each side by narrow bays extending far into the land. In the western bay we found the camping ground on which for generations past aborigines and white men, mighty hunters and guides, had encamped. Here we pitched our tent, and that night and next day (Sunday) we called up in imagination and made them pass in array before us that motley host of hunters and warriors that had ascended the Tobique, crossed the portage, and thence down the Nipisiguit. The land around these lakes toward the east is for some distance

low and flat, showing that at one time it was probably one large sheet of water. South and west the land abruptly rises into several lofty peaks, the highest of which is Teneriffe.

On Monday, August 22nd, we "carried" across the portage, nearly three miles, to the Tobique Lakes, and on Tuesday climbed Bald (Sagamook) Mountain, which rises on the south side of Nictor Lake. I ascended this mountain in the year 1884 with Mr. Chalmers of the Geological Survey, having the same season made the ascent of the Tobique and the portage across to the Nipisiguit Lakes.

On the 7th October of that year I read a paper before this Society giving some of the results of observations made on the Tobique, with some adjacent tributaries of the St. John, so that any extended mention is not now necessary.

The scenery of this portion of the province is strikingly wild and picturesque. The two lakes which give rise to the Little Tobique river have a united length of over four miles, and are joined by a rapid and crooked thoroughfare difficult to navigate. Both lakes are very irregular in outline, with rounded points and deep coves, with virgin forests on all sides, the abode of moose, deer and caribou. Shallow ponds at the east extremity are fed by two streams. The temperature of the water here was found to be 41°F., the lowest met with on our trip, the next coldest being that of the stream flowing into the south side of Big Nipisiguit Lake (49°F.). Two plants new to the province were found here, *Potamogeton heterophyllus* and *Pyrola secunda* var. *pumila*.

We reached Andover on our trip down the Tobique the 30th August, after a pleasant and safe run of nearly 100 miles, through rapids and quiet stretches of river, rendered all the more enjoyable from our toilsome ascent of the Nipisiguit.

The list of plants, recorded on another page, contains eight species and varieties not hitherto recorded in the province. I am indebted to Mr. Walter Deane, and others, of Cambridge, for their kind assistance in determining difficult species, and to Prof. L. H. Bailey, of Cornell University, for determinations of the carices.

Our northern rivers are better known to outsiders than they are to our own people. In the course of a summer's exploration among them you would meet with a dozen foreigners to one native of the province seeking sport, recreation and rest in those wildernesses where the only

sign of a habitation is an occasional white tent, the only sounds the voices of woodland songsters, the roar of the wind through innumerable trees, or the rushing waters through foaming rapids. To be sure it is the sport of salmon or trout fishing, or hunting, that draws so many to these northern streams. A few are tempted to seek rest in the solitude of a wilderness, whilst still fewer go with some scientific purpose in view, such as a better knowledge of our natural history and resources. The members of our Dominion and Provincial natural history surveys have done great service in this direction; but the results of their observations are contained in reports not sufficiently available for general purposes, and not sufficiently minute to suit the specialist. What is needed is a studied and systematic investigation of our forests, streams, mountains, plants and animals, in order to acquire a fuller knowledge of the soil, climate and capabilities of the province. This can be done to a great extent by amateur students trained in our schools and colleges to observe and report accurately upon the phenomena occurring about their own homes. They should be taught to make observations with the barometer and thermometer; to make weather reports daily; to study the rock exposures and soils; to make maps on which would be outlined the courses of the streams in their neighborhood, the lakes, cleared and wild lands, mountains, valleys and plains; to measure the length, course, velocity of current, depth at various points of small streams in their vicinity; to give the dimensions and depth of lakes; to measure the height of hills and mountains, thus acquiring an insight into the use of the barometer and level, and incidentally the importance of barometric readings at different places; to be able to distinguish at sight and classify the native plants and animals of the vicinity, with observations on their habits, mode of life, uses, appearance, occurrence. To these studies and observations might be added the survey of school grounds and adjacent fields, the dimensions and height of the largest trees in the neighborhood, the depth of the snow in the woods in winter, the dates of closing and opening of lakes and streams, the migrations of birds, and other data that I will not here stop to detail, but which would be of the greatest value to science if made with accuracy and regularity. But how is all this to be done, and who is to do it? will be asked.

Children are born observers and investigators. They will become interested in and readily undertake such observations as I have outlined above, under proper direction. Such work will not interfere with school work,—it will rather stimulate and encourage a greater

zest for knowledge at first hand. Very little of such work can be done in the schoolroom. So much the better, if it is not, provided that the impulse and direction come from the teacher, in the organization of an Out-door club, a Ramblers' club, an Observation club, a Snow-shoe club, or whatever it may be termed, provided there is a definite end in view. Interested students will not be satisfied with investigations in their own district. They will come to find out that every hill, every valley, every river, stream, lake, bog, has some peculiarity, in formation or in the life which inhabits it, which stamps it as different from every other hill, stream, lake, etc., found elsewhere. They will have an interest in comparing their own section with others, and hence will travel into other sections or meet with other students to compare the results of their observations. This is the spirit of investigation that is abroad everywhere in this nineteenth century, and one is surprised that it has not taken a greater hold in this province, where so much awaits the enthusiastic and keen-eyed explorer, and where such matchless scenery tempts him to its rivers and woodlands.

In Massachusetts out-door clubs are found everywhere through the state for the exploration of its mountains, hills and streams. Many individuals in these clubs are tempted by fishing, hunting, or the mere love of adventure, but others are investigating the occurrence and extent of plant and animal life, and other out-of-door problems, combining this free life with the healthful exhilaration that springs from quest and discovery which give tone and relaxation to body and mind. There have been many in our own province who have united this spirit of scientific investigation with a keen love of nature, and among many I may mention the late Edward Jack, C. E, whose knowledge of the natural history and resources of the province were gained through explorations for many years, during summer and winter, over large areas of New Brunswick. If the results of these explorations, which were published from time to time in newspapers and magazines in Canada and the United States, could be collected and published, they would stimulate many amateur explorers to collect and publish information about sections of the province that are too little known. We have all been greatly interested in the physiographic and natural history notes that Dr. Ganong has furnished this Society, the results of his explorations in different parts of the province; and we have endeavored to give the widest publicity possible to these notes, with the hope that they will direct the attention of our amateur

naturalists and explorers to the rich field for observation that awaits them in New Brunswick. Dr. Ganong has pointed out that the highest mountain in the province is as yet a matter of conjecture; that the heights of but very few mountains have been determined with any degree of accuracy; and that a vast amount of information in the location of tributary streams, in the size and depth of inland lakes, with thorough and accurate measurements of mountains, lakes, streams, is yet required before the maps in many sections of the province can be reconstructed with accuracy. While the distribution and occurrence of the flowering plants of the province have been determined fairly well in a few sections, others have had only a passing glance by a few of our botanists, while vast areas of the province have not been examined at all for plants. With the exception of our mosses, ferns and algæ, no attempts have been made since Professor Fowler's list was published in 1879 to publish lists noting the occurrence of our lichens and fungi, the investigation of which promise to yield rich results to the botanists of the future.

The examination into the occurrence and distribution of animal life has not been as complete as one might wish, and there is consequently much ignorance yet as to the distribution of species, even of the larger animals, found in the province. Since Mr. Chamberlain's list of birds and mammals was published many years ago, no additional results have been made public. Dr. Cox has been steadily working up the fishes. No one appears to be occupying the field of invertebrate zoology since Dr. Ganong published his results twelve years ago, and the field of insect life, in which Mr. McIntosh has made so promising a beginning in our own vicinity, has no worker outside of our society in the whole province,—at least no worker who publishes results. When this Society last year, through the generosity of a friend, offered a series of prizes for the best collections of weeds, insects and fungi, the results were meagre and disappointing, so far as the province at large is concerned. And yet the work done by our Society is on the whole very encouraging. It is to be hoped that as many as possible of our members will meet on the Restigouche this year with the Summer School of Science and give what encouragement we can to that body in its efforts to encourage the study of science.

But the workers are too few. Why is it? There should be hundreds of workers, not only in the cities but in the country districts, where now there is but one, or at least only a very few. These should be investigating and publishing their investigations in local papers, or

corresponding for information with the members of the Natural History Societies already established in the province. Is there a lack of interest in natural science among young people? There would not be if an interest is once aroused and some pains taken to maintain it. We all remember that when our summer camp was held at Lepreau what an active interest was taken in our investigations and at our evening meetings by the residents, both young and old, of the place. Two years ago, at St. Martins, you will remember what a large number of bright and intelligent students accompanied us on our excursions and gathered at our evening lectures. These had been trained to observe at the excellent school in that place; and it is to the teachers and schools that we must look for a foundation of the habit of trained observation, if the natural history of the province is to be studied so that the results will far exceed what has been accomplished already. The grand scenery of our province, its resources and natural history, should be examined by scores of active and enthusiastic young people to collect data, for which the scientific world has long been patiently waiting. But the greatest advantage would be to young people themselves in awakening their interest in the capabilities and fine natural scenery of New Brunswick, thus begetting a wholesome admiration and respect for their own country—a kind of loyalty that needs to be patiently and insistently cultivated.

REPORT OF THE BOTANICAL COMMITTEE.

The Committee on Botany reports the discovery of several species and varieties of plants new to the province, to which may be added the occurrence in fresh localities of a few of our rarer species, which will furnish data in the preparation of a revised list of New Brunswick plants. The committee regrets that there are so few workers, and would urge on all interested in this science the importance of investigating and making yearly reports of the plants which may come under their observation, either in their own vicinity or in their excursions from home. Such information in regard to our weeds, as well as of our fungi and other plants too little known, is greatly needed.

In the list appended the names of species and varieties new to the province are printed in full faced type. The numbers correspond to those in Fowler's catalogue (Bulletin IV). All those found on the Nipisiguit and Tobique lakes and rivers were collected by Messrs. Ganong and Hay on their recent trip across the province.

10*a*. **Ranunculus circinatus,** Sibth. Nipisiguit Lakes.
222*a*. **Myriophyllum alterniflorum,** D. C. Nipisiguit Lakes.
240 Cicuta bulbifera, L. Nipisiguit Lakes.
248 Conioselinum Canadense, Torr and Gray. Nipisiguit River.
285 Viburnum panciflorum, Pylaie. Nipisiquit River.
266*a*. V. acerifolium, L. Parish of Dufferin, Charlotte Co. Vroom.
311 Aster Novi-Belgii, L. Nipisiguit River.
312*a*. A. junceus, Ait. Nipisiguit River.
314 A. linariifolius, L. Nipisiguit River.
346 Artemisia caudata, Michx. Bull's Island, opposite Woodstock. Hay.
391*a*. **Vaccinium uliginosum,** L. Bald Mountain, Nipisiguit River.
406 Pyrola secunda, L., *var.* **pumila,** Gray. Head of Tobique Lakes.
407 P. chlorantha, Swartz. Nipisiguit River.
347*a*. Euphorbia maculata, L. Denis Stream, near St. Stephen. Vroom.
665 Juncus Balticus, Dethard. Nipisiguit River.
671 J. pelocarpus, E. Meyer. Nipisiguit River.
679 Sparganium simplex, Hudson. Nipisiguit River.
697 Potamogeton Spirillus, Tuckerman. Nipisiguit Lakes.
701*a*. **P. heterophyllus,** Schreb. Tobique Lakes.
707 P. pusillus, L. Nipisiguit Lakes.
758 Carex Scoparia, Schk., *var.* minor, Boot. Nipisiguit River.
768 C. stricta, Lam., *var.* ———. Nipisiguit River.

776 C. fusca, All. Nipisiguit River.
783*a*. C. laxiflora, Lam., *var.* **varians,** Bailey. Nipisiguit River.
799 C. filiformis, L. Nipisiguit River.
800 C. lanuginosa, Michx. Nipisiguit River.
811 C. utriculata, Boot., *var.* **minor,** Boot.
834 Alopecurus geniculatus, L. Nipisiguit River.
940 Lycopodium complanatum, L., *var.* **Chamæcyparissus,** Nipisiguit River.

I am indebted to Mr. Walter Deane and others, of Cambridge, Mass., for identification of difficult species, and to Prof. L. H. Bailey, of Cornell University, for decisions on the carices.

G. U. HAY,
Chairman Committee on Botany.

REPORT ON ZOOLOGY.

The Committee beg to submit the following notes. Mr. McIntosh has prepared a list of the Butterflies found in the province, which will be found in another part of the Bulletin. Next year it is the intention to publish further lists of our insects. The committee are pleased with the great interest taken at the present time in zoological studies in the province.

INSECTS.

During the present year, insects have not been noticeably injurious with perhaps the exception of the Tussock Moth, **Orgyia leucostigma.** Many of the trees in the city and suburbs were almost completely defoliated by the caterpillars of this species, and judging from the number of eggs on the trees at the present time. they will be very numerous during the coming summer.

WM. MCINTOSH.

BATRACHIANS.

Hitherto but five species of Ranidæ have been recorded as found in New Brunswick. Rana catesbiana, R. clamata, R. virescens, R. silvatica and R. palustris. (See Bulletin XVI. pp. 64-66, 1898.)

It has been my good fortune, during the past season, to be able to add to the list the Northern or Mink Frog, Rana septentrionalis.

The first specimens, which were identified by Dr. Philip Cox, were taken in a small lake near Golden Grove Road. I afterward saw two other specimens at Murphy's Lake, near Treadwell's place, on the Loch Lomond Road, but only succeeded in capturing one of them.

The specimens taken were as follows:—Length, two-and-a-half inches; back, dark brown, almost black with lighter greenish vermiculations; white underneath, with a slight tinge of yellow on throat; muzzle green; limbs more mottled than barred, much the same as back; tympanum slightly smaller than eye, colored brown. Fold-down sides of back very slight, if any.

The markings of the backs of the younger were not so perfect as on those full grown, and there were two rows of large oblong blackish spots down the back, which are hardly discernible in the adults.

CHAS. F. B. ROWE.

BIRDS.

The numbers refer to the list of birds printed in Bulletin 1, 1883.

SECTION A.

(Species which occur in St. John and Kings Counties.)

147. Knot. Robin Snipe (Tringa canutus). A rare autumn visitant and only one reported as taken at St. Martins on September 8, 1881.

NOTE.—A female taken at Red Head Beach on September 5, 1898, by Wm. Hare.

152. Red-backed Sandpiper. "Dunlin" (Tringa Alpina Pacifica) a rare autumn visitant, two records, one each of 1 and 4.

NOTE.—A female taken at Quaco on October 12, 1898, by George Hare, Esq.

197. Rurdy Duck (Erismatura rubida). Only two instances of its occurence known (in addition a male and female were reported in Bulletin XVI (page 74) and I now have in my collection a female taken at Wickham, on November 4th, 1898, by John Craft.

A. GORDON LEAVITT.

A. GORDON LEAVITT.
WILLIAM McINTOSH,
CHAS. F. B. ROWE,
Zoological Committee.

METEOROLOGICAL ABSTRACT FOR 1898.

OBSERVATIONS RECORDED AT ST. JOHN OBSERVATORY. LATITUDE, 45° 17' N.; LONGITUDE, 66° 4' W.

METEOROLOGICAL ABSTRACT FOR 1898.

OBSERVATIONS RECORDED AT ST. JOHN OBSERVATORY. LATITUDE, 45° 17′ N.; LONGITUDE, 66° 4′ W.

D. L. HUTCHINSON, Director.

	Barometer.			Temperature.			Cloudiness: 0=Clear. 10=wholly clouded.	Precipitation Rain and Melted Snow.	Wind Direction and Velocity.																		Thunder Storms.
									N.		N. E.		E.		S. E.		S.		S. W.		W.		N. W.				
	Mean.	High st.	Lowest.	Mean.	Maximum.	Minimum.			Hours.	Miles.	Hours.	Miles.	Hours.	Mile s.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Calms.	Total Miles.	
January	29.96	30.68	28.94	16	42 9	– 14.6	5	5.11	177	1271	74	796	26	243	24	344	33	590	40	599	59	665	174	2736	137	7,244	1
February	30.09	30.70	29 02	26.7	41.8	– 2.6	7	3.59	71	465	147	1881	38	364	35	407	63	831	64	755	37	248	124	1337	93	6,288	0
March	30.20	30.95	29.44	33.6	52 7	16.5	5	2.38	70	602	46	415	13	53	37	263	186	1426	123	1239	13	114	44	2432	112	6,544	0
April	29.90	30.41	29 33	38 2	61.5	21 5	7	5.47	50	434	231	2818	24	205	51	366	33	133	62	601	30	225	154	2277	85	7,059	0
May	29.98	30.41	29 61	48.9	68.3	29.2	6	1.27	42	349	145	1216	22	126	113	765	131	758	123	1179	4	26	55	729	109	5,148	0
June	29.94	30.43	29.37	56 4	73.5	44	7	2.38	15	79	130	1019	22	99	94	558	186	1019	80	870	8	32	114	1715	71	5,391	0
July	30.04	30.52	29.62	64.4	78.5	18	6	1.26	29	230	49	369	18	66	121	634	232	1399	112	971	6	27	62	474	115	4,170	1
August	29.96	30.28	29.66	62.5	77	49 5	7	3.26	18	97	49	294	66	396	103	432	220	1141	74	878	10	112	68	605	136	3,955	1
September	30.02	30.43	29.50	55.8	81.2	32.5	4	4.04	14	47	51	333	21	105	80	400	95	472	112	1249	44	515	158	2247	145	5,368	1
October	30.10	30.62	29.41	47.1	73	29.5	6	7.50	39	392	125	958	23	102	73	950	41	267	166	2422	12	98	159	2182	106	7,371	0
November	29.96	30.53	28.98	38.2	56.5	19.3	8	4.19	134	1675	167	2657	33	332	18	241	34	600	91	1378	30	383	144	1558	69	8,824	0
December	29 95	30.67	29.19	23.9	44.2	– 8.7	7	4.21	37	322	115	1069	29	252	26	561	9	144	110	1414	111	1428	276	3904	31	9,094	0

Barometer readings reduced to sea level and 32° Fahrenheit. The – when used indicates temperature below zero. The maximum temperature, 81.2, was registered on the 6th September; the minimum, – 14.6, on the 31st January.

MAGNETIC DISTURBANCES.

I am indebted to Mr. W. P. Robinson, of the Canadian Pacific Telegraph Co., for the following note:

The last magnetic disturbances of a serious nature were on September 9th, 1898, covering a period of five hours—from 11 A.M. to 5 P.M., St. John local time. The earth currents on this occasion were very constant. We worked with Fredericton part of the time without battery at either end. Although the manifestations of aurora were brilliant that evening, our circuits were not affected at all after 5 P.M. During the hours mentioned all circuits, east and west, were affected. March 14th and 15th of 1898 we also observed magnetic disturbances, on the latter date particularly being of unusually troublesome nature. On that date the aurora was of remarkable brilliance. We were affected between 2 and 9 P.M., local time. S. W. K.

EARTHQUAKE SHOCK, AUGUST 14, 1898.

A slight earthquake shock was felt on the above date at points on the St. John River between Torryburn and Oak Point. The first shock was felt at 3.09 A.M., the second at 3.14 A.M. (75th meridian time). The first shock was preceded by a slight noise; the second shock was sufficiently strong to overturn light objects, and aroused many of the residents at Ingleside, Westfield, Hampstead, Oak Point and Rothesay. Mr. Shewen, who was at Rothesay, said it seemed like a train approaching, followed by a shaking of the house. It was felt most severely in the vicinity of Oak Point.

S. W. KAIN.

THIRTY-SEVENTH ANNUAL REPORT OF THE COUNCIL

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

Your Council beg leave to submit the following report for the year now ending:

The past year has been both active and progressive. More frequent opportunities have been afforded the public to visit the museum. The lecture courses have been excellent alike in variety and interest, and the attendance at meetings more than usually satisfactory.

Membership.

Thirty-six members were added to the rolls in the course of the year; but we have had losses, caused by resignations, change of residence and death, which have reduced the actual gain to the Society to twenty members.

We have to record the deaths of Henry F. Perley, who was for many years a life member; and of Mrs. Charles Medley, who took a warm interest in the Society and its work.

Finances.

The Treasurer makes the following statement:

Receipts.

Balance from 1898	$ 31 56	
Membership Fees	196 00	
Bulletins sold	13 00	
Interest on Investments	144 00	
Donations	37 00	
Dividends from Botsford Estate	30 00	
Prizes from Exhibition Association	20 00	
Donation, James Manchester, Esq	100 00	
Government Grant	125 00	
Carried forward		$696 56

Receipts carried forward		$696 56

Expenditure.

Printing and distribution of Bulletin XVI	$145 56	
Prizes for Provincial Exhibition	100 00	
Maintenance of Museum	223 74	
Library: Books and binding	40 00	
Miscellaneous	89 19	
Balance	98 07	
		$696 56

It will be seen that a balance remains on hand, but the whole amount will be required for the publication of Bulletin XVII.

Library.

For the first time in several years we are in a position to announce real improvement in this department. After some correspondence certain numbers required to complete several important series have been secured. Sixty volumes have been bound. Not only have important additions been made by exchange, but some works on Entomology and Geology have been purchased, thus providing students in these branches with much-needed text books. The librarian recommends the publication of a catalogue.

Publications.

Bulletin XVI, which was issued in the month of August, differs from its predecessors in the size of the page, which has been enlarged. It was necessary to print an edition of 600 copies, instead of 500 as formerly, in order to meet the demands made upon it by a large and growing exchange list and membership.

The articles are valuable and have been read with interest. Dr. L. W. Bailey, S. W. Kain, John Moser, Dr. Matthew, Dr. W. F. Ganong, and Dr. Philip Cox, each contributed.

The reports of the Fredericton Natural History Society, and the Kings County Natural History Society, find a place in our Proceedings.

Museum.

A new insect cabinet has been obtained, and good work has been done by expert entomologists in naming specimens.

Among important accessions in other branches, the donations of Dr. Reynold J. Kirkland, of Grand Rapids, Michigan, Miss Warner, and Geoffrey Stead, C. E., are worthy of special notice.

LECTURES AND ESSAYS.

Nine regular meetings were held at which the following papers were read:

1898.

Feb'y 2. (1) Study of Insects, by Wm. McIntosh.
(2) Note on Turtles' Nests, by Henry F. Perkins.

March 1. (1) New Brunswick Thunder Storms in 1897, by S. W. Kain. (Published in U. S. *Weather Review*, pp. 105-106, March 1898.)
(2) Gun Reports at Grand Manan, by W. B. McLaughlin.
Published in U. S. *Weather Review*, March 1898, together with articles by Prof. W. F. Ganong and others on the same subject.
This reprint reviewed in *Nature*, p. 353, August 11, 1898.
Nature, for June 9, 1898, p. 130; also gives synopsis of studies by an Italian on similar sounds in Umbria.
(3) Mean Sea-level at St. John, by E. T. P. Shewen, C. E. (Published in Bulletin XVI, p. 78, 1898).
(4) Physiography of the Lepreau Basin, by Prof. W. F. Ganong.
(5) Note on Crayfish in New Brunswick, by Prof. W. F. Ganong.
(6) Note on Marine Invertebrates of the Western part of Bay de Chaleur, by Prof. W. F. Ganong.

April 5. (1) Biographical Sketch of late R. Foulis, C. E., by Percy G. Hall. (Published in *New Brunswick Magazine*, Vol. I, pp. 247-256, 1898.
(2) Habits of Birds, by A. Gordon Leavitt.

May 3. Notes on the Trees of New Brunswick, by W. S. Butler.

June 7. (1) Report of Delegate to the Royal Society, by W. J. Wilson.
(2) Early Forms of Decoration and Art, by Miss Jack.

Oct. 4. (1) Geological and Topographical Features of Newfoundland, by Dr. Geo. F. Matthew.
(2) Notes on Some Phenomena in Grand Manan, by D. I. W. McLaughlin. (Published in St. John *Globe*, October 6th, 1898). Describes remarkable sound heard at midnight, September 15th, 1898; auroral display on evening of September 17th; very heavy ground swell on September 18th. Attributes the heavy swell to hurricane which swept over West Indies on September 10th.
Prof. A. W. Duff, among letters to the editor in *Nature*, Vol. LIX, pp. 247-248, January 12th, 1899, refers to this heavy ground swell in explaining the nature and cause of secondary undulations in the Bay of Fundy and elsewhere.
(3) Note on Lack and Cost of a Topographical Survey of New Brunswick, by Prof. W. F. Ganong.

Nov. 1. (1) Note upon Natural Pavements and their possible misinterpretation in Archæology, by Prof. W. F. Ganong.
(2) Note, Attempts at Oyster Culture in Passamaquoddy Bay, by Prof. W. F. Ganong.

1898.

Nov. 1. (3) Bird Enemies, Natural and Unnatural; and why Birds should be Protected, by A. Gordon Leavitt.

Dec 6. (1) New Brunswick Butterflies, by W. McIntosh.

(2) Note on the Dip of the Magnetic Needle in New Brunswick, by Prof. A. Wilmer Duff.

(3) Preliminary Outline for a Study of the Precise Factors Determining the Features of New Brunswick Vegetation, by Prof. W. F. Ganong.

(4) Note on the Nature of the Mud in our many Mud Lakes, by Prof. W. F. Ganong.

1899.

Jan. 3. (1) Note, Upon Biological Opportunity in New Brunswick, by Prof. W. F. Ganong.

(2) Note, Upon a Current Error as to the Location of (Nictor) Bald Mountain, Tobique, by Prof. W. F. Ganong.

(3) Address, Economic and Social Conditions in Newfoundland, by W. Frank Hatheway.

Elementary Series.

1898.

Jan. 11, 25. Elementary Talks and Laboratory Work on Bog and Pond Deposits, directed by Dr. Geo. F. Matthew.

Feb. 8, 15, 22. Talks and Laboratory Work on Plants, directed by President Geo. U. Hay.

March 15, 22. Talks and Laboratory Work on Insects, directed by Wm. McIntosh.

March 29. Notes on Batrachians and Reptiles of New Brunswick, by Chas. F. B. Rowe.

April 12, 19. Talks and Laboratory Work on Birds, directed by A. Gordon Leavitt.

The Associates' Afternoon Series.

The weekly lecture, held on Thursday afternoon of each week, enjoyed considerable popularity. Papers were read by Miss Jack, Miss Eleanor Robinson, Miss Frances Murray, Miss Christine D. Matthew, Dr. Geo. F. Matthew, Robert Matthew, and S. W. Kain.

General.

We have pleasure in announcing the complete success of the assistant librarian scheme. The requisite number of new members was found, and their fees amply covered all expenses. The assistant has been at her post on Tuesday, Thursday and Saturday afternoons, performing her duties in a manner that has given entire satisfaction. Nor have her duties been light, for a great increase of visitors has resulted. Formerly about one hundred and fifty persons registered in the course of a year; during the past year over eleven hundred.

names are entered, and as many as fifty persons (in this case mostly school children) have examined the collections in a single afternoon. No better argument for the continuance of the plan of more frequently opening the museum to the public could be produced. The conversazione held on the evening of June 29th, in honor of the members of the Teachers' Institute, was a very pleasant affair, in spite of the fact that the rooms were somewhat crowded. Addresses were delivered by His Honor the Lieutenant Governor, His Worship Mayor Sears, and others, after which the guests circulated through the museum, finding much that was interesting and curious.

By the generosity of a well-known citizen the Society was enabled to offer prizes for the best collections insects, weeds and fungi. Circulars setting forth the conditions of the competitions were distributed throughout the province. Prizes were awarded for six collections,—four for insects, two for weeds.

Such competitions we believe to be very useful in stimulating the study of natural history, and we trust that we may again be permitted to offer such inducements to the young naturalists of our province.

At the request of the Exhibition Association the Society occupied considerable space alongside of the exhibit of the Provincial Government. The prize collections of plants were displayed on this occasion, together with a lot of ores and other minerals and constituted an attractive feature of the fair.

The Committee on Economics has continued to urge upon the Dominion Government the desirability of erecting a plant for the creosoting of timber at St. John. We believe that the government is alive to the wisdom of such a course, and hope that they will soon take steps in the matter.

Our thanks are due to the editors of the daily papers of St. John for the free insertion of notices and reports of meeting, and to the ladies and gentlemen who contributed to the various courses of lectures.

In the past year the Society has gained in membership, the lecture courses have been more varied and extensive, the additions to the museum and library have been important, and many hundred visitors have been attracted to the museum, including many of our young people, in some of whom has doubtless been awakened an interest in natural history, and from whom the ranks of our Society may in the future be recruited. Respectfully submitted,

PERCY G. HALL,
Secretary to Council.

Natural History Rooms, Market Building,
January 17th, 1899.

FREDERICTON NATURAL HISTORY SOCIETY.

(Instituted February 2nd, 1895.)

The officers for the current year are:

L. W. Bailey, Ph. D.,	*President.*
G. N. Babbitt,	*Vice-President.*
John Brittain,	*Secretary.*
B. C. Foster, M. A.,	*Treasurer.*
H. H. Hagerman, B. A.,	*Curator.*

Eight regular meetings were held during the year, at which papers were read as follows:

1898.

Mar. 21. Radiate Animals, by Dr. Bailey.
Apr. 18. Electricity and the X-rays, by Dr. Bailey and Mr. G. N. Babbitt.
May 16. Jottings by the Way, by Very Reverend Dean Partridge.
June 20. Under the Southern Cross, by Mr. H. E. West.
Oct. 17. Coal, by Dr. Bailey.
Nov. 21. The Woodpeckers of New Brunswick, by W. H. Moore.
Birds and their Ways, by John Brittain.
Dec. 19. The Mountain Systems of North America, by Dr. Bailey.

1899.

Jan. 16. Electricity, by H. H. Hagerman, B. A.

Several donations have been made to the museum during the year.

JOHN BRITTAIN,
Secretary.

KINGS COUNTY NATURAL HISTORY SOCIETY.

(Organized at Sussex, Kings County, N. B., October 2nd, 1897.)

The society had for president Mr. Robert King, A. B., until September 3rd, 1898, when he resigned on account of moving to Montreal, and Inspector R. P. Steeves, A. B., was elected president.

During the year closed October 1st, 1898, the society held ten regular meetings.

The work of the year has been along the lines of collecting specimens and reading of papers on scientific subjects. There have been added to the scientific collections, eighty specimens in the five branches, as follows: Geology and Mineralogy, 24; Entomology, 20; Ornithology, 16; Zoology, 4; and Botany, 16.

During the year the following papers were read before the society:

1897.

Dec. 4. Sea Plants in the Interior of New Brunswick, by R. King, A. B.

1898.

Feb. 5. Plaster of Paris Methods in Blow Pipe Analysis, by R. King, A. B.
March 5. The Chicadees, by H. J. Perry.
5. A Canoe Voyage on the Restigouche, by G. U. Hay.
April 2. Our Winter Birds, by W. N. Biggar.
2. An Ice Age, by W. A. Alward, A. B.
May 7. The Structure and Characteristics of Birds, by Dr. S. H. Langstroth.
7. Spring Birds, by W. N. Biggar.
June 4. Spring Flowers of Kings County, by Milton Price.
Sept. 4. Characteristics of the Frog, by Annie White.

The society has a registry department, with four divisions, for recording observations in—Migrating of Birds, Leafing and Flowering of Plants, Changes in Weather, and Observations in Insect Life. Each division is under the management of an officer elected by the society.

During the year the society received as donations a number of books from members, a set of Bulletins and Bye-Laws from the N. B. N. H. Society, and a fine miscroscope from Mr. E. A. Charters.

Regular meetings are held in the Oddfellows' Hall the 1st Saturday in each month, a 8 o'clock p. m.

WM. N. BIGGAR,
Secretary.

THE NATURAL HISTORY AND ANTIQUARIAN SOCIETY OF PRINCE EDWARD ISLAND.

On the 28th March, 1889, Donald Montgomery, Superintendent of Education in the Province, invited those interested to attend a meeting in his office for the purpose of forming a Natural History Society. Six gentlemen attended, but from this small beginning a vigorous society developed, and continued its active co-operative work until the winter of 1891-92, when it decided to discontinue its regular public meetings lest they should in any way interfere with a course of lectures upon Botany, being delivered under the auspices of the local University Extension authorities, by Mr. Francis Bain, whose lamentable death, in November 1894, was a great loss to the Society in that it robbed it of its most valuable member and most frequent contributor to its lecture course. Still, while no public meetings were held, the Society continued to exist, and it was felt that it would be desirable to widen its scope, and thereby lighten the work of the few already over-busy members upon whom would devolve the task of preparing papers for the public meetings. Accordingly at a meeting held January 10th, of this year, the Society was re-organized with above name, having added to its work the study of Provincial antiquities.

The following are the officers:

John Newson, Esq., - - - - - - - - - - *President.*
John MacSwain, Esq., - - - - - - - - - *Vice-President.*
Lawrence W. Watson, M. A., - - - - - - - *Secy-Treas.*
The above and Miss Peppy, Messrs. J. M. Duncan,
J. D. Seaman and W. J. Bulman, - - *Executive.*

The new society hopes to publish a periodical Bulletin (probably quarterly) and desires exchanges, which may be addressed to the Secretary at Charlottetown, P. E. I.

To give an idea of the work already done, we append a list of papers read before the original society.

1889.

July 2. The Study of Island Botany. Francis Bain.
Sept. 4. The Ferns of P. E. Island. John MacSwain.
25. The Asters of P. E. Island. Francis Bain.
Nov. 14. Some Enquiry into the Ethnology of the Island. Col. J. Hunter Duvar.

1890.

April 20. The Red Sand-Stone of P. E. Island. Francis Bain.
May 12. Carnivorous Plants. Lawrence W. Watson, M. A.
June 9. The Animals of P. E. Island at the Beginning of the Nineteenth Century. Geo. F. Owen.
July 14. Our Forest Trees. Hon. David Laird, P. C. (President).

1891.

The Proposed Subway to the Mainland. Francis Bain.
Feb. 2. Insect Intelligence and Instinct. T. Leeming, M. D.
23. The Diseases of the Potato. John MacSwain.
Mar. 12. Plants and their Uses. Rev. W. Hamlin, B. A.
Apr. 5. Plant Food and How they Obtain It. Prof. Schuttleworth.
13. The Life History of the Butterfly. L. W. Watson, M. A.

The Society has published several lists of plants of the province by Messrs. MacSwain and Bain, which will likely appear, revised or supplemented, in the proposed Bulletin of the Society.

DONATIONS TO THE LIBRARY, 1898.

Donor's Name.	Residence.	Work.
Royal Geographical Society	London	Journal.
Trustees British Museum	do	Guides.
Royal Society	do	Proceedings.
Royal Colonial Institute	do	Journal.
Geological Society	do	Abs. of Proceedings.
Director Royal Gardens	Kew	Bulletins.
Manchester Geological Society	Manchester	Proceed. and Trans.
Biological Society	Liverpool	do
Liverpool Geological Society	do	do
Marine Biological Association	Plymouth	Journal.
Naturalists' Field Club	Belfast	Report.
Philosophical and Literary Society	Leeds	78th Report.
Natural History Society	Glasgow	Proceedings.
Royal Society of Canada	Ottawa	Proceed. and Trans.
Ottawa Field Naturalists' Club	do	Ottawa Naturalist.
Department Inland Revenue	do	Bulletins.
Department of Agriculture	do	Census Reports.
Experimental Farms	do	Bulletins.
Literary and Scientific Society	do	Transactions.
Entomological Society of Ontario	London, Ont	Can. Entomologist.
Hamilton Association	Hamilton	Journal.
Natural History Society	Montreal	Can. Record of Scien.
Historical and Scientific Society of Manitoba	Winnipeg	Report.
Nova Scotia Institute of Natural Sciences	Halifax	Proceedings.
Canadian Institute	Toronto	Transactions.
Toronto Public Library	do	Report.
Astronomical and Physical Society	do	Transactions.
R. F. Stupart	do	Weather Review.
Government of British Columbia	Victoria	Mining Record.
Dr. Geo. F. Matthew	St. John, N. B.	Pamphlets.
Samuel W. Kain	do	Six Volumes.
New Brunswick Historical Society	do	Collections.
G. U. Hay	do	3 vols. His. Mank'd.
Scientific Association of Trinidad	Port of Spain	Proceedings.
Australian Museum	Sydney, N. S. W.	Report.
Australian Association for Advancement of Science	do	do
Linnæan Society of N. S. W	Elizabeth Bay	Proceedings.
New Zealand Institute	Wellington, N. Z.	Proceed. and Trans.
U. S. Bureau of Ethnology	Washington	Reports.
U. S. Geological Survey	do	Reports and Bulletins
U. S. Fish Commission	do	do
U. S. National Museum	do	Reports and Procecd.
U. S. Dep't. of Agriculture (Botanical Division)	do	Bulletins.
U. S. Coast and Geodetic Survey	do	Report.
U. S. Weather Bureau	do	Weather Review.
Smithsonian Institution	do	Report.
University of California	Berkeley, Cal	Bulletins.
Cornell University	Ithaca, N. Y.	Bulletins.
John Hopkins University	Baltimore	Circulars.
Leland Stanford, Jr., University	Palo Alto, Cal.	Proceedings.
Boston Society of Natural History	Boston	do.
Essex Institute	Salem	Transactions.
Maine State College	Orono	Bulletins.
Society of Natural History	Buffalo	do
Academy of Natural Science	Davenport, Iowa	Proceedings, 6 vols.
Geological Survey of Iowa	Des Moines	Report. Vol. VII.
Iowa Academy of Sciences	do	Proceedings.
New York Academy of Sciences	New York	Journal
New York Microscopical Society	do	Abstract of Proceed.
Linnæan Society of New York	do	Report.

DONATIONS TO THE LIBRARY—*Continued.*

DONOR'S NAME.	RESIDENCE.	WORK.
American Museum of Natural History	New York	Bulletin.
New York Public Library	do	Bulletins.
University of New York	Albany	Museum Report.
Colgate University	Hamilton	Circulars.
Natural Science Association of Staten Island	New Brighton	Proceedings.
Rochester Academy of Natural Sciences	Rochester, N. Y.	do
Society of Natural History	Cincinnati	do
Academy of Natural Science	Philadelphia.	do
Minnesota Academy of Natural Sciences	Minneapolis	Bulletins.
Texas Academy of Science	Austin	Transactions.
Indiana Academy of Natural Sciences	Indianapolis	Proceedings.
California Academy of Sciences	San Francisco	do
Colorado Scientific Society	Denver	Transactions.
C G. Lloyd	Cincinnati	Plates.
Missouri Botanical Gardens	St. Louis	Report.
Field Columbian Museum	Chicago	Publications.
Societe Scientifique du Chili	Santiago	Actes.
National Museum	Montevideo	Annales.
Royal Academy of Science	Stockholm	Proceedings.
Comite Geologique du Russie	St. Petersburg	Memoirs.
Imperial Academy of Sciences	do	Bulletins.
Royal Academy	Barcelona	do
Ch. Janet	Paris	Pamphlets (8).
Institute of Geology	Mexico	Bulletins.
Geological Institute	Upsala	do
Royal Society of Belgium	Brussels	do
G. O. Sars, Esq	Christiania	Fauna Norvegiæ.

PURCHASED.

Insect Life. Vols. I–IV.

Insects of New York. Vols. I and II.

Manual of Paleontology, by Alleyne Nicholson. Vols. I and II.

A Text Book of Entomology, by Dr. A. S. Packard.

Manual of Entomology, by Comstock.

DONATIONS TO THE MUSEUM, 1898.

DATE.	DONOR'S NAME AND DESCRIPTION OF ARTICLE.
March	UNITED STATES NATIONAL MUSEUM. 17 Fossil Plants of the Richmond (Va.) coal field, ("Rhœtic"); 40 Fossil Plants of the Potomac formation.
	MR. ALFRED MORRISEY. Japanese Bird Skins.
	MR. GEO. E. FAIRWEATHER. Two St. John papers of the year 1789.
April	MR. JAS. PATTERSON. Number of Marine Forms preserved in alcohol.
	DR. R. J. KIRKLAND, Grand Rapids, Mich. 250 Fresh Water and Land Shells.
May	PROF. JAS. FOWLER, Kingston, Ont. Number of mounted plants.
June	E. T. P. SHEWEN, C. E. Specimens of polished marble from Bras D'Or, C. B.
	MR. A. H. HANINGTON. Cocoon of the Emperor Moth.
October	MRS. JAS. WARNER. Collection of Shells, Egg cases of Conch Shell, Spawn of Ray, from Gulf of Mexico.
	MISS AGNES L. WARNER. Collection of New Brunswick plants.
	MR. W. FRANK HATHEWAY. Stone Gouge, from Random Sound, Newfoundland.
	MR. SAMUEL LYONS. Stone Gouge, from Westfield Beach.

DONATIONS TO THE MUSEUM.—*Continued.*

Date.	Donor's Name and Description of Article.
October	Geoffrey Stead, C.E. Geological specimens from New York.
Nov.	Mr. A. Gordon Leavitt. Black-backed Gull; Ichneumon Fly.
	Mr. C. G. Knott. Diseased root of Viburnum cassinoides.
	Mr. Robert Murdoch. Diatomaceous Earth.
Dec.	Mrs. Percy Owen-Jones. Granite ball, from Pot Hole, Peterboro, Ont.
	Miss Harriet Peters. Slate from Cape Town, South Africa (near home of Cecil Rhodes).
	Dr. Babbitt. Stone Pestle; Skin roller and Arrow Heads, from Oregon.
	Miss Nannary. Ink-stand of California minerals, Bark and wood of big redwood tree, California shells.

DONATIONS TO THE FUNDS, 1898.

James Manchester, Esq. (for Exhibition Prizes)	$100 00
Anonymous	37 00
	$137 00

Officers and Committees of the Natural History Society for 1899.

Patron.

His Honor the Lieutenant Governor, Honorable A. R. McClelan.

Council for 1899.

President—Geo. U. Hay, M. A., F. R. S. C.
Vice-Presidents—William Murdoch, C. E., H. Geo. Addy, M. D.
Treasurer—Mr. A. Gordon Leavitt.
Secretary—Mr. Chas. F. B. Rowe.
Librarian—Mr. Samuel W. Kain.
Curators—Dr. Geo F. Matthew, W. McIntosh.
Additional Members—J. Roy Campbell, W. Frank Hatheway, W. H. Mowatt.
Assistant Librarian and Curator—Miss Edith McBeath.

Associate Members' Branch.

President—Mrs. Geo. F. Matthew.
Secretary-Treasurer—Miss Edith McBeath.

Standing Committees for 1899.

Physics—Wm. Murdoch, Prof. A. Wilmer Duff, E. T. P. Shewen, C.E.
Geology—Dr. G. F. Matthew, Prof. L. W. Bailey, Geo. J. Trueman.
Ornithology—A Gordon Leavitt, A. Morrisey, Miss Annie Page.
Botany—George U. Hay, Mrs. William Bowden, James Vroom, Mrs. H. Geo. Addy, Prof. W. F. Ganong.
Archæology—Samuel W. Kain, F. E. Holman, William Mowatt, Miss Alice Jack.
Library—Samuel W. Kain, Mrs. George U. Hay, C. F. B. Rowe, Mrs. W. F. Hatheway.
Rooms—Dr. H. Geo. Addy, Miss K. A. M. Cotter, Mrs. Geo. U. Hay, C. F. B. Rowe, Wm. McIntosh, Mrs. F. E. Holman.
Finance—A. Gordon Leavitt, J. Roy Campbell, W. F. Hatheway.
Press—Samuel W. Kain, A. Gordon Leavitt, C. F. B. Rowe, Miss Theodora Matthew, Miss Edith McBeath.
Lectures—Geo. U. Hay, Miss A. Jack, Dr. H. Geo. Addy, S. W. Kain. A. Gordon Leavitt.
Publications—Dr. G. F. Matthew, Samuel W. Kain, George U. Hay, A. Gordon Leavitt.
Microscopes—Dr. W. W. White, Wm. McIntosh, Chas. F. B. Rowe.