BULLETIN

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

No. XI.

PUBLISHED BY THE SOCIETY.

ST. JOHN, N. B.:
BARNES & CO., PRINCE WM STREET.
1893.

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THE CLIMATE OF ACADIA IN THE EARLIEST TIMES.

(Annual Address by G. F. Matthew, M.A., F.R.S.C.)

Warm-Water Faunas and Cold-Water Faunas of the Modern World Contrasted.

Climate may be shortly defined as the condition of a place in relation to the various phenomena of the atmosphere, as temperature, moisture, winds, etc. These vary with the geographical position, the altitude and other conditions. We are familiar with these climatic peculiarities upon the land, but in a similar way the surrounding conditions impress themselves upon *submarine* tracts in the ocean, affecting the distribution of life beneath its waters. Thus there are submarine climates as well as terrestrial ones, and these sometimes very diverse from each other, in closely contiguous regions.

Climatic differences have existed on the globe in times past, as they do at the present day, and my endeavor this evening will be to bring before you some proofs of the variations of subaqueous climate in this part of America, in the

very earliest periods of which geology has cognizance by mean of organic remains, and of terrestrial climate in the later, Devonian age.

To illustrate the past, let us take a brief survey of some peculiarities of existing climates by contrasting tropical marine life with the living beings of the northern seas; and also by observing the kinds of animals that characterize the shores as contrasted with those found in deep water.

We will thus learn what kind of creatures are suited to warm water; and on the other hand what other kinds prefer to live in the cold seas, and if we can prove by the distribution of the sea-animals in ancient times that there were areas of cold water, and others of warm water on the surface of the globe, we have shown the existence of varying climates on the land as well as in the sea; for I have only to call your attention to the well-known influence of the Gulf Stream on the climate of Western Europe, to show what effect warm currents in the ocean will produce on the neighboring land.

Certain broad features in which tropical marine life differs from that of northern seas are of a kind that might have left their impress on the animals of former geological ages, had these animals been constituted then, as their descendents are now. Such creatures, for instance, as the corals and the shell-fish (shelled molluscs), whose skeletons are composed of stony matter, would have left imperishable memorials of their existence, to show where these animals had flourished, and also to certify us of the particular kinds which had once existed on the earth.

In regard to the reef-building corals, you will notice that they are confined to tropical seas, and that even in such seas the reef builders are found at work only where the water is pure, as well as warm; thus while coral reefs skirt the eastern shores of Brazil, they are wanting off the mouth of the Amazons, and only re-appear where the Windward Islands rise abruptly from the profound depths of the Atlantic. And further, it has been found that the "coral animal" does not flourish at great depths in the ocean, but only where rocky reefs approach the surface of the sea.

Then in regard to the shell-fish (molluscs), those which exist in the ocean at the present day, are governed by certain laws of distribution, which confine some kinds to warm seas and others to cold. And further, we may note that the majority of shell-fish (molluscs) of the ocean are shore dwellers. An exception to this rule in the shell-fish is the ancient class of Lampshells, now reduced to a small number of species, but once universally prevalent, exceedingly numerous, and of great variety. This class of the Lampshells, or Brachiopods, was spread in the earliest ages both in shallow and deep waters, as they are at the present day.

The richest collecting grounds for the common molluscs are at this day found on the hot, tropical shores of the East and West Indies, and among the coral islands of the Pacific. Here the great marine snails and bivalves are to be found in immense numbers, and are of great variety and beauty.

Coming north a marked change in the appearance of these animals may be observed; the highly burnished shells of the tropics disappear, the shell itself, as a rule, is thinner and is covered by a dull colored skin, and the great variety of species of the south is replaced by a monotonous assemblage in which, while the individuals are numerous, the species are fewer than in tropical seas, and many are small. We may therefore conclude that warm, clear seas have always been the favorite homes of reef-building corals and the marine snails and bivalve shell-fish, as we know them to be at the present day.

But while there are thus certain forms of life which flourish along shores and in warm shallow seas, the open ocean is not without inhabitants, though these in their more lowly forms are not of a kind to attract attention; yet owing to their immense numbers their skeletons have been of great importance in building up the layers of the earth's crust.

MODERN FAUNAS OF THE OCEANIC TRACTS.

Among these lowly forms are the Foramenifera, the great majority of which are very small, and many so minute that they cannot be seen without a microscope. Animals of this kind constitute the bulk of the English chalk, and are now being showered down in countless numbers on the bottom of the sea, in its warmer parts. The mud which covers the submarine plateau in the North Atlantic, where the electric cables are laid, is largely composed of the shells of Foramenifera, some large enough to be seen with the naked eye, others invisible.

Another class of these low organisms of the ocean is that typified by the Sertularian Zoophites. These little creatures live in colonies attached to the "gulf-weed" which floats on the surface of the Atlantic. The gulf-weed is a kind of sea-weed *(Sargassum natans)* which floats on the broad surface of the Atlantic, south of the Gulf Stream; it is so abundant in some areas as to conceal the surface of the sea itself. These tracts of the ocean, undulating with every billow, have been compared to vast pasture fields. Such a tract is the Sargasso Sea: uch another is found in the Pacific Ocean. The imagination would lead one to think that these weeds must seriously impede navigation; and it was in this sea that the sailors of Columbus became so much alarmed, that their commander had great difficulty in persuading them to continue their voyage.

The gulf-weed harbors a minute world of its own; here we find little crabs crawling about, and other minute crustaceans take shelter under its branches. Small fish may be seen to harbour in the weeds, sheltered there from their enemies, as they would be in the weeds that still grow along the shores of the sea, or in the rivers.

Another class of little creatures which are found in the open ocean are the Pteropods, or, as the French call them, "Butterflies of the Sea." They are so called because their organs of locomotion consist of two little fins, or membrana-

ceous appendages, which are kept in constant motion. In the rapid flapping of these little fins, they resemble butterflies on the wing. These small creatures are protected by a thin, translucent shell, usually of a conical form, but sometimes spiral, or sack-like.

All these are animals which live and reproduce their kind in the open ocean; but there is another class of animals, many of which are found in the deeper waters and which also reproduce at a distance from the land, but in their adult state are of much greater size and live upon the bottom of the sea; these are the sponges, an order of which the Euplectella, or glass-sponge, may be taken as an example. This animal is found in the China Sea and other closed seas of the Pacific Ocean.

Thus we see in contrast two groups of animals — those that inhabit the warm shallow seas and those that may be found in the deeper and colder parts of the ocean. The forcing of marine animals into special associations shows thus the existence of water of different temperature in the ocean, just as we have the more familiar climatic differences that modify the association and distribution of animals over the surface of the land.

As there are now tracts in the ocean occupied by waters of different temperatures, so there were in the earliest Palæozoic times, and this is shown by the remains of marine animals entombed in the rocks. In certain regions are found the remains of the coral building forms and the molluscs, which correspond to those of the warm, shallow seas of the present day; in other regions, as in the confines of this city, and at various points in the Maritime Provinces, are entombed the remains of animals corresponding to the Sertularians, the Pteropods, the Glass-sponge and other forms of the open ocean.

The Abyssal Channels of the Ocean.

The prime cause of climatic differences, for the earlier ages of geological time, is to be sought in the action of the sun's heat on the surface of the globe; and can be traced by its influence on marine organisms, because we know of no land animals or plants in the earliest ages.

The explorations of the Challenger and other vessels sent out to measure and explore the depths of the sea, have shown that there are enormous areas of the ocean where the depth is from 2,000 to 4,000 fathoms. If we estimate the average level of the land surfaces at 1,000 feet, as Dana has done, and bear in mind that the surface area of the land is only a third of that of the sea, it will be clear that if this land were flung into the ocean it would go but a short way to filling it up. The sea, in fact, would roll above it two thousand fathoms deep.

We are told that there was a time when the "earth was without form and void," and in view of the apparently artificial or unnatural way in which the continents are bolstered up, it seems not unreasonable to suppose that there has been a time when all these lands were buried beneath the ocean, and that the earth was actually thus formless. But in the earliest times of which we have any knowledge through geological evidences, some portions of the land was above the sea, and continental or emerged areas existed. How, then, were those lands sustained above the ocean? What was this mysterious power which for uncounted ages kept these lands with more or less completeness above the sea, or at least above the deep abysses of the ocean. The rains, the frosts, the winds and the transporting power of rivers have been ceaselessly at work through uncounted ages levelling down these continents, but have not destroyed them. There must be something in the physical constitution of the globe itself which maintains them. The abysses in the ocean themselves offer the explanation of the phenomenon, for they have been found to be the channels by which frigid waters

from the poles reach the tropical regions.* These bottom waters would convey away heat from the earth's crust immediately beneath them, rendering it rigid and immovable, and fitting it to perform the duty of a buttress to the border of the continent adjoining. The resulting action would be that in any movement of the crust which might occur while the continental borders would rise by expansion, the adjoining ocean abysses, as they became colder and more rigid, would have a tendency constantly to become deeper. Thus in these ocean depths there have been established *rivers in the ocean* complementary to the surface river — the Gulf Stream and other warm currents — of which Maury wrote in his work on the Physical Geography of the Sea. Thus it has come about that in the border lands of this continent there has been for ages a fluctuation between the influence of the warm seas to the southward, bringing in a tropical and shallow-water fauna, and the frigid waters of these submarine rivers, carrying northern species from the Arctic zone to temperate latitudes.

The region in which we live, at a point half way between the equator and the pole, has, stowed away in its rocks, the record of the prevalence at one time of warm-water faunas, at another of those to which the cooler water of northern seas was more congenial. But the warm-water faunas are of rare occurrence compared with the cold-water faunas.

Volcanic Outbursts in Pre-Cambrian Times.

The dawn of the palæozoic ages was ushered in in many countries by grand volcanic outbursts. Such was the case in Great Britain, where vast sheets of lava and ashes are found beneath (and included in) the Cambrian rocks. Such, also, was the case in Norway, where the lava streams continued to flow in Cambrian times. Such was the case, also, in our own country, where the Carleton Heights, on one side of

* In the ocean abyss, just eastward of the Windward Islands, in the West Indies, the lower layers of water are very little above the freezing point, but westward of these islands, in the Carribean Sea, the surface temperature exceeds 80°.

the harbour, and the Loch Lomond and Quaco Hills on the other, testify to the activity of volcanic vents near St. John in those early times. And it has recently been discovered that a similar substratum of volcanic deposits underlies the Cambrian rocks in Pennsylvania and southward.

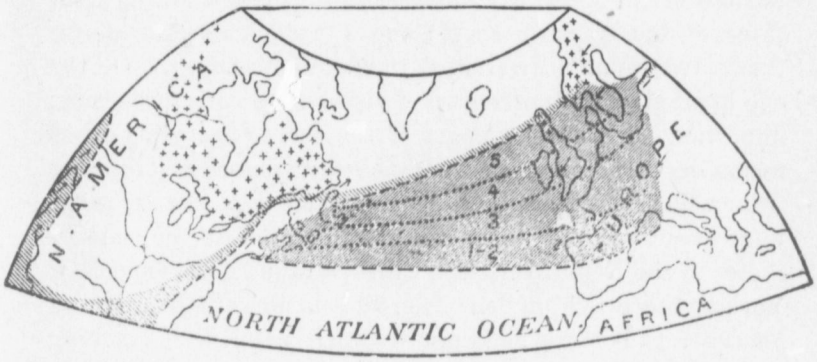
In nearly all countries where we know of the presence of Cambrian rocks, this time of volcanic activity was followed by the appearance of a warm-water fauna, as though the volcanoes themselves, either by the heat they liberated, or by their effect on atmospheric phenomena, had sensibly influenced the temperature of the sea. This warm-water fauna (or warm and shallow-water fauna) is found wide-spread along the base of the Rocky Mountains, has recently been discovered in the southern Appalachian range, and existed also in the St. Lawrence valley and near St. John.

On the other side of the Atlantic it has been found in the west of England, in the north of Scotland and in Norway and Sweden.

In these latter countries it was superseded by the Paradoxides fauna; whose origin we know not, except that as it was borne from Europe to our shores, its fountain head would seem to have been the Arctic regions of the Old World. This is the best known fauna of the St. John group; it came to us on the cold current from northern Europe, but so far as we know was never able to pass the mountain barrier of eastern North America, or establish itself in the interior of the continent.

After spreading itself along these Atlantic shores, changes supervened, which brought in a new fauna in the colder seas. The cause of this change is unknown, but it was accompanied by a rising of the land here, as well as in Wales and France. When the land sank again, we find that the northern seas were in the possession of a new group of animals, the gigantic Paradoxides had disappeared, and the Oleni, little crustaceans, many of them not larger than a filbert, had taken their place.

SKATCH MAP SHOWING THE DISTRIBUTION OF ANIMALS IN LOWER CAMBRIAN TIME.



Canadian Laurentian Continental Nucleus aud the "Fundamental Gneiss" of the west of Europe, these ares are supposed to have been emerged land in Cambrian time. Other smaller areas on the Atlantic coast of America and in France and Germany are not represented. The "deeps," or abyssal areas of the ocean, skirt the border of North America about 100 or 200 miles from the coast, except along the Newfoundland shore, where the deep waters are thrust out a distance of 400 miles by the "Grand Bank."

Outcrops of rocks containing the Olenellus fauna, an assemblage of Cambrian animals found mostly in warm shallow seas. Three outcrops in the Rocky Mountain region and four in the Appalachian region in America; outcrops also in Scotland, Norway, Sweden and Russia.

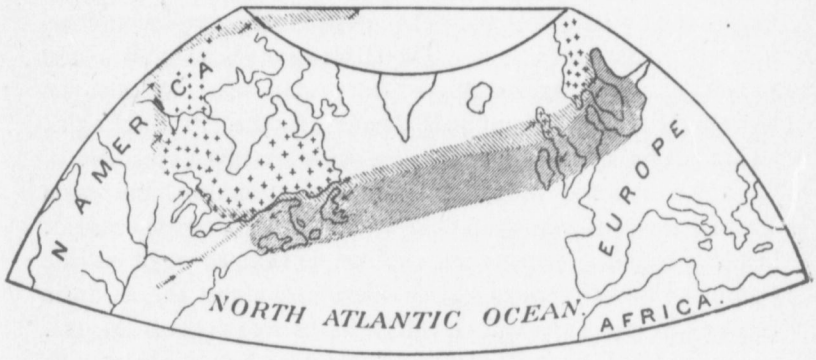
Outcrops of the Paradoxides fauna. Five sub-faunas are distinguishable occurring in chronological sequence, the complete series known only in Sweden, which, therefore, was nearest the origin or centre of dispersion of the fauna, and had the physical conditions of temperature, etc., best suited to its propagation.

Cambrian Faunas of the Interior Sea and of the Atlantic Basin.

Meanwhile there had been growing up in the interior of America a fauna of an entirely different type. There the warm seas had nourished crustaceans of genera differing from those of the Atlantic coast; and the molluscs had shown themselves capable of variation in several directions. On the one hand Maclureas presented themselves as one of the most important early developments of the sea snails, and various forms of Orthocerata showed the early phases of the class from which the Nautili subsequently sprang. These forms were borne on the warm waters which laved the eastern shores of the North American continental nucleus, from New York to the Strait of Belle Isle, and its western shore from Manitoba to Boothia Felix and Grinnell Land, thus reaching Europe by the circuitous route of the Arctic circle. Shallow waters and warm currents enabled these shells born in the Mediterranean of America to penetrate to the pole itself, and this before they had been able to invade the chilled waters of the Atlantic coast. However, we should remember that the continental lands were then probably of less extent than now, and the earth's atmosphere denser, conditions which would favor a more uniform distribution of heat over the earth's surface and enable the animals of the tropical seas to invade the Arctic circle.

While these early sea snails and straight nautiloid forms had been growing up and developing in the warm seas of the interior, another type of beings had been fitting themselves to the very different conditions of existence in the North Atlantic. These, the Graptolites, were roving creatures, fitted to propagate their kind in the open sea. Through the subsequent ages we find them gradually simplifying their structure, so that the colonies of many branches of the earliest times are reduced at last to colonies of one stem without a branch, and with rows of cells on one side of the stem only. In modern times we have the Sertularians, branching colonies of minute creatures as representatives of the Graptolites. In

SKETCH MAP SHOWING THE DISTRIBUTION OF ANIMALS IN LOWER ORDOVICIAN TIME.



Areas of Laurentian rocks as in the preceding map.

Outcrops of the Chazy fauna, found chiefly in limestone rocks, and areas of sandstones supposed to be of that age. Corals and numerous forms of molluscs appeared at this time, and the fauna is supposed to have flourished in shallow, warm seas.

Outcrops of the Arenig fauna The rocks of this fauna are, to a large extent, mud rocks, with thin flagstones, and the fauna is supposed to indicate the prevalence of colder and deeper waters than those of the Chazy fauna. Since the above map was drawn I have learned that the Arenig fauna has been recognized in the south of France ; if this region were included in the Arenig area, the shaded portion of this map would correspond almost entirely with that of the map on page 11.

Compare the range of the faunas represented on this sketch-map with those of the preceding. The upper Cambrian faunas are intermediate between the two faunas represented on these maps.

a previous part of this address I have spoken of these zoophites as growing upon the gulf weed that floats in the mid-Atlantic, but they are found also in shallower water.

The king-crabs and other modern crustaceans were represented in ancient times by the Trilobites, of which some species were fitted for the deeper seas and others for shallow waters. The trilobites were the most highly developed crustaceans of that early time. The Glass-sponge, which has been spoken of as an inhabitant of deep still seas, had also its representative in Cambrian times in the Protospongiæ, Cyathospongiæ, and other sponges with six-rayed spicules.

The contrasted faunas or groups of animals of the warm shallow seas and the deep cold seas in this part of the world, lasted through a long period of time, so that throughout the Cambrian and Ordovician ages there were along the Atlantic coast of North America, as well as in many parts of Europe, extensive tracts of cold sea water, more or less charged with fine mud, that supported the second group of animals I have spoken of; and over the central parts of North America, and subsequently in Europe, there were wide areas of the ocean, shallow and warm; here flourished the corals, nautiloid shells and sea snails belonging to the first named or warm-water fauna.

Time, however, brought changes. The marginal areas of the continent were elevated, and in the Silurian time the cold-water faunas had but a precarious footing in many parts of the eastern provinces of Canada.

Both at the opening and close of Silurian time, if not throughout its whole extent, lava-flows and discharges of volcanic ashes occurred in various parts of Acadia, as preliminary, perhaps, to the appearance above the water, of large tracts of land which are found to have existed here in the succeeding geological age — the Devonian.

Climate of Acadia in Devonian Times.

Another aspect of our climate was now ushered in. No land plants are known to have existed on the shores or in the interior of this region in Cambrian times, and this would lead us to suppose that the land was bare of vegetation; but a very different state of things prevailed in Devonian times, for in various parts of eastern Canada remains of land plants of the Devonian age have been found. Without going into the minutiæ of the physical changes which passed over the land during the whole of the Devonian age, let us note the conditions of things here at a time which is supposed to have been in the middle term of the Devonian.

The border of the continent was then far off to the eastward of New Brunswick. Extensive ridges throughout eastern Nova Scotia and southern New Brunswick were covered by a vegetation, almost the first land vegetation that we know of. A few rare plants of greater antiquity are known. Remains of such have been found in the hills of central New York and Pennsylvania, and latterly in the sandstones of Wales. These are of different species from our Devonian plants, but have a general resemblance to them.

The Devonian vegetation of the Maritime Provinces of Canada consisted largely of plants similar to those which prevailed over extensive areas in Europe and eastern North America during the coal period. They grew in extensive swamps or flat low-lying tracts of land. Ferns and calamites were plentiful, a proof that a moist climate prevailed. Fresh water crustaceans and the larvæ of neuropterous insects are found, and so we suppose there were ponds in these marshes; and further than this the insects which flew through these thickets and bracken were related to the dragon-flies and the may-flies, which at the present day delight in the borders of marshes and streams. The beds which form the St. John basin of Devonian rocks are thickest and coarsest to the eastward, and we suppose that from that direction came the river which bore down into the estuary near St. John, the sand

and mud which subsequently became the solid rocks of the Devonian age.

The belief that the rings of growth in trees mark the alternate periods of growth and repose which the returning seasons bring to vegetation is not altogether dissipated, though it has been attacked. Such a view of the source of these annular rings has been called in question of late years, and it has been stated that these rings are found in trees that grow in tropical regions, where there are no changing seasons. And further (that on testing the question by noting the number of rings in certain young trees that have been made the subject of observation) it has been found that these rings are more numerous than the actual known years of the life of the tree.

We should remember, however, that within the tropics, while there is no winter and summer, as with us, there are in most parts of that great belt of the earth's surface certain seasonal changes which, in their effect on vegetation, are similar to the alternations of the seasons which we enjoy. In some parts of the tropics there are two seasons in every year, in others four; but in either case the trees would be alternately stimulated to rapid growth, or left to mature the wood and fruit whose growth had begun in the rainy season. At the present moment (January) the woods on the uplands and mountains in the West Indies are as brown and bare of leaves as our own hardwood forests.

Admitting, then, that these annular rings do indicate seasonal changes, let us examine the condition of the logs which may be found buried in the Devonian sandstones of our city, to see if they exhibit any proofs of changing seasons of the kind alluded to above. These logs occur in the lower part of the formation, or terrain, and are often found in clusters, as though they were parts of broken rafts that had been ground and worn in their transit by water from the interior of the country, before they were buried in the sands of the bars along the course of the river, or at its mouth.

When cut across, these trees show distinct annular rings of growth, proving that the plant had alternate periods of rapid and slower increase. They had very large pith-cylinders as compared with those of our living coniferous trees; these cylinders are sometimes as much as an inch across; and if the large pith had the same significance as it has in modern plants, the trees had a rapid growth.

The microscope reveals a beautiful structure in the Devonian trees. Side by side lie immense numbers of little cells, which went to build up the trunk of the tree, and each of these cells carries a number of pores along its walls, arranged in several crowded rows, running lengthwise in the cell. Even with the naked eye one can see the medullary rays that radiate from the pith cylinder to the outer surface of these old Devonian trees. Thus in these trees entombed so many ages ago you may see the whole economy of structure of the trunk as we have it in modern trees, the central pith so important, especially in the early growth of the plant, the vascular or woody tissue, of which the principal part of the trunk was composed, and the medullary rays that serve to unite the centre of the tree with its periphery, and portions of the bark that once enveloped the whole.

Such are the morphological conditions of the tree; but you may also in these trunks study the effect of dynamical and chemical action in rending apart the layers of the tree and filling the space with a wedge of calcite, or else in replacing the substance of the wood by a siliceous deposit. But this is apart from our subject, which was to show by the mode of growth in these trees that the earth at that early period of Devonian time possessed seed-time and harvest, if not summer and winter. It is true that man did not witness this sowing and ingathering, but he may still glean of the harvest and pick up the spare seeds that escaped the germinating influence of the Devonian soil.

This smiling Devonian country, covered with vegetation and teeming with life, existed but for a time. Rougher conditions supervened, the sandy beds became coarser, and fewer

plants were preserved. Finally the sea swept over it and destroyed its verdure. Great rugged hills rose in the interior, and from time to time, here and there in the neighboring country, volcanoes, emerged and submarine, poured out their lava, ashes and mud over the surrounding tract. The forest and fern growth was swept away, not to return until the Carboniferous age.

It would tire you were I to attempt to draw a sketch of the physical condition of this region in later geological time, or to indicate the climatic changes that have supervened, but those which I have hastily sketched for the Cambrian and Devonian ages may interest you, as they are attested by rocks which underlie your city, and proved by the animal and plant remains its rocks contain.

ARTICLE I.

NOTES ON THE GEOGRAPHY AND NATURAL HISTORY OF THE TOBIQUE.

BY GEOFFREY STEAD, C. E.

The Tobique Valley seems to be a "terra incognita" to many people in St. John and the southern part of this province. From a summer's stay on the river, I am able to give a short account of its Geography and Natural History.

The Tobique is one of the larger left-hand branches of the St. John, having a basin of 1,500 square miles. It enters the latter river about twenty miles below Grand Falls, and nearly opposite Andover. Its course for the lower twelve miles is about westerly, above which it bends nearly parallel to the St. John, so that after ascending the Tobique twenty-five miles we are nearer Grand Falls than at the mouth of the river.

The course of the valley of the Tobique beyond the lower twelve miles is, though very crooked, about north-north-east till the Forks are reached — fifty-four miles from the mouth. Here the river divides; the two branches shortly sub-dividing to form four large streams. The chief of these — the right hand branch — rises in several large lakes, draining parts of Northumberland and Victoria Counties, and flows north-westerly to the Forks. The left branch, or Little Tobique, rises at Lake Nictor, in Restigouche, quite close to the head-waters of the Nepisiquit.

The course of the river at the Forks is peculiar. The two branches come together from different ends of the same valley. There is a sudden break in the ridge which forms one side of the valley, and through this the waters escape which form the main river, flowing in a course at right angles to the direction of the branches.

Riley Brook, a few miles below the Forks, is the last Post-office ascending the river, and a short distance above this, settlements cease. Extensive lumbering operations are carried on on the branches of the Tobique, which are ascended by canoes, and during freshets by flat boats, towed by horses. On this upper part of the river are some of the finest salmon and trout fishing-grounds of the province.

Plaster Rock, twenty-six miles from the mouth, is the present terminus of the Tobique Valley Railway, and from here down I can bear testimony to the great beauty of the river scenery.

The main Plaster Rock is a cliff about 130 feet high, standing on the left hand or eastern side of the river. It is chiefly of a reddish color, the gypsum not being quite pure, alternating with thin layers of white fibrous gypsum. On the opposite side of the river the plaster is not so distinct, the layer is thinner, limestone forming most of the bank. The bank is more sloping and bushy on this side, but the set of the stream on to the eastern shore keeps a fresh surface exposed there. Every spring large masses fall, loosened by the action of the frost, and being friable in time disappear.

About two miles further down on the same side is another exposure of gypsum separated from the river by a small interval. The chief supplies have been drawn from this lower rock, and many thousands of tons removed, but it has made scarcely any perceptible impression on the mass.

Just below this lower rock, the Wapskehegan, the most important tributary of the Tobique, enters. At the mouth of this branch, the Tobique takes a great bend, enclosing in the semicircle a beautiful flat, well cleared, back of which the land rises hilly and wooded.

The river next passes steep banks and bluffs, many of them quite changed now by the railway embankment passing along the face. Then flats—lands which make good farming tracts. Then there are bluffs and hills again, covered with second growth of poplar and white birch.

Odell River, an important lumbering branch, which enters about seven miles below Wapskehegan, is the next large stream. Its waters rise within a mile or two of the south-west Mirimichi.

On the opposite side of the river is Arthurette, the nearest approach to a town, on the Tobique, for the original eighty rod lots have in some cases been subdivided in passing from father to children, so as to leave only a narrow strip with each house.

The Arthurette Flat is one of the most extensive on the river. A "bogan," or back-water creek, runs for some distance behind the flat, and a large peat bog is found there also; both good collecting grounds for the botanist.

The Red Rapids commence a little below Arthurette, and within a couple of miles are several low falls caused by ridges of red conglomerate rock crossing the river at these points.

A couple of miles below Red Rapids the alluvial land ends. High banks and precipitous rocks encroach on the river from both sides until we reach the valley of the St. John.

The last mile of this passage is called the "Narrows." Here the river rushes through a narrow rift in the rocks, which rise on each side about one hundred feet. In spring the rapids are a fine sight, and when the water is at its height, impassable for boats or rafts.

Geology.

The geological structure of the Tobique region consists primarily of a basin of Lower Carboniferous rocks in the midst of a large tract of the Silurian age. Along the southern border of this tract masses of granite appear, flanked by belts of pre-Cambrian and Ordovician.

The Silurian region includes the whole of the north-western part of the province, with the adjacent parts of Quebec and Maine; but in places its strata are overlaid and concealed by rocks of newer age, such as Devonian or Lower Carboniferous. It forms the "fertile belt" of New Brunswick and

north-eastern Maine. The river St. John occupies a depression in these strata, or, as at Grand Falls, has cut a channel through them. The river valley is now in great part occupied by terraces, which form such a conspicuous part of the scenery of the upper St. John.

These terraces continue for about a mile up the Tobique, ceasing for a short distance at the Narrows, where the river has cut its way through a high Silurian ridge, which here has barred its course to the St. John. The rocks consist here, as elsewhere in the Silurian tract, of calcareous slates with thin bands of limestone, all of which, through great bending and contortion, stand almost vertical. In the limestone, fossils of Silurian age have been found. Elsewhere plant remains have been found, which are thought to be of Devonian species, an evidence that the Devonian is also included in the Silurian region, though it is separated with difficulty from true Silurian strata.

The ridge just mentioned as situated near the mouth of Tobique, attains a height of 1,200 feet a few miles back of Red Rapids. The crumbling calcareous slates produce a rich soil, and where the hills are not too steep, it makes a fine farming country. Several settlements, as Birch Ridge and Scotch Settlement, have already sprung up here and are thriving.

About Red Rapids we come to the outskirts of the Lower Carboniferous outlier of Victoria County, already referred to, which occupies a depression in the Silurian. It has a maximum width of twelve and length of twenty-seven miles, its length being in the direction of the river valley.

The beds have a slight dip towards the north, and therefore towards the centre of the basin, so that in travelling up river we see a section of the formation.

Skirting the upturned Silurian rocks are coarse red conglomerates and sandstones, the successive ledges of which are well seen in ascending Red Rapids. Above the rapids for some miles no further outcrops appear along the river, for its banks are occupied by terraces and alluvial flats, but

on the slopes of the surrounding hills the same beds appear through the soil.

The Lower Carboniferous in this district is not found at any considerable elevation except at Plaster Rock and perhaps Blue Mountain, and the hills over this formation are generally kames or gravel ridges except Blue Mountain, which is of volcanic origin, and Plaster-Rock ridge.

Passing on up river we come at Black Rock to further outcrops. The rock is here not so coarse in structure, consisting of red and grey grits with thin beds of red and bright green shales.

The grits would make a good building stone and are traversed by joins which produce natural blocks, though these are often too small; part of the beds split into wide sheets which might be used for sills or flagstones.

The sandstones now get softer and more calcareous. A railway cutting a mile and a half below Wapskehegan shows them well. They are here beautifully coloured in shades of grey, purple and red. The shales also increase in thickness, one green band being over a foot thick. They quickly crumble on exposure to the atmosphere.

Just below Wapskehegan we come to still higher beds of the same series; here limestone ledges stretch out into the river and are covered by the water during freshets. Above the limestones are fine sedimentary beds with red and white layers, which rise perpendicularly out of the water to a height of fifteen feet. From the regular facing of the cliff on the river and the somewhat level top, it goes by the name "Tom Day's Wharf," called after a well known character in the neighborhood.

Above this on the bank are limestones partly compact and crystalline and partly having a conglomerate or nodular structure, and with them layers or masses of olive green shales.

The limestones show no trace of animal remains, and would seem to be a chemical deposit and not formed as those of Windsor, N. S., and other localities, principally from the relics of sea life.

These limestones and shales are seen cropping out for two miles at least further up river and underlie the gypsum. This I have before described as exposed just above the mouth of the Wapskehegan. It here forms a cliff not more than thirty or forty feet high, but becomes much thicker at the main Plaster Rock, which rises perpendicularly to from eighty to one hundred and twenty-five feet.

About one mile and a half back of the river at Plaster Rock is the so-called Plaster-Rock Ridge, a long, level ridge with rather steep ends and sides. It stands considerably higher than the "rock," and is prominent in the view from far down the river. It is composed, according to Dr. L. W. Bailey, of conglomerate, forming the highest member of the Lower Carboniferous series of Victoria County. Between this ridge and Plaster Rock are numerous sink holes, caused by the solvent action of water on the gypsum beneath. Two mineral streams join the river near the rock, they are weak solutions of Epsom or some such salt.

About two miles further up river I noticed red cliffs, probably of red sandstone. My remarks on the geology of the district beyond this point are borrowed, chiefly from reports by Dr. Bailey and Mr. R. Chalmers, of the Geological Survey.

Trap rocks usually occur with the first and last beds of the Lower Carboniferous. On the Tobique they have been noticed near the ends of the basin, on the Otelloch Brook at Red-Rapids Bridge, and at Blue Mountain, which is at the northern limit of the formation. They are supposed to be contemporaneous with the newer and higher beds of the series.

Beyond the carboniferous basin the river and its tributaries run through a Silurian area, the northern and western branches passing only through this formation, while the southern and eastern branches rise among older formations in highlands which form the watershed between the Miramichi and Nepisiguit. At the head of the Wapskehegan and Gulquac rivers rocks of the Ordovician System appear, as well as on

the right hand branch of Tobique. The rock consists of feldspathic sand-stones and quartzites, with hard, blue slates.

These in turn are succeeded by highly metamorphic rocks, felsites, syenites and schists, of supposed pre-Cambrian age. They are seen about four miles above the mouth of the Serpentine and in the region of Long and Tobique Lakes. Long granite belts penetrate this region, parallel to the great granite axis which runs north-easterly through the counties of York, Carleton, Northumberland and Gloucester. One of these belts intrudes on the pre-Cambrian, crossing the Serpentine River. At Long Lake the junction between granite and the pre-Cambrian is well marked by boulders, though rock in situ is not seen. Granite boulders are strewn thickly over the upper part of the lake, while the rest is occupied by boulders from pre-Cambrian rocks.

This watershed region is generally 1,000 to 1,200 feet above sea level, but some of the many hills rise considerably above this, as Bald Mountain, on the south branch of the Nepisiguit, and Bald, or Sagamook Mountain, near Lake Nictor, both of which are 2,500 feet above the sea.

The geology of the district is very difficult to study. The country is covered with drift material and forests, which conceal the underlying formations almost everywhere. Again, the rock is greatly altered, stratifications obscured, and the folding and crumbling of the beds and injections of volcanic and granite masses have further confused the structure of the region.

Many of the characters of the whole Tobique region are explained as results of the so-called "Devonian Revolution." This geological disturbance resulted in the crushing and folding of the Silurian and Devonian systems against the older formations which had previously been raised and solidified.

Great masses of granite were extruded during the disturbance, the granite of the Nerepis Hills and Spoon Island (St John River), and also of the great central belt of the province, being supposed to date from that time. The Cam-

brian and other rocks of St. John city shared in the disturbance. Indeed it has been said that New Brunswick owes her chief physical features to this revolution, some of her highest hills and ridges, and the basins and hollows where later deposits have accumulated. It was the last great movement of the kind New Brunswick experienced; for throughout the province we see the beds of the next formation—the lower carboniferous—almost as level now as they were when deposited on the ancient sea bottom.

I have mentioned before terraces near the mouth of the river. Above the Narrows they are again to be seen, and here much higher, being as high as forty feet and over, as if during the glacial period the Narrows had been blocked with drift and the river converted into a lake; and in support of this idea we notice in ascending, that as the river rises the height of the terraces above it decreases. But it is generally to be noticed that when the river valley is wide, terraces are extensive and low, while when the valley is contracted they are narrower and to be found at higher elevations.

Above the mouth of the Otelloch Stream the railway cuts through an alluvial bank, a spur of a terrace, and giving a section of the surface deposits, extending back from the place. The railway rests on a bed of light colored clay, above which in the section is a layer of dark loam, a foot or two thick, abounding in plant remains, grasses, twigs and stems of plants, and through part of the thickness remains of small beetles were common. Above this are ten feet of red gravelly clay, very springy (for water cannot get through the pure clay below) which caused a great deal of trouble in excavation. These beds have a decided dip up river which is especially noticeable on account of the dark layer.

In the high bluff above the mouth of the Odell River, beds of gravel and sand, with boulders, dip down stream at angles of about forty-five degrees. This is perhaps due to a ridge of rock in the centre of the hill, below which gravel and sand carried over by the current would necessarily be deposited

at an angle. Just above are horizontal beds of fine sand. On account of the high inclination of the gravel beds, railway ballast was hard to obtain, for it seemed to occur in pockets, and at no place could more than two cars be loaded at once; and it was the same in most of the bluffs cut into along the line of the railway.

Mr. Chalmers speaks of terraces as occurring all the way to the Forks, and up the Nictor Branch, where they get higher as Lake Nictor at the head of the river is approached. The lakes at the heads of the branches are results of glacial action, for the hollows they occupy were, before the glacial period, supposed to have been filled with disintegrated rock. Glaciers scooped this out and dammed up the hollows with drift. Lake Nictor, Long and Tobique lakes, and others, were formed in this way.

There is strong reason for believing that Lake Nepisiguit formerly discharged into the Tobique, but was dammed by drift at its southern end, and forced to empty its waters by the Nepisiguit into Bay Chaleur.

Botany and Zoology.

I had very little time to give to the botany of the district; where possible I pressed specimens of the rarer kinds of plants. One of these—*Aster corymbosus*—is not mentioned in the last New Brunswick list.* Some of the others had not before been reported from this region.

I outline the chief habitats met with, with some plants noticed in each.

First.—The Hard Wood Ridges—notably those of Birch Ridge and Leonard's Settlements, back of Red Rapids. Birch, beach, and maple, are the commonest trees, they grow to a large size and afford valuable timber. There is no thick undergrowth in these woods though the ground is carpeted with green plants—ferns, trilliums, etc.

* Mr. G. F. Matthew, however, had collected it near St. John.

The road from Perth passes through such woods in what is called the Gulch—a beautiful ravine with a rapid stream flowing down the centre and high and steep hills on either side. I found here the Maiden-hair, but this fern does not seem to extend up the Tobique.

This land when first cleared yields wonderful crops. Oats are usually the first planted, and grow up rank and luxuriant, yielding an immense amount of straw as well as a large increase of grain.

In hollows and beside streams flowing between these ridges, hemlock and spruce are more common, and are extensively lumbered.

Second.—Rich hills and slopes along the river valley, burnt over and since grown up with poplar and white birch, with sometimes a greater variety of trees — cherry, fir, spruce, etc. Here grow the two coral roots, the *Goodyera repens*, *Smilacena racemosa*, and numerous other plants. This includes a large part of the land bordering the river.

Third.—Borders of intervals and meadows. Here we find fine elms and poplars and a thick margin of alders, in the shade of which the ostrich-fern and wood-nettle grow abundantly. The agrimony is very common in more open ground. Hazel is more abundant on the borders of the higher meadows.

This bordering of trees and shrubs affords great protection to the lowlands of the river plain from the ice and currents.

Where intervals have not been cleared, the flora is far richer, containing besides the last mentioned species, large ash, spruce, fir, and hemlocks, with the Indian turnip, the larger coral root, wild ginger, blood root, etc. At the mouth of the Wapskehegan is just such a luxuriantly clothed interval.

Fourth.—The peat bogs, sometimes covered with small dead tamaracs, sometimes grown over with cedars. Bogs bordering on lakes are usually covered by heaths, such as sheep laurel and andromeda.

In a bog of the first mentioned kind, at Arthurette, there grows an immense number of the *Cypripedium spectabile*, our most beautiful lady-slipper, which was one of the first

orchids brought to England, when an interest began to be taken in the cultivation of the plants of this order.

Also the yellow lady-slipper, the Arethusa—*A bulbosa*; a small lily—the *Tofieldia glutinosa*. The wild calla, *C. palustris* grows in very wet places, as where streams run through a bog.

Fifthly.—The Bogans. This word *Bogan* I have only heard used on the Tobique; it means a back-water creek such as are common among intervals and lowlands on the St. John and all its tributaries. In these muddy and stagnant creeks grow the common and the smaller yellow water-lilies, the water crowfoot and the bladderwort.

Among other plants noticed on the river is the curious strawberry blight, with its large heads of soft, juicy flowers, which I found in the burnt railway clearing through a grown-over swamp. A resident of the Tobique told me it is called Indian paint, and that it is used by the Indians to stain their baskets. On my way up the Tobique I saw numbers of the beautiful purple clematis in bloom along the St. John, from Woodstock to Perth, but on the Tobique none could be seen.

The butternut, common on the St. John, does not asce... the Tobique, and the same with the oak.

The hemlock, I have been told, does not extend more than twenty-five miles up the river, or at least does not grow abundantly above that distance.

Botrychium lunaroides, an uncommon plant about St. John, grows very commonly on the Tobique. *Botrychium matricariæfolium*, a rarer species, also occurs.

Several species of land snails were collected. Of fresh water clams I only saw one kind in the river, and that a common one. The river snails, except a couple of small species, are common on the St. John River, even as far down as Kennebecasis bay.

Lymnæa catescopium is more abundant on the lower St. John, but I never found such large specimens of it there, as on the Tobique.

Among land snails, the very small kinds are in the majority, especially on the rich intervals where they are common, and easily found sticking to decaying drift-wood, bark and leaves. On the hard wood ridges some larger kinds live. These are to be found under old logs, sticks, and leaves. The largest of those shells, the *Helix sayii*, looks quite plain when deprived of its occupant, but the body of the animal is beautifully marked with brown spots and bands which show through the translucent shell, and give the creature when alive a beautiful appearance. It is uncommon about St. John, but abundant where I found it on the Tobique.

The birds of any region are apt to attract notice, and though not a student of ornithology, I could not help observing the commoner and larger kinds. A large fish hawk made his beat as regularly as a policeman up and down the river at Red Rapids. I often watched him, but never happened to see him catch a fish. Wild ducks were very abundant on the river, and are not troubled by the natives. A brood were reared on an old pier just opposite one of my boarding places, and this pier they had used for several years. Occasionally, a heron or marsh hen is also to be seen. The moose bird, familiarly called Joe Goddard's Ghost, after an old lumberman, is always seen hovering round the lumber camps; and I notice it sometimes mistakes the Tobique houses for lumber camps, and hovers around them too. It is a very tame bird. When I have been using level or transit, it has stood about in picturesque attitude as though it expected me to take its photograph. I saw where a pair had their nest in the top of an old tree trunk, too high to examine. Its more beautiful and more noisy relative, the blue-jay, is even commoner, and its harsh note often disturbs the quiet of the country roads. Partridges are abundant and tame. I saw one killed by a stone after a dozen had been thrown at it without its moving. They used to be more plentiful, and afforded good sport to boys skilful at throwing stones.

Among mammals, I noticed scarcely anything of interest. There are plenty of wild animals, but they generally keep out

of the way; the foxes and smaller quadrupeds are bolder. A little wood-chuck wanted to block the road once and not let me pass. I saw an otter trying very patiently to catch some ducks. They kept well out of his reach, but always returned when the animal swam ashore, and again scattered when he came after them. A mink was observed.

The resources of the region lie in lumbering, farming, plaster, grain mills, and saw mills; and the more speculative pursuits of limestone burning and gold mining Last summer, work was carried on on the Serpentine, in getting out gold-bearing quartz, and about a ton was sent away for examination and analysis. Gold was also reported to have been rediscovered on the Wapskehegan, where a specimen was found many years ago.

Much plaster is used in Aroostook County, Maine, and mills have been put up there for grinding it, as it enters the United States in a crude state free of duty. It is principally brought from Albert County; for the demand for Tobique plaster has been far greater than the supply, which was limited by the number of teams able to work at hauling gypsum from the rock to the mouth of Tobique. A great many tons, however, have been taken out in this way. In 1887, the only year for which I have the returns, the amount was 1,300 tons. The railway now being built along the river, will help transport and by greatly decreasing the price of the material in the farming centres, will cause a large increase in the consumption. A considerable section of the plaster rock is in the hands of men who are largely interested in the railway, and the intention is to set up mills at the rock to crush gypsum for the New Brunswick and Canadian markets, as well as to export large quantities of raw material to the farming districts of Maine and other States.

It is also proposed to start shingle mills on the river to take advantage of railway transportation, and the large supplies of lumber still existing. Mills for grinding grain are much needed on the Tobique, as there is only one now, and

it far up river. Another is being built at Red Rapids, which will be a great boon to farmers of the neighboring settlements.

Victoria County now is very much as Carleton was before the building of the New Brunswick Railway. Farming and lumbering are still carried on together, and by the same persons, and consequently neither is so flourishing as it ought to be.

A great drawback arises from the large tracts of land withheld from cultivation by the New Brunswick Railway Company, which is apparent now, when we see that almost all with that exception is being farmed, and there seems no very near prospect of this land being put on the market, though much of it is very fertile.

Within ten or fifteen years, Victoria County will probably become such another as Carleton in its farms, and have beside the advantage of the gypsum deposits and other natural resources.

ARTICLE II.

OBSERVATIONS ON THE DISTRIBUTION AND HABITS OF SOME NEW BRUNSWICK FISHES.

BY PHILIP COX, A. B., B. SC.

The sources of the Restigouche and many tributaries of the upper St. John, rise in a comparatively level area in the north-western part of New Brunswick. Thence the two waters diverge; those of the Restigouche north-easterly about one hundred and forty miles into the Bay des Chaleurs; those of the St. John, south south-easterly three hundred miles into the Bay of Fundy. Their mouths are on the same meridian, and two hundred miles apart, with an intervening coast line of about four hundred miles, two hundred and fifty of which border on the Gulf of St. Lawrence. Emptying into the latter between these rivers are several others, such as the Nepisiguit and north-west and south-west branches of the Miramichi, which have their rise in a low water-shed a little eastward of the sources referred to above.

Between these two river-systems a marked ichthyological contrast exists. In the three latter streams there is an abundance of salt water or semi-marine fish, but a dearth of the larger fluviatile and lacustrine species. Even many purely fresh water forms, frequenting small streams, and, under favourable conditions, such as the interlacing of tributaries and high freshets, spreading in time over large areas, are here limited both in numbers and species, notably the Cyprinidæ, including the carps, chubs, minnows, etc.

Though fished for years by Indians and settlers, and carefully examined of late by the writer for scientific purposes, these rivers with their numerous forest lakes have never been known to yield a single specimen of the togue or tuladi,

Salmo namaycush, Walbaum); white-fish or gizzard-fish, (*Coregonus clupeiformis*); or fresh-water cusk (*Lota maculosa*, Le Sueur); all of which are found in large numbers in the waters of the St. John and Restigouche. In the latter rivers, too, the writer has found *Uranidea boleoides*, Girard, a small fresh-water sculpin, never before reported, as far as he knows, from the Maritime Provinces.

As a general rule, the first three are lacustrine species, frequenting the largest and deepest lakes, though the white-fish and fresh-water cusk are also fluviatile to a limited extent; yet, under the latter conditions, their preference for long, still, deep reaches, betrays their primitive habits and distribution. This is the case on the lower St. John, where their existence is probably due to a few having been originally carried over the Grand Falls from the lake region above, where they abound. Whenever thus restricted to a river life, the white-fish will, on the approach of winter, sometimes descend to the sea. To a slight extent this is the case on the lower St. John, but more characteristic of the fish in the Arctic regions, where the lower temperature of such waters must induce periodical migrations.

The togue occurs in many widely separated places in New Brunswick, such as the Chamcook Lakes, near St. Andrews; Long Lake at the Head of the Lepreaux River, St. John County, and in some drained by the Tobique. It is also found in Lake Metapedia, Quebec, whose waters empty into the Restigouche; and the writer has verified its presence in States Lake draining into the Kegewick, an affluent to the same river. After a long and careful examination of the lacustrine waters of the Miramichi, including the lake in question, there seems no room for doubt, but that M. H. Perley was mistaken in assigning this fish to the Miramichi Lake in his "Reports on the Sea and River Fisheries of New Brunswick, 1852." No trace whatever, nor other record of its occurrence there can be found.

Between the togue and fresh-water cusk there is a singular association;—the two are almost invariably found in the same

lakes, but the cusk, as remarked above, is more or less fluviatile also in distribution; and, in the latter case, is held by some naturalists to return periodically to the sea. Such, however, is not a well established fact. On the lower St. John it is quite common, and the facilities for reaching salt water are excellent; yet numerous enquiries among the fishermen and fishery officers of the Bay of Fundy, and especially St. John harbor, fail to show a single specimen ever taken there in net or weir. Did the fish visit the sea, as claimed, it seems incredible that no trace of its presence would be detected in the maze of fish traps studding those waters. That it makes limited migrations on the River St. John is well known, but these are entirely restricted to a fresh water range and due to a natural preference for cool, deep reaches, modified by spawning habits. In fact, its movements are similar to those made in lakes where it lives constantly,—another presumptive proof of the lacustrine character of its ancient distribution.

The presence of the "cusk" in the Restigouche seems to have been unnoticed till Mr. Brittain and the writer discovered it there in 1888. In Lake Utopia, Charlotte County, it sometimes attains the length of four feet. It has never been reported from Nova Scotia—a fact setting strongly against the theory of an annual migration to the salt water. The "cusk" is the only fresh-water species of the Gadidæ, or cod family, und in New Brunswick.

The presence of these three forms — the togue, white-fish and "cusk"— in the deep fluviatile and lacustrine waters of the Restigouche and St. John, cannot be satisfactorily accounted for by the interlacing of their smaller tributaries. It seems more probable that their present range has been determined by causes operating in remote times in which the intermediate coast region did not participate, and by which extensive lacustrine areas were drained, leaving these species in their present widely separated localities, or obliging them to adapt themselves to the conditions of new and often unnatural habitats.

One of the best known fish of the Miramichi and St. John is the striped bass (*Roccus lineatus*, Bloch), attaining in the former river, perhaps, its greatest perfection of delicacy and flavor — an excellence doubtless due to its food, the smelt (*Osmerus mordax*, Mitchell), with which the bays and estuaries swarm. This species has a very wide distribution, ranging from the Bay of Fundy to the Gulf of St. Lawrence. Though ascending some rivers, as the St. John, far above the influence of the salt water, its fluviatile movements on the Miramichi are wholly confined to brackish water, but, unlike salmon, shad, etc., which retreat, on the approach of winter, to the deep and warmer waters of the ocean, the bass enters the mouths of rivers, and ascends to the very heads of their estuaries, where the temperature must be many degrees colder than outside. This singular habit has not been satisfactorily explained. The fishermen of the Atlantic States of America and some ichthyologists, especially DeKay, are of the opinion they hibernate, buried, or partially so, in soft muddy bottoms; and it is a strange coincidence that the Acadian French, dwelling around the mouth of the Big Tracadie, Gloucester County, N. B., hold the same views. This common belief of people so far isolated and having little intercourse, if any at all, would seem to arise from an observation of facts; yet the writer's investigations and enquiries have failed to find a well attested case in support of this theory. Others solve the problem by asserting that the bass is peculiarly insensible to cold. G. Brown Goode, of the Smithsonian Institution, is rather inclined to this view. It is not clear, however, that such is a fact; for under some conditions they are very sensitive to sudden changes, and the power of bearing a low temperature seems in proportion to size and age — the larger fish being the least affected. The latter are found at the head of the estuary where the fresh water, little affected by the ebb and flow of the tide, must fall to a low temperature; the June fry congregate in the lower part in the deeper, brackish or salt, and warmer waters; between these extremes the rest are found distributed according to size. During a thaw, when, owing

to the melting snow, the temperature of the river water sinks, the larger fish are found to scatter in all directions down the estuary, to resume their former places when the freshet subsides. A low temperature destroys the characteristic voracity of the bass. In winter the stomach is invariably empty.

On the St. John it spawns in fresh, but on the Miramichi in brackish or salt water, and generally in shallow places. During the operation there is no evidence of pairing as seen among the Salmonidæ, nor indeed any definite sexual arrangement of individuals, except that the males are said to keep sometimes tidewards of the females. The eggs hatch in from thirty-six to seventy-two hours, according to the temperature of the water; and in December the fry are from two and a half to three inches long. This rate of growth is much less than on the New England coast; but in the latter case the season is longer.

The striped bass is eminently fitted to perpetuate itself. Of rapid movement; provided with formidable means of defense in the sharp, strong dorsal spines, inhabiting areas of our coast waters peculiarly free from enemies, exceedingly prolific, with the young so rapidly developed from the egg that little or no destruction of spawn can take place; this excellent food fish should be very abundant. And so it was in the Miramichi Bay until lately. In a few months of the winter of 1884 the estuary of the north-west Miramichi alone yielded 94,000 pounds, worth from twelve to fourteen cents a pound; but the catch declined, until in 1889 it was only 2,000 pounds. This falling off was due to over-fishing and the destruction of young fry in smelt bag-nets, which, with a strange disregard of consequences, were permitted to be set in their winter habitat. As this was stopped and the taking of bass prohibited for three years, these waters were soon restocked.

Respecting the distribution and number of species of Gasterosteidæ, or stickle-backs, in New Brunswick, much uncertainty has hitherto existed. Perley knew but one form —*Gasterosteus biaculeatus*, Storer; and Professor Gill, though

including this and two other species in his "Fishes of the Gulf of St. Lawrence and Bay of Fundy," did not regard them as properly determined. In "Field and Forest Rambles," A. Leith Adams follows Gill without determining the doubtful forms, while J. M. Jones in his "List of Nova Scotia Fishes," see "Natural Science Institute of Nova Scotia, 1878–9," includes only *G. biaculeatus*. The writer has succeeded in establishing the existence here of three species, and has reasons for believing that a fourth also exists. A very handsome one, about three inches in length and like a diminutive mackerel in shape and coloration, is the "nine spined stickle-back," *G. pungitius*, L. Though sometimes found in brackish water, it has a decided preference for sluggish streams, ditches and ponds, resorting to springs and the mouths of brooks on the approach of winter, during which it seems as active and lively as in summer. In the latter season the writer has not identified many of these in brackish waters; but they so increase there in number on the approach of winter as to favor the idea of a seasonable migration. Notwithstanding its formidable array of spines, the nine dorsal ones diverging at irregular angles, a deviation of a highly protective character, it then falls a victim to the greedy frost fish, *Gadus tomcod*, Walbaum, which alone of all the winter fish retains the well-known family appetite unimpaired.

A second, smaller, and less beautiful form, limited to an entirely fresh-water range, is *G. inconstans*, Kirtland. As the specific name implies, the dorsal spines are variable in size and number, and arranged nearly in a direct line. They are never less than four, nor greater than six. This species has its greatest distribution in the southern parts of the province, occurring but rarely in the north.

The third form identified is *G. aculeatus*, L.—the *G biaculeatus* of Shaw and DeKay, included in Perley's list. This has been regarded as an exclusively salt-water species, and such it generally is, but the writer collected fine specimens on the Restigouche, over one hundred miles from its mouth,

proving that it, too, possesses the remarkable vitality and powers of adaptation to altered conditions of life, so characteristic of the whole family. It is the largest of the sticklebacks, being fully four inches long, and has but two, rarely three, dorsal spines. These are hinged at the base and capable of being so set as to resist great pressure before yielding. The tail is keeled laterally with a sharp ridge, the function of which is not understood.

Wherever found in large numbers, these little creatures play an important part in the destruction of other species. Active, bold and greedy, they never tire hunting up spawn and fry in the shallow waters they frequent, and into which the helpless young of other species flee for safety from larger enemies.* Indeed, so marked is this spirit of destruction that they will attack and kill their own young—a singular fact, as under certain conditions, no other fish evinces more parental affection. Many not only build nests for the reception and safety of their spawn, but the males stand guard at portals, fanning the water with their fins and tails to keep up a healthy circulation, which cannot otherwise be had, as the nests are made in sluggish or altogether stagnant water. They are even said to enter the nests from time to time and stir up the eggs thus securing their more uniform aeration. These extraordinary precautions, in such strong contrast with the usual indifference of fish to the fate of their offspring, are seemingly suggested by a sense of their own destructive habits.

Their undue multiplication is chiefly prevented by certain birds, such as the blue heron (*Ardea herodias*, Linn.); American bittern (*Botaurus lentiginosus*, Motag.); green heron (*Ardea virescens*, Linn.); yellow legs (*Totanus flavipes*, Gmel.); and other waders, besides the belter kingfisher (*Ceryle alcyon*, Linn.), which incessantly prey upon them in every

* A small stickle-back, kept in an aquarium in England, devoured in five hours seventy-four young dace, which were about a quarter of an inch long and about as thick as a horse hair. Two days after it swallowed sixty-two, and would likely have eaten as many every day could they have been procured.

pond, creek, marsh and shallow lagoon. Did such a check not exist, the Gasterosteidæ would, in favored localities, cause a decrease in the supply of certain food fishes, not directly indeed, but by preying on the forms supplying the latter with food.

Of the forty genera and two hundred species of the Cyprinidæ found in North America, only six undoubted forms are known to occur in New Brunswick. There must be more, but identification of many members of this family is extremely difficult, owing to uniformity in size, coloration, and habits, as well as to changes due to season and age. Then, again, they are esteemed of no value as food-fishes — a general passport to neglect.

The shiner, or red-fin (*Minnilus cornutus*, Mitch.), is found generally distributed over the whole province, occurring in streams and brooks, and shallow portions of rivers. It is rarer in northern than in southern waters, a fact largely due to the presence in the former of great numbers of trout (*Salmo fontinalis*, Mitch.), which are extremely partial to this brightly colored and attractive minnow.

The pretty little black-nosed dace (*Rhinichthys atronasus*, Mitch),) is found in all the inland waters of the province, generally associated with the last species, but preferring smaller streams and more shallow waters. For a similar reason, it is, like the red-fin, less abundant in northern streams.

The chub, or horned dace (*Semotilus corporalis*, Mitch.), and the silver chub (*S. bullaris*, Raf.), frequent the larger brooks and still reaches of rivers; but the latter is also found in great numbers in many lakes, especially those of the Miramichi, examined by the writer in the summer of 1890. They sometimes grow to the length of eighteen inches, and weigh from three to four pounds; but never show the maxillary barbel, so characteristic of the fish in more southern waters. In the Miramichi lakes the larger ones feed principally on red-fins and fresh-water clams, with the broken shells of which their stomachs are often found gorged.

The fifth Cyprinid, heretofore reported only from the southern part of the province, is the golden shiner (*Notemigonus chrysoleucus*, Mitch.); but the writer has taken them from some lakes drained by the Miramichi. They are, as far as he knows, confined to ponds and lakes,—at least such is their distribution in New Brunswick.

The sixth species,—*Phoxinus neogæus*, Cope — the writer found in 1889. It does not seem to have been previously observed east of Michigan where it is by no means common. It is a small minnow, about three inches in length, frequenting ponds and sluggish lowland brooks, shy, quick in movement, and keeping itself generally concealed among grass and weeds.

Leuciscus argenteus of Perley's list must be dropped from the catalogue of Cyprinids. It is but the young of *Semotilus corporalis*, Mitch.

Some years ago a not uncommon fish of the St. John and north-west Miramichi was the sturgeon (*Acipenser sturio*, variety *oxyrinchus*), which found a congenial haunt and plenty of food on the muddy bottoms of those rivers. In contrast, however, with its migrations on the St. John, it never ascended beyond the influence of the tidal waters on the Miramichi, keeping well within the brackish portion of the estuary, even to the extent of spawning there. It was observed, too, that young fish varying from six to eighteen inches in length passed the winter in the estuary where they were often taken in considerable numbers in bass scoop-nets. Large specimens, however, were never so caught, from which it is inferred that on the approach of the cold season they withdraw to the deeper bay, or, more likely, ocean waters. Of late years it is rare.

It is, indeed, singular that a fish so exceedingly prolific, for a single female produces three millions of eggs, and fairly well protected by means of bony plates, should be so easily and rapidly reduced in numbers, as was the case lately on the river St. John, where by no means excessive fishing almost depleted those waters in three or four years. The drain bore

no relation to the apparent fecundity of the fish. Even before that, it was by no means very common. Growing to a great size and remaining several months in the rivers and estuaries, it might be thought that the food supply would prove inadequate to the wants of large schools, and so check rapid multiplication. From evidence afforded by some stomachs examined, it does not appear that much food is consumed at this time; so that some more general and far-reaching cause must be operating to produce this effect. Being ground-feeders, and frequenting bottoms affording concealment to certain predaceous fish, it would seem that many must fall victims to those strange marine harpies—the lampreys (*Petromyzon marinus*, Linn.) Indeed the natives of the Miramichi, as well as of the St. John, account for the leaping of the sturgeon on the ground that it is trying to get rid of its tormentors. Cod-fish, too, are not unfrequently found with lampreys attached to them, and even salmon sometimes share the same fate. Squirrel-hake taken through the ice near the mouth of the Kennebecasis frequently have two or three small lampreys from six to twelve inches long clinging to a single fish. Once a lamprey has attached itself to a young sturgeon by means of the circular cupping-glass-like mouth, the latter was doomed, for it could not long survive the operation of those saw-like teeth and loss of blood. Indeed the writer has seen many sturgeons which had seemingly been killed in this way, as the circular wound on the side just behind the gill indicated. These eels are quite common in our coast waters, and ascend the rivers in large numbers.

APPENDIX.

THE REPORT OF THE COUNCIL.

The Council of the Natural History Society of New Brunswick beg leave to submit the following report for the year now ending.

MEMBERSHIP.

Additions has been made to the membership roll as follows:

Ordinary Members	8
Corresponding Members	3
Associate Members	12
Total addition to Membership	23

It is a source of gratification to the Council that the associate members have banded themselves together for the purpose of more effectively aiding in the work of the Society.

The Council desire to see a large increase in the number of ordinary members, and to this end they would ask the hearty co-operation of all the members.

It is also hoped that our corresponding members, scattered through different parts of the province, will take a greater interest than heretofore in the work of the Society.

FINANCE.

The executors of the Botsford estate paid two thousand dollars of the principal of the Botsford bequest and also paid interest for a year and a half on the bequest up to June 1st, 1892. This amount is now in the hands of the finance committee awaiting investment.

The Treasurer's report shows the following receipts and expenditures:

Balance on hand from last year	$177 34
Receipts from dues	67 00
Provincial grant	125 00
Bulletins sold	1 00
Rent from University Extension Course	22 50
	$392 84
Expenditure for year	187 75
Balance on hand	$205 09

Most of this balance will be required to pay the cost of the Bulletin just issued, and of books purchased for the library.

LECTURES AND ESSAYS.

Seven regular meetings were held, at which the following papers were read:

1892.

Feb. 2. Natural History of Fish, by Wm. M. McLean.
Mar. 1. The Stone Age in New Brunswick,— a Discussion.
Apr. 5. General Business. No paper
May 3. Address in regard to the Summer School of Science.
Nov. 1. Dr. Gesner — his Life and Works, by G. F. Matthew.
Dec. 6. Observations on the distribution and habits of some New Brunswick fishes, by Philip Cox.

1893.

Jan. 3. The Stone Age in Egypt and Babylon, by G. F. Matthew

LIBRARY.

Additions have been made to the library by the receipt of many exchanges.

In the earlier days of our Society, papers of more than usual interest were published in the "Canadian Naturalist." It has been thought desirable to have these publications in our possession, and so the first series of eight volumes of that journal has been purchased.

BOTANY.

The botanical committee report the discovery of a number of plants not heretofore known to occur in this province; also a more extended range for some plants than yet recorded. The report of this committee will be found attached. The subject of forestry is full of importance to our people, and is well worthy the attention and close study of some of our members.

MUSEUM.

Our custodian has continued his work on the museum during the year. The rooms are open every Tuesday night and every Saturday afternoon, and we invite the members to avail themselves oftener of these opportunities to examine and study the collections.

PUBLICATIONS.

During the year our tenth Bulletin has been issued and is now in the hands of the members. This number completes the second volume of this publication and is furnished with an index. Five hundred copies have been printed of all the Bulletins except No. III, of which only three hundred were printed. This proved, however, to be too few, and for some time it has been impossible to secure copies of this Bulletin. In consequence of this it was considered advisable to reprint part of it in Bulletin No. X.

FIELD MEETING.

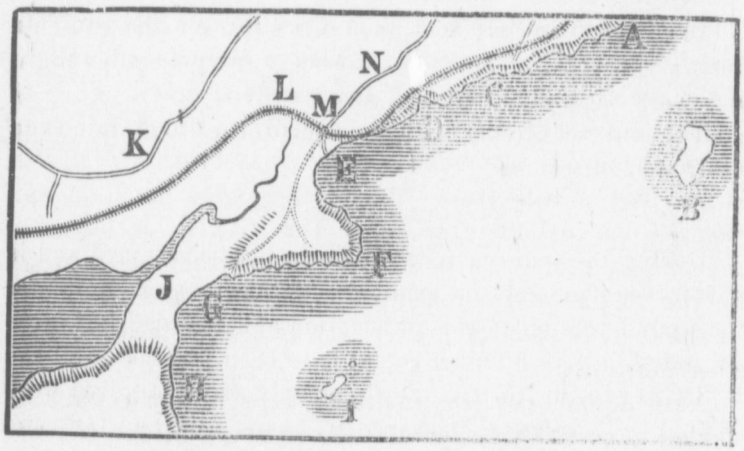
On Wednesday, August 10th, the Society held a very successful field meeting at Sand Cove and Manawagonis Beach.

The party proceeded to Sand Cove by the Shore Line R.R., and through the kindness of James Manchester, Esq., were permitted to use his grounds and buildings as headquarters for their excursion.

The geological party visited Sheldon's Point in the forenoon, and made themselves familiar with the trap-ash rocks which there form the point on the West side of Sand Cove.

From this point they walked along the Manawagonis beach, inspecting the excellent exposures of the Post-pleiocene formation shown in the clay banks and high hills of gravel along the shores. In the afternoon they visited the Fern Ledges to the eastward of Sand Cove, and studied the exposures of the Devonian sandstones and shales visible there, collecting ferns and calamites from these ancient rocks.

The zoological and botanical parties rambled around the vicinity of Sand Cove and Sheldon's Point, making collections



SAND COVE AND MANAWAGONIS.

Scale 1¼ mile to inch.

A Negrotown Point.	H Taylor's Island.
B Partridge Island.	I Manawagonis Islands.
C Fern Ledges.	J Manawagonis Marsh.
D Duck Cove.	K St. Andrew's Road.
E Sand Cove.	L Shore Line R. R.
F Sheldon's Point.	M Sand Cove Station.
G Manawagonis Beach.	N Sand Cove Road.

from the woods and fields of the neighborhood. A section of this party also made an excursion to Manawagonis Island to collect seaweed and marine animals along its shores.

The ladies' committee had in the meantime been busy and prepared at Mr. Manchester's "pavilion" refreshments for the excursionists. Here prizes were awarded for the best collec-

tions in zoology, botany and geology, and a vote of thanks was given to Mr. Manchester for his liberality in placing his premises at our disposal.

The members of the Summer School of Science were present as our guests and a very pleasant day was spent.

A conversazione was held on August 12th. This proved a very enjoyable affair, both to the members of our Society and to the staff and students of the Summer School of Science.

By the death during the year of R. Peniston Starr, the Society has lost a valuable member. He was one of the founders of our Society and its first recording secretary. He gave liberally of his time and means to promote the welfare of the Society and always had its interests at heart.

The University Extension movement, to which reference was made in our last annual report, was continued in the earlier part of this year. Two courses were given in our rooms — one in botany, with Mr. Geo. U. Hay as lecturer; and one in geology, with Mr. Geo. F. Matthew as lecturer.

The thanks of the Society are due the press of St. John for the free insertion of preliminary notices of meetings and other courtesies.

Your Council cordially invite all the members to unite in making the coming year even more prosperous than the one just closed,

Respectfully submitted,

SAMUEL W. KAIN,
Secretary to Council.

January 17, 1893.

REPORT OF THE COMMITTEE ON BOTANY.

The following is a list of plants new to the province, or giving fresh localities for those that are described as rare in former lists. The list contains thirty-seven species of plants new to the province. These are italicized in the list that follows:

1 Clematis verticillaris, D. C. Upper Restigouche, Cox and Brittain; Douglas Road, St. John, A. C. and G. Stead; Keswick Ridge, F. G. Berton.

4a *Anemone parviflora*, Michx. Restigouche River, Cox and Brittain.

6 A. cylindrica, Gray. Restigouche River, Cox and Brittain.

43a *Arabis perfoliata*, Lam. Restigouche River, Cox and Brittain.

55a *Thlaspi arvense*, L. West Side, St. John, A. C. and G. Stead; F. G. Berton.

64 Viola primulæfolia, Lily Lake, near St John. A. C and G. Stead.

73 Polygala Senega, L. Restigouche River, Cox and Brittain; near Fredericton, F. G. Berton.

86a *Stellaria graminea*, L. Introduced from Europe. Fredericton, Brittain.

146a *Astragalus oroboides*, Hornem, *fide* Macoun. Restigouche River, Cox and Brittain; Mouth of Aroostook, Brittain.

149a *Desmodium acuminatum*, D. C. Sprague's Falls, St. Croix, Geo A. Inch; Island at Woodstock, Brittain.

157a *Lathyrus pratensis*, L. Native of Europe. Miramichi River, Cox; Salmon River Flats, below Grand Falls, Geo. A. Inch; Sandy Intervale, Big Hole, Miramichi, Cox.

228a *Epilobium Hornemanni*, Reichenb. Quatawamkedgwick River, Restigouche, Cox and Brittain.

237 Sanicula Canadensis, L. South Bay, St. John County, A. C. and G. Stead.

247a *Pimpinella saxifraga*, L. Well established for several miles along the river at Springhill, York Co. Brittain.

269a *Triosteum perfoliatum*, L. Islands in St. John River, and in Carleton County. Brittain.

279*a* *Galium boreale*, L. Restigouche River, Cox and Brittain.

307 Aster Lindleyanus, Torr. and Gr. Near Fredericton Junction. Brittain.

310*a* *A. junceus*, Ait. Below Mouth of Eel River, York County. Brittain.

310*b* *A. longifolius*, Lam.; var. *villicaulis*, Gray. Fredericton, Brittain.

330 Ambrosia artemisiæfolia, L. Gagetown, A. C. and G. Stead.

333*a* *Senecio Pseudo-arnica*, L. Small island off Grand Manan. Judge Churchill, Boston, Mass.

363*a* *Hieracium aurantiacum*, L. St. Stephen (collected by G. W. Chamberlain, Calais,) J. Vroom.

392*a* *Vaccinium Vitis-Idæa*, L. Common on and near the coast. (Omitted from list).

418 Lysimachia quadrifolia, L. Mouth of Nerepis, Hay and Brittain.

438*a* *Cynoglossum officinale*, L. Springhill, York County. Keswick, Brittain.

482*a* *Pinguicula vulgaris*, L. Restigouche River, Cox and Brittain.

493 Hedeoma pulegioides, Pers. Moss Glen, Kings Co., F. G. Berton.

503*a* *Lamium album*, L. Spreading from ballast about Newcastle, Miramichi, Cox,

526*a* *Polygonum ramosissimum*, Michx. Moncton, Brittain. *Fide*, Prof. Macoun.

576*a* Salix sericea, Marsh. *Fide* M. S. Bebb. St. John River, Brittain.

577*a* *S. candida*, Willd. Below mouth Eel River, York Co., Fredericton, Westfield. Brittain.

585*a* *S. longifolia*, Muhl. Along the St. John River. Brittain.

606 Microstylis monophyllos, Lind. Owen's Lake, St. John. G. Stead.

649*a* *Allium Canadense*, Kalm. Near Mactaquac Island, St. John River. Geo. A. Inch.

672*a* *Juncus alpinus*, Villars, var. *insignis*, Fries. Restigouche, Cox and Brittain.

715*b* *Cyperus dentatus*, Torr. and Gr. Fredericton, Brittain.

715*a* *C. aristatus*, Rottb. Fredericton, Brittain.

723*a* *Eleocharis pauciflora*, Link. Restigouche River, Cox and Brittain.

732*a* *Eriophorum cyperinum*, L. Common. Omitted from list.

740*a* *Rhyncospora glomerata*, Vahl. Near Pokiok, York Co. Brittain.

748*a* *Carex cephaloidea*, Dew. Below Bear Island, St. John River. Brittain.

763*a* *C. alpina*, Swartz. Upper Restigouche, Cox and Brittain.

763*b* C. atrata, L. Restigouche River, Cox and Brittain.

777*a* *Carex bicolor*, Allioni. *Fide*, Prof. Macoun. Restigouche River Cox and Brittain.

784 C. oligocarpa, Schk. The plant so reported is probably C. conoidea.

785*a* *C. concinna*, R. Br. Restigouche River, Cox and Brittain.

831*a* *Phalaris arundinacea*, L. Rather common. Omitted from list.

833*a* *Alopecurus pratensis*, L. Fry's Island, Hay, Brittain.

843*b* *Sporobolus serotinus*, Gray. Fredericton, Brittain.

843*c* *S. depauperatus*, Vasey. Keswick, Brittain.

843*d* *S. minor*, Vasey. Keswick, Brittain.

876 Puccinellia distans, Parl. (Glyceria distans of list). Near Sackville, Brittain.

855*a* *Agropyrum violaceum*, Hornem. (Triticum violaceum.) Restigouche River, Cox and Brittain.

894*a* *Equisetum palustre*, L. Fredericton, Brittain.

907*a* *Phegopteris calcarea*, Fée. Restigouche River, Cox and Brittain.

923*a* *Woodsia glabella*, R. Brown. Restigouche River, Cox and Brittain.

936 Lycopodium inundatum, L. Lord's Cove, Deer Island, 1891, Bonny River Station, St. George, 1892, J. Vroom.

940*a* *Selaginella spinosa*, Beauv. Restigouche River, Cox and Brttain.

123*a* *Celastrus scandens*, L. (Wax-work, Staff-tree). Mactaquac Island, Islands near Woodstock, Geo. A. Inch.

DONATIONS TO THE MUSEUM.

Date.	Donor's Name and Description of Article.
1892. July	Mrs. John Berryman. — Portfolio of pressed flowers gathered in Ontario and Quebec by Mrs. Roy.
Sept.	Mrs. R. P. Starr.—A collection of minerals, mostly zeolites from Nova Scotia; also fossil plants from the coal measures of Grand Lake and the Devonian rocks of St. John; also a collection of tropical and other sea shells.
	Mrs. G. A. Hamilton.—Fossil shells and phosphate rock from the phosphate beds of Faison, N. C.; also belemnites and teeth of sharks—fossil—from Duplin, Duplin Co., N. C.

DONATIONS TO THE LIBRARY.

Date.	Donor's Name and Description of Book.
1892. Jan'y.	U. S. Geological Survey, Washington.— Tenth Annual Report, 1888–'89, Parts I and II, Bulletins 62, 65, 67, 69—'81, '82.
	Colorado Scientific Society, Denver.—Proceedings, Vol. III, Part III, and on a series of Peculiar Schists near Salida, Col., by Whitman Cross.
	Essex Institute, Salem, Mass.— Bulletin, Vol. XXIII, Nos. 7–12; Bulletin, Vol. XXIV, Nos. 1,2, 3; "Our Trees," by John Robinson.
	Director do Museu Nacional do Rio de Janeiro.— Archivos, Vols. I (1, 2, 3 and 4) II, III, IV and V. Essay, "LeMuseum National, et Son Influence sur les Sciences Naturelles au Brasil," par. S. Netto.
	Journal of the New York Microscopical Society.— Vol. VIII, Nos. 1, 2, 3; Vol. IX, No. 1.
	The Author.—H. Forir, C. E., Liege, Belgium, Quelques particularites remarquables de la planchette de Herve. Sur un facies remarquable de l'Assise de Herve. Relations entre l'etage Landenien &c., Belge.
Feb'y.	Minnesota Academy of Natural Sciences, Minneapolis. —Proceedings, 1887–'89.
	Edward Gilpin, C. E., Halifax.—Quarterly Journal Geological Society, London, No 189.
	Nova Scotia Institute of Science, Halifax.— Vol. I, Part I (second series).
	Academy of Natural Sciences, Philadelphia.—Proceedings 1891, Part III; Part I and II of Proceedings for 1892.
	Ottawa Field Naturalists' Club, Ottawa.—Transactions, Vol. V, No. 10; Vol. VI, Nos. 1, 2, 3, 4, 5, 6, 7, 8 and 9.

DONATIONS TO THE LIBRARY — (*Continued.*)

DATE.	DONOR'S NAME AND DESCRIPTION OF BOOK.
1892. March.	FEUILLE DES JEUNES NATURALISTES, Paris.—Nos. 257 to 267, and Catalogue No. 15.
	SMITHSONIAN INSTITUTION, Washington.—Annual Report for 1889; Annual Report for 1890.
April.	LIFE HISTORIES OF NORTH AMERICAN BIRDS.—Special Bulletin, No. 1.
	U. S. NATIONAL MUSEUM, Washington.—Bulletin 41 and 42.
	AMERICAN MUSEUM OF NATURAL HISTORY, New York.—Bulletin, Vol. III, No. 2; Annual Report for 1891.
	CANADIAN RECORD OF SCIENCE, Montreal.—Vol. V, Nos. 1, 2, 3 and 4.
	MARINE BIOLOGICAL LABORATORY, Boston.—Fourth Annual Report for 1891.
June.	PORTLAND SOCIETY OF NATURAL HISTORY, Maine.—Catalogue of Maine Plants (second edition).
	THE CANADIAN INSTITUTE, Toronto.—Transactions, Vol. II, Part II, No. 4, Annual Archæological Report; Vol. III, Part I, "An Appeal to the Canadian Institute on the Rectification of Parliament," by Sanford Fleming.
	U. S. FISH COMMISSION, Washington.—Bulletin, Vol. IX, 1889.
July.	LABORATORY INLAND REVENUE DEPARTMENT, Ottawa.—Bulletins 1 to 30.
	BRIDGEPORT SCIENTIFIC SOCIETY, Bridgeport, Conn.—List of birds found in the vicinity of Bridgeport, by C. K. Averill, Jr.
August	LINNAEAN SOCIETY, New York.—Abstract of Proceedings for year ending March, 1892.
	HAMILTON ASSOCIATION, Hamilton, Ont.—Journal and Proceedings, Vol. VIII.
	GEOLOGICAL SURVEY OF CANADA, Ottawa.—Catalogue of Canadian Plants, Part VI; Musci. Maps for Annual Report of 1888—1989. Contribution to Canadian Micro-Palæontology, Part IV.

DONATIONS TO THE LIBRARY — (*Continued.*)

DATE.	DONOR'S NAME AND DESCRIPTION OF BOOK.
1892.	
August	ROYAL SOCIETY OF CANADA, Ottawa.—Proceedings and Transactions, Vol. IX.
	GEOLOGICAL SOCIETY OF LONDON, London, G. B.—Abstracts of Proceedings, Nos. 578–594.
Oct.	THE AUTHOR.—A Chapter in Glacial History; Rivers and the Evolution of Geographic Forms; The Geology of Oneida County, by Albert P. Brigham, Colgate University, Hamilton, N. Y.
	THE AUTHOR.—My Cholera Experience, by James Death, Fairville, N. B,
Nov.	THE LITERARY AND HISTORICAL SOCIETY OF QUEBEC.—Transactions, No. 21.
Dec.	SOCIÉTÉ SCIENTIFIQUE DU CHILI, Santiago —Proceedings, Vol. II, Part I.
	NATURAL HISTORY SOCIETY OF GLASGOW, Glasgow.—Proceedings and Transactions, Vol. III, Part II.
	BOSTON SOCIETY OF NATURAL HISTORY, Boston.—Proceedings, Vol. XXV, Parts III and IV.
	NATURAL SCIENCE CLUB, St. John, N. B —Records, April 2nd, 187., to April 23rd, 1878
	COLORADO SCIENTIFIC SOCIETY, Denver —On a Series of Peculiar Schists near Salida, Col., by Whitman Cross.
	NEW YORK STATE MUSEUM, Albany.—44th Annual Report

Officers and Committees of the Natural History Society for 1892.

Patron — His Honor Sir S. L. Tilley.

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President — Geo. F. Matthew, M. A., F. R. S. C.
Vice-Presidents — Geo. U. Hay, Ph. B., Wm. Murdock, C. E.
Treasurer — Alfred Seely, Esq.
Secretary — Mr. Samuel W. Kain.
Curators — Dr. H. G. Addy, Philip Cox, B. Sc., G. Stead, C. E.
Librarian — Frank G. Berton, B. A.
Additional Members — J. Roy Campbell, Edwin Fisher and G. Ernest Fairweather.

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Geology — G. F. Matthew, G. Stead and Prof. L. W. Bailey.
Invertebrates — W. F Ganong, M. A., G. Stead.
Ornithology — Philip Cox, F. W. Daniel and A. Morrisey.
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Essays and Lectures — G. U. Hay, G. F. Matthew, G. Ernest Fairweather, Dr. H. G. Addy, J. Roy Campbell and G. Stead.
Publications — G. F. Matthew, G. U. Hay, Alfred Seely, Samuel W. Kain and G. Ernest Fairweather.
Rooms — Dr. Addy, Wm. Murdock, G. F. Matthew and S. W. Kain.
Finance — Alfred Seely, Edwin Fisher and J. Roy Campbell.
Press — Geo. U. Hay, J. Roy Campbell, F. G. Berton and S. W. Kain.
Botanical — G. U. Hay, John Brittain, James Vroom and F. G. Berton.