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NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

ARTICLE I.

DR. JAMES ROBB.

First Professor of Chemistry and Natural History in King's College, Fredericton—A Sketch of His Life and Labours,

By L. W. Bailey, LL. D.

Read April 5, 1898.

In the course of the development of knowledge as regards the structure, history and natural resources of a country, it is usually the case that distinct steps of progress may be recognized, and that with each of such steps the life and labours of some one individual are prominently associated. The names of such men as Aristotle, Linnæus, Cuvier, Agassiz and Gray, make such steps of progress for the world at large, but even within the comparatively narrow limits of a single state or community a like process of development by successive, well marked stages is usually recognizable, and New Brunswick is no exception.

The first period in all such cases is usually that in which some one individual, as a result either of a more intense sympathy with nature or circumstances especially favorable for her study, devotes his whole energy to such work, and thus, by gathering and comparing the isolated and disconnected observations of many observers, begins to give to the latter a definite direction and definite methods. To us who have to labour in fields already pre-occupied by so many workers, and where the discovery of even one new fact or species is a rare occurrence, in

some departments indeed well-nigh an impossibility, a glance backward into the territories investigated by the early pioneers cannot but awaken a feeling of envy. On whichever side they turned something entirely novel was almost sure to meet their gaze. They had only to stretch out their hands and a veritable Klondyke of rich rewards awaited their grasp. No wonder that their imaginations were aroused to the highest pitch, and that conclusions and anticipations should be indulged in, which would require time and the crucible of criticism, and more exact observation to reduce to their proper value. In New Brunswick the period of pioneer exploration, and of enthusiastic but not always well justified prophecy, is identified with the name of Dr. Abraham Gesner, a sketch of whose life and labours has been published by the Society in its No. XV. Bulletin. That of the beginning of more exact observation and of critical analysis is similarly associated with the subject of the present sketch, Dr. James Robb.

Dr. Robb was born in the city of Stirling, Scotland, in the year 1815. Of his early life and education I have been unable to obtain any particulars, but, from letters written at the time, I find that he entered upon a course of medical study in Edinburgh University in the year 1831. He could hardly have ever entered seriously upon the practice of his profession, for in August of the year 1835 we find him travelling, while still a student, on the continent of Europe, and in September, 1837, he had already come to New Brunswick to accept the position of Lecturer in Chemistry and Natural History in King's College (now the University of New Brunswick), in which as Professor he continued to work until the time of his death, in 1861.

It is very evident that, even at the time of his European journey, which lasted for several months, he had already acquired a fondness for scientific, as distinguished from merely medical or professional, work, for he himself says, in writing to his mother, that the trip "was more for science than for pleasure," and resulted in the "collection of vast numbers of plants and shells and minerals." He must also have already gained for himself an enviable reputation as a naturalist, for he was accompanied by Dr. Van Beneden, already well known in the scientific world, and carried with him letters to many distinguished savants, making, as he says, the entire journey a "*voyage d' agrément.*" Switzerland would seem to have had special attractions for him, though Nice, Milan, Genoa and Sardinia were also visited. The journey was made *on foot*, and in the passage of the Juras was not unattended with danger, the party being on one occasion storm-bound for three days in

a hut on the Auberge, from which they only escaped with difficulty, and where, to use his own words, "had they been much longer confined, they would have had to eat each other, like the Kilkenny cats, because there was nothing else to eat." He grows quite enthusiastic over their reception at the University of Pavia, where, despite their clothing, much the worse for travel, "the Professors of that time-honored seat of learning vied with each other in attentions and affability, one giving us objects of natural history, another presenting us with his works, and a third giving us iced sherbets and chocolate." He would never, he says, "think of his visit to Pavia but with feelings of the highest gratification." He adds that not at Pavia only, but throughout the journey, every moment was not only pleasurable, but of inestimable value to him. He was constantly in an atmosphere of science, and as the collections then made were undoubtedly those which subsequently became the nucleus of the cabinet now in the University in Fredericton, the writer of this notice, to whom these facts have only recently become known, can now the more readily understand, as he has always been surprised at, their extent and value.

The special circumstances which led to Dr. Robb's coming to New Brunswick are not definitely known ; but as about the same time at least one other Professor from Scotland came to the Provinces for a similar purpose, it is probable that enquiries or advertisements had been instituted there with a view to the obtaining of properly qualified instructors. However this may have been, it is certain that Dr. Robb had not long been here before his influence began to be felt in the community. Accustomed to cultured society, fond of music, well read in the literature of the day, and, though not practising medicine, recognized universally as one thoroughly competent to advise, and, in the case of the poor, ever ready to give advice without compensation, he could not fail to be an acquisition to any community, and especially to such a one as then existed in Fredericton. Proofs of the estimation in which he was held are not wanting. Old residents of the city, and among all classes, speak of him even now in terms of the highest regard. His opinion was sought upon many subjects outside the line of his ordinary professional work. He was the first President and the most active spirit in the Fredericton Athenæum, a society or club for the promotion of literary and scientific research ; he was nominated, in 1849, and chosen a member of the first Council of his adopted city, and again in 1850, in this latter case declining to serve that he might be the more free to give his attention to what he conceived to be a

still more important duty—the promotion of the agricultural interests of the Province. He enjoyed in an eminent degree the confidence of the then Lieutenant-Governor of New Brunswick, Sir Wm. Colebrook, as also that of the Bishop, the Chief Justice, the Master of the Rolls, and the other chief officials of the colony. As a teacher he was loved as well as respected by his pupils, seeking always for accuracy and clearness of statement rather than for a show of words, and endeavoring, as far as his very isolated position and remoteness from books and fellow-laborers would allow, to keep himself acquainted with the latest results of scientific thought and experiment. In December, 1840, he married Miss Ellen Coster, daughter of the Archdeacon of New Brunswick, and from that time his residence in the College building was a centre from which he continued to influence for good a constantly widening circle of individuals and of interests.

We, as naturalists, are chiefly concerned with his scientific labours. As might be expected, the natural products of a country quite new to him were quick to attract his attention, and the dates attached to specimens in the college herbarium show how soon after his arrival he entered upon the study of the botany of the Province. Practically he was our first botanist, for though others had made a few scattered observations on the occurrence of particular species, he seems to have been the first to attempt anything like a systematic collection. This collection is now in the museum of the University of New Brunswick, and embraces several hundred species, some of them forms of very rare occurrence, and some species re-discovered long afterwards by other observers. It was, of course, arranged on the old Linnæan system, but both in its extent and in the accuracy of its determinations shows clearly the labour expended upon its preparation. It is to be regretted that in this, as in so many other instances, the results of his work were never printed, so that little besides the collections which he made remains to indicate the extent of his services. He must, however, have maintained correspondence and exchanged specimens with naturalists abroad, as along with his own collection are many specimens sent from the herbaria of Messrs. Hooker and Balfour. He must also have continued to enjoy an enviable reputation among the botanists of the motherland, as his letters indicate the interesting fact of his having been suggested as a possible successor to Sir W. Hooker in the botanical chair in Glasgow, a position which, however, he says that he could not, in view of his engagements here, honourably accept.

A study of the wild plants of the Province was accompanied by an interest in the cultivated forms and in the conditions of their production. In April, 1850, having refused to be elected to the Fredericton City Council, he took hold of a Provincial Society for Encouragement of Agriculture, which, he says, "gave him more to do than the Council." He was elected its president, and soon after wrote a paper on the subject of Manures, which, with others, was afterwards printed, though no copies, so far as known to the writer, are now extant. Practically, he became Secretary of Agriculture for the Province, an office not actually established until a much later period, retaining the position until his death, and in that capacity visiting many parts of the Province, giving frequent lectures on agricultural subjects, and correlating the statistical returns submitted to him by his many correspondents. I have before me his lecture, "On Agricultural Progress in New Brunswick," and find it to be a model of terse statement, extended observation, careful criticism of existing methods, and sound judgment in the direction of possible improvement. The government of to-day could not do better than to have this lecture reprinted and widely circulated among the class for whom it was chiefly intended.

Such a man as Dr. Robb would of course naturally understand the intimate relationship between the nature of soils and that of the rocks from which they are derived. His interest in geology had, moreover, already been aroused by his European tour, the fruits of which were before him, and no doubt employed in the illustration of his daily lectures. We may be sure, therefore, that it was with no indifferent eye that he scanned the results of the geological survey begun by Dr. Gesner in 1837, and continued during the four following years.

In the commencement of this sketch it was stated that Dr. Robb represents the second period in the history of scientific progress in New Brunswick. Strictly speaking, he and Dr. Gesner were contemporaries, but the first published observations of Dr. Robb, of a geological nature, are subsequent to those of Dr. Gesner, and are largely in the direction of criticism of the latter,—criticisms, however, based on his own personal observations and evidently having no other object than that of reaching more reliable conclusions. These criticisms are mostly contained in the report of Prof. J. W. F. Johnston on the Agricultural Capabilities of New Brunswick. Dr. Robb here especially objects to the enthusiastic and in many instances grossly exaggerated

statements of Dr. Gesner, relative to the occurrence of coal, and shows, by reference to all known outcrops, that the coal field of New Brunswick, instead of being one of the largest discovered on the globe, as stated by Gesner, was really small as compared with those of Illinois and Pennsylvania, and that the coal supply, instead of being "inexhaustible" and "of the highest importance not only to New Brunswick but to Great Britain and the United States," was really very small, the only workable seam known, and that of limited extent (the Grand Lake seam), not exceeding eighteen or twenty inches.

Another point in which Dr. Robb took issue with Dr. Gesner, of less economic significance, but still involving important consequences, was that of the true stratigraphical position of the red saliferous and gypsiferous rocks which cover such large areas in southern and some parts of northern New Brunswick. These, on account of their lithological resemblances to the rocks of the New Red Sandstone formation of England, with which he was familiar, were asserted by Dr. Gesner to be newer than the Coal formation, whereas Dr. Robb, following the view of Sir Charles Lyell, maintained, and correctly, that the greater part of them are really older than the coal measures.

But the most important contribution in this direction made by Dr. Robb is that of a Geological Map, contributed to Prof. Johnston's Report, in which, taking Dr. Gesner's incomplete maps as a basis, but modifying them as influenced by his own observations, as well as by those of Jackson, Logan and Lyell, he makes a distinct advance in the representation of the geological structure of the Province. With characteristic modesty, however, he observes that the map, made at Prof. Johnston's request, is unsatisfactory to himself, and is offered with very great diffidence.

In a sketch of the scientific work of Dr. Gesner, prepared by Dr. G. F. Matthew, and published in a Bulletin of this Society (No. XV, 1897), a very full discussion of the former's view is given, together with a representation of his map reduced from the map in the hands of the Natural History Society of New Brunswick, showing the result of his first three years' survey, and the more complete one in the possession of the Crown Lands Department at Fredericton, which shows also the work of his fourth year. Unfortunately we are without any record of Dr. Robb's observations and conclusions, excepting the very brief observations embraced in the letter to Prof. Johnston accompanying his own map. We are therefore limited to a

mere statement of the differences presented by the latter, as compared with the earlier map of Gesner, on which it is avowedly based.

The first feature to attract attention in such comparison is the larger area embraced in the map of Dr. Robb, the latter including the whole Province, while that of Gesner did not extend, except along the St. John river, north of a line connecting Woodstock and Chatham. Gesner's map, however, represents the results of his first four season's work only, while in the following year he made explorations of the northern counties sufficient to indicate their general character, and it is upon these, no doubt, that the completion of the work by Dr. Robb is based.

In his representation of the distribution of the granites which are so conspicuous a feature in the geology of New Brunswick, Dr. Robb's map — at least as regards the southern part of the Province — is less fortunate than that of Dr. Gesner, the more recent explorations embodied in the maps of the Geological Survey showing, especially in Charlotte County and Western Kings, a much closer approximation to the outlines as given by the latter than to those of the former. Gesner also indicates the existence of an axis of such rock extending from the Kennebeccasis River, near Hampton, to Eastern Albert, which in the map of Dr. Robb is represented by a corresponding band of "Trap, Syenite, Felspar Rock and Porphyry." As a matter of fact, this ridge includes but little true granite.

The northern granite belt, represented in Gesner's map only between the St. Croix River and the St. John, in that of Dr. Robb is extended across the Province to Bathurst. The granitic area of the Serpentine is also indicated.

The including of so many different rocks under a common colour, irrespective of age or origin, as in the case of the Trap, etc., referred to above, is, in the maps of both authors under review, an unfortunate feature, but is far more conspicuous in that of Dr. Robb than in that of his predecessor, the former being in almost all parts, not occupied by the coal-formation or red sandstones, blotched with small patches represented as occupied by one or other of these rocks, and which include intrusives of every age from the Laurentian to the Trias.

As regards the earlier Palæozoic rocks, the two maps differ widely, the Cambrian system being made, in that of Dr. Robb, to include large portions of Charlotte and Kings Counties, which in that of Dr. Gesner are represented as granitic or trappean, while the great band of slates and quartzites north of the York County granites, and includ-

ing the area about Woodstock, represented by Gesner simply as clay slate or argillites, and differently marked from that of the similar belt south of the granite, is by Robb, and correctly, made of the same age as the latter. It is probable that in referring both of these great belts, which are more or less metalliferous, to the Cambrian system, Gesner and Robb were, upon the whole, more correct than the officers of the Geological Survey so many years later.

In Gesner's map a considerable belt of rock skirting the southern seaboard from Passamaquoddy Bay to Chignecto Bay, and now known to be Pre-Cambrian (Laurentian and Huronian), is referred to the Lower Silurian, or its supposed equivalent, the Graywacke System. This, undoubtedly the oldest group of rocks in the Province, and a part of the Acadian protaxis, is by Robb made still younger, or Upper Silurian, possibly through the knowledge of the occurrence of Upper Silurian shells in some of the areas, such as Passamaquoddy Bay, where they are to some extent associated with and overlie the beds of the older system ; or, the fact that such Upper Silurian rocks had been shown by Jackson to occupy large areas along the coast of Maine, rendered it probable that the apparent extension of these in New Brunswick should be referable to the same horizon. The Upper Silurian rocks of Northern New Brunswick, not indicated in the incomplete map of Dr. Gesner, are by Dr. Robb clearly distinguished, the lines representing its southern margin showing a somewhat close approximation to their true position as determined by later investigation. On the north the border is made to exclude Temiscouata Lake, of which the greater part is really bordered by Silurian strata.

In this connection the following extract from a letter of Sir Wm. Dawson to Mr. S. W. Kain, in answer to certain enquiries of the latter, will be read with interest :

As stated in Acadian Geology, p. 502, the first fossil plant seen by me from the Devonian of southern New Brunswick was a Calamite (C. *radiatus* Brongt. *C. transitionis* Goept.), afterward illustrated by many specimens from the vicinity of St. John. This specimen Dr. Robb brought to Montreal, I think, at the time of the meeting of the American Association here in 1857. At the time these rocks near St. John were supposed to be Lower Silurian, and the Calamite showed that there must be newer beds there, though it was a species not found in the coal formation. I suggested at the time to Dr. Robb that on his return he should endeavour to ascertain if other fossil plants were present, and what portion of the slates and sandstone rocks near St. John contained them. This he proposed to do, but did not live to carry out his intentions, and the work fell into the hands of Messrs. Matthew and Hartt, by whom it was so successfully carried out. I did not know if Dr. Robb had any conference with

these gentlemen on the matter; but after his death I know I encouraged them to collect, though I had no idea of the rich results that were to reward their researches, and especially those of Mr. Matthew.

Sir William goes on to say: "I regarded Dr. Robb as an accomplished geologist, though I often regretted that the pressure of educational and other work, and perhaps his own quiet and retiring disposition, prevented him from cultivating more extensively the field for original research presented to him in New Brunswick."

In this connection it is gratifying to know that one of the largest and most abundant of the fossil plants found in the Fern Ledges at Carleton is a *Cordaites*, bearing the specific designation of *C. Robbii*.

No Devonian rocks, as such, are distinguished in the map of Dr. Robb, those of the vicinity of St. John and Lepreau being included in the supposed Upper Silurian area, while those of Passamaquoddy Bay (St. Andrews' peninsula) are, not unnaturally, associated with the red rocks of Kings and Westmorland and Albert, under the lithological designation of "Red Sandstones," etc. These, as already stated, were by Gesner regarded as newer than the coal formation, while by Robb they were looked upon as being beneath the latter, and "of the age of the mountain limestone, or perhaps of the Devonian strata. As it is now known that these "red sandstones," etc., include not only the equivalents of the mountain limestone and other lower carboniferous strata, but the Devonian plant-bearing beds of Perry, Maine, and those which, on the Bay Chaleur, hold remains of *Coccosteus*, *Pterichthys*, and other fishes of the old red sandstone type, it will be seen that Dr. Robb's anticipations in this respect have been fully confirmed. It is to be noticed, also, that the area assigned to these red rocks in Albert and Westmorland Counties is greatly reduced in the map of Dr. Robb, the districts thus represented being referred, though not with strict accuracy as to limits, to the coal formation.

The Lower Carboniferous outlier of the Tobique Valley is correctly indicated, though not definitely referred to this formation.

With the exception above referred to, the tracts assigned to the coal formation, as outlined by Dr. Robb, agree with those of Dr. Gesner and with the results of later observations. In their estimate, however, of the productive capacity of the coal field, the views of the two authors differ widely, those of Dr. Robb being far more moderate, and, as now believed, much nearer the truth.

It has been already stated that the red sandstones, etc., regarded by Dr. Gesner as "New Red," were by Dr. Robb referred to a Lower

Carboniferous or Devonian horizon. The existence of true Triassic beds, occupying as they do extremely limited areas on the coast, and not readily distinguished from associated Carboniferous strata, do not appear to have been known to him. The accompanying traps, with those of Grand Manan, are not, in the maps of either author, distinguished from other eruptives or assigned to any definite period.

Upon the whole, the map of Dr. Robb, though confessedly based upon that of Dr. Gesner, shows the results of extensive original observation and reflection, and though in some instances, as stated, less correct in its representations than the former, shows a decided advance in the direction of sound views and more exact limitations. It was the first published geological map of New Brunswick, and, so far as this Province was concerned, was reproduced, without essential change, in that accompanying the first edition of the "Acadian Geology" of Sir William Dawson.

Another, among the comparatively few instances in which Dr. Robb gave public expression to his views upon geological subjects, was in connection with the celebrated controversy as to the nature and origin of the mineral *Albertite*. The question having arisen as to whether this was to be regarded as coal or asphalt, or a variety of either, a question involving, in connection with the then existing mining laws, the ownership of a property of enormous value, experts were brought forward, in several instances from considerable distances, the consideration of whose testimony made the trial a very lengthy one, at the same time that it tended to extend very greatly the knowledge of the class of substances of which Albertite may be regarded as the type. On the one hand Dr. Chas. T. Jackson, of Boston, and his associates, maintained that the mineral was a true coal, while Prof. Richard C. Taylor, in association with Dr. Robb, asserted that it was either asphalt or a variety of asphalt. The published deposition of Prof. Taylor, on behalf of Dr. Gesner, the claimant, contains many interesting observations on the geology of the vicinity of Hillsborough, as well as regards the peculiarities of the Albertite deposit, all of which he states were made in company with Dr. Robb.

The final decision of the jury hinged, by the direction of the judge, simply upon the question whether Albertite was a *mineral* or not, and, there being no real doubt upon this point, was given in favor of the defendants. It is, however, interesting to observe that, as regards the real nature and origin of the material, the views of Taylor and

Robb have in every particular been confirmed by the results of later investigation. The very recent discovery of Albertite veins penetrating the pure white gypsum or alabaster deposits of Hillsborough, is a singular commentary upon the views that the mineral in question is a *coal*.

It has been said that Dr. Robb's published observations are but few. But important as these are, we should form a very inadequate idea of the man and of his work if we restricted our estimate to these only. In reality his researches took many different directions, and, had his manuscript notes, after his death, not unfortunately gone astray, their publication would have been a source of much valuable information. This is especially true of researches made by him in regard to the early occupation of the country by the French, as well as regards the language and traditions of the still earlier Indian tribes.

In referring to these manuscripts Rev. W. O. Raymond, in whose keeping they now are, says in a letter to the writer:

After the attempt by Peter Fisher in 1825, of Alex. Wedderburn in 1836 Moses Perley in 1841, Calvin Hatheway in 1846, and Abraham Gesner in 1847, to give something of the history of the Province, Dr. Robb seems to have formed the design of writing a history of a more elaborate kind, embracing the Acadian period as well as the history of the Pre-Loyalist English settlements and the later history. To this end he compiled, from time to time, such materials as he could glean from Champlain, Charlevoix and other French writers, and also from certain documentary materials in Halifax and Massachusetts. The manuscript books in which the result of his researches are to be found are interesting. They contain many corrections, interliniations, and on the pages opposite to the ink-written narrative, many supplementary notes in pencil, and observations which go to show that the work was regarded by him as of a tentative nature.

There is also among the Robb papers a lot of Indian words with observations on the same, and rude attempts at classification. In nearly all the papers one is struck with the industry that Dr. Robb displayed, and although he did not live to complete his historical work sufficiently for publication, he was following the right path, and really, with the time and opportunities afforded, he accomplished a good deal. Modern students of provincial history have fuller and better sources of information than had he, and I do not know that his manuscript contains much that is *original*, which is to be regretted.

The museum which Dr. Robb founded in connection with King's College (now the University of New Brunswick) is well worthy of notice. It has been already said that during his European tour Dr. Robb embraced every opportunity to make collections of minerals, rocks, fossils and plants. From the nature of the collections now in

the college, it is quite evident that the larger part of this material was brought with him across the Atlantic, though it may possibly have been supplemented by orders subsequently given. In particular may be mentioned a collection of European fossils, several hundred in number, all duly named and classified, similar collections of minerals and rocks, partly from the continent and partly from Scotland, examples of slags and furnace products, models of iron and soda furnaces, specimens of moulds and utensils employed in the manufacture of china and porcelain, Sopwith's geological models, glass models of crystals, etc., etc. In the botanical department, besides numerous flowering plants, are many specimens of mosses, lichens, ferns and seaweeds, also identified and classified.

Dr. G. F. Matthew tells me that he remembers Dr. Robb very well, and when the former began to study mineralogy he received much assistance and advice from Dr. Robb. This could only be on the rare occasions when Dr. Matthew visited Fredericton and had time to go up to the college. Dr. Robb took great pleasure in showing and explaining the collections in the museum, among which were specimens from the copper mines of Lake Superior, including an example of quartz crystals containing native copper, which Dr. Robb exhibited as a remarkable inclusion, not easily explained. It was from him that Dr. Matthew learned that Rogers had found "Lingulæ" in the slates at St. John, and that there were obscure remains of plants at the Barrack Shore in St. John city.

A somewhat curious specimen is that of a Malay child, which is partly double, having only one face, but four arms and four legs, obtained from a sea-captain, and which so interested its possessor that he sent all the way to Paris for standard works on the subject of monstrosities. It is accompanied by a number of carefully executed drawings, which indicate not only his interest in the subject, but also his skill in the use of pencil and brush. This latter faculty is also evidenced by the large number of pictures, some in pencil, but many in water colours or oils, and embracing views of volcanoes, coral atolls, coal plants, fossil fishes, etc., besides numerous geological sections, which are still in the possession of the university, and which were evidently made by Dr. Robb for the illustration of his lectures.

A circumstance which must have greatly embarrassed him, as it has his successor, was the want of access to libraries or books of reference. This want he endeavoured to remove, as far as in his power, by additions to the college library, and a review of the works

of a scientific character possessed by the latter at the time of Dr. Robb's decease, shows with what judgment his selections were made. The extent of this collection would have been much larger had it not been for the unfortunate shipwreck, on Sable Island, of a steamer containing a large number of books, among them the publications of the Ray Society, destined for him, besides a large quantity of furniture, crockery, etc. He must also have had an extended correspondence, one proof of which is of personal interest to the writer. Soon after assuming the duties laid down by Dr. Robb, he had occasion to make a detailed inventory of the apparatus and specimens in the chemical laboratory and museum of the college, and quite early in the search was at once surprised and gratified by finding a considerable number of packages, the written labels of which were recognized as being in the handwriting of the writer's father, the late Prof. J. W. Bailey, of West Point, N. Y. They contained samples of the so-called *Fossil Infusoria*, and, as the gentleman last referred to was at that time the principal authority in America on these microscopic organisms, he had evidently been written to by Dr. Robb that the latter might thereby be the better able to identify any similar forms which he might meet with here.

Dr. Robb's choice of apparatus, like that of books, was most judicious. Nothing but the best would satisfy him, and his chemical laboratory, though small, was a model of convenient arrangement, and, for the time and place, of ample equipment. The necessities of the case made him also his own mechanic, and in one of his letters he refers to his having been required to polish and repair a lot of instruments injured in, but recovered from, the Sable Island disaster, and which he describes as a "shocking wreck." His laboratory was fully supplied with carpenter's tools, and there is no doubt that he knew how to use them. He was a good analyst, and many specimens of ores now in the university collection are accompanied by labels bearing the results of his quantitative determinations.

His association with the Fredericton Athenæum has already been referred to. In this connection he prepared and published an almanac, of which he says, in a letter to his mother, "I can tell you it cost me a good deal of work." It was issued in 1849, is a volume of 142 pages, of which the object, as avowed on the preface, was neither profit nor remuneration, but the "furnishing of a compendium of information, useful for the time and place." He adds, "In a colony like this, where as yet food for the mind is but scantily supplied, care ought to

be taken that the quality of it is good, and that the poor settler, who often has no other library than his Bible and his almanac, should find in the latter something more nourishing than the chaff of Astrology, Alchemy and Divination." With this purpose in view, there is given a vast quantity of information, including, besides the usual monthly tables and accompanying tidal and lunar changes, a most interesting synopsis of provincial chronology, revised lists of provincial latitudes and longitudes, a register of the executive and legislative departments of the government, the judicial department, the roll of barristers and attorneys, a list of clergy of all denominations, banks, public institutions, etc., etc. It contained, also, tables of exports and imports, rates of duties, abstracts of revenue returns, tables of temperature, times of the opening and closing of navigation for successive years, tables of roads and distances in New Brunswick, and rules for the calculation of interest. It was, in fact, a sort of universal gazetteer, which, in the breadth and accuracy of its information, would compare favorably with much more recent and more pretentious volumes.

It will appear, from what has now been stated, that the life of Dr. Robb, though it has left but few records in the form of published contributions to knowledge, was a very busy one, and exerted a very extended influence upon the progress of intellectual and scientific development in New Brunswick. In estimating the results of his labours we must, as with Gesner, bear in mind the fact that science in that day was, in many of its branches, and especially in geology, in its early infancy. Dr. Robb's isolated position, as has been said, also made it difficult for him to know what was being done in the way of investigation elsewhere. And, finally, the facilities for travel in the Province were far inferior to such as exist at present. Of railways there was only one, that of St. Andrews, and, speaking of the proposed construction of another, he remarks, "There is great talk of railways at present (this was in 1847), but I am doubtful. Unless there be a federal union of the provinces, I doubt whether the great line from Halifax to Quebec would pay."

Dr. Robb was a member, and in 1849 and succeeding years President, of the Fredericton Society of St. Andrews, as also member of the Church Society of New Brunswick, and in both capacities is remembered as a zealous and energetic worker.

The removal at an early age of a man of such great and varied capacity, occupying so many different positions in the community, and at the same time ever ready to give advice, professional or otherwise,

to those who needed it, irrespective of their rank in society, could hardly fail to be deeply and universally deplored. That it was so is sufficiently indicated from the following announcement of his death in the Fredericton Reporter of April, 1861 :

The sudden death of Dr. Robb, occasioned by a violent pulmonary attack, which took place on Tuesday afternoon, is an event which, while it will awaken feelings of the deepest regret in this community, will also be regarded as a public loss all over the Province. His earnest and constant devotion to the duties of his profession, his zealous attachment to the agricultural interests of the country, his high qualifications as a scholar, and his kind and affable manners as a man, have for many years been recognized and duly acknowledged by all who either had the pleasure of his personal acquaintance or who knew him only through the medium of the familiar, yet learned and useful essays with which he so frequently favored the public. It is, however, now that he has gone, that the full impression of the loss we have sustained becomes painfully evident. Every one bewails his loss; and every one, in this city especially, has good reason for unaffected sorrow."

Any one of whom the above could be written, as voicing the feeling of the community in which he lived and labored, needs no other eulogy.

The following is a list of the published writings of Dr. Robb, derived partly from Bulletin 127 (1896) of the U. S. A. Geological Survey, and in part from other sources :

1. Remarks upon certain geological features of the River St. John, in New Brunswick, with an account of the Falls upwards from the sea, which occur near its embouchure in the Bay of Fundy.
   Brit. Assoc. Rep., Vol. 10, Trans. of Sections pp. 115–118 (1841).
   Abs. Amer. Journ. of Science, Vol. 41. Pp. 55–56. 1841.
2. Encœnia oration. King's College, Fredericton. Pp. 16.
3. Report on the Agricultural Capabilities of the Province of New Brunswick. By Prof. J. W. F. Johnston. Fredericton, 1850. [This work contains a letter by Dr. Robb on the geological structure of the Province, with an accompanying geological map.]
4. Report of the New Brunswick Society for the Encouragement of Agriculture, Home Manufactures and Commerce. Fredericton, 1851.
5. Deposition of Richard C. Taylor, respecting the Asphaltum mine at Hillsborough, Albert County, N. B. Philadelphia, 1851. [This contains a joint report on the same subject by Messrs. Taylor and Robb.]
6. Notice of Observations on Drift Striæ in New Brunswick. Am. Assoc. Adv. Sci. Proc. Vol. 4, pp. 349–351. 1851.

ARTICLE II.

LIST OF RECORDED EARTHQUAKES IN NEW BRUNSWICK.

Compiled from Published Works and from Private Information.

By Samuel W. Kain.

Read March 1st, 1898.

In recent times much attention has been given to the study of earthquakes. In the historic period a number of shocks have been felt in this Province. Information in regard to them, however, is scattered and not easily accessible. Some of the shocks have been noted only in the newspapers, and a few of the more recent, in Grand Manan, have been drawn to my attention by one of our corresponding members resident there.

The following list has been compiled for the convenience of students, both in New Brunswick and abroad, and will be found complete for all shocks recorded. The time given (unless otherwise stated) is local time. To reduce St. John local time to 75th meridian time, deduct 35 mins. 44 sec.

1663. February 5; 5.30 p. m., 8 p. m.

This earthquake was of considerable violence, and was felt throughout the St. Lawrence Valley, Acadia and New England. (*Can. Nat.*, Oct., 1860).

1755. November.

Three or four shocks are recorded as having been felt in New England and Nova Scotia (then including New Brunswick). Sir William Dawson states (*Can. Nat.*, October, 1860) that two of these shocks were violent.

1764. September 30; about noon.

In the *Halifax Gazette* (Nova Scotia), December 13, 1764, occurs the following news item: "We hear from St. John's, in this Province, that on the 30th of September last, about 12 o'clock at noon, that a very severe shock of an earthquake was felt there."

1817. May 22; 3.31 a. m.

Felt in all parts of New Brunswick. The following account is from the *Courier:* "A heavy shock of earthquake was felt in St. John on the 22nd,

31 minutes past three o'clock, a. m. It was preceded by a noise as if a gale of wind sprang up, after which the earth began to shake violently, rumbling as if heavy carriages were passing. The trembling continued 15 seconds. The air was clear, with not a breath of wind. A minute after the shock moanings were heard from the southward. The earthquake was felt at Fredericton, fully as violent as at this place. At St. Andrews the shock was severely felt; the alarm was so great as to occasion the soldiers to leave their barracks. The shock at Fredericton occurred at 3.25 a. m.; tremulous motion lasted 25 seconds; profound calm; atmosphere heavy."

The same journal has also an account of the shock as felt at Grand Manan, which is of interest: "The earthquake of 22nd May was felt at Grand Manan; occurred just before daybreak, commencing with a loud sound, at the same time a violent shaking of houses. The shaking did not continue, but the sound lasted from 30 to 45 seconds. All agree in describing the motion as violent and the sound very loud. Weather fine and serene; light wind from northward; previous day uncommonly hot."

Peter Fisher, in his *History of New Brunswick* (1825), refers to this shock in the following paragraph: "New Brunswick appears to be but little liable to the great convulsions of nature, such as earthquakes, hurricanes, tornadoes, etc. There has been but one shock of an earthquake experienced by the present inhabitants since they settled in this country (*i. e.*, 1783–1825). This shock happened on the 22nd May, 1817, at 25 minutes past 3 o'clock in the morning. The duration of the shock was about 45 seconds. It was attended with the usual rumbling noise, without thunder, the weather being serene and pleasant. The appearances, however, usually indicating earthquakes, such as fiery meteors, the uncommon brilliancy of the aurora borealis, etc., had been frequent the winter preceding."

In the journal* of Azor Hoyt, 1813–1855 (of Lower Norton, Kings Co., N. B.), the following entry occurs: "May 22nd (1817) a shock of an earthquake." This shock was felt all through the Maritime Provinces.

1824. July 9.

Severe shock felt all over the Province. —(*Can. Nat.*, October, 1860).

1855. February 8; 6.30 a. m.

Felt all over the Province; also in Nova Scotia and in parts of the State of Maine. Moderate.

Dr. P. R. Inches has placed in my hands the following note made by him at the time:

"Saint John, February 8th, 1855.

This morning at half past six o'clock several shocks of an earthquake were felt here. I was lying in bed at the time, not quite awake, when I was startled by hearing a roaring and rumbling noise as of a chimney on fire, but much louder, followed by a violent shaking of the house and bed. I at once started out of bed to see what was the matter, but could find no cause for the noise. I could not imagine what was causing it unless it was an earthquake. I got into bed and shortly after, I think in about five or

* Manuscript: in possession of Rev. W. O. Raymond, St. John.

six minutes, felt another shock, but so very slight as to be just perceptible and no more. Again a few seconds after this second shock I thought I felt another, but I was not positive. The first shock lasted forty or fifty seconds, the second about the same time. It has, I believe, been felt at Chatham, Fredericton, Dorchester, and in the State of Maine. It appears to have been felt at Dorchester more than anywhere else. Some windows in the house of the Hon. E. B. Chandler of that place were broken."

Speaking of this shock in *Acadian Geology*, pp. 39–40, Sir Wm. Dawson says: "Its point of greatest intensity appears to have been at the bend of the Petitcodiac (Moncton). At this place there were several shocks, one of them sufficiently severe to damage a brick building."

In the Journal of Azor Hoyt, the following entry occurs: "February 8th, (1855). Three shocks of an earthquake — felt all through the Province." This is the last entry in the Journal.

1860. October 17; 6.25 a. m.

Felt over a large area of Eastern Canada and the New England States. Also felt in this Province. Moderate in New Brunswick, but severe in Quebec and Ontario.

The *Morning News* of October 19th, 1860, says: "A vibration of the earth from twenty to thirty seconds in duration occurred about twenty-five minutes past six o'clock on Wednesday morning along the western side of the harbour, causing the houses to shake quite perceptibly, and in several cases awakening people from their slumbers. We do not know what distance it extended or whether it was perceived in St. John or not; but parties residing in the vicinity of Negrotown Point felt it very distinctly, as did persons living near the Asylum."

1869. October 22; 5.48 a. m.

This earthquake was of considerable violence, and was felt all through the Maritime Provinces, St. Lawrence Valley and the New England States. The reports published in our city papers describe it as the most violent shock ever felt here. It was preceded by a rumbling rushing noise like the noise of distant thunder, and then came the vibrations, or series of them, which seemed to pass away in the distance as though a wave like motion had been imparted to the crust of the earth. These vibrations appeared to be travelling nearly east and west. Houses were shaken, dishes rattled, and bells rang, and in some cases flower pots, etc., where rolled over. The shock lasted about fifteen seconds. The papers of that date (October 25th, 1869) state that the waters of lakes and streams were discoloured by the shock, and it is noticed in particular that the water of the stream at Penobsquis, which supplied the paper mill at that place, turned chalky and had not regained its clearness on the following day. It is worthy of remark that at Fredericton, in Mr. Babbit's shop, the clocks facing north-west were stopped, while those at right angles to that direction were not affected.

W. Watson Allen has given me the following note about this shock: "At Derby (Miramichi), at the Mill Pond, known as Wilson's Mills, a spring on

the west bank of the pond, before the earthquake, boiled out of the ground, rising to a height of about a foot. After the earthquake, the fountain part of the spring disappeared, although the spring itself is still there, but diminished. Mr. William Wilson, who had lived there many years, always claimed that the pond had increased in volume of water to a large extent.

"At the forks (the confluence of Cain's River and S. W. Miramichi), Mr. Jacob Layton, who had resided there continuously for a number of years, states that in the bed of the main Miramichi River, near the shore where the water was quite shallow, and on a spot of ground that he knew very well, after the earthquake there appeared a spring of boiling water, sufficient to make a commotion upon the surface. There never had been any indications of it before the earthquake."

1870. March 17; 6 to 8 a. m.

Felt at St. John and Fredericton. Light. It was at this time that a landslide occurred at Sand Point, carrying the end of the Point out into the deeper water of the harbour. Sand Point is a gravel deposit formed by the meeting of the harbour tides and the river, and is underlaid by clay. This clay had probably been eroded by the action of water, and a heavy storm the day before had hastened a condition of instability which, even without a slight earth movement, would soon have caused the landslide.

1870. October 20; 11.40 a. m.

Felt all over the Province. In the lower part of the St. Lawrence Valley it was much more violent than in New Brunswick.

Dr. Jack, of the Provincial University, at Fredericton, in a despatch to the St. John *Daily Telegraph* (October 21st, 1870), thus describes it: "It was at seventeen minutes before noon that the first shock was felt here. This lasted perhaps two seconds, and was shortly followed by another of about the same severity, which may have been the return stroke, as the interval between was not over half a minute. The motion was vibratory, and seemed to be from south to north. It was not as strong as the earthquake of last year. There was violent wind all of Tuesday afternoon and night, and this afternoon we have a heavy rain and lowering darkness." The time at St. John was accurately noted to be 11.40; at Fredericton it was 11.43.

1882. December 31; 9.56 p. m.

St. John, Rothesay, Sussex and Fredericton. Light. Two shocks felt. The following is from the St. John *Daily Sun* (January 2nd, 1883): "At four minutes to 10 on Sunday night a slight shock of earthquake was felt. In one residence on Charlotte street a vase was thrown from its stand to the floor and broken; in another house, in an opposite part of the city, all the ornaments on a Christmas tree were set swinging vigorously. The shock was also distinctly felt in Indiantown and on the other side of the harbour. It was also felt at Sussex, Fredericton, and very markedly at Rothesay."

1884. January 26.

At Rothesay. Three light shocks. Reported in *Daily Telegraph* of January 29th.

1885. June; 10 a. m.

Rothesay, Seal Cove and Southern Head, Grand Manan. Light at Rothesay, but severe at Southern Head, where several tons of rock fell from the cliffs near the lighthouse.

1896. March 22; 7.56 p. m.

This shock was felt in Charlotte and York Counties, New Brunswick, and in Washington County, Maine. The area disturbed has a diameter of about 100 miles, and lies adjacent to the shores of the Bay of Fundy and the Gulf of Maine.

By correspondence with observers at different points, I have been able to secure some notes on this disturbance.

Eastport, Maine.—The shock took place here March 22nd, at 7.56 (75th meridian time), and lasted four or five seconds. This office is located in the new government building, built of granite, and on a solid ledge. Still the tremor was distinctly felt throughout the building, and more so by those living in wooden houses. The shock had no perceptible effect on our barograph. It had been rising steadily since noon, and I failed to see the least deviation in the trace. D. C. Murphy,

U. S. Meteorological Observer.

Beaver Harbor, N. B.—Shock slightly felt here on 22nd March at 8.45 p. m. Jar enough in some buildings to make glass rattle.

Flagg's Cove, Grand Manan, N. B.—A slight earthquake shock was felt here on Sunday, March 22nd. The noise was very distinct, but only lasted a few moments. It was felt all over the island at the same time as at this station. Clara C. Seely,

Dominion Meteorological Observer.

St. Andrews, N. B.—The shock was markedly felt at St. Andrews. A well known gentleman resident there wrote me as follows: "The noise at first was very sharp and was succeeded by a gradually lessening sound, and was all over in three seconds. It occurred at 8.45 p. m."

In addition to the above places the shock was felt in all the West Isles, on the mainland northward to McAdam, some distance along the line between McAdam and Woodstock, and at St. Stephen and Pennfield.

The shock was not felt at St. John, Fredericton, or Yarmouth, N. S.

1896. May 15th; 11.00 p. m.

A light shock was felt on this date at Fredericton, along the Nashwaak Valley, at Andover, and up the Tobique Valley as far as Three Brooks. A gentleman at Fredericton, in a letter to me, described it as "one momentary concussion." Dr. Welling, writing from Andover, says: "Two

shocks from an earthquake were felt here on the night of 15th of May about 11 o'clock. I was in bed at the time and felt the bed shake and tremble. One gentleman was about retiring when he heard what he thought were horses running around the house, but when he reached the door the noise was repeated and he saw at once that it was the shock of an earthquake. It was heard at Three Brooks on the Tobique River some twenty miles distant about the same hour."

1897. January 26; in the morning.

Felt at Campobello and Deer Island. Light.

1897. January 28; 9 p. m.

A sharp shock felt at Southern Head, Grand Manan. Duration about two seconds. Mr. W. B. McLaughlan, the light-keeper, in writing, says: "It shook us up so violently that it set my dogs barking and the horse and cattle in the stable tried to break loose. I made a record of it in my journal."

1897. February 14; 9 p. m.

Mr. McLaughlan goes on to say: "On the evening of the 14th inst., about the same hour, we felt another sharp shock, but not so violent as that of January 28th.

"I am of the opinion that these shocks are of frequent occurrence in the Bay of Fundy, and are generally thought to be the reports of cannon. I recollect that about twelve years ago the middle of next June, at 10 o'clock a. m., we felt a violent shock at this station and at Seal Cove, but the only place on the mainland that I noticed it reported was at Rothesay, Kings Co. That shock was so violent that several tons of rock fell from the cliff near the lighthouse."

1897. September 25; 1.30 p. m.

Parts of Charlotte and York counties in this Province, and in some parts of Eastern Maine. Light. Felt distinctly at Canterbury, McAdam and St. Stephen. At St. Stephen it rattled dishes, etc., and at McAdam the earth trembled as from the passing of a heavy railway train. It lasted fifteen seconds.

Not felt at St. Andrews, Eastport, or Woodstock.

1897. October 12; 10.35 p. m.

South West Head, Grand Manan. Light. "Duration about five seconds. Wind due south, strong gale and hazy weather, about two hours to high tide. Shock from southeast with a roar like a waggon over a frozen road. It shook the buildings sufficiently to alarm my watch dog." (Letter from W. B. McLaughlan).

1898. January 11; 2 a. m.

At South West Head, Grand Manan.

"We felt a sharp shock of earthquake at this place on Tuesday, the 11th inst., at 2 a. m. It sounded like a heavy explosion, Wind northeast, light, high water, clear cold weather." (Letter from W. B. McLaughlan).

The greater frequency of earthquakes at Grand Manan than at any other place in the Province is worthy of note, and it is possible that further observations may show some connection between the so-called "gun reports" (see Bulletin XIV, pp. 40–44, 1896,) and these light earth movements.

In the discussion which followed, Dr. Geo. F. Matthew said: "This part of the Bay of Fundy it remarkable for its great depth and precipitous shores. Off Brier Island the bottom descends to a depth of 100 fathoms in a distance of three miles from the outermost ledge; it is almost equally abrupt on the Grand Manan slope; the trough between is deeper than the bottom of the Gulf of Maine outside adjoining. This is the only part of the Bay of Fundy where there have been heavy outflows of trap of Triassic age on *both* sides of the bay, and the abyss between may be complementary to these ejections of lava. The weakness of the earth's crust here in Triassic times, as shown by the volcanic eruptions of that age, may not even yet be altogether removed; but the greater tendency to earthquake movements in this district may be the dying throes of the old Triassic disturbances."

ARTICLE III.

LIST OF MOSSES OF NEW BRUNSWICK.

Compiled by John Moser and Edited by G. U. Hay.

Read October 2, 1894.

[Containing 15 new species, but several also reported by Prof. Macoun and others.]

1. Sphagnum fimbriatum, Wils., Gravet. Bogs and swamps, Kent County, (F's C.)[1]
2. S. strictum, Lindb. New Mills, Restigouche. (Hay). Peat bog, Kingston, Kent Co. (F's C.) Canaan Forks,[2] Queens Co. (Moser). Herb.
3. S. fuscum, Schimp. Grand Lake. (F's C.)
   Var. fuscescens. Swamps, Bass River,[3] Kent Co. (F's C.)
4. S. acutifolium. Common. Herb.
   Var. rubrum. Common. Herb.
   Var. versicolor. (F's C.)
5. S. rubellum, Wils. Peat bogs, Kingston, Kent Co. (F's C.)
6. S. recurvum, Russ. Swamps, (Moser). Herb.
   Var. mucronatum. Grand Lake. (F's C.)
   Var. amblyphyllum. (F's C.)
   Var. parvifolium. Indian Harbour, Halifax Co., N. S. Swamp, Canaan Road, Kings Co. (Moser). Herb.
7. S. cuspidatum, Ehrh. Nashwaaksis, York Co. (Moser). Herb.
8. S. squarrosum, Pers. Tay, York Co. (Moser). Herb.
   Var. spectabile. Grand Lake. (F's C.)
   Var. semi-squarrosum. (F's C.)
9. S. wolfianum, Girg. (Moser). Herb.
10. S. rigidum, Schimp. Var. squarrosum. Peat bogs, Kingston. (F's C.) (Moser). Herb.
11. S. subsecundum, Nees. (F's C.) Wet woods. (Moser). Herb.
12. S. imbricatum, Hornsch. Var. affine. Bogs (Moser). Herb.
13. S. papillosum, Lindb. Bog, Salem, Kings Co. (Moser). Herb. Lily Lake, St. John. (F's C.)
14. S. cymbifolium, Ehrh. Common. Herb.
    Var. laeve. (Moser). Herb.
15. S. tenellum, Ehrh. Peat bog, Kingston, Kent Co. (F's C.)

1. F's C. (Fowler's Catalogue) published in 1878. Herb. (Herbarium of Natural History Society of New Brunswick.)
2. As most of Mr. Moser's plants were collected at Canaan Forks, Q. Co., the name of this locality is omitted before "Moser" throughout this list.
3. As most of Prof. Fowler's mosses were collected at Bass River, Kent County, the name of this locality is omitted before F's C. throughout this list.

16. S. medium, Limpr. Var. laeve, forma purpurascens. (F's C.)
Var. roseum. Grand Lake. (F's C.)
17. Wesia viridula, Brid. Shelf of rock, Tay, York Co. (Moser). Herb.
18. Dicranodontium pellucidum. Wet bank, Tay, York Conuty. (Moser). Herb.
19. Trematodon ambiguum, James. Tay and Nevers' Rapids, Queens Co. (Moser). (F's C.) Herb.
20. Dicranella crispa, Schimp. Common. (Moser). Herb.
21. D. squarrosa, Schimp. Shore of Washadamoak, Queens Co. (Moser). Herb.
22. D. cerviculata, Schimp. Damp earth, Carleton Co. Rotten wood, St. John. (F's C.) Gravelly bank near spring, Tay, York Co. (Moser). Herb.
23. D. varia, Schimp. Face of cliff. (Moser). Herb.
24. D. rufescens, Schimp. (F's C.) Road-sides. (Moser). Herb.
25. D. subulata, Schimp. Kouchibouguac. (F's C.) Red Bank, Tay. (Moser). Herb.
26. D. heteromalla, Schimp. Road-side, banks, common. Herb.
27. Dicranum montanum, Hedw. Rotten wood, common. Herb.
28. D. fulvum, Hooker. Boulders, damp woods. (Moser). Herb.
29. D. viride, Schimp. On old trees, common, but always barren. Herb.
30. D. flagellare, Hedw. On rotten wood, common. Herb.
31. D. scoparium, Hedw. Common. Herb.
Var. nigrescens. (Moser). Herb.
32. D. fuscescens, Turn. Common on old logs. Herb.
33. D. undulatum, Turn. Grand Lake, Q. Co. (F's C.) Madawaska and Tobique. (Hay). (Moser). Herb.
34. D. Bergeri. Wet woods, Kent Co. (F's C.)
35. Dicranodontium longirostre, Bruch and Schimp. On boulders, Tay. (Moser). Herb.
36. Fissidens adiantoides, Hedw. On rocks, St. John. (F's C.)
37. F. osmundoides, Hedw. Rough Waters, near Bathurst. (F's C.)
38. Leucobryum vulgare, Hampe. (Moser). Herb.
39. Ceratodon purpurens, Brid. Very common. Herb.
40. Distichium capillaceum, Bruch and Schimp. Tete-a-Gouche Falls. (F's C.) Wet cliff, Long Rapids, Washadamoak Lake. (Moser). Herb.
41. Blindia acuta, Bruch and Schimp. Washadamoak, Q. Co. (Moser). Herb.
42. Didymodon rubellus, Bruch and Schimp. On rocks and earth, Tobique River. (Hay). (Moser). Herb.
43. Leptotrichum tortile, Muell. On old roots, Washadamoak. (Moser). Herb. (F's C.)
44. L. vaginans, Lesq. and James. Road-side, Kent Co. (F's C.)
45. Barbula tortuosa, Web. and Mohr. (F's C.) On rocks, Tobique River. (Hay). (Moser). Herb.
46. B. unguiculata, Hedw. Common on earth. (F's C.) (Moser). Herb.
47. Grimmea conferta, Funck. (Moser). Herb.
48. G. apocarpa, Hedw. On rocks, St. John Co. (F's C.) (Moser). Herb.
49. G. rivularis. Fredericton. (F's C.) (Moser). Herb.
50. G. gracilis. Dry rocks. (Moser). Herb.

51. Racomitrium fasciculare. On rocks, McDonald's Brook, Forks Stream and Tay. (Moser). Herb.
52. R. microcarpum, Hedw. Rocks, Forks Stream. (Moser). Herb.
53. Hedwigia ciliata, Ehrh. On rocks, common. Herb.
54. Amphoridium Lapponicum, Schimp. Long Rapids, Q. Co. (Moser). Herb.
55. Ulota Ludwigii, Brid. On old trees, common. (F's C.) (Moser). (Hay). Herb.
56. U. crispa, Brid. On trees, common. Herb.
57. U. crispula, Brid. On birch trees. (F's C.) On trees. (Moser). Herb.
58. Orthotricum speciosum, Nees. On trees. (F's C.) (Moser). Herb.
59. O. sordidum, Sulliv. and Lesq. On trees. (F's C.) (Moser). Herb.
60. O. Ohioense, Sulliv. and Lesq. On trees. (F's C.) (Moser). Herb.
61. O. strangulatum, Beauv. On trees. (F's C.)
62. O. obtusifolium, Drumm. On poplar trees. (F's C.) (Moser). Herb.
63. Encalypta Macounii, Aust. On ledges. (Moser). Herb. Crevices of rocks, Tobique. (Hay).
64. Tetraphis pellucida, Hedw. On rotten stumps, common. Herb.
65. Taylorii tenuis, Schimp. Barrens. (Moser). Herb.
66. Tetraplodon angustatus, Bruch and Schimp. Madawaska (Brittain). Near Lily Lake, St. John (Hay).
67. T. mnioides, Bruch and Schimp. Highland Park, St. John, and Tobique. (Hay).
68. Splachnum ampullaceum, Linn. On earth, Fredericton Junction (F's C.) Swamps, Bocabec and St. John (Hay). On earth (Moser). Herb.
69. S. rubrum, Linn. (F's C.) Lancaster (Hay). Hunter's Home, Queens Co. (Moser). Herb.
70. Bartramia œderiana, Swartz. On rocks, Tete-a-Gouche Falls, Gloucester (F's C.) Near St. John (Hay).
71. B. pomiformis, Hedw. On ledges and banks, along streams, common. Herb.
72. Philonotis fontana, Brid. About springs, common. Herb.
73. P. glabriuscula, Kindberg. (New species).

"Tufts radiculose below, 4 cm high. Stem slender. Leaves small, green, distant, spreading and straight when moist, twisted when dry, indistinctly decurrent, short ovate lanceolate, short acuminate, acute, slightly papillose, pellucid, plane at the margins, not plicate, minutely ser ulate, principally above. Cells oblong, hexagonal, the lower narrower, less chlorophillose. Costa subcurrent, Habit of Webera albicans." (From "Canadian Musci.")

It varies to a delicate floating form, as also does P. fontana.

Spring, in Owl Bridge Gully, Q. Co., but principally across the Washadamoak (south) in a spring in the woods east of Martin's farm; also at Hunter's Home and at Elmwood, Kings Co. Always barren (Moser). Herb.

74. Amblyodon dealbatus, Beauv. Brooklets. Herb. "One summer there was abundance in a spring brooklet, the next summer there was not any, nor since." (Moser).
75. Leptobryum pyriforme, Schimp. On recently burnt soil, common. Herb.
76. Webera acuminata, Schimp. On rocks, also in Restigouche Co. (F's C.)
77. W. nutans, Hedw. Common. Herb.

78. W. Lescuriana, Lesq. and James. On the ground by roadsides. (F's C.) Sandy bank, Tay, Glen Margaret, Halifax Co., N. S. (Moser). Herb.
79. W. cruda, Schimp. (F's C.) Crevices of rocks, Hunter's Home, Q. Co. (Moser). Herb.
80. W. albicans, Schimp. On banks. (Moser). Herb.
81. Bryum pendulum, Schimp. On rotten wood. (F's C.)
82. B. uliginosum, Bruch and Schimp. Tay. (Moser). Herb.
83. B. intermedium, Brid. Rocky places. (Moser). Herb.
84. B. cirrhatum, Hoppe and Hornsch. (Moser). Herb.
85. B. bemum, Schreb. Borders of swamps. (F's C.) Wet woods, Forks. Boggy places, Elmwood, Kings Co. (Moser). Herb.
86. B. pallescens, Schleich. On earth. (Moser). Herb.
87. B. subrotundum, Brid. (Moser). Herb.
88. B. alpinum, Linn. Hunter's Home. (Moser). Herb.
89. B. caespiticium, Linn. On dry ground. (F's C.) Common at Canaan, Q. Co. (Moser). Herb.
90. B. pseudo-triquetrum, Schwaegr. Wet rocks. (F's C.) On earth. (Moser). Herb.
91. B. roseum, Schreb. Shady woods. (F's C.)
92. B. Ontarioense. (Moser). Herb.
93. Mnium medium, Bruch and Schimp. Deep shady ravines. (F's C.)
94. M. cuspidatum, Neck. Common. Herb.
95. M. Drummondii, Bruch and Schimp. In large patches on the ground in shady places. (F's C.) Tay. (Moser). Herb.
96. M. affine, Bland. Damp shaded bank of brook. (F's C.); also at Fredericton. Tay. (Moser). Herb. Common St. John Co. (Hay).
97. M. hornum, Linn. St. John Co. (west) abundant. (Moser). Herb.
98. M. orthorrhyncum, Bruch and Schimp. Grand Falls, Nepisiquit. (F's C.) (Moser). Herb.
99. M. pseudo-lycopodioides. In damp shaded ravines (F's C.); also at Fredericton. (Moser). Herb.
100. M. spinulosum, Bruch and Schimp. Damp shaded places. (F's C.) (Moser). Herb.
101. M. stellare, Reichard. Carleton. (F's C.) (Moser.
102. M. punctatum. Damp shady ravines (F's C.); also at Fredericton. Swamps, Tobique River, (Hay). (Moser). Herb.
103. Aulocomnium palustre, Schwaegr. Common. Herb.
104. Atrichum undulatum, Beauv. On the ground. (F's C.) (Moser). Herb.
105. A. angustatum, Bruch and Schimp. On the ground. (F's C.) (Moser). Herb.
106. Pogonatum brevicaule, Beauv. On clayey soil. (F's C.) (Moser). Herb.
107. P. urnigerum, Drumm. Dry turf on a ledge. (Moser). Herb.
108. P. alpinum, Roehl. Wet rocks, Tobique, (Hay). (Moser). Herb.
109. Polytrichum piliferum, Schreb. Gravelly knolls (F's C). Dry ground on rocks, Forks Stream. (Moser). Herb.
110. P. juniperinum, Willd. Gravelly knolls, common. Herb.
111. P. strictum, Banks. In swamps. (Moser). Herb.

112. P. commune, Linn. Common on wet barren ground. (Moser). Herb.
113. Fontinalis antipyretica, Linn. In brooks, common.
Var. gigantea, Sulliv. Shallow streams, Tobique, (Hay). (Moser). Herb.
114. F. Dalecarlica, Bruch and Schimp. In brooks. (Moser). Herb.
115. Dichelyma capillaceum, Bruch and Schimp. Grand Lake and Newcastle (F's C.) On sticks and roots skirting swamps, Forks. (Moser). Herb.
116. D. palliscens, Bruch and Schimp. On roots of alders, Hunter's Home. (Moser). Herb.
117. D. obtusulum. Fredericton. (F's C.)
118. Neckera pennata, Hedw. On trees, common. Herb.
119. Homalia Macounii, C. M. and Kindberg. (New species).
H. trichomanoides, Lesq. and James. "Mosses of North America." (Drummond, Waghorn and Macoun). On rocks, Forks Stream and Tay, York Co. (Moser). Herb.
120. Leucodon sciuroides, Schwaegr. On bark of trees, common. Herb.
121. Pteriginandrum filiforme, Hedw. (F's C.)
122. Thelia compacta. On trees. (Moser). Herb.
123. Myurella julacea, Bruch and Schimp. On damp rocks. (Moser). Herb.
124. M. Careyana, Sulliv. On rocks, St. John. (F's C.) Crevices of rocks, Queens Co. (Moser). Herb.
125. Leskea polycarpa, Ehrh. On trunks of trees, Nashwaaksis, York Co. (Moser). Tobique, (Hay). Herb.
126. L. nervosa, Sulliv. On trees, Fredericton, (F's C.) Tay, (Moser). Herb.
127. L. denticulata, Sulliv. On roots of trees. (Moser). Herb.
128. Anomodon rostratus, Schimp. Fredericton, (F's C.) On the sides of wet cliffs and on wet roots. (Moser). Herb.
129. A. attenuatus, Hueben. Bases of old trees and stumps. Moser). Herb.
130. A. obtusifolius, Bruch and Schimp. Old stumps, Tay. (Moser). Herb.
131. A. veticulosus, Hook. and Tayl. Ledge of rocks, Butternut Ridge, Kings Co. (Moser). Herb.
132. Platygirium repens. Bruch and Schimp. On dead wood. (Moser). Herb.
133. Pylasia polyantha, Bruch and Schimp. On the bases of trees, common. Herb.
134. P. intricata, Bruch and Schimp. On trees, Fredericton, (F's C.) Tobique, (Hay).
135. P. velutina. On trees F's C.) Tay. (Moser). Herb.
136. Entodon cladorrhizans. On logs, Tay. (Moser). Herb.
137. E. brevisetum. On old logs and rocks. (Moser). Herb.
138. Climacium dendroides, Web. and Mohr. On the ground in dense shade, Molus River, Kent Co. (F's C.)
139. C. Americanum, Brid. Wet places (F's C.) (Moser). Herb.
140. Heterocladium dimorphum, Bruch and Schimp. On a wet bank, Tay, York Co. Scarce. (Moser.) Herb.

141. H. frullaniopsis, C. M. and Kindberg. (New species). Base of poplar trees, Hunter's Home, Queen's Co. (Moser). Herb.
This species differs very much from allied species principally in the uniform leaves, the absence of paraphyllia and the not cordate leaf base. Dioecious.
142. THUIDIUM scitum, Aust. On trees, Fredericton. (F's C.)
143. T. minutulum, Bruch and Schimp. (F's C.)
144. T. recognitum, Lindb. (Moser). Herb.
145. T. gracile, Bruch and Schimp. (Moser). Herb.
146. T. delicatulum, Bruch and Schimp. Common. (Moser). Herb.
147. T. abietinum, Bruch and Schimp. On rocks and ground, Restigouche. (F's C.)
148. T. Blandonii, Bruch and Schimp. Bogs. (Moser). Herb.
149. CAMPTOTHECIUM nitens. Schimp. Swamp, Hunter's Home. Not common. (Moser). Herb.
150. BRACHYTHECIUM laetum, Bruch and Schimp. On rocks, ground and roots of trees, common. (F's C.) (Moser). Herb.
151. B. digastrum, C. M. and Kindb. (New species). On rocks, Ottawa, Ont., Oct. 12th, 1889 (Macoun). On rocks, Canaan Forks, Queens Co., 1889 (Moser).
152. B. acuminatum. Bases of trees. (Moser). Herb.
153. B. salebrosum, Bruch and Schimp. On earth, common about the Tay. (F's C.) (Moser). Herb.
154. B. albicans, Bruch and Schimp. (F's C.)
155. B. harpidioides, C. M. and Kindb. (New species). On old logs in woods. Columbia River, May 6th, 1890. (Macoun). 1889. (Moser).
156. B. pseudo-collinum, Kindb. Queens Co. (New species). Under platform of a well. (Moser).
157. B. velutinum, Bruch and Schimp. (F's C.)
158. B. Starkii, Bruch and Schimp. (F's C.)
159. B. oedipodium. Under shade on light ground. (Moser.) Abundant. Herb.
160. B. curtum. On earth in woods. (Moser.)
161. B. reflexum, Bruch and Schimp. On rocks, Queens Co. (Moser.) Herb.
162. B. rutabulum, Bruch and Schimp. (F's C.)
163. B. leucoglaucum, C. M. and Kindb. (New species). On loose earth, Queens Co., and at Elmwood, Kings Co. September 10th, 1888. (Moser). Herb.
Intermediate between B. rutabulum and B. curtum.
164. B. mirabundum, C. M. and Kindb. (New species). On old logs in woods, Canaan and Elmwood. July, 1888. (Moser). Herb.
165. B. campestre, Bruch and Schimp. On the ground. (F's C.) On rocks and logs. (Moser). Herb.
166. B. rivulare, Bruch and Schimp. (F's C.) Also at Fredericton. On wet ground and stones in brooks. (Moser.) Herb.
Var. obtusifolium, Kindb. Also named Novæ Brunsviciæ. On wet rocks, Fredericton. (F's C.) Ontario and British Columbia. (Macoun). Near springs. (Moser). Herb.

167. B. populeum, Bruch and Schimp. (F's C.) On granite boulder in brook. (Moser). Herb.
168. B. plumosum, Bruch and Schimp. (F's C.) Also at Fredericton, Elmwood. (Moser). Herb.
169. Sclerodium illecebrum, Bruch and Schimp. On damp rocks. (Moser). Herb.
170. Eurhynchium strigosum, Bruch and Schimp. (F's C.) (Moser). Herb.
171. E. piliferum, Bruch and Schimp. Rare. (Moser).
172. E. prælongum, Bruch and Schimp. Tay. (Moser). Herb.
173. E. Sullivantii. On rocks. (Moser). Herb.
174. E. hians. (Moser).
175. E. crassinerve, Schimp. Var. laxorite, Kindb. New var. On rocks in woods. (Moser).

    Differs in the leaves being nearly entire or faintly denticulate above, shorter, acuminate, and the cells larger. Only male flowers found. Allied to E. colpophillum.

176. Raphidostegium recurvans. Kent Co. (F's C.) Common. (Moser). Herb.
177. R. demissum. On stones, rare. (Moser). Herb.
178. R. cylindrocarpum. On decayed logs. (Moser).
179. R. Jamesii. (Moser).
180. Rhyncostegium serrulatum. (Moser). On rotten wood. (F's C). Herb.
181. R. rusciforme, Bruch and Schimp. On rocks, St. John River (F's C). Tobique River. (Hay). (Moser). Herb.
182. Plagiothecium pulchellum, Bruch and Schimp. On rotten wood, Nashwaaksis, and Canaan. (Moser.) Herb.
183. P. turfaceum, Lindb. Common. Herb.
184. P. Muehlenbeckii, Bruch and Schimp. On old logs. (F's C.) Tobique and Norton. (Hay.)
185. P. denticulatum, Bruch and Schimp. (F's C.) Highland Park, St. John. (Hay). Common. (Moser.) Herb.
186. P. sylvaticum, Bruch and Schimp. Fredericton. (F's C., and Moser.) Herb.
187. P. Sullivantiæ, Schimp. On earth, Elmwood and St. John. (Moser). Herb.
188. P. aciculari-pungens, C. M. and Kindb. (New species.) On earth, 1889. (Moser.)

    This species is nearly allied to Plagiothecium sylvaticum, but the leaves are larger, the tufts more compact.

189. Amblystegium speirophillum, Kindb. (New species.) On face of wet stones, York Co. (Moser). Herb.
190. A. confervoides, Bruch and Schimp. On stones in woods. (Moser.) Herb.
191. A. serpens, Bruch and Schimp. (F's C.) (Moser.) Herb.
192. A. porphyrrhizum, ——. Fredericton. (F's C.) On damp earth. (Hay and Moser.) Herb.

193. A. varium, Hedw., Lindb. Near Fredericton. (F's C.) On roots of trees. (Moser). Herb.
194. A. orthocladon. (F's C.)
195. A. fluviatile, Bruch and Schimp. On rocks, St. John River. (F's C.) (Moser.) Herb.
196. A. adnatum. On stones in woods. (Moser). Herb.
197. A. compactum. On the bases of trees. (Moser.) Herb.
198. A. riparium, Bruch and Schimp. On stones in brooks, Molus River. (F's C.) Kennebecasis Island, (Hay). Tay, (Moser). Herb.
199. Hypnum hispidulum, Brid. Bass River and Little Branch, Miramichi. (F's C.) On bases of trees. (Moser). Also at Elmwood. Herb.
200. H. Sommerfeltii. On old logs. (Moser). Salmon River, Kent Co. (F's C.) Herb.
201. H. chrysophillum, Brid. On logs, Tobique River. (Hay). (Moser). Herb.
202. H. unicostatum, C. M. and Kindb. (New species). (Moser). Near Ottawa, October 4th, 1890. (Macoun). Near Kingston, Ont., May 23rd, 1884. (Prof. Fowler).
203. H. polygamum, Wils. Base of trees. (Moser). Herb.
204. H. Kneiffii, Schimp. In swamps, Queens Co.. (Moser). Herb.
205. H. sendtneri, Schimp. In bogs. (Moser). Herb.
206. H. fluitans, Linn. In bogs, Coldbrook. (Hay). Herb.
207. H. exannulatum, Guemb. In boggy places. (F's C). Queens Co. and Elmwood, Kings Co. Common. (Moser). Herb.
208. H. uncinatum, Hedw. Common. (F's C.) (Moser). Herb.
209. H. Moseri, Kindb. (New species).
Differing from H. uncinatum in the leaves not being striate, but sometimes recurved at the base; costa faint, often failing; differing from all the other Harpidia in the stem, being densely radiculate.
On the bases and trunks of poplar trees, Dec. 30th, 1889 (Moser). Newfoundland (Rev. A. Waghorne). Herb.
210. H. filicinum, Linn. Near springs, Tobique River. (Hay). Forks (Moser). Herb.
211. H. chloropterum, C. M. and Kindb. (New species).
Resembles H. Novae-Angliae in habit, but differs considerably in the distinctly papillose, looser and patent, wider areolate leaves and the monoecious inflorescence, and in other respects.
On rocks, New Harbour, Newfoundland. (Rev. A. Waghorne). Near a spring, Owl Bridge Gully, Forks, and on wet ground, in shade, at Elmwood, K. C. (Moser). Herb.
212. H. Novae-Angliae, Sulliv. and Lesq. In large patches, Bass River. (F's C.) (Moser.) Herb.
213. H. commutatum, Hedw. On earth in a swamp. (Moser). Herb.
214. H. crista-castrensis, Linn. On old logs. (Moser). Herb. Bass River. (F's C.) Tobique River (Hay).
215. H. molluscum, Hedw. On logs, Tobique. (Hay). (Moser.) Herb.
216. H. reptile, Michx. On stones and bases of trees, common. Herb.
217. H. pallescens, Beauv. Fredericton and Grand Lake. (F's C.) (Moser).
218. H. callichroum. (Moser). Herb.
219. H. fertile, Sendt. (F's C.) (Moser). Tobique. (Hay).

220. H. imponens, James. Old logs. (Moser). Herb.
221. H. subimponens, Lesq. Old logs. (Moser). Herb.
222. H. complexum, Lesq. and James. On rocks. (Moser). Herb.
223. H. Lindbergii, Mitt. (H. arcuatum, Lindb.) On rocks. (Moser.) Also at Elmwood. Herb.
224. H. Renauldii, Kindb. (New species). On damp earth in shade; abundant. (Moser). Herb. Reported by Macoun and Rev. A. Waghorne.
225. H. curvifolium, Muell. Common along wet banks and in brooks. (Fowler, Hay and Moser). Herb.
226. H. pratense, Koch. On earth. (Moser).
227. H. Haldanianum, Grev. On old logs, common. (F's C., and Moser). Herb.
228. H. nemorosum, Koch. On decayed wood. (Moser).
229. H. flaccum, C. M. and Kindb. (New species). On logs and rocks. (Moser). Owen Sound, Ont. (Macoun). Herb.
230. H. palustre, Hedw. On rocks in brooks. (Moser). Herb.
231. H. circutifolium, C. M. and Kindb. (H. molle, Lesq. and James).
Nearly allied to H. dilatatum, Wils.
On rocks in brooklet emptying into Tay. (Moser). Herb.
232. H. engyrium, Schimp. On stones. (F's C.)
233. H. ochraceum, Turn. On stones in brooks, Nashwaaksis and Canaan. (Moser). Kent County and Fredericton (F's C.) Herb.
234. H. stramineum, Dicks. Among sphagnum. (F's C.) Tay (Moser). Herb.
235. H. cordifolium, Drumm. In wet, sandy places; common. Herb.
236. H. giganteum, Schimp. Springs and swamps (Moser). Herb.
237. H. sarmentosum, Wahl. Bogs. (Moser). Herb.
238. H. cuspidatum, Linn. Shore of Washadamoak. (Moser). Herb.
239. H. Schreberi, Willd. Common everywhere. Herb.
240. H. splendens, Hedw. In dense mats on damp rocks, or on the ground but at Nashwaaksis, in the woods, it is gregarious. (F's C.) (Moser). (Hay). Herb.
241. H. umbratum, Ehrh. (F's C.) (Moser). Common by brooklets. Have not found it in fruit. Herb.
242. H. brevirostre, Ehrh. In dense mats on granite boulders in the shade, no fruit, Halifax Co., N. S. Herb. (Moser).
243. H. squarrosum, Linn. In grassy, shady slopes. Have not found it in fruit. (Moser). Herb.
244. H. triquetrum, Linn. Common. (Moser). (F's C.) Herb.
245. H. pyrenaicum, Spruu. (H. Oakesii, Lesq. and James). On old logs and stones. (Moser). Herb.

ARTICLE IV.

RECENT DISCOVERIES IN THE ST. JOHN GROUP, No. 2.

By G. F. Matthew, D. Sc., F. R. S. C.

(Read January 5, 1897.)

(See also Bull. IV., p. 97; Bull. V., p. 25; Bull. X., p. 34, x. and xi.: Bull. XI., p. 11; Bull. XIII., p. 94.)

Since the description was given in Bulletin X., page 34, of the genus Protolenus, and its place in the Cambrian succession, and of Trematobolus, in Bulletin XIII., p. 94, no record has been presented to the Society of the progress made in the study of the Acadian Cambrian faunas. It seems desirable, therefore, to add here a few words on this subject.

The Protolenus Fauna.—The chief work done of late in this direction has been the elaboration of the Protolenus Fauna*, which appeared in the Transactions of the New York Academy of Science (Vol. XIV., p. 101 to 153, Pl. 1 to 11, and Fig. 1).

Any fauna which can be found in the sediments of the earth's crust older than those which contain the Primordeal Fauna of Barrande is of interest to naturalists and geologists, because Barrande named this fauna as being the oldest, as he thought, except traces of worms that had existed on the earth. But beside the peculiar fossils of the Laurentian and other pre-Cambrian rocks, several faunas of greater antiquity have since been described by Linnarsson in Sweden, by Kjerulf in Norway, by Schmidt in Russia, and by Hicks in Wales; but these European faunas agree in having only a few species of trilobites. A fuller representation of pre-Primordeal trilobites is that discovered by C. D. Walcott in Newfoundland; but even this does not reach, in variety of trilobites, the number shown in the Protolenus Fauna. From this cause and others, a brighter light is thrown on various zoological problems by the facies of this fauna than by that of any of the others.

* This fauna is contained in Division 1, Band *b*, or the Zone of Protolenus (Bergeronia articephalus (formerly *Agraulos articephalus*). See Bull. X., p 12.

In studying the development of the Primordeal trilobites by means of their young, we find certain features in the latter which are lost in the adult. But among the trilobites of the more ancient Protolenus Fauna these features are to be found subsisting in the full-grown trilobite.

One of these features is a long, cylindrical glabella (or middle lobe of the head-shield). This in many of the larval trilobites is enlarged in front, and so we find it in the adult of the genera Micmacca and Ellipsocephalus of this fauna, showing how primitive these forms are. Many of the trilobites have cylindrical glabellas (Avalonia and Protolenus), which cylindrical shape is the second phase shown in the glabella of the larval trilobites. Moreover *none* of the trilobites of the Protolenus Fauna have contracted their glabellas to the short, conical form prevalent in the trilobites of the Primordeal Fauna (Ptychoparia, Conocephalites, Conocoryphe, Ctenocephalus, etc.)

Another feature in the trilobites of the Protolenus Fauna is the prevalence of a continuous eyelobe. The eyelobe is a protective ridge extending along a portion of the seam between the middle piece of the head-shield and the movable cheek. In many Cambrian trilobites this lobe is quite short, but in others, while it is short in the adult, it is longer in the larval stages; this is notably the case in Paradoxides, which in the earliest species, and in the young of all the species studied, has continuous eyelobes—that is, eyelobes extending to the posterior furrow of the head-shield. Now this character of a continuous eyelobe marks *all* the trilobites of the Protolenus Fauna in which this part of the headshield has been preserved.

A narrow, movable cheek is apt to be associated with a continuous eyelobe, and such movable cheek is the only kind so far found with the trilobites of the Protolenus Fauna; sometimes with, sometimes without a genal spine. Such a cheek exists in the early larval examples of Pytchoparia and allied genera of the Primordeal Fauna, but disappears in the adult, in which the area of the cheek is often quite wide, owing to the withdrawal of the eye from the margin of the headshield during growth.

A fourth primitive character of the trilobites of the Protolenus Fauna is the shortness of the pleurae, or lateral extensions of the thoracic rings. This may be observed as a characteristic of many trilobites in the larval state, but disappears as the species comes to maturity. Ellipsocephalus and several Agrauli preserve this character in the adult condition, but in the majority of Primordeal trilobites

(*See page 36*).

Some Types of the Protolenus Fauna.

Brachiopod.

Trematobolus insignis.—*a.* Interior of the ventral valve. *b.* Interior of the dorsal valve. *c.* Dorsal valve seen from behind. *d.* Inside of beak of ventral valve. *Notation of the muscles, etc.* *p. a.* Posterior adductor. *a. d.* Adjuster muscles. *l. m.* Lateral muscles. *a. p.* Anterior depression. *c. p.* Cardinal pit. *c.* Cardinal process. *s.* Hinge socket. *t.* Dentiform process of the ventral valve. *f.* Foramen. From Assize 2, Band *b*, Div. 1, St. John Group at Hanford Brook, St. John County, N. B.

Trilobites.

Protolenus elegans, W. D. Matthew (second group on left side).—The upper figure represents the head shield. The detached piece to the right is the movable cheek. The middle figure shows a joint of the thorax. The third figure is a side view of the head-shield.

Protolenus paradoxoides (second group on right side).—This represents the head-shield, with the movable cheek to the right, a little separated from the middle piece.

N. B.—All the above are figured of the natural size.

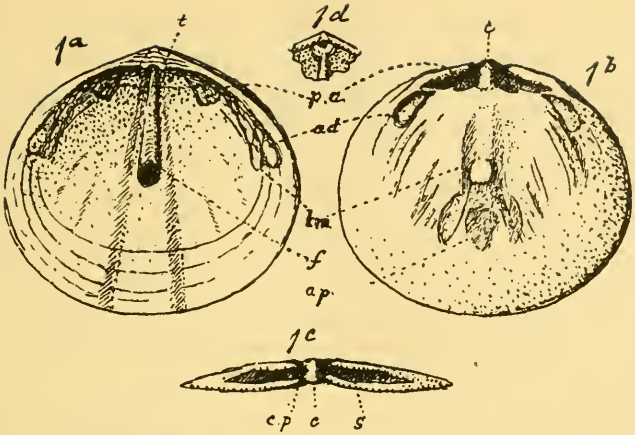
Protolenus articephalus (third group on left side).—The upper figure represents the middle piece of the head-shield. The second figure shows this part viewed from the side.

Ellipsocephalus galeatus (third group on right side).—The upper figure represents the head-shield, with the movable cheek somewhat separated. The second figure is a side view of the same. The third figure represents a segment of the thorax. The fourth figure is a side view of the middle piece of the head-shield, of the variety or mutation agrauloides.

N. B.—All the figures of the third groups, right and left sides, are magnified two diameters.

Olenus Zoppii, Menigh.—A complete trilobite, supposed to be a later derivation from the same stock as Protolenus. From the Cambrian of Sardinia, Italy. Introduced to show an entire trilobite of this family, and the relation of the different parts of the test of a trilobite to each other. The other figures of trilobites here given show parts of the test only.

The following genera compose the Protolenus Fauna: Foraminifera, Orbulina 4 sp., Globigerina 4 sp. Spongida, Monadites, Protospongia, Astrocladia? Brachiopoda, Lingulella 2 sp., Lingulella? 2 sp., Obolus, Botsfordia, Trematobolus, Protosiphon, Obolella, Linnarssonia, Acrotreta 2 sp., Acrothele. Mollusca, Hyolithellus? Coleoides? Orthotheca, Hyolithes 5 sp., Diplotheca 2 sp, Pelagiella, Volborthella. Ostracoda, Hipponicharion 3 sp., Beyrichona 6 sp., Aparchites 2 sp., Primitia 4 sp., Schmidtella, Leperditia 4 sp., Beyrichia. Phyllopoda, Lepiditta. Trilobita, Protagraulos, Ellipsocephalus 3 sp., Micmacca 4 sp., Avalonia, Protolenus 2 sp., subgen. Bergeronia 2 sp.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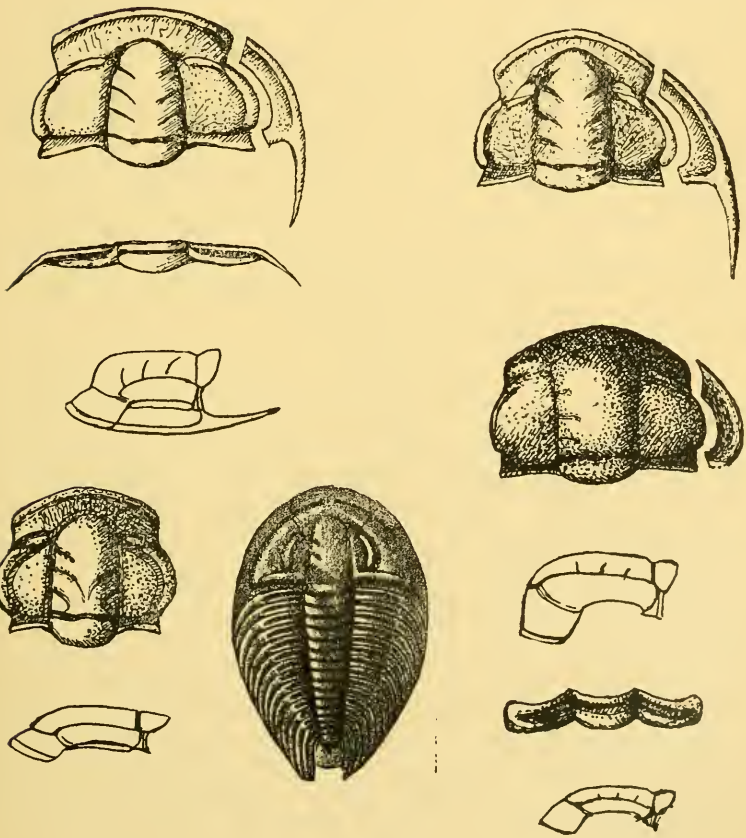


the pleuræ become extended in length when the animal is fully grown. Many of the trilobites of the Protolenus Fauna have short pleuræ, and none have been found to possess the prolonged pleuræ which mark many species of the Paradoxides and Olenus Zones (Primordeal).

The development of a pygidium, or tail-piece of many joints, is common in many trilobites of the Primordeal Fauna, and is still more common in the Ordovician system above it. This part of the body-covering is built of segments that were added gradually in the different moults as the individual trilobite progressed toward maturity. A pygidium of a few joints is therefore a primitive character, and the entire subordination of this part to the headshield is a mark of simplicity of structure ; it is so throughout the Cambrian system*, but in the next geological system (Ordovician) we sometimes find the pygidia preserved in greater numbers and perfection than the head-shields (*e. g.*, Asaphus). As a contrast to this, it may be said that while there are thirteen species of trilobites in the Protolenus Fauna, of which a hundred or more of heads have been found, only one pygidium has been recognized. The pygidia of many of these species must, then, be small and insignificant.

The primitive standing of the trilobites of this fauna is shown by the following characteristics :

1. The long, cylindrical glabella.
2. The continuous eyelobe.
3. The narrow movable cheek.
4. The short pleura.
5. The small pygidium.

This fauna is remarkable for the variety and size of its ostracods, and they differentiate the fauna into two sections — the lower in Assize 1 marked by the presence of the genus Hipponicharion, the upper in Assizes 2-4 marked by that of Beyrichona. These ostracods are of comparatively large size, and, with other genera of this order, there are a score of species. We seem to find this section of the crustaceans beginning to take the place of the trilobites in those oldest Cambrian beds, and it may be the dominant order in older deposits.

In this fauna we find ourselves among a very primitive assemblage of Brachiopods, for among them are forms which it is difficult to assign

* The two genera, Microdiscus and Agnostus, may seem not to bear out this principle, but it is to be remembered that these are abnormal genera, for in the former the joints of the thorax may be from two to four, while in the latter they are strictly limited to two; hence the pygidium enlarged, by additional somites, as a counterpoise to the enlarging headshield. This provision enabled the animal to fold itself together and thus protect its soft under parts.

to any known genus ; many are small, some are minute, and the larger forms belong to the Obolidæ and Siphonotretidæ. One of the latter is remarkable as being of the inarticulate order, yet having a distinct articulation at the hinge (Trematobolus). Another is notable in beginning life as one genus (Schizambon) and closing it as another (Siphonotreta), this being shown by the larval stages through which it passed.

A remarkable occurrence in this fauna is that of Foramenifera, of which several genera are present. The most notable are Orbulina and Globigerina, which at present are inhabitants of the open sea, on whose bottom they have left in modern times deposits of vast extent and thickness. Foramenifera abound in some of the Carboniferous deposits, but they have not been reported, so far as I know, from older geological systems ; they will, however, probably be found in the intermediate deposits.

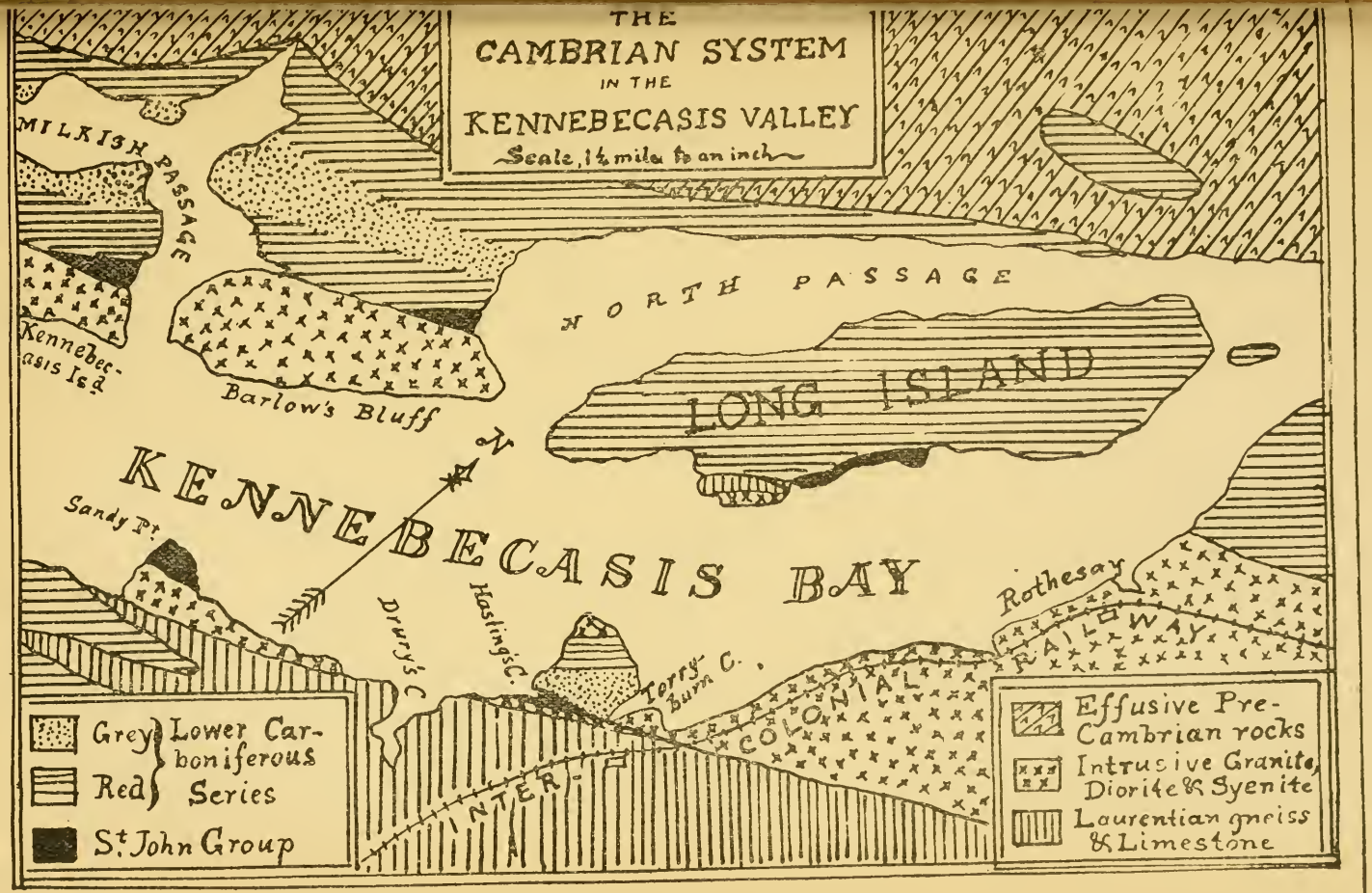
From the preceding remarks it will be seen that the exploitation of the Protolenus Fauna has resulted in a useful addition to the knowledge of early Cambrian geology.

The Geological Map of part of Kennebecasis Valley. (*See next page*). —This map, originally prepared to show the distribution of the Cambrian rocks of Kennebecasis valley, is useful also to exhibit other points in the geology of this interesting basin. The index to the formations is divided and placed in the lower corners, that part to the right shows the Pre-Cambrian rocks, that to the left the Cambrian and later terranes.

The foundation of the whole geological structure is the portion indicated by vertical bars. These are very ancient sedimentary masses classed with the Laurentian system of Canada. These old stratified rocks have been broken through by igneous intrusions (quartz-diorites, etc.,) of great age, which form a belt across the map, interrupted at points by the waters of Kennebecasis Bay.

Next in age come the great mass of igneous rocks of effusive or volcanic origin which form the principal part of the parish of Kingston, these occupy the upper side of the map. A parallel arrangement may be seen to hold for these three belts ; this is due to the presence of ancient and profound faults or breaks in the earth's crust of very ancient date that run in an E. N. E. direction ; along these fault lines the rocks have moved up and down more or less during the ages.

Black areas are those occupied by Cambrian rocks which now form


THE
CAMBRIAN SYSTEM
IN THE
KENNEBECASIS VALLEY
Scale, 1¼ mile to an inch
MILKISH PASSAGE
Kennebecasis Isd
Barlow's Bluff
NORTH PASSAGE
LONG ISLAND
KENNEBECASIS BAY
N
Sandy Pt.
Drury's C.
Hastings C.
Torry Burn C.
Rothesay
RAILWAY
COLONIAL
INTER-
Grey
Red
Lower Carboniferous Series
St. John Group
Effusive Pre-Cambrian rocks
Intrusive Granite, Diorite & Syenite
Laurentian gneiss & Limestone

narrow strips or wedge-shaped belts of small extent, which it will be seen, are always closely connected with the older rocks.

Lastly, the Lower Carboniferous rocks form basins of sediments, filling in the hollows of the Cambrian and the older rocks and spreading in the valleys. They are the youngest rocks visible in this area, except the loose aggregations of Post-pleiocene gravel, sand and clay which are not represented in this map. The Lower Carboniferous shows two principal divisions — one reddish and of marine origin, the other of grey color and containing scanty remains of land plants rare in this part of the valley, but more abundant farther eastward. The relative antiquity of these two parts of the formation has not been determined. The grey beds are seen at Hasting's Cove, on the south side of Kennebecasis valley, and in Milkish passage on the north side.

A great accumulation of boulder beds in the red division of this system is well exposed on Long Island, where it comes out on the river at the "Minister's" Face, a bold bluff extending from the outcrop of Cambrian rocks half-way to the eastern end of the island.

The Cambrian Rocks of the Kennebecasis Valley.— It will be remembered that in the annual report of the Society for 1897 allusion was made to work carried on on the Cambrian rocks of the Kennebecasis valley. We are now able to present some of the results of this work.

Sedimentation.—The sedimentation of the Cambrian in this valley was found to show important differences from that of the valleys to the north and south.

All through the Etcheminian period, which preceded the true Cambrian, this valley, with the surrounding territory north, south and west, was elevated above the sea, and was apparently an island having recently ejected volcanic rocks to the north-west and south-east of the present Cambrian valleys. This island and the volcanic ridges furnished sediment to the Etcheminian sea.

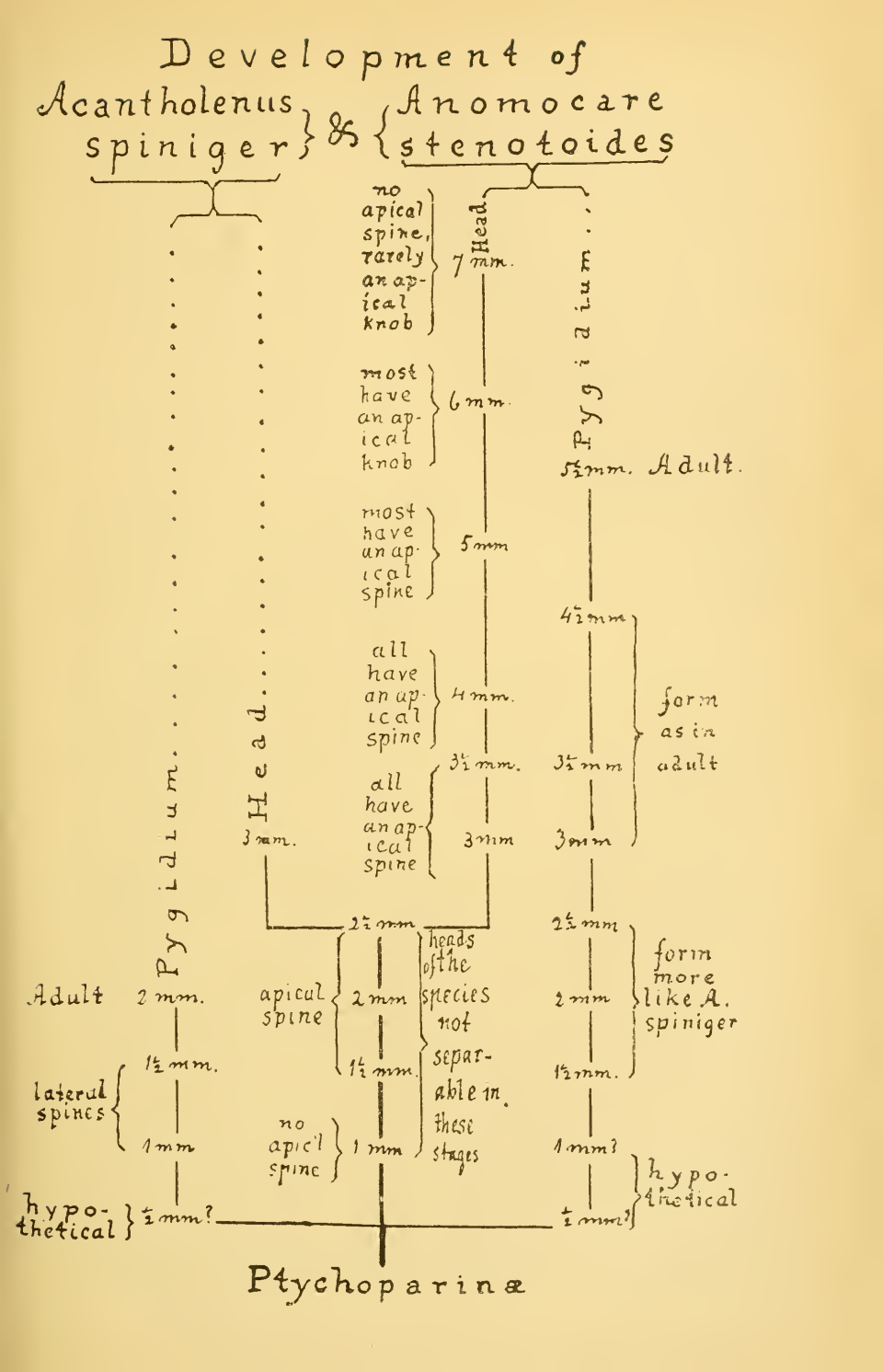
When the Cambrian time arrived changes of level in the land took place, so that while the Kennebecasis valley sank beneath the sea, the ridges on either side of it, consisting, on one side of volcanic rocks, and on the other of old Laurentian sedimentaries, remained above the sea. Thus was the Cambrian sea in this district divided into three areas of deposition, which to some extent were independent of each other, but not so far as to make any very material difference in the faunas.

It is evident that the deposits in the middle basin (Kennebecasis valley) were much thinner than those of the southern (St. John) basin. This is shown by the small narrow strips of sediments of which the Cambrian here is composed, and by the absence of the upper division (Bretonian), which, being of fine soft shale, would be easily removed by denudation. The middle division (Johannian), which in the southern basin shows a thickness of 1,000 feet, is here so reduced as to show only a tithe of this thickness. The Paradoxides beds, though not well exposed, also seem much thinner than in the southern basin, and only the Protolenus beds, by their volume and texture, fully bear out the aspect of their counterpart in the southern basin.

It would appear, then, that while a great part of the Cambrian series is present in this valley, it is very much reduced in thickness; from this it may be inferred that the floor of the Cambrian sea was sinking in the area of the southern basin much more rapidly than in the middle basin, and for most of the time was being filled up with sedimentary deposits as fast as it sank.

Faunas.—An interesting discovery in the Kennebecasis valley was that of the fauna of Hasting's Cove, which is a sub-fauna of the Paradoxides beds. Hitherto we had not found in the Acadian Cambrian rocks anything to correspond to the Upper Paradoxides beds of Sweden, the sub-faunas found in the southern (St. John) basin being such as are paralleled by the Lower Paradoxides beds of that country. At Hasting's Cove, however, we came across some genera not before found in this region, and which recalled the facies of the Swedish Upper Paradoxides beds, these were Anomocare and Dolichometopus; and associated with them was the easily recognized genus Dorypyge, found in the Middle Cambrian of western America and of China. By this sub-fauna we can link the upper part of our Paradoxides beds with the corresponding rocks in Sweden, West America and China.

Another interesting discovery made in this valley was finding of a type of trilobite in company with *Agnostus pisiformis*, L., which showed peculiar phases of development. In this type were contained two species which, so far as the headshields are concerned, could not in the earliest stages be distinguished from each other. They first become separable by their pygidia, which in one species takes the form of Olenus and in the other that of Anomocare. It would thus appear that from the one phylum or stem-form two genera were developed. (*See the opposite page.*)


Development of
Acantholenus spiniger & Anomocare stenotoides
Pygidium
Head
Pygidium
no apical spine, rarely an apical knob
7 mm.
most have an apical knob
6 mm.
most have an apical spine
5 mm
all have an apical spine
4 mm.
all have an apical spine
3½ mm.
3 mm.
3 mm
2½ mm
5½ mm. Adult.
4½ mm
3½ mm
3 mm
form as in adult
2½ mm
2 mm
1½ mm.
1½ mm
1 mm?
½ mm?
form more like A. spiniger
hypothetical
Adult 2 mm.
1½ mm.
1 mm
½ mm?
lateral spines
apical spine
2 mm
1½ mm.
heads of the species not separable in these stages
no apical spine
1 mm
Ptychoparinæ

The distinction of the headshields of the two species come at a later period of growth. Both, in the younger stages (though not in the youngest) have an apical spine on the margin of the headshield; this spine continues on the headshield of the Oleniod form, whose growth is arrested, so that it never reaches the size of the Anomocaroid form. In this latter the apical spine is gradually absorbed, so that in the final moult there is no trace of a spine in the front of the shield.

We see from this example how not only two species, but two genera, may be developed from the same rootstock. That is, the differentiation may produce two separate genera direct from the phylum, without the indirect method of producing separate species before the generic characters appear.

To make this instance of development more easily understood the diagram on the preceding page has been prepared, showing the branching of the trilobite *Acantholenus spiniger* from the stock which eventuated in *Anomocare stenotoides*. From this diagram it will be seen that the divergence occurred in very small heads, for even the caudal shield, 1 mm. long, of the former species has all the rings of the adult, hence the differentiation must have occurred in a still earlier moult. We assume that this may have been the $\frac{1}{2}$mm. size. But if so the companion species *A. stenotoides* must have had an equally small pygidium as a starting point; so the differentiation must have occurred as early as the 1 mm. moult (*i. e.*, when the head and caudal shield together were of this length).

But, as the diagram shows, the head-shields of the two species cannot be distinguished until they reach a size of $2\frac{1}{2}$mm. Had we perfect tests, however, showing the head and caudal shields in connection, we should be able to distinguish the two trilobites by the pygidia when this part was no more than $1\frac{1}{2}$mm. long, but failing this the separation of the head cannot be effected before the $2\frac{1}{2}$mm. moult. In the very smallest size the spine at the front of the shield (apical spine) cannot be found, but immediately thereafter becomes a distinguishing feature, and continues so through all the earlier moults. But by degrees it becomes absorbed in *Anomocare stenotoides*, as the diagram shows, but in the other species it continues as a distinct ornament until the full size is attained, which, however, is much below that of the species last named.

As no other type of trilobites that can be confounded with them occurs with these, it is clear that we have here a case of development

from a common stock which at once pass to different genera, one somewhat closely like an Olenus, the other diverging from a Pychoparian ancestor into the resembling genus Anomocare.

Other points of less moment have been noted in reference to the Cambrian faunas of the Kennebecasis valley; thus two of the thirteen species of trilobites of the Protolenus Fauna were found in olive-grey sandstones in this valley, and two new Ostracods were also obtained from the same beds. A very interesting Brachiopod from these sandstones was that which is referred to on an earlier page as passing during its growth from the condition of a Schizambon to that of a Siphonotreta.

Though since their deposition the Cambrian beds of this valley have suffered great disturbance and enormous denudation, and what remains of them are now to a great extent covered by the lake-like expansion of the Kennebecasis River, or concealed by sediments of Lower Carboniferous age, enough remains exposed to throw considerable light on their sedimentation and palæontology.

Upturnings and Dislocations of the Cambrian Beds.—The sharp folds into which the strata of the St. John basin were thrown have been described in Volume VIII of the Transactions of the Royal Society of Canada, pages 125 to 128, and displacements along faults of a high hade, of hundreds of feet. Horizontal displacement has also been shown by the result of well borings in the city of St. John and its neighborhood; the most remarkable are those that have come to light through borings in the upper (Bretonian) division. At Jones' Brewery on Union Street, a boring was put down to a depth of 385 feet, in what appeared to be a deep narrow trough of black shales, having an overturned dip of about 70 degrees. Theoretically, this bore should have been continuously in the black shales of this division, but at the depth of 317 feet the flag-stones of Division 2 were struck: these flags at the surface are about 300 feet to the N. W., hence there would appear to be a horizontal overthrust of the black slates on the flagstones to the extent of about 280 feet.

Similarly on the eastern side of Courtney Bay at the Almshouse, hard grey flags were encountered in a well sunk in the black slates at a depth of 700 feet and penetrated for 55 feet. Here the dip of the beds is about the same as in the city and the grey flags of Division 2 (Johnnannian) appear at the surface about 500 feet to the N. N. W.; hence there would appear to be an overthrust here of about 460 feet.

A force operating from the same direction as that which produces these old conditions of overthrust strata, is in operation on a milder scale at the present day, for by reference to No. 12 of this Bulletin, page 34, it will be seen that since the Glacial Epoch there has been dislocation of the strata of the St. John Group whose phenomena show thrusting from a S. E. direction. The old displacements, however, are on a gigantic scale compared with these.

ARTICLE V.

NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong.

4.—On the Color of the Water in New Brunswick Rivers.

Read March 2nd, 1897; re-written April, 1898.

New Brunswick is a land of splendid rivers. I have looked on the maps in vain for an equal extent of country elsewhere which can show so fine a series. For it might the words have been written: "A good land, a land of brooks of water, of fountains and depths that spring out of valleys and hills."

Everyone who has been much with rivers must have felt that they possess distinct characters or individualities. This character is a subtle aggregate, but a leading physical component of it is the purity and color of the water. The characters of our rivers I shall try elsewhere to express; I ask the Society now to consider the physical problem involved in their colors.

It is possible to find in the province every gradation between the sluggish, heavily sedimented, almost black streams of the peaty districts of Kent, Gloucester, and parts of Charlotte, and the rippling, limpid streams of the central and northern watershed. The causes of the color and opaqueness of the former are plain enough; they leach out the dark coloring matters of swamp and bog, together with much of the flocculent organic matter. But the clear northern rivers, when low in their stony beds, carry little sediment, and that not organic; but they show curious differences in color, for some of them are green and others are brown. In thus speaking of color, I do not refer to glint from their surfaces, nor the hue in rapids and waterfalls, but to that which one sees at low water, when he looks through a still surface, nearly vertically, into a deep pool with gravel or boulder bottom. Seen thus, the Restigouche is light green, and the Metapedia light brown; and where these two come together, one may run a canoe for three hundred yards on a boundary so sharp that on the right all is clear

green and on the left all equally clear brown. One may see the same contrast where Green River enters the St. John, but with a result less striking, for the greater river, though brown, is less clear. Indeed, the St. John water is of mixed color and texture—one might call it a golden brown—as would be expected from its receiving so great a mixture of streams. Another striking contrast of color is to be seen in the two branches of Charlo River. Where they cross the highway road, a quarter of a mile apart, the western is clear green, the eastern clear brown. The upper branches of the Restigouche are green; Nepisiguit is, I believe, brown; but I have no exact information as to the color of Tobique, and the many other clear rivers which abound in all the northern wilderness from Temiscouata and the St. John eastward. A Blue River empties into St. Francis, but I know not whether the name describes the water; and Blue Lakes are mentioned near the Cascapedia in the Geological Survey Reports (1881, D., p. 20), though the color is not in the water, but by reflection from the blue clay bottom. Blue water lakes occur, however, in Europe,* though green is much more common in clear lakes, both there and in this country.

The explanation of the difference between the green and brown colors is no doubt this: the physical composition of the purest river water is such that when white light enters and is reflected back through it, the green rays are absorbed least, and hence preponderate in the light which comes to the eye. The clear, brown rivers, on the other hand, though possessing green water as a basis, have added to it a brown liquid (not sedimentary) coloring matter, leached out from swampy places. What we know of the Restigouche and Metapedia is consistent with this, for the former has hardly any, if any, swampy area upon it, while the latter has at least some swamp around Metapedia Lake (Johnston, Notes on North America, I, 387). I have no such data for the two branches of Charlo River.

The subject has been carefully studied in Europe, and an important memoir on the subject has recently appeared.† It will aid to the solution of the problem if members of the Society will make exact observations upon the color of the water in our clear rivers, particularly giving attention to the character of the country through which they flow.

*The deep blue color of the Lake of Geneva differs from that of the other Swiss lakes, which are all more or less of a greenish hue . . . the cause of the phenomenon has never been actually ascertained —Baedeker's Switzerland, 15th Ed., p. 222.

†La Couleur des Eaux. Par Ad. Kemna. Bull. de la Soc. Belge de Geologie. X, 241.

5.—On the Heights of New Brunswick Hills.

Read April 6th, 1897; re-written April, 1898.

In the summer of 1896, I climbed two of the best-known and most accessible of the higher hills of the province—Squaw Cap in Restigouche, and Mount Pleasant in Charlotte. Later I sought information about their heights, but found, with surprise, that for neither was it accurately known; and later inquiry showed that this is true as to the heights of most New Brunswick hills. Indeed, nobody knows positively where the highest point in New Brunswick lies, much less how high it is.

It is generally stated that the highest point in the province is Big Bald Mountain, at the head of the Lower South Branch of Nepisiguit; but this, if not an error, is at least not proven. It rests solely on the authority of the Geological Survey map, which marks that mountain as 2,700 feet, the greatest height marked anywhere in the province. But this height appears to be a compiler's or copyist's mistake, for Dr. R. W. Ells, in his Geological Report (for 1881, D, 35) describing that region, estimates Bald Mountain at 2,500 feet—not 2,700—and he has recently had the kindness to write me that his estimate really was as given in his report, and that he does not know how the greater height came to be placed on the map. No other officer of the Geological Survey has been there, nor are measurements by anyone else known. He says, however, that he thinks Bald Mountain "the highest land in Northern New Brunswick—at least as far as I have travelled." The Geological map marks in that region "Peaks rising to 2,600 or 2,700 feet," which, of course, is so stated to include the height given to Bald Mountain. We must, therefore, consider that it is far from settled whether or not Bald Mountain is the highest in New Brunswick. If this measurement of 2,500 feet by Dr. Ells is correct, there is another higher peak in the province, namely, Bald Mountain, beside Nictor Lake, which is given on the Geological map as 2,537. This must therefore stand as, for the present, our greatest known height. It is not likely that any point in the province will reach 2,800 feet. Who will be the first to demonstrate the highest point in New Brunswick?

It will be of interest to note some heights elsewhere, for comparison. The highest in the world is Mount Everest, 29,000 feet; in Europe, Mount Blanc, 15,730 feet; in England, Scawfell, 3,208; in Wales, Wyddva, 3,571; in British America, St. Elias, 18,086; in the United States, Blanca Peak, 14,463; in New Hampshire, Washington, 6,290;

in Maine, Katahdin, 5,248; in Nova Scotia, the Cobequids, about 1,100. New Brunswick heights are therefore not great.

Our knowledge of New Brunswick heights above sea level is based upon the following data:

(1) Levels determined by canal, railroad, and waterworks surveys. These are many and valuable, but scattered, and not easily accessible, and he who would collect, and reduce them to a single datum, would do great service to our physiography.

(2) The line of levels run along the St. John from high tide at Chapel Bar, above Fredericton, to Grand Falls, by Robert Foulis, for the New Brunswick government, in 1826. They are recorded on a map in the Crown Land Office. It has been pointed out by Hind (Preliminary Report, 30) that Foulis' figures are too low, which Mr. Shewen tells me is confirmed by the railroad levels.

(3) Barometric and spirit-level observations made in connection with the Boundary disputes. One of these was a series across the province from Grand Falls to Bay Chaleur, made by the Boundary Commissioners in 1839. The full account of them is given in "Correspondence relating to the North American boundary," British Blue Book, 1840. A central station, whose height was determined from Foulis' levels, was established at Grand Falls, where the central observations for weather were made, and by mercurial barometers many heights along the Tobique, Nepisiguit, and Jacquet rivers were carefully determined. As Foulis' figures were used for the datum, all heights in this series are too low. These, with some others, are given in a list by Hind in his report on the geology of N. B., 1865, pp. 23-24, and many others from railway surveys and other sources are contained in the same work. Along the north line from the source of the St. Croix two lines have been run — one with barometer, by Bouchette, about 1817 (much too high), and another with spirit-level, by Graham, in 1840-41, published in a document of the 3rd Session, 27th Congress.

(4) The measurements by the Admiralty Survey of heights along the coasts, recorded on their charts. I do not know how they were made, nor their base level, but without doubt they were taken with care.

(5) The determinations with the aneroid barometer made by the officers of the Geological Survey of Canada, particularly by Robert Chalmers. These are all recorded on the official maps, and are frequently referred to in the various geological reports. They include lake surfaces, as well as hills. The controls for weather changes were obtained from the nearest meteorological stations in the province. Like all aneroid observations made by a single instrument in the field, the results can be regarded as only approximate. The base level is, on some maps, high tide; on others, mean tide.

(6) Aneroid and theodolite observations made by surveyors and others for their private satisfaction. William Murdoch, C.E., of St. John, has made more numerous measurements than any other that I know of, and he has kindly sent me a list of these. A few made by myself are recorded in a later note of this series (No. 13).

Most of our greater heights are of hills composed of very hard, intrusive rocks, the only kinds which have been able to withstand the long erosion which New Brunswick has suffered, and the awful battering which it received in the glacial period. They are either of granite, as in the higher Bald Mountain group, the Cow Mountains, Bald Mountain (Queens), Mount Pleasant, etc., or else of trap (Dolerite and Diorite), as in Squaw Cap,* the Blue Mountains, Moose Mountain, etc. The trap mountains are more abrupt and isolated than those of granite, both because they are intruded in smaller masses, and also, perhaps, because they are newer and less eroded, as well as harder. New Brunswick owes most of its bold and beautiful scenery to these intrusive rocks ; and flat and tame indeed would much of its surface be were it not for them. Some heights occur in the hard pre Cambrian rocks, as in Bald Mountain, and others near Nictor, and those along the Shepody Road in Kings and St. John. Some appear to be in much softer rocks, as Shepody Mountain, Green River Mountain, etc., though none of these are of great height. Possibly some of them are protected by local caps of trap, as in Chamcook.

The heights of New Brunswick will not be completely nor accurately known until a unified topographical survey of the entire province has been made ; and this, because of its great expense, will be long in coming. In the meantime, there is here offered, to those of us who enjoy the pleasures of the chase, the opportunity to pursue, to our complete content, that most elusive and alluring of all great game, new, hard facts—in this case all the more charming since they must be sought through the hardships of the northern wilderness. The determination of our principal heights is a fine problem for young New Brunswickers.†

The heights recorded for the province have been taken above various datum lines. A single datum was wanting, but this has recently been established, by the calculation of mean tide level at St. John, by Mr. E.T. P. Shewen,‡ and no doubt future measurements will all be referred to it.

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* The Geological Survey map colors it as composed of Upper Silurian rocks, but I found it to be made of the same intrusive, igneous rocks as compose Sugar Loaf and the other heights in that vicinity, and the red color on the map should be extended southwest to include them. Probably the surveyors did not visit them, and were deceived by the name Slate and by local descriptions. The rock breaks up into flat, somewhat slaty, pieces.

† Two observers working from the railroad levels with good barometers, one remaining at base level to check the other, could do much in summer excursions. Or a long line of levels could be carried across country by two parties with good aneroids—or, better, mercurial barometers—one going ahead a few miles to a new station, while the other remained as a check for weather; the latter then coming up, while the former was fixed as a check. This would establish a line of stations in which, supposing the instruments to work together, the only source of error would be the difference in weather pressure between the two stations, which would be the less the nearer the stations were together.

‡ See this Bulletin, later page.

A List of the Heights above Sea Level of the Best-known Hills of New Brunswick, with Authorities.

[A., Admiralty Charts; B., Boundary Commissioners; M., William Murdoch; G., myself (see note 13 of this series); G. F., Geological Survey, Maps of Formations; G. S., Geological Survey, Maps of Surface Geology.]

Bald Mountain, Victor—2,537 (G. F.)
Bald Mountain, South Branch Nepisiguit—2,500 (R. W. Ells).
Squaw Cap—2,600 (G. S.—probably on authority of Hind).
Bald Head, Victoria—1,866 (G. F.)
Blue Mountain, Victoria—1,724 (G. F.)
Mars Hill, Maine—1,688 (B. C. and G. F.)
Moose Mountain—1,030 (G. F.)
Nashwaak Mountain—855 (G. F.)
Bald Mountain, Queens—1,120 (G. S.), 1,390 (M.), 1,462 (G.)
Shepody Mountain—1,050 (A.)
Sugar Loaf, Restigouche—950 (A.)
Mount Pleasant—1,200 (G.)
Chamoook—637, 627 (A.)
Ben Lomond—850 (M.)

For fuller lists, see Hind (already referred to) and Bailey, Report, 1886, G. 6.

6.—Dalhousie and Saint Andrews.—A Coincidence.

Read June 1st, 1897.

There is a curious likeness between the most northerly and most southerly towns of New Brunswick—Dalhousie and Saint Andrews. They stand where tidal rivers empty into salt bays, and circling about them are superb hill and sea views, in which Dalhousie has the advantage as to hills, and Saint Andrews as to water. Prominent in their landscapes are the Lower Carboniferous sandstones, which bear rich farms and wear into soft, red cliffs, contrasting beautifully with the blue of the sea. Both places are summer resorts, with big hotels, and the colors and chatter of the summer visitor in the streets. All of this is due to similar physiographic environment. Both are extremely neat, with tasteful, old-fashioned residences and gardens, which shows something in common in their people, perhaps a large proportion of thrifty Scotch. Both are regularly laid out, on ample scale, for both were expected to be—and for a time were—the principal towns of their counties. But the grass grows and quiet reigns in their streets, though with them both there is that air of self-respecting submission to the fall from better days which so often makes both places and people charming. For both are being surpassed by neighbors far less

attractive, but more happily situated for business, which in both cases happen to be about sixteen miles away at the head of navigation. One may trace yet other resemblances, some natural, some accidental. All of these things—physiography, history, people, accident—combine to produce in the two places an atmosphere not only remarkably alike, bnt extremely agreeable ; and we may speak affectionately of the one as the Saint Andrews of the north, or of the other as the Dalhousie of the south, according to our point of view.

7.—On Halophytic Colonies in the Interior of New Brunswick.

Read Nov. 2nd, 1897; re-written April, 1898.

In the geographical distribution of plants no phenomena are of greater interest than the occurrence of colonies isolated far from their congeners in the midst of a different flora. The best known case of this, and one which will occur to everyone in this connection, is the presence of Arctic plants on high mountains even near the equator, and in bogs and other cold places. We have Arctic plants in New Brunswick, as Dr. Matthew* and Professor Fowler† have shown ; but we have also another kind of isolated colony, which has not yet been described by our botanists—a colony of sea-shore plants at the Salt Springs near Sussex.

These springs—three or four in number—occur three miles east of Sussex, beside the highway road to Moncton. The brine was formerly, but is not now, boiled down for salt. They break out in the open fields and flow down to a fresh-water brook near by. On the sandy shore around the springs and along their outlets grow plants which give the place the appearance of a bit of the sea-shore. Several years ago I noticed these plants, and last August I visited the place, and collected the species listed below. The Phanerogams were identified for me by Mr. Walter Deane and Dr. B. L. Robinson of Cambridge, and the Algæ by Mr. F. L. Collins of Malden, to all of whom, for their valued aid, I tender my sincere thanks. They are listed about in the order of their abundance, and the notes were made on the spot.

1. *Salicornia herbacea*, *L.* The most abundant and characteristic plant; very red and succulent.
2. *Spergularia (Buda) salina*, Prest. On the sandy banks; very abundant.
3. *Spergularia salina*, var. *minor*, Rob. (?)
4. *Spergularia borealis*, Rob.

*See Canadian Naturalist, 1869. †See Trans. Royal Soc. Canada, V.

5. *Ranunculus Cymbalaria*, Pursh. On edge of the streams from the springs.
6. *Atriplex patulum*, L., var. *hastatum*, Gray. In sandy places.
7. *Distichlis maritima*, Raf.
8. *Puccinellia maritima*, Parl., var. *minor*, Watson. In very salt places.
9. *Scirpus pungens*, Vahl.
10. *Juncus bufonius*, L.
11. *Ilea fulvescens* (Ag.) J. Ag.
12. *Rhizoclonium*, probably *Kochianum*.
13. *Rhizoclonium*, probably *riparium* var. *implexum*.

It will be noticed that all of the above species, except No. 10, are of marked halophytic habit, characteristic of salt marshes or sea-coasts. Probably a more skilful collector would find yet other species. One in the list, *Spergularia borealis*, is new to our flora.

It is easy to understand how these plants persist where they are, for the salt water of the springs is sufficiently like the salt water of the sea. But how did they come there? The nearest sea-coast is, in an air line, at least twenty-one miles away, with high hill-ranges between. For the occurrence of such a colony, one of three explanations is possible:—First, the plants may have been transported from the sea-coast by man; but the large number of the species, and especially the presence of the Algæ, is against such accidental introduction. Second, natural modes of dissemination may have carried them from the coast; but the most of them are so little specialized for such locomotion that this is very difficult to believe. Third, under different geographical conditions in the past they may have extended continuously from the sea to this place, but have since become extinct between. This is doubtless the correct explanation, and is homologous with that of the occurrence of isolated Arctic colonies. During the latest post-glacial subsidence this region dipped beneath the sea to an extent estimated by Dr. Matthew at 200 feet.* At that time the sea, bringing the coast plants with it, must have extended up the Kennebecasis, deeply burying these springs, which, as shown by the Intercolonial Railroad levels, are not over seventy feet above present high-tide mark at St. John. The subsequent elevation of the land, with the return of the fresh water, would of course exterminate the Halophytes everywhere except where they could find salt, which happened to be the case at these springs.

There are other salt springs in New Brunswick—in the parish of Upham, and at Bennett's Brook, near Petitcodiac; while others are said to occur on Coal Creek, Queens County. There is also a brook

* Bulletin of this Society, No. 2, page 4.

with slightly saline taste just above Plaster Rock, on the Tobique. Here is a most attractive problem for our local societies — to determine whether other colonies occur in these places.

Halophytic colonies occur about the salt springs near Syracuse, New York, and no doubt at other places in Eastern North America; but they appear not to have been studied from this point of view.

8.— Upon the Manner in which the Bay of Fundy Rivers of New Brunswick empty into the Sea

Read Dec. 7th, 1897; re-written April, 1898.

The remarkable difference between the way in which most of the rivers east of St. John and those west of it fall into the Bay of Fundy must be well known to members of this Society; but I have not seen in our physiographic literature any special reference to its causes. On the one hand, those of the western series — the St. Croix, the Digdeguash, the Magaguadavic, New River, the Lepreau — all have falls where they meet the salt water, and, at least at high tide, fall directly into it from considerable heights.* On the other hand, the eastern series (beginning really not at St. John, but beyond Mispec, which has a fall and belongs with the western series), including the two streams at Quaco, Big Salmon, Little Salmon, Quiddy, Goose, Point Wolfe, and Upper Salmon rivers, and the brooks amongst them, all run evenly into the sea without natural falls. At first the question as to the causes of this constant difference in the two series is puzzling, but really its solution is not difficult.

We notice, first of all, that this feature of their mouths is really characteristic of their entire courses. Thus those of the western series, running all in comparatively open country, consist largely of long deadwaters (in some cases forming large lakes), or stretches with little fall, and often without ledge-rock bottoms, separated by falls over rocky ledges; and it is up one of these deadwaters of the sunken valley to the next fall above that the tide in every case runs. But those of the eastern series, which all run in deep, V-shaped valleys, cut down 400 to 600 feet below the level of an elevated plateau, have bottoms of ledge rock, and run as torrents, but with no vertical falls of any account, and with deadwaters or lakes only on top of the plateau. The question, then, resolves itself into this — what has produced the falls and deadwaters in the one case and not in the other?

* This fact is noted by Mr. Chalmers in his Report on Surface Geology, 1890, N. 13.

Falls in glaciated regions are chiefly the result of the damming or filling of shallow valleys by glacial drift dropped across them at the close of the Glacial Period, by which the water was held back and made to seek an outlet over the lowest point of the rim of the valley, which usually is a rocky ledge. Such dams are easily to be seen at the falls on these western rivers. On the other hand, where long stretches of rapids or of even descents over ledge-rock occur, the river is probably in its pre-glacial channel ; and pre-glacial channels usually have no falls, other than small ones due to unequal hardness or jointing of the rock, and hence to uneven erosion, because there was ample time in the pre-glacial ages for any which may have existed to have become eroded out, as all falls are tending to do. In general, then, we may conclude that where falls and deadwaters are, the pre-glacial valleys are more or less filled up, while long series of rapids over ledge-rock, as a rule, indicate a pre-glacial channel. Now, while the western series of our rivers have large portions of their valleys of the dammed-up sort, those of the eastern series show no glacial dams, and no glacial falls — at least in their lower courses ; but the channel is always of bed rock, except where thinly covered by gravel and boulders, brought down by the stream itself. But why were these eastern valleys not also dammed by the glacial drift? Was the region not glaciated? Now there is abundant evidence that it was, though probably not so heavily as the less elevated western section. But while the quantity of drift dropped in Southern New Brunswick was sufficient to fill the comparatively shallow valleys of the western series, it could not fill to the tops these eastern valleys of 400 to 500 feet of depth, and, unless they were filled completely to the top, and a little more, the rivers would not be forced out of them, and hence would form neither new falls nor new valleys, but would simply cut out and wash away the glacial dam itself and resume their pre-glacial beds. The depth of these valleys, then, if this explanation be correct, has been their salvation, and the different depths of the valleys in the two series is the real reason for the presence of the falls at the mouth of the one series, and their absence from the other.*

* The same general explanation will no doubt also apply to some other deep valleys, such as that of the Restigouche, which has no falls, but everywhere a rocky channel.

Dr. G. F. Matthew, in remarks made after the reading of this paper, suggested, as subordinate influences at work to aid in producing the differences between the two series, the following: First, the high eastern plateau tended to turn aside the glacial currents into the St. John, and hence less drift was dropped into the eastern than into the western series, which have valleys directly along the line of the glacial flow. Second, the much greater slope of the eastern rivers must have given them greater power to wash out drift. Third, the formation through which the eastern series have cut their valleys is fairly uniform

9.—The Crayfish in New Brunswick.

Read March 1st, 1898.

In the sixth Bulletin of this Society there was published a short paper with the above title. In the *Educational Review* for November, 1889, appeared an article, with some additional information, unsigned, but known to be by the same author. In the proceedings of the United States National Museum, volume XIII., p. 612, in a work by Dr. Walter Faxon, the chief authority on this group, the New Brunswick localities of the two preceding papers are summarized, but no new ones added. Since then nothing further has appeared, nor does a paper by Dr. Faxon, on the Crayfishes, now in press, contain any new data for this region. The subject is of sufficient interest to warrant calling the attention of the Society once more to it.

Only a single species of Crayfish is known to occur in New Brunswick—*Cambarus (Astacus) Bartonii* (Fabr.) Gir. It has been found abundantly in the valley of the St. John (into which it has no doubt spread from Penobscot waters), in the Restigouche, Upsalquitch, and Miramichi; but it has not been reported from the Nepisiguit, St. Croix, Richibucto, Petitcodiac, nor from Nova Scotia nor Prince Edward Island. As it cannot live in salt water, it probably has not spread into either of the latter provinces, but it ought to occur in other New Brunswick rivers, especially those connected by low, swampy portages with the Penobscot or St. John. The distribution of single species in relation to the influences controlling it is always of much scientific interest, and members of this Society should be on the watch for additional data in this case.

The Crayfish cannot be mistaken for any other animal. It is like a miniature lobster, three to four inches long, of a dark, ashy-brown color. It lives only in fresh water, and forms burrows in alluvial lands.

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in texture, while the western valleys have cut across many bands of different composition and hardness, producing an alternation of deeply eroded, with less eroded, stretches. The filling of the former by drift would force the rivers to seek new outlets over the harder ridges Practically, however, the alternating bands are too broad to have had much effect of this kind, and an inspection of the geological map of Charlotte shows that there is no relation between positions of the falls and the transition between formations. Fourth, post-glacial changes of level, known to be going on, may have buried falls once existing at the mouths of the eastern series, as they have done in the case of the St. John, off Partridge Island. But against the former presence of such falls on the eastern series must speak the fact that there are at present none above the mouths, as on the western series.

10.—The Marine Invertebrates of the Western Part of Bay Chaleur.

Read March 1st, 1898.

There is no part of our marine invertebrate fauna so little known as that of the western part of Bay Chaleur. The subject has been studied for the Bay of Fundy by Stimpson, Verrill, and members of this Society, and for Northumberland Strait by Whiteaves, and the works of these investigators are well known: but for Bay Chaleur, except references by Whiteaves to dredgings at its mouth, and scanty notes by Bell (Canadian Naturalist, IV, 197) on Caraquette, with a single reference to Dalhousie, together with a reference by Morse to the occurrence of *Littorina litorea* at Bathurst in 1855 (Bulletin Essex Institute, XII, 176), there appears to be nothing in the literature of the subject. Yet the question as to what invertebrates occur in the western part of that bay is of considerable interest in connection with the distribution of the southern colony so remarkably developed along our North Shore from Caraquet to Bay Verte, the history of which may be found fully traced in the Transactions of the Royal Society of Canada, VIII, iv, 167–185, and by Upham in American Journal of Science, XLIII, 1892, p. 203. It was therefore natural that during a visit to Dalhousie and Campbellton in August, 1896, I should examine the shores with some eagerness. As it was time of neap tides, I could not see all of the littoral fauna, but to my surprise, what I did see showed no trace of the southern species which I had expected to find there. At Campbellton the Restigouche River makes the water brackish and the shores muddy, conditions which result always in a sparse fauna. At Dalhousie, however, the abundant species were *Mya arenaria*, *Macoma fusca*, *Mytilus edulis*, *Littorina palliata*, *Tectura testudinalis*, small crabs, a small starfish probably *Asterias littoralis*, and many Bryozoa, etc. *Littorina litorea* was, however, very rare, and I could not find a single specimen of *Purpura lapillus*. Stranded on the beaches in abundance was a large medusoid jelly-fish resembling *Cyanea arctica*, though often of a deep amethyst color. *Fucus vesiculosus* and *nodosus* were abundant, the former less so than the latter. In fact the general aspect of the shore forms, including the dead shells cast up on the beaches, was much more like Passamaquoddy Bay than like Shediac Harbor, which I visited last summer, and which has the southern colony. It must be noted, however, that Bell reports *Crepidula fornicata*, a decidedly southern form, from Dalhousie, but I saw no trace of it. In general, then, these notes,

scanty as they are, seem to show that the southern fauna is but slightly represented at the head of Bay Chaleur. Though the summer temperature of the water seems high, it is probably, owing to the proximity of deeper water and more considerable tides, lower than at Shediac, and a little below the surviving point for these southern forms; and perhaps also the more rocky character of the shores is unfavorable to sand-loving species such as most of the southern ones are. Dredging may yield some other forms, though the general character of the coast does not promise a rich fauna.

11.—A Natural History of New Brunswick projected in 1771.

Read March 1st, 1898.

From June, 1770, until June, 1771, Lieut. William Owen, R.N., lived at Campobello, and his journal, part of which has been printed by the Historical Society, contains in the yet unpublished parts some items of no little scientific interest. Thus, under date of October 1st, 1770, he says that, when near Indian Island, he "made here two hauls of the trawl, but took nothing material except a few curious shells, and other sub-marine productions." No doubt this is the earliest existent reference to dredging in New Brunswick waters. Three years earlier he speaks of dredging off the coast of Massachusetts and finding scallops, and "sea-eggs, starfish, coral, weeds and other curious sub-marine productions." During the entire year at Campobello he kept a very careful meteorological record of temperature, wind direction and force, and general weather, the whole given in full in his journal. This is no doubt the earliest record kept in New Brunswick, and is so full and carefully made that it must be of much more than antiquarian interest. But most important of all is the following passage:

"It was his [i. e., the author's] intention (and some time before he left the island he began) to make very particular observations on the quantity of rain and snow that fell; the greatest depth of the snow upon a plain; the depth the frost penetrated into the earth; the nature and quality of the soil, and the different strata under; some remarks in the three kingdoms — animal, vegetable, and mineral; the progress of vegetation; the migration of birds and fish; the seasons for the spermaceti whale, cod, haddock, and pollock fisheries, as well as the river fisheries of sturgeon, salmon, shad, bass, and alewives; the mode and time of killing seals; the Indian's seasons and manner of hunting for their furs and peltries; their fishing and fowling; the mode and best season for hunting the moose or orignal, the cariboo, the fallow deer, and every other miscellaneous matter or event that might occur. This work he left to be carried on by a sober and ingenious young man he left there, who was, unfortunately, lost in the "Owen" (with all her crew and passengers) on his return to England eighteen months after."

This comprehensive plan, even though not carried out, entitles Lieut. Owen to a place in the list of naturalists who have worked in New Brunswick, and his name would come next after that of Nicolas Denys, whose natural history of the Maritime Provinces, published at Paris in 1672, is the foundation work for our natural history.

12.—On the Physiography of the Basin of the Mahood (Lepreau) Lakes.

Read April 5th, 1898.

At the head of the Lepreau River lies a chain of small lakes known to a few fishermen but hitherto unvisited by any naturalist. No officer of the Geological Survey has been there, and, aside from a brief mention of them in one geological report, there does not seem to be a single reference to them in all scientific literature. The published maps show them inaccurately in details, and the manuscript plans in the Crown Land Office differ much from one another and from the actual geography. There is perhaps no part of the province so near to settlements which is so little known. Last summer, with three companions, I spent two weeks—July 10th–24th—on the lakes and river, and, although we found little of interest, it is, nevertheless, some satisfaction to know just what kind of a country it is from the scientific standpoint.

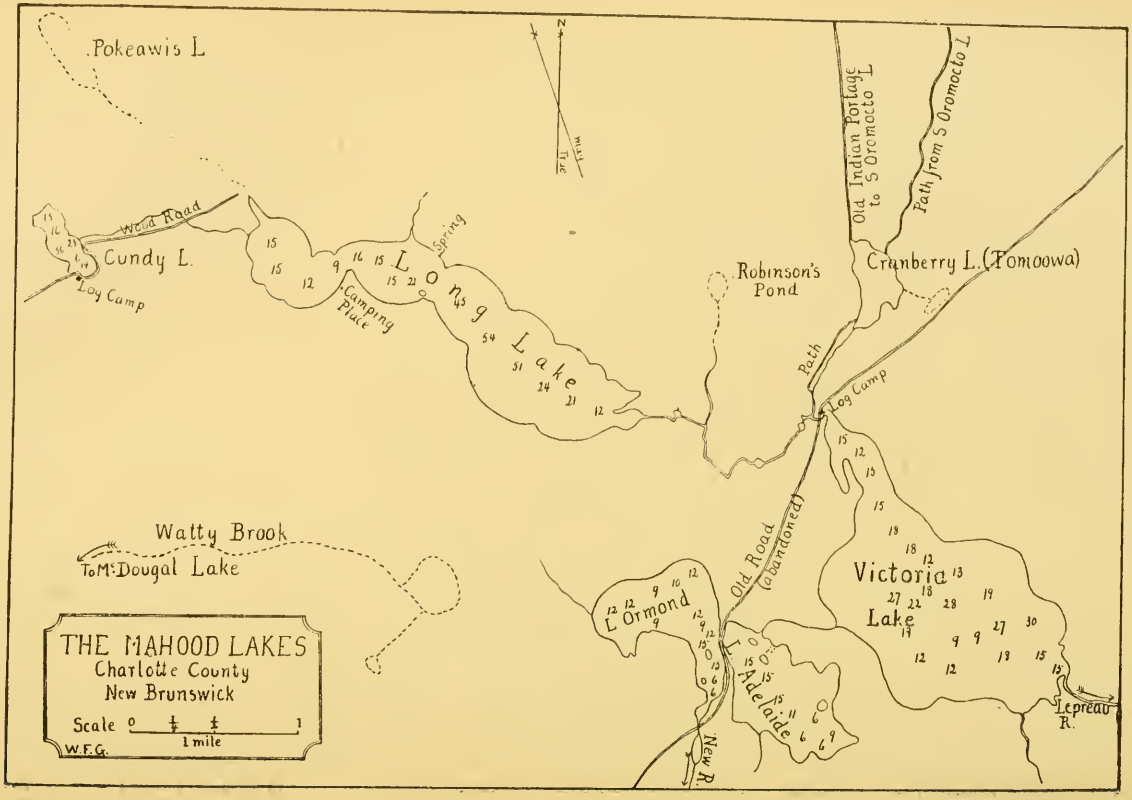
Most of the lakes in this chain were first surveyed and mapped in 1837 by William Mahood, Deputy-Surveyor for Charlotte County. As there is no name in use for them taken collectively, I have ventured to apply Mahood's name to them, to preserve the memory of a worthy man and skilful surveyor, who did more than any other to make known the geography of Charlotte County. His name is already applied on some maps to the lake commonly called Disappointment or Mistake Lake, which, though not shown on the accompanying map, may be considered as belonging to the same series. The names of these lakes were apparently all given by Mahood—Victoria in honor of the young Queen who in that year came to the throne, Adelaide for the Consort of the King who had just died, Ormond in honor of an Irish Earl from near whose seat Mahood had come; while Tomoowa, now obsolete, seems Indian, and is perhaps that of a guide. Long Lake is descriptive, but was not added until after the others, which is true also of Robinson's Pond. Six miles to the southeast, and emptying into the Lepreau, lie two other lakes, now commonly known as the Hurd Lakes, but on the maps called Coronary and Rooskey, and these names also, as the late Mr. Andrew Inches has told me, were given by Mahood in

remembrance of those places in Ireland, near which his boyhood had been passed. The accompanying map is based partly on Mahood's original plan, partly upon others, with many corrections based on angles taken by compass by myself. Though still far from accurate, it is yet much nearer the truth than any other of that region known to me. The depths were measured by me.

The Mahood Lakes lie in an undulating country, near the summit of a minor watershed, from 550 to 600 feet above sea level. They drain eastward through the Lepreau, but interlocking with them are streams which flow north, west, and south. The country is built of granite, heavily glaciated, and across it run trains of immense, and often angular, boulders. It is to these trains of boulders that the lakes owe their very existence, for in all cases the outlet is over a dam of this kind, a dam so hard to erode and so impossible to remove that the waters have not been able to cut their way through it. The lakes are all shallow, even the deepest part of Long Lake not exceeding sixty feet. We have here all of the conditions and characteristics of a land of bad drainage. Mr. Chalmers, simply from an inspection of the maps, has described this region with perfect exactness, and I cannot do better than to quote his words, especially since they contain the only printed scientific reference to these lakes :

"The great number of small lakes which dot the surface of the region about the head-waters of the Musquash, Lepreau and New rivers is a somewhat remarkable feature. The region here would seem to be a comparatively undrained one. The small volume of the rivers, their consequent feeble erosive power, and the hardness of the rocks, are such that the rivers have been unable, since the glacial period, to cut channels sufficiently deep to drain off these lakes. These rivers and lakes are therefore in much the same condition as in their early post-glacial history, and will necessarily remain so for a long time owing to the slow wearing processes going on."—(Geological Survey Report, 1890, N, 15.)

The lakes may be reached by a foot-path from South Oromocto Lake, or by an extremely bad wood-road from MacDougal Lake ; and by the latter route we were portaged in with canoes and baggage. Formerly there was a winter road from Lepreau Village to Lake Victoria, but with the passing of lumbering this was abandoned. In 1839 a road, locally called the "Old Magaguadavic" or "Military Road," was surveyed from St. George Village to the Nerepis, and passed among these lakes by the route shown on the map. Its course is shown fully on Wilkinson's map. It was little more than a track through the woods, was soon abandoned, and now not a trace of it remains.


Pokeawis L.
N
Old Indian Portage to S Oromocto L
Path from S Oromocto L
Wood Road
Cundy L.
Log Camp
Camping Place
Spring
Long Lake
Robinson's Pond
Cranberry L. (Tomoowa)
Path
Log Camp
Watty Brook
To Mc Dougal Lake
Old Road (abandoned)
L Ormond
L Adelaide
Victoria Lake
Lepreau R.
New R.
THE MAHOOD LAKES
Charlotte County
New Brunswick
Scale 0 ¼ ½ 1
1 mile
W.F.G.

Cundy is a small lake amidst dense woods in an undulating country. Its height above mean sea level is, according to my aneroid measurement, about 600 feet. Its approximate size, shape and depths are, like those of the remainder of the chain, represented on the accompanying map.

Of Pokeawis, I know nothing, except that the stream which empties it is much larger than that from Cundy. Like other features dotted in on the map, it is added from other plans, principally one loaned me by Mr. George Barnhill of St. John, who knows this region more intimately than any other man.

Long Lake lies about forty feet lower than Cundy. Its shores rise into low rolling wooded hills, and it occupies a winding valley, though I do not think it is an old valley of erosion, but rather is a basin formed by a dam amongst irregular hills. It has the typical appearance of a northern lake of the granite country, with dark, somewhat turbid water, shores of granite boulders lined up by action of the ice to almost the regularity of masonry, with a dense evergreen forest above and overhanging them. It has one sandy point, however, and altogether is not unattractive. At its lower end it empties amongst great angular granite boulders by a straight, rapid passage of one hundred yards, falling about four feet into a deadwater below. From this outlet down to Victoria is a thoroughfare winding about amidst a heath bog which occupies the shallow basin of an old lake, and expanding at times into pools of considerable size. Robinson's Pond is said to be small, shallow, and marshy, and the same is true of Cranberry or Tomoowa Lake, which is rapidly being overgrown by the bog from its southern end.

Victoria Lake is well known to some St. John people, for it is famous for its trout fishing. For the most part its shores are of the typical boulder sort, but on the west and southwest occurs much attractive white sand beach, which has no doubt been derived by wave and ice action from the ridge of sand and gravel along the western side. This ridge extends out northward in the peninsula shown on the map. The height of this lake above sea level is, by aneroid, about 550 feet*. It is rather a shallow lake, especially in its western part, which is probably due to the washing out of the sand and gravel from the western shore. At its eastern end appear hills of considerable height, which have been burnt over and are partly covered with a low second growth bristling with great rampikes. Victoria is on the boundary between the great burnt country, of which I shall presently speak, and the unburnt country to the westward.

* See the next note of this series

Southwest of Victoria, some forty feet higher and emptying into it, lies Lake Adelaide, a shallow lake with wooded shores. The same description will apply to Ormond, and both are typical of badly-drained granite country. Between Adelaide and Ormond is nothing but a glacial dam of morainic materials only a few yards wide; indeed in places it is hardly wide enough for the road which was once intended to run over it. Yet Ormond stands about thirteen feet higher (thirteen feet ten inches according to Mahood's map) than Adelaide, and drains into New River. The dike between must be composed largely of clay in order to form so efficient a dam. This, however, may not be perfect, for it is said that at the western end of Adelaide, some eighty feet from shore, is a large "bubbling spring," and moreover, that attempts made in the days of lumbering to "flood" Ormond were always unsuccessful. These two facts may be connected, and mean that there is a high-water communication between the two lakes.

From this brief account it will appear that these lakes do not differ in any important character from innumerable others in the granite areas of the province, and they possess no special scientific attractions.

The Lepreau River flows from the eastern end of Lake Victoria, and runs to the eastward eight miles, where it is joined by the North Branch. The country slopes away rapidly in that direction, and is of the roughest granite character, so that the river, in addition to its considerable fall, is constantly obstructed by trains of boulders and ledges which it has been unable to erode away. While it has no marked falls in that interval and very few deadwaters (only two or three), it has innumerable rapids, particularly of the kind over and among boulders. Probably no stream in the province carrying an equal volume of water is so difficult for canoe navigation. It required of us, at a time when the water was fairly high, two long days of the severest labor, with twenty portages by actual count, all along the rough bed of the river, to cover this eight miles to the North Branch. The entire country has been burnt over, and so thoroughly that it can bear no second growth. The very soil has been burnt and washed away, and nothing shows but the bare granite boulders, with scanty moss and an occasional low bush, while the great rampikes show how noble a forest once clothed this land. The view from some of the low hills as one looks eastward is the most desolate it is possible to imagine; to me the Arizona deserts are less forbidding. It is said that this country was burnt shortly after the Saxby gale, which levelled immense quantities of timber, and this gave the fire tremendous power. It

started near Lepreau Village and swept northward and westward. Earlier than that date a fire started near Musquash and burnt the country to the eastward.

At the North Branch the river turns to the southward and flows twenty miles to the salt water. The river continues to fall much, though with no large falls, until Eagle Mountain is reached. This mountain, which by direct aneroid measurement we made 520 feet above the river at the brook just above it, and about 850 feet above sea level, affords a splendid view in all directions, including especially the burnt country. Here, again, one has forced upon him a conception of the awful power of these great forest fires. The granite hills are not only stripped forever of their covering, but are scorched and bleached. Before one's eyes lies, white and grinning, the very naked skeleton of the land.

Below Eagle Mountain the navigation becomes easier. Just below Squaw Mountain the sharp boundary between burnt and unburnt country is passed, and one comes with joy into the grateful shade of the woods. Here, too, the granite country is left behind, and the character of the river changes. It now runs rapidly, but smoothly, over a gravel bottom, justifying its Indian name of *Wis-e-amk-ay-nis*, or *gravelly river*, and becomes a charming canoe-stream. Its water seems to become clearer the farther it is from the lakes, and it is richer in water-plants than any other stream I have noticed. Its course is broken by three great falls, and one or two minor ones ; the former are known, respectively, as Ragged, Big and Little Falls. Ragged and Big Falls are each over eighty feet high, could very easily be dammed, and have immense basins above them in which great quantities of water could be stored. This fact, together with the ease with which water could be stored in abundance among the lakes at the head of the river, is likely to make the Lepreau a valuable river in the time to come when economical transmission of power and increasing cost of fuel will direct attention to natural sources of power. Finally, the river falls over a ledge into salt water at Lepreau Village.

13.— On New Heights in New Brunswick, determined with Aneroid in 1897.

Read April 5th, 1898.

During the summer of 1897 I made, with a good aneroid barometer, a number of measurements for heights above sea-level in New Brunswick. These have been corrected for weather changes by comparison with readings from the barometers of the meteorological stations at

Fredericton and St. John. I wish here to thank Dr. Harrison of the University, and Mr. Hutchinson of St. John for lists which they have supplied to me. Mr. Hutchinson also, on July 9th, determined the error of my aneroid, and this of course has been taken into account in calculating the results below. Many of my readings were taken at times so different from those of the two stations that I have rejected them, and I have kept only those of the five important points here mentioned. In none of the cases admitted did the time between my reading and those of one of the stations exceed twenty-four minutes, except in one of the Mount Pleasant observations, when it was sixty-six minutes, on a very clear day. It will be noticed that in all cases comparison with figures from the Fredericton Station gave results higher than those from the St. John Station. The list of readings from Mr. Hutchinson was reduced to mean sea-level, while those from Fredericton were for a height 164 feet above it; and the constancy of the discrepancy suggests that the height assigned to the Fredericton Station is too great. I do not give all of the figures in detail, since at the best, like most other measurements of this kind which have been made in New Brunswick, they can be but approximations, but I have calculated them carefully and repeatedly, and think there is no error in the figuring. The three places first mentioned have not been measured before:

Surface of Victoria Lake, Charlotte County.—Saturday and Sunday, July 17 and 18.—Two observations compared with Fredericton, 624 and 614 feet; two compared with St. John, 480 and 510 feet; mean of all, 557 feet. This agrees with another measurement made July 10th, which by direct, uncorrected reading made Cundy Lake about 500 feet above the railroad at Bonny River, and hence about 600 feet above mean tide. Cundy is about forty-five feet above Victoria, which thus would be 555 feet above the sea.

Eagle Mountain, Charlotte County (near boundary of Kings).—By direct measurement, July 20, this mountain was 520 feet above the mouth of Eagle Mountain Brook; latter, by comparison with Fredericton, is 334 feet above the sea; hence Eagle Mountain is 854 feet.

Mount Pleasant, Charlotte County.—Aug. 12 and 13.—By comparison with Fredericton, 1,224 feet; with St. John, 1,175; mean, 1,200. Gesner, in his first Geological Report, guessed its height to be 1,300 feet, and Mahood, upon one of his MS. plans in the Crown Land Office, guessed it at 3,000 feet.

Bald Mountain, on the Kings-Queens Boundary.—Aug. 14.—By comparison with Fredericton, 1,494 feet above mean sea-level; by comparison with St. John, 1,430 feet; mean of the two, 1,462 feet. Conditions were particularly favorable, and my observations covered the time of both stations. Gesner, in one of his reports, guessed its height to be 1,120 feet; the Surface Geology map, probably following Gesner, gives it as 1,120 feet; Mr. William Murdoch of St. John, by theodolite angle, has given it to me as 1,390 feet.

Cherry Hill, Harvey.—Sept. 3.—By direct measurement, above the track, 315 feet; by comparison with Fredericton, 884 feet above mean sea-level.

ARTICLE VI.

BATRACHIA OF NEW BRUNSWICK.

By Philip Cox, Ph.D.

Read April 5, 1898.

As the following list records only the writer's personal observations, it must be found to contain fewer species than have hitherto been assigned to the province. He does not believe it includes all our batrachian fauna, though he regardsthe occurrence here of some forms, included in early publications, as extremely doubtful. It is the result of many years' research in various parts of the province, made as reliable as possible, by means of the views and opinions of distinguished specialists, who were always consulted on doubtful matters.

Among the Urodela, *Desmognathus fuscus*, Rafinesque, and *A. opacum*, Gravenhorst, the latter closely related to *A. punctatum*, a common salamander, are both likely to be found. They have a place on old lists.

Of the Anoura, *Rana septentrionalis*, Baird, and *R. cantabrigensis*, Baird, may likely be found in the western part of the province, or in the lake region near the Bay of Fundy.

AMBLYSTOMIDÆ.

Amblystoma punctatum, L. Yellow-spotted Salamander.
Generally distributed, but not abundant.

A. jeffersonianum, Green. Granulated Salamander.
Common in river valleys of the southern parts of the province; rare in the northern.
Oromocto Island, Sunbury Co. Roy McLean Vanwart.

A. jeffersonianum, var. *laterale*, Hallowell.
Occurring with the last; but more abundant, and characteristic of our fauna.

PLETHODONTIDÆ.

Plethodon cinereus, Green. Red-backed Salamander.
Same range as *A. jeffersonianum*, but rather rare. Have not collected it on the North Shore.

P. cinereus, var. *erythronotus*, Green. Red-backed Salamander.
Specifically related to the last, but with dorsal stripe very red. Common, and characteristic of our region.

P. glutinosus *(Salamandra glutinosa).* Green. Blue-spotted Salamander.
Very rare, and only in the southern parts of the province.

Spelerpes bilineatus *(Salamandra bilineata).* Green.*
Small brook at Curry's Mountain, York Co. Roy McLean Vanwart.

S. bilineatus, var. *borealis.* Baird.
The typical form in New Brunswick.
Valley of the St. John.

DESMOGNATHIDÆ.

Desmognathus ochrophæa, Cope. Painted Salamander.
Oromocto Island, River St. John, *fide* Prof. E. D. Cope. Its first record.
In gratitude to this distinguished naturalist, whose kind heart and facile pen were ever at the service of the humblest plodder, I may be pardoned for quoting from a letter, among the last he ever wrote: "The specimen of *D. ochrophæa* represents a variety with a spotted belly, such as I never saw in the United States."

PLEURODELIDÆ.

Diemyctylus viridescens, Rafinesque. *(Salamandra millepunctata,* Storer*).*
Spotted Newt.
The most aquatic of our Salamanders. In all suitable lakes and ponds.

D. viridescens, var. *miniatus,* Hallowell.
A smaller, red, finless, and less aquatic variety, always found with the former. Represents, probably, a mere seasonal phase.

BUFONIDÆ.

Bufo lentiginosus americanus, LeConte. Toad.
Very common and variable. A more extended and careful examination may show the occurrence here of at least two sub-species.

HYLIDÆ.

Hyla pickeringii, Storer. Tree-Frog.
Found everywhere.

H. versicolor, LeConte. Tree-Frog.
Seems to be rare. Have heard its note in several parts of the province, but seen only one specimen, collected in Gloucester County, and now in the museum of the Miramichi Nat. Science Association, Chatham, N. B.

RANIDÆ.

Rana virescens *(Rana halecina),* Kalm. Green Frog.
Generally distributed over the province.

* Striped-back Salamander.

R. virescens brachycephala, Cope. Green Frog.
A short-headed and stouter form; the dominant type in New Brunswick.

R. palustris, LeConte. Marsh Frog.
In the southern part of the province; not common. Have not met with it in the four northern counties.

R. catesbiana, Shaw. Bull-Frog.
All over the province, but local. The most aquatic of our frogs.

R. fontinalis, LeConte. Spring-Frog.
Generally distributed; varies greatly. In *fontinalis* I recognize a stout, pustular form, the prevailing type in the northern counties.

R. fontinalis nigricans, Agassiz. Spring-Frog.
A small, black variety, or sub-species met with in rocky brooks. Noonan Brook, Sunbury Co.

R. fontinalis clamitans, Holbrook. Spring-Frog.
A long-legged, slender, less webbed and less aquatic variety, which I have collected only in the St. John valley. Mr. C. F. B. Rowe has taken specimens in the vicinity of St. John.

R. silvatica, LeConte. Wood-Frog.
Occurs generally, but not abundant. [Mr. C. F. B. Rowe has noted that this species spawns several weeks earlier than other frogs.—Ed.]

APPENDIX.

REPORT ON THE SUMMER CAMP AT QUACO.

Held July 1-10, 1897.

In past years the Society has held Summer Camps at different points of scientific interest in the province, the object being twofold — (1) to enable members to acquire experience in field work, (2) to stimulate, in the localities visited, an interest in the study of nature.

In July last a camp was held at Quaco, this village having been selected as presenting a number of advantages for our purposes. About thirty persons attended, and in every way the camp was a success. The residents of Quaco attended the evening lectures, and a strong interest was aroused in our work. Lectures were given by President G. U. Hay, Dr. G. F. Matthew, Prof. L. W. Bailey, Prof. A. W. Duff, and Dr. W. F. Ganong. Field work was carried on daily under the different leaders, and many important observations were made on the geology, physiography, and botany of the surrounding region.

Professor Bailey and Dr. Matthew led the geological parties, President Hay and Dr. Ganong had charge of the botanists, and Professor Duff carried on tidal observations in the harbor. Messrs. Berton and Rowe made a collection of the small mammals, reptiles and batrachians. The camp was under the management of the Secretary of the Society, Percy G. Hall, and valuable local assistance was rendered by our resident members — Dr. Gilmour and Geo. J. Trueman.

Report on the Geological Data obtained at Quaco — Summer Camp of 1897.

By Dr. Geo. F. Matthew.

The fine exposures along the coast at Quaco in sea-cliffs of varying height, give excellent opportunities for studying the geology of that district. Here only, in all New Brunswick, is there a formation of the Mesozoic, or Reptilian Age, of sufficient extent and thickness to represent in any adequate degree the strata of vast extent in many regions of the earth, which tell the story of this important portion of the world's past history.

Heretofore there has been recognized at Quaco only two members of the Mesozoic system, viz., the bright red sandstones, so conspicuous on numerous cliffs along the coast, and the overlying pebble beds. A third member of this system, probably as important in volume and thickness as the two lower ones together, was recognized in our excursions along the eastern part of the shore. This member is so like the Lower Carboniferous rocks that it has heretofore been confounded with them. The proofs that it is Mesozoic are the following: 1. Its lowest bed are found to graduate by alternation of measures into the pebbly member of the heretofore recognized New Red Sandstone 2. Its conglomerates are full of rounded fragments of dark-red shale, which in this district can have no other source than the Lower Carboniferous rocks. 3. The plant remains found in its grey sandstone layers (though poorly preserved), by the flabellate leaves with stout petioles, and the leathery strap-shaped leaves that are found, as well as by the absence of Sigillaria, Lipidodendron, and Calamites, appear to be a Mesozoic assemblage, and certainly are not of the ordinary Carboniferous type.

This upper member of the Red Sandstone series holds the shore from Melvin's Beach to Fown's Beach; it also appears on the shore at Berry's Beach, beyond which in going westward it passes inland; and it has a considerable width behind Quaco Village.

Our party visited the intrusive trap and manganese deposits at Quaco Head. The trap has forced its way through the red sandstones, partially altering it and discharging the red color from the sandstone for some distance from the line of contact; the trap also becomes fine grained and loses its feldspar crystals near the contact with the sandstone.

The shores at Quaco and the surface deposits there abound with pebbles derived from the pre-Cambrian volcanic rocks of the hills inland. There is the greater profusion of these because the great pebble beds of the middle member of the Mesozoic or Red Sandstone system abound with fragments from this source. At Vaughan's Creek (McComber's Beach) the pebbles of the conglomerate are mostly of purple quartzite and felsite, sometimes without any admixture of sand, so that when the calcareous cement which holds them in place weathers away, they fall to the beach in great numbers, and repeat in modern times their accumulation as beach-shingle in the Mesozoic Age.

Tidal Phenomena at Quaco.

By Prof. A. Wilmer Duff.

The point that the writer was chiefly interested in was the occurrence of those somewhat puzzling phenomena called "secondary undulations." Anyone who examines the record of the Kelvin Tidal Gauge at St. John will find that it gives a wave-shaped curve, the heights of which correspond with the time of high water and the hollows with the time of low water; but, in addition, he will discover that on this main curve there are smaller indentations, indicating minor risings and fallings of water level, the whole time from greatest of these minor undulations to the next greatest rise being, on an average, about forty minutes. These small and comparatively rapid oscillations of level are the so-called "secondary undulations," and the time of forty minutes required for them to complete their cycle of changes of level is called their period.

The author had already shown* that these secondary undulations could be explained as due to a long, slow oscillation of the whole body of water between the New Brunswick and the Nova Scotia coast, the vibrations being similar to these that are set up in a wash-basin full of water when it is disturbed. It became, then, an interesting point to determine whether the rest of the body of water in the bay partook of this same general motion, and whether the period was the same as at St. John. The author fully expected that it would be.

With this in view, the tide gauge described in a former communication† to the Society was used at Quaco. On three different days the gauge gave clear records of "secondary undulations;" but, contrary to his expectations, the period in all cases was $12\frac{1}{2}$ minutes. This was a somewhat puzzling result, until it occurred to the writer to examine the chart of the bay off the New Brunswick coast in the neighborhood of Quaco, when he found that the presence of a reef called the Quaco Ledges, and the two headlands that project into the bay above and below Quaco, respectively, marked out a smaller bay (open, it is true, to the east), in which the water would naturally oscillate in a period of its own, determined by its own dimensions. From the smallness of its dimensions these oscillations might be expected to be much quicker than those across the bay at St. John, although the irregularity in shape of this small bay precludes any attempt to calculate mathematically what the period of the oscillations of the water in it would be.

* See American Journal of Science, Vol. III, No. 17, 1897.

† See Bulletin XV of the Natural History Society of N. B., 1897.

The author has thus been led to the view that a large body of water such as the Bay of Fundy is broken up into smaller areas of oscillations, each having its own characteristic period as determined by its dimensions. In a part of the bay where there is a comparatively free, unobstructed sweep from side to side, as between the general contour of the New Brunswick coast at St. John and that of the opposite Nova Scotia coast, the period of oscillation would be that of the whole bay, or perhaps half that dimension, since such a large body of water might have itself a tendency to divide up into two halves, each oscillating in half the period that the whole would take if set into free swingings to and fro.

The author hopes on future occasions to explore other parts of the bay in the same way, with a view to confirming or refuting this hypothesis.

It should be noted that the point here considered is merely the cause of the periods characteristic of these motions. How the motions themselves originate, what causes the initial disturbance, is a different question. The difference is similar to the difference between the enquiry, What disturbs a wash-bowl, and, the other enquiry, what determines the rate at which the water "wish-washes" when disturbed? It can, however, hardly be doubted, I think, that the first disturbance in the bay comes from the action of wind in a storm, since an examination of many cases of "secondary undulation" at St. John and at Quaco seems to show that they are only prominent when the sea has been disturbed by a gale. Thus there need be none of the mystery as to the origin of "secondary undulations" which some writers delight in attributing to them.

Report on the Botany of the Summer Camp.

By G. U. Hay.

During the ten days that the Society was at work at Quaco and vicinity, several botanical excursions were made about the village, and one to Salmon River. There was much interest manifested in these excursions and in the lectures given in the evenings, one by Dr. W. F. Ganong, and the other by Mr. G. U. Hay. Many smaller gatherings were also held for the study and analysis of plants, in which many of the young people of Quaco took part. The examination of the beach in front of the village revealed an absence of plant and animal forms that might be expected to occur here. The two common forms of

Fuci—F. Vesiculosus and *F. Nodosus*— were common. *Corallina officinalis* was quite abundant in pools, with several species of *Ulva*. On the adjacent cliffs of West Quaco, clumps of the brilliant *Sedum Rhodiola*, with patches of *Ligusticum Scoticum*, form a pleasing contrast to the dark back-ground of trap rock. In the salt marshes above the limit of the tide the vegetation was more varied and abundant. *Atriplex hastata*, *Salsola kali*, *Statice limonium*, *Carex paniculata*, *Carex norvegica*, *Carex maritima*, *Comandra livida*, *Glaux maritima*, and other forms common to such a habitat, were observed. Further up from the shore were *Kalmia glauca* in great abuundance, *Cypripedium acaule*, *Andromedra polyfolia*, etc., and the honeysuckle, *Lonicera involucrata*, its first recorded appearance in the southern part of the province.

The visit to Salmon River did not result in the discovery of any rare species of plants. This river, with its narrow gorge and lofty hills on each side, reminds one strongly of the Restigouche.

At Greer Settlement, five miles from Quaco, the beautiful *Cypripedium spectabile* was found in great abundance, and on the roadside near by a few groups of *Scrophularia nodosa*, its first recorded appearance in this province. This plant belongs to Southern New England and the Middle States. It was thriving well here, but whence or how it came no one in the vicinity could tell. The abundance of the showy blossoms of the *Cypripedium* made our lecture hall during the remainder of our stay a place of beauty, from the presence of this orchid of tropical-like richness of color.

A visit to the ravine near Rourke's River, during the half-day previous to our departure, was one of the most pleasant outings that the botanists enjoyed. Amid the sandstones and calcareous slates, there was growing, in the greatest profusion, *Cystopteris bulbifera*, *Cystopteris fragilis*, and other ferns ; *Geranium Robertianum* in great luxuriance, *Habenaria rotundifolia*, *Equisetum scirpoides*, etc.; and on a hill near by one specimen of *Echium vulgare*.

Zoology.

The beaches at Quaco show little animal life, and that only of the very commonest forms. There are few tide-pools, and these are rather barren.

Several hauls of the dredge were made in Quaco Bay, but with disappointing results. A few dead shells and two or three living forms

of the commonest species were brought up from muddy bottoms. The conditions off Quaco are not at all favorable to an abundance of animal life, which clusters rather about sheltered passages where gentle tidal currents sweep constantly through.—[W. F. G.]

Origin of the Name Quaco.

By Dr. W. F. Ganong.

There is no real doubt as to the origin of this word. By the Micmacs it was, and is, called *Gool-wah-gah-kek* (the first *g* very obscure and easily missed), from *Goolwaakw*, the hooded seal, with the locative, *ek*. Hence the word means, "Place of the hooded seal." It first occurs on the Franquelin-DeMeulles map of 1686 in the form *Ariquaki*, which, allowing for the French sounds, for the omission of the obscure preliminary *g*, for the replacement of the *l* by *r*, as was invariable with the French, and for the omission, common on French maps, of the final *k*, is plainly from the Indian word. It next appears on Blackmore's map of 1712 as *Roquaque*, of which the relation to the French form is plain, and later plans have *Oreequaco*. Finally, on a plan of 1762, it first occurs in its present form. Several other explanations of the word have been given, but in no case has any evidence been adduced in their support. The history of the word is traced with greater fulness in the Transactions of the Royal Society of Canada (new series), Vol. II, section ii, page 264, and in a letter in the St. John Daily Telegraph, Nov. 16, 1896.

Another word, in the same vicinity, of great interest is *Point St. Tooley*, applied locally, though on no chart, to the eastern headland of Quaco Bay. This is probably a survival, and English corruption, of Point St. Louis, given by Champlain in 1604. Champlain named a river at Quaco (probably Vaughan's Creek), *Riviere de St. Louis*, and it seems probable, though there is no proof of it, that this name became extended to the cape, and was passed along by the French and New England pilots down to the present.

REPORT ON ZOOLOGY.

The Committee beg to submit the following notes. Dr. Cox has prepared a list of the Batrachians of the province, which will be found in another part of this bulletin. Several inquiries have been made for a list of our insects, and the Committee hope to have a list of our Butterflies and Hawk Moths prepared in time for publication in the next bulletin. Dr. Cox has kindly furnished the notes on fishes for this report.

Additions to the List of New Brunswick Fishes.

(For Catalogue, see Bulletin XIII, 1896.)

Siphostoma fuscum (Storer). Jordan and Gilbert. Common Pipe-fish.
A single specimen taken in a smelt bag-net in Miramichi Bay, February, 1898, and donated to the museum of the Mir. Nat. Hist. Association.

Atherina notata, Mitchell. Silverside.
Abundant around the shores and islands of Mir. Bay in mid-summer.

Aspidophoroides monopterygius (Block). Storer. Alligator-fish.
One found among smelts in a net in Mir. Bay, Feb., 1898, and donated to museum of Mir. Nat. Hist. Association.

Phycis tenuis, Mitchell. White Hake.
Not uncommon in Mir. Bay in early part of winter.

Pleuronectes glaber, Storer. Smooth Flounder.
Miramichi Bay and Bay des Chaleurs, but not abundant.

Birds.

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

Section A.

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

6. Bluebird (Sialia Sialis). Only three authentic instances of occurrence in the province said to be known.

Note.—A female collected by M. G. B. Henderson on October 20th, 1897, on Loch Lomond road, about four miles from this city. Several seen.

76. Rusty Blackbird (Scoleophagus Carolinus). A male collected on April 2nd, 1898, by A. Gordon Leavitt.

101. Red-headed Woodpecker (Melanerpes Erythrocephalus). Only reported from "Garnett's."

Note.—A male collected at Little Lepreau on June 5th, 1897, by G. L. Hanson.

114.—American Hawk-owl (Surnia Ulula Caparoch). Given as rare, and none reported for this immediate vicinity.

NOTE.—A female collected by Byron Lingley at Lily Lake on November 24th, 1894. Also a female collected at Little Lepreau by G. L. Hanson on January 29th, 1896.

136. Black-crowned Night Heron (Nycticorax nycticorax Naevius). Only a few observed near St. John.

NOTE.—Male collected at Little River, October 24th, 1895; two males on September 5th, 1896, by M. G. B. Henderson; and a female, at same place, on September 7th, 1896, by Wm. Hare.

197. Ruddy Duck (Erismatura rubida). Only two instances of its occurrence known.

NOTE.—A. Gordon Leavitt has a pair, male and female, in the same plumage (brown and grey), which were brought to him by a farmer living near Quaco. They were shot on October 23rd, 1893.

SECTION B.

(Species which have not been observed in St. John or King Counties, but which occur in other parts of the Province.)

227. American Titlark (Anthus Pensilvanicus). On Red Head marsh, on October 9th, 1897, A. Gordon Leavitt collected a female, and on the same day, at the same place, Walter Harrison collected two females.

Lincoln's Sparrow *(Melospiza Lincolni)*. A specimen taken in June, 1897, at Scotch Lake, York County, by W. H. Moore. Mr. Moore also observed two Shore Larks at Macnaquack, February 26th, 1898, and at Scotch Lake, on March 5th, 1898, the White-winged Crossbill.

MAMMALS.

Mr. Geo. W. Bailey reports a specimen of the Grey Squirrel *(Sciurus carolinensis)*, taken in York County. Not before observed, except in Charlotte and Carleton Counties.

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

Report of the Botanical Committee.

The following are the names (printed in full-faced type) of new plants added to our provincial flora during the past year, and new localities for some rare plants :

89. **Stellaria borealis,** Bigel. Salt Springs, near Sussex. Dr. W. F. Ganong.
91. Arenaria peploides, L. Portage Island, Miramichi. Dr. Cox.
273. Lonicera involucrata, Banks. Quaco. Hay.
366. *a* **Hieracium pilosella,** L. Charlo, and Eel River, Restigouche. Dr. Cox.
436. *a* **Sabbatia chloroides,** Pursh. St. John. Miss A. R. Warner.
457. *a* **Schrophularia nodosa,** L. Greer Settlement, near Quaco. Hay.
513. *a* **Chenopodium Bonus-Henricus,** L. Chatham. Dr. Cox.
901. Pellæa gracilis, Hook. Loch Lomond, St. John Co. R. B. Gilmour.
902. *a* **Asplenium trichomanes,** L. Loch Lomond, St. John Co. R. B. Gilmour.

G. U. HAY,
Chairman Botanical Committee.

Bibliography of Scientific Publications Relating to the Province of New Brunswick, other than those contained in the Bulletin of the Society, 1898.

By Samuel W. Kain.

Lists similar to the one here given will be found in Bulletins XIII–XV. They contain titles from 1890 to June, 1897. The present list contains titles from July, 1897, to June 1898, with a few omitted from previous lists.

Geology.

Bailey, Prof. L. W.—The Bay of Fundy Trough in American Geological History.
Trans. Royal Soc. Canada, 2nd series, Vol. III, Sec. IV, pp. 107–116, 1897.

Belding, A. M.—Bog Manganese in Albert County.
St. John *Daily Sun*, December 25th, 1897.
(Pub. Anon.)

Dawson, Sir J. W.—On the Genus Lepidophloios.
Trans. Royal Soc. Canada, 2nd series, Vol. III, Sec. IV, pp. 57–78, 14 pl., 1897.

Matthew, George F.—The Rockwood Bog. (Abstract.)
St. John *Daily Sun*, November 4, 1897.

Studies in Cambrian Faunas:

Part I. On a new sub-fauna of the Paradoxides Beds of the St. John Group.

Part II. Billing's Primordial Fossils of Vermont and Labrador.
Trans. Roy. Soc. Can., 2nd series, Vol. III, Sec. IV, p. 175, 4 pl., 1897.

Mickwitz, August.—Uber Die Brachiopodengattung Obolus. *Eichwald.*
Memoirs Imp. Acad. Sciences, St. Petersburg, 8th series, No. 2, pp. 21–22, 1896.
(Describes fossil shells from Caton's Island, and reviews Dr. G. F. Matthew's studies on the genus Botsfordia.)

Trueman, Howard—Reclaiming the Misseguash Marsh.
St. John *Daily Sun*, December 29, 1897.
(Pub. Anon.)

Whittle, Charles Livy—The Beach Phenomena at Quaco, New Brunswick.
Am. Geologist, Vol. VII, pp. 183–187, 1891.
(Omitted from list in Bulletin XIII.)

Genesis of the Manganese Deposits at Quaco, New Brunswick.
Boston Soc. Nat. Hist.. Proc., Vol. XXV, pp. 253–258, 1891.
(Omitted from list in Bulletin XIII.)

Meteorology.

Kain, Samuel W.—Thunderstorms in New Brunswick, 1897.
U. S. Weather Review, Vol. XXVI, pp. 105–106, March, 1898.

McLaughlin, W. B.—Remarkable Sounds heard along our Southern Coast.
St. Croix Courier, March 31st, 1898.
Also *U. S. Weather Review*, Vol. XXVI, April, 1898.

Botany.

Ganong, W. F.—On Raised Peat Bogs in the Province of New Brunswick.
Trans. Royal Soc. Canada, 2nd series, Vol. III, Sec. IV, pp. 131–163, 1897.

Vroom, James—Trees and Forests.
St. John *Daily Sun*, August 2, 1897.

Zoology.

Hall, Ansley—The Herring Industry of the Passamaquoddy Region, Maine.
U. S. Fish Com. Report, 1896. pp. 443–447, map, 1898.

Moore, H. F.—Observations on the Herring and Herring Fisheries of the Northeast Coast, with special reference to the vicinity of Passamaquoddy Bay.
Ibid., pp. 387–442, pl. 1, map, 1898.

Perkins, Henry F.—Notes on the Turtles of New Brunswick.
St. John *Daily Sun*, February 5th, 1898.

METEOROLOGICAL ABSTRACT FOR 1897.

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

D. L. HUTCHINSON, Director.

	BAROMETER.			TEMPERATURE.			Cloudiness: 0 = Clear, 10 = wholly clouded.	Precipitation Rain and Melted Snow.	WIND DIRECTION AND VELOCITY.																	Thunder Storms.
									N.		N. E.		E.		S. E.		S.		S. W.		W.		N. W.		Calms	Total Miles.	
	Mean.	Highest.	Lowest.	Mean.	Maximum.	Minimum.			Hours	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles	Hours.	Miles.	Hours.	Miles.			
January	30.00	30.86	29.11	19.7	32.5	—13.5	5	3.91	65	645	109	1087	12	204	61	1470	25	347	95	1115	154	2046	190	2789	33	9,683	0
February	30.03	30.55	29.60	21.6	41.5	— 1.5	5	1.08	64	546	62	745	50	503	28	398	16	126	38	395	62	597	320	4073	32	7,383	0
March	30.00	30.92	29.20	29.1	46.5	— 8.5	6	5.99	50	338	74	646	59	343	73	902	77	713	62	812	49	510	270	42.6	30	8,480	0
April	30.04	30.65	29.48	38.4	62	15.5	7	3.82	50	506	107	1152	50	310	56	404	126	1118	95	1362	102	1326	77	1099	57	7,277	0
May	29.98	30.37	29.69	49.4	64.7	28.5	7	9.95	65	562	140	1432	36	193	78	413	197	1495	64	869	8	45	54	643	10 2	5,622	1
June	29.91	30.38	29.47	55.6	73.5	42	6	3.76	41	181	100	819	46	269	73	616	146	885	70	1018	28	117	133	1210	83	5,115	4
July	30.05	30.41	29.68	60.6	78.8	47.3	7	2.73	42	264	62	541	11	253	93	575	310	1823	70	841	1	6	25	237	100	4.540	2
August	29.96	30.13	29.63	61 7	76.5	48	5	3 88	61	357	30	201	45	480	69	533	183	1177	128	1395	56	561	67	616	105	5.183	6
September	30 01	30 39	29 61	55 1	84 2	26.7	5	1.39	58	323	31	147	17	226	23	90	83	113	116	1221	30	137	241	3586	91	6 173	0
October	30.13	30 65	29 42	46.8	68.8	26	4	3.50	69	468	38	281	16	49	32	356	94	817	176	1720	33	236	210	3396	76	7.323	0
November	29 99	30.70	29.87	35.2	54.5	7.5	7	6 87	30	208	105	803	14	147	58	1091	23	383	111	2.86	26	228	319	5136	34	10,282	0
December	30.01	30.66	29.20	26.7	53.5	2.5	6	3 56	78	527	27	281	11	57	49	1002	32	542	96	1316	68	544	298	4400	75	8,669	0

Barometer readings are reduced to sea level and 32° Fahr. The – sign indicates temperature below zero. The maximum temperature, 84.2, was registered on the 6th of September; the minimum temperature, —13.5, on the 19th of January.

MEAN SEA LEVEL AT ST. JOHN.

(Abstract of paper by E. T. P. Shewen, C.E.; read March 1st, 1898.)

The determination of mean sea level at St. John furnishes a fixed datum from which to calculate tidal fluctuations, besides elevations for geological, geodetic, and physiographic studies.

Last year this determination was made from an analysis of two years of tidal observations, recorded by the Thomson gauge at Reed's Point, covering the period between April 1894, and May 1896. The gauge is in charge of Mr. D. L. Hutchinson of the St. John Observatory; and the records obtained have been carefully reduced to datum by Mr. W. Bell Dawson, Engineer in charge of the Tidal Survey. The resulting values of mean sea level, and of high and low water, ordinary spring tides, have been referred to a bench mark cut for the purpose on the southeast corner of the Custom House. (See Bull. N. H. S. of N. B., No. XIII, p. 109.)

Mean sea level is 41.65 feet below the bench mark, or 12.67 feet below high water ordinary spring tides, the range being 25.33 feet.

City Levels.—City levels are taken from forty feet below assumed (extreme) high water. The elevation of any point above mean sea level is the reduced level, according to city datum, minus 25.49 feet.

Intercolonial Railway Levels (St. John to Shediac).—The elevation of any point above mean sea level is the reduced level, according to I. C. R. datum, minus 86.95 feet.

EUROPEAN AND NORTH AMERICAN RAILWAY DATUM (NOW I. C. R.)

	Feet.
High water spring tides, St. John (Bay of Fundy)	100.00
Mill street	104.95
The Marsh	102
Lawlor's Lake	162
Rothesay (9 miles from St. John)	107
Hampton (22 " " "	117
Sussex (44 " " "	155.53
Penobsquis (51 " " "	154
Moncton Station (89 " " "	136.74
Sackville (128 " " "	116.25
Shediac Wharf, rail level (Northumberland Strait)	93.30
High water, Shediac (108 miles from St. John)	89.30

A detailed statement of levels from St. John to Shediac is given in Report of the Railway Commissioners of New Brunswick, 1859, pp. 84–88.

Mr. A. L. Light, Chief Engineer of the European & North American Railway, reported, on the 2nd Feb., 1859 : "It will be observed that the level of the rails on Shediac wharf is 6.70 below high water at St. John, and the level of high tide at the latter place is 10.70 feet above that at Shediac Harbour."

On the close of the exploratory survey for the Intercolonial Railway, made in 1864, Sandford Fleming reports that the various levels were found to be relatively as follows :

First Datum.

Restigouche to Green River; then to Toledi and Rimouski waters; thence to River Trois Pistoles; also from the Restigouche to the Tobique; thence to Nashwaak and to Keswick Summit — said to be high water on the Miramichi	84.81

Second Datum.

From a point five miles up Keswick valley to Keswick Summit; also from the same point past Fredericton to Little River	101.81

Third Datum.

On this datum levels were carried from Little River to Coal Creek	58.08

European and North American (now I. C. R.) Railway Datum.

Fourth Datum.

Said to be 100 feet under high water on Bay of Fundy, at St. John City,	0.00

The datum for Nova Scotia is low water at Parrsboro, on the Basin of Minas.

The datum for the Matapedia survey is high water above Campbellton on Bay Chaleur, and on the River St. Lawrence at St. Flavie.

High water, River St. Lawrence, at Trois Pistoles	70.00

THIRTY-SIXTH ANNUAL REPORT OF THE COUNCIL

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

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

Membership.

A very satisfactory increase has taken place in the membership, to which we note the following additions :

Ordinary	12
Associate	24
Corresponding	1
	37

Finance.

The Treasurer makes the following statement :

Receipts.

Balance from 1897	$ 6 44
Membership fees	140 07
Investment, interest on	144 00
Proceeds of lecture by Prof. Bailey	14 50
Bulletins sold	19 90
Dividend from Botsford estate	16 00
Donations	11 00
Government grant	125 00
	$470 91

Expenditures.

Balance on Bulletin XIV	$ 88 75
Printing and distributing Bulletin XV	183 37
Maintenance of Museum	88 60
Expense Camp for field work at Quaco	27 99
Miscellaneous (expressage, labor, postage, etc	50 64
Balance on hand	31 56
	$470 91

Library.

The rapid expansion of the library has necessitated some changes in arranging for space to accommodate the books we now have, and at the same time allow for future additions.

Among important accessions we notice Geological Reports on New Brunswick (complete set), written by Dr. A. Gesner, presented by Henry F. Perley, and the Journal of the Royal Geographical Society, which we obtain in exchange for our bulletin.

Publications.

Bulletin XV was issued in June last. It contains valuable articles by Dr. Geo. F. Matthew, Professor A. Wilmer Duff, and Dr. W. D. Matthew. As this number concludes Volume III, it is furnished with an index.

Bulletin III (1884) has long been out of print, and the Society has been unable to supply copies to numerous applicants. We are glad to be able to announce that, by the enterprise of one of our members, this number has been reprinted without any expense to the Society.

A number of the shorter papers read before the Society have been published in the daily papers.

Lectures and Essays.

Nine regular meetings were held, at which papers were read as follows:

Feb'y 2. Tidal Phenomena of the St. John River at Low Summer Level, by Prof. A. Wilmer Duff. (Pub. in Bulletin XV.)

March 2. Address on Peat-Bogs, by Dr. Geo. F. Matthew.
Note "Upon the Colour of the Waters in New Brunswick Rivers," by Prof. W. F. Ganong.

April 6. Note "Upon the Heights of New Brunswick," by Prof. W. F. Ganong.
Address on the Geological Features of Quaco, by Dr. Geo. F. Matthew.
The Relations of France to Newfoundland, by H. Geo. Addy, M.D.

May 4. Address on "A New Palæozoic Insect, with Notes on the Fauna in which it Occurs," by Dr. Geo. F. Matthew. (Pub. in Bulletin XV.)
"Some Probable Jesuit Influences Upon our North-Eastern Flora," by Prof. M. L. Fernald.

June 1. "The Indian Potato: What was It?" by Rev. W. O. Raymond.
"Trees and Forests," by James Vroom.

Oct. 4. Reports on the work of the Quaco Camp, by President Hay, Dr. Matthew, and Percy G. Hall.

Nov. 2. Address on the History of Rockwood Bog, by Dr. Geo. F. Matthew.

Dec. 7. "Notes on a Wild Garden," by Geo. U. Hay.
Note "Upon the Manner in which the Bay of Fundy Rivers of New Brunswick empty into the Sea," by Prof. W. F. Ganong.

Jan'y 4. "Niagara," by Prof. L. W. Bailey.
Canadian Earthquakes in 1897, by Samuel W. Kain.

In addition to the above, an elementary series of lectures was delivered, viz.:

London Museums; Geology from a Railway Train; Peat-Bogs — three lectures by Dr. Geo. F. Matthew.

* Philosophy of Art — Dr. D. R. Moore.

Upon Trinidad and the Customs of Its People — J. V. Ellis, Jr.

Pre-Historic American Pottery — S. W. Kain.

Anatomical Features of Birds; Plumage of Birds; Observation, Collecting, and Mounting — three lectures by A. Gordon Leavitt.

Invertebrates.

The Chairman of this Committee reports that the entire collection of insects has been re-mounted and re-arranged by Mr. Wm. McIntosh. He has also added some 500 specimens, which, with about 200 specimens presented by Mr. Philip McIntosh and Mrs. S. B. McPherson, constitute the most important accession of the year.

Archæology.

But little work has been done in this department. A circular has been received from Prof. Penhallow asking the co-operation of the Society in a scheme having for its object the collection of information relative to the ethnography of Canada. The Committee hope to aid in this work when definite plans have been arranged by the promoters.

Museum.

The museum has been open to the public, as usual, on Tuesday evenings and Saturday afternoons, and, as the register shows, has attracted many visitors. The rooms underwent a thorough cleaning in October, but constant attention is required to keep them in good condition.

Botany.

The Committee on Botany record a few plants found new to the province. A list of these will be found on page 75.

Geology.

The report of the Chairman of the Geological Committee deals at some length with the work at Quaco (in connection with the Summer Camp), where a third member of the Mesozoic system, the presence of which has not been before noticed, was recognized by Dr. Matthew.

* Published in pamphlet of 23 pp., 1897; reviewed in Pop. Sci. Monthly, Oct., 1897.

General.

A movement, originating, we need scarcely say, in the minds of the Associate Members, is now on foot to open the rooms to the public three afternoons in the week. They propose to employ a lady librarian and curator, who will place and keep the museum in good order, and catalogue and re-arrange the library, under the direction of the regular officers of those departments. The necessary funds will be obtained by enlarging the membership and by special donations.

A programme of the winter's work has been distributed, and exhibits a new departure—that of laboratory work—which we think will prove both interesting and profitable.

We desire to remind you that a building fund has been established by one of our members; and we trust that further donations will soon be forthcoming; for we must remain alive to the fact that the space at our disposal is quite inadequate to our purpose, and that our collections, being unsafely housed, must, in case of fire, be entirely destroyed. Let us hope that our new building is not so very far in the future.

The Summer Camp of July last was, perhaps, the most enjoyable in the history of the Society. The trustees of the St. Martins Seminary very courteously placed their large building at our disposal, and we found ourselves in comfortable quarters, provided with excellent facilities for class-work and lectures, and centrally and pleasantly situated. Amongst those who attended we may mention Prof. L. W. Bailey, Dr. Geo. F. Matthew, President G. U. Hay, Prof. W. F. Ganong, and Prof. A. Wilmer Duff.

To the press of St. John we owe our best thanks for the free publication of notices and reports of meetings, and of articles of much greater length; and also to the gentlemen who contributed to the lectures and essay series during the year.

While on reviewing the past year we do not find so many remarkable features as in its predecessor, yet we feel quite justified in considering it one of more than average excellence. It witnessed a large addition to the membership, a most successful Summer Camp, considerable accession to the museum and library, the issue of a large bulletin, and, finally, the appointment of a permanent assistant librarian and curator. We feel confident that the ensuing year will be equally active and equally prosperous.

Respectfully submitted.

PERCY G. HALL,
Secretary.

REPORT OF THE FREDERICTON NATURAL HISTORY SOCIETY.

(Instituted February 2nd, 1895.)

The Fredericton Natural History Society, of which L. W. Bailey, Ph.D., LL.D., is President, held nine regular meetings during the year ending 20th February, 1898, at which the following papers were read :

1897.

Mar. 15. "The Geology of England from a Railway Train," by Dr. G. F. Matthew.

April 19. "The Body-Covering of Animals," by Dr. L. W. Bailey.

May 17. "The Bony Framework of the Human Body," by H. H. Hagerman. B.A.

May 27. "The Forms, Sizes, and other Characteristics of Flowers," by Prof. W. F. Ganong.

Oct. 18. "Niagara," by Dr. Bailey.

Nov. 22. "The Face of the Earth," by Dr. Bailey.

Dec. 13. "The Botany of the Restigouche," by G. U. Hay, M.A.

1898.

Jan'y 17. "Rocks, and What They Tell Us," by Dr. Bailey.

Feb'y 21. "Rock Ruins," by Dr. Bailey.

Through the efforts of members of the Society, the common schools of the city of Fredericton have been supplied with sets of common minerals for class use, and the High School is being supplied with a collection of the minerals of New Brunswick. Some field work has been done by the members of the Society, but not as much as might be desired. Mr. W. H. Moore, however, one of our ornithologists, has been able to add two birds to the list of summer residents of New Brunswick — the Marsh Wren *(Cistothorus palustris)* and Lincoln's Song Sparrow *(Melosphiza lincolni)*.

JOHN BRITTAIN,
Secretary.

REPORT OF THE KINGS COUNTY NATURAL HISTORY SOCIETY.

Organized October 2nd, 1897, at Sussex, Kings Co., N. B.

Officers.

President—Robert King, A.B., Sussex.
Vice-President—Miss Louise Wetmore, Sussex.
Secretary-Treasurer—Mr. W. N. Biggar, Sussex.
Chairman of Executive Com.—Mr. Wm. Goold, Sussex.

Objects of the Society.

The objects of the Society, as set forth in its Constitution, are as follows :

The study of the natural history of the Province of New Brunswick in general, and especially of Kings County;

The collection and preservation of specimens;

The foundation of a library of scientific books;

The meeting of members at regular periods for mutual instruction in natural science.

Meetings, Membership, Etc.

Regular meetings are held at 9.30 a. m. on the first Saturday in each month. The Society, which started with twenty-four charter members, has now fifty-two names on its roll. The increase in membership and interest has been steady, and the results obtained by united endeavor, so far, satisfactory. For convenience in working, the members are divided, according to their own preference, into five sections, as follows : Geology and mineralogy, botany, zoology, ornithology, and entomology. Each of these sections is in charge of a committee of three. The annual membership fee is twenty-five cents, and visitors, invited by members, are welcomed. The election of officers takes place on the Saturday before Labor Day in each year. The thanks of the Society are due the Natural History Society of New Brunswick, and especially to President G. U. Hay for help in organizing, copies of bulletins, and many other favors.

W. N. BIGGAR,
Secretary.

DONATIONS TO THE LIBRARY, 1897.

Donor's Name.	Residence.	Work.
Royal Geographical Society	London	Journal
Hugh Robert Mill	do	1 Vol., 4 Pamphlets.
Trustees British Museum	do	Guides.
Royal Society	do	Proceedings.
Royal Colonial Institute	do	Journal.
Geological Society	do	Abs of Proceedings.
Director Royal Gardens	Kew	Bulletins.
Manchester Geological Society	Manchester	Proceed. and Trans.
Biological Society	Liverpool	do
Liverpool Geological Society	do	do
Marine Biological Association	Plymouth	Journal.
Natural History Society	Glasgow	Proceedings.
Mason College	Birmingham	Calendar.
Royal Society of Canada	Ottawa	Proceed. and Trans.
Ottawa Field Naturalists' Club	do	Ottawa Naturalist.
Department Inland Revenue	do	Bulletins.
Department of Agriculture	do	Census Reports.
Experimental Farms	do	Bulletins.
Hon. Geo. E. Foster	do	9 Volumes.
Henry F. Perley	do	Gesner's Reports.
Entomological Society of Ontario	London, Ont.	Can. Entomologist.
Hamilton Association	Hamilton	Journal
Natural History Society	Montreal	Can. Record of Scien.
Historical and Scientific Society of Manitoba	Winnipeg	Report.
Nova Scotia Institute of Natural Sciences	Halifax	Proceedings.
Canadian Institute	Toronto	Transactions.
Toronto Public Library	do	Report.
Astronomical and Physical Society	do	Transactions.
R. F Stupart	do	Weather Review.
Government of British Columbia	Victoria	Mining Record.
Natural History Society of British Columbia	do	Bulletin 2.
Dr. Geo. F. Matthew	St. John, N. B.	Pamphlets.
Dr. W. D Matthew	do	do
Thomas Cunard	do	3 Volumes.
D. Russell Jack	do	30 do
Mrs. Gilbert Murdock	do	Water Rep , 1854-94.
Samuel W. Kain	do	Gray's Botany.
New Brunswick Historical Society	do	Collections.
Scientific Association of Trinidad	Port of Spain	Proceedings
Australian Museum	Sydney, N.S.W.	Report.
Australian Association for Advancement of Science	do	Report, Vol. VI.
Linnæan Society of N. S. W.	Elizabeth Bay.	Proceedings.
New Zealand Institute	Wellington, N.Z	Proceed. and Trans.
U. S. Bureau of Ethnology	Washington	Reports.
U. S. Geological Survey	do	Reports and Bulletins
U. S. Fish Commission	do	do
U S. National Museum	do	Reports and Proc.
U. S. Department of Agriculture (Botanical Division)	do	Bulletins.
U. S. Coast and Geodetic Survey	do	Report.
U. S. Weather Bureau	do	Weather Review.
Smithsonian Institution	do	Report.
University of California	Berkeley, Cal.	Bulletins.
University of Michigan	Ann Arbor,	Report.
Cornell University	Ithaca, N. Y.	Bulletins.
Tufts' College	Tufts' Col., Mass	Studies.
John Hopkins University	Baltimore	Circulars.
Amherst College	Massachusetts	Calendar.
Leland Stanford, Jr., University	Palo Alto, Cal	Proceedings.
Boston Society of Natural History	Boston	Proceedings.
Boston Public Library	do	Report.
Essex Institute	Salem	Transactions.
New York Academy of Sciences	New York	Journal.
New York Microscopical Society	do	Abstract of Proc.
Linnæn Society of New York	do	Report.
American Museum of Natural History	do	Bulletin.

DONATIONS TO THE LIBRARY — *(Continued).*

DONOR'S NAME.	RESIDENCE.	WORK.
New York Public Library	New York	Bulletins.
University of New York	Albany	Museum Report.
Colgate University	Hamilton	Circulars.
Natural Science Association of Staten Island	New Brighton	Proceedings.
Rochester Academy of Natural Sciences	Rochester, N.Y	do
Iowa Academy of Sciences	Des Moines	do
Academy of Natural Science	Philadelphia	do
Minnesota Academy of Natural Sciences	Minneapolis	Bulletins.
Texas Academy of Science	Austin	Transactions.
Indiana Academy of Natural Sciences	Indianapolis	Proceedings.
California Academy of Sciences	San Francisco	do
Colorado Scientific Society	Denver	Transactions.
C. G. Lloyd	Cincinnati	Plates.
Missouri Botanical Gardens	St. Louis	Report.
Field Columbian Museum	Chicago	Publications.
Societe Scientifique du Chili	Santiago	Actes.
National Museum	Montevideo	Annales.
Royal Academy of Science	Stockholm	Proceedings.
Comite Geologique du Russie	St. Petersburg	Memoirs.
Imperial Academy of Sciences	do	Bulletins.

DONATIONS TO THE MUSEUM.

DATE.	DONOR'S NAME AND DESCRIPTION OF ARTICLE.
1897.	
Feb.	MR. E. J. ARMSTRONG. Specimen of Asbestos.
	MR. L. L. CASSIDY. Specimens of Gold, Silver, and Copper Ores.
Mar.	MR. G. S. FISHER. Specimens of Wood gnawed by Beavers, from Rockwood Bog.
	MR. W. A. JACK. Tadpoles and small Fishes.
Apr.	MRS. GILBERT MURDOCK. Cup and Saucer, manufactured in 15th century. Fire Bucket, Two Vases, One Dollar Bill and one Quarter Dollar, which went through St. John fire of June 20, 1877.
	MR. A. GORDON LEAVITT. Harlequin Duck (mounted).
May.	GEN. D. B. WARNER. Honeycomb in spruce tree, on stand.
	MR. W. F. BEST. Star-fishes and Sea-urchins from Partridge Island.

DONATIONS TO THE MUSEUM — *(Continued)*.

DATE.	DONOR'S NAME AND DESCRIPTION OF ARTICLE.
1897.	
May	MR. JOS. ALLISON. Curious section of Wood.
	MR. NORMAN ROBERTSON. Mineral specimens from Kootenay, B. C.
Oct.	MR. W. A. BUTLER. Calamites approximates.
	MR. ROBERT THOMSON. Ammonite imbedded in flint pebble : also minerals from Giant's Causeway, Ireland.
	MR. F. J. MCNAUGHTON, Fossil Footprints of reptile from Joggins, N. S.
Nov	DR. GEO. F. MATTHEW. Section of Rockwood Bog, and section of large cedar tree.
Dec.	MR. WM. MCINTOSH, PHILIP MCINTOSH, and MRS. S. B. MCPHERSON. Collection of Native Insects, 534 specimens.
	MR. JOSHUA P. CLAYTON. Pair of child's clogs from Bury, Lancashire, G. B. Chart of St. John Harbor, dated September, 1761.

DONATIONS TO THE FUNDS, 1897.

A. Gordon Leavitt, Esq. (to Building Fund).....	$10.00
Anonymous.....	1.00
	$11.00

Officers and Committees of the Natural History Society for 1898.

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

Council for 1898.

President—Geo. U. Hay, M.A., F.R.S.C.
Vice-Presidents—H. George Addy, M.D.; William Murdoch, C.E.
Treasurer—Robert Matthew, Esq.
Secretary—Percy G. Hall, Esq.
Librarian—Samuel W. Kain, Esq.
Curators—Dr. Geo. F. Matthew, A. Gordon Leavitt, and William McIntosh.
Additional Members—J. Roy Campbell, W. Frank Hatheway, Frank E. Holman.
Delegate to the Royal Society—William J. Wilson.
Assistant Librarian and Curator—Miss Edith McBeath.

Associate Members' Branch.

President—Mrs. Geo. F. Matthew.
Secretary-Treasurer—Mrs. Frank E. Holman.

Standing Committees for 1898.

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

MARINE BIOLOGICAL LABORATORY.

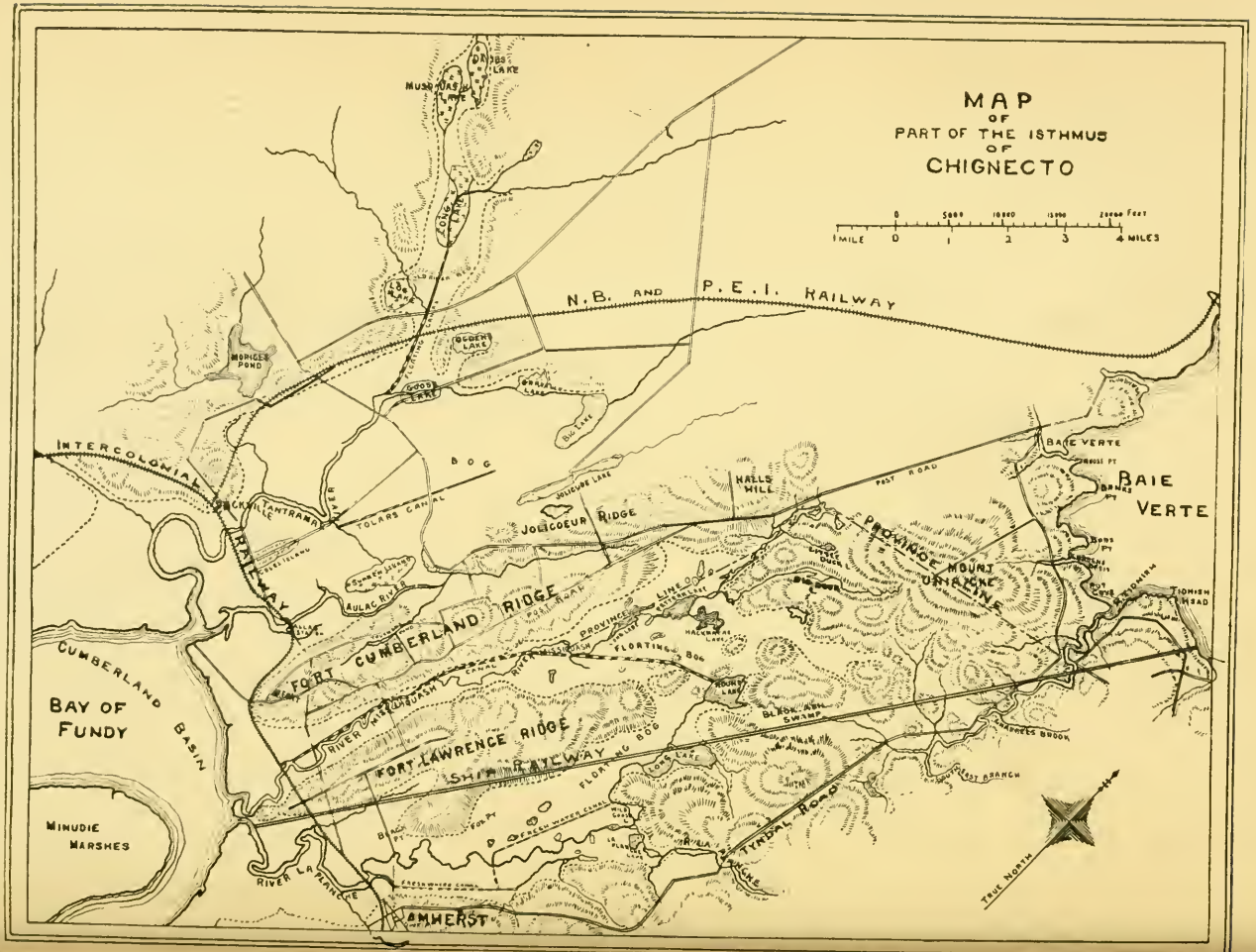
Received 1879.

Accession No. 1572.

Given by Nat. Hist. Soc. N. Brunswick.

Place,

*** No book or pamphlet is to be removed from the Laboratory without the permission of the Trustees.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FORT LAWRENCE RIDGE
SHIP RAILWAY
JOLICOEUR RIDGE
PROVINCE LINE
MOUNT UNIACKE
BAIE VERTE
TYNDAL ROAD
AMHERST
TOLARS CANAL
AULAC RIVER
RIVER LA PLANCHE
FLOATING BOG
BLACK ASH SWAMP
HALLS HILL
POST ROAD
TRUE NORTH

BULLETIN

OF THE

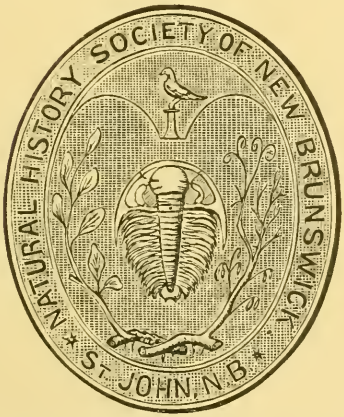
NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

No. XVII.

(Volume IV. Part II.)



PUBLISHED BY THE SOCIETY.

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1899.

BULLETIN

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

ARTICLE I.

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

By George J. Trueman, M.A.

Read April 2, 1896.

CONTENTS.

Geographical Description, ... Page 93
Surface Geology, ... " 94
Marsh Improvements, ... " 96
Formation of Lake and Bog. ..... " 98
The Marsh Soil, ... " 102

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Unclaimed Marsh near Amherst, 1897—

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

Sackville Marsh, 1897—

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

Unclaimed Marsh at Quaco, 1897—

Air dried sample.

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

Mud from Five Islands, N. S.—

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

Gaspereau River, N. S.

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

ARTICLE II.

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

By Prof. A. Wilmer Duff.

Read December 6, 1898.

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

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

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

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

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

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

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

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

ARTICLE III.

NOTES OF A WILD GARDEN.

By G. U. Hay.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1889.

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

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

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

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

1890.

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

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

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

1891.

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

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

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

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

1892.

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

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

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

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

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

1893.

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

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

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

1894.

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

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

1895.

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

1896.

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

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

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

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

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

1897.

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

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

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

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

1898.

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

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

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

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

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

ARTICLE IV.

THE BUTTERFLIES OF NEW BRUNSWICK.

By William McIntosh.

(Read December 6th, 1898.)

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

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

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

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

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

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

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

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

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

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

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

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

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

LEPIDOPTERA.

RHOPALOCERA

Family NYMPHALIDÆ.

Sub-family EUPLOEINÆ.

Danias archippus, Fabr.

(ANOSIA PLEXIPPUS.)

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

Argynnis idalia, Drury.

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

Argynnis cybele, Fabr.

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

Argynnis aphrodite, Fabr.

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

Argynnis atlantis, Edw.

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

Argynnis myrina, Cram.

(Brenthis myrina.)

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

Argynnis bellona, Fabr.

(Brenthis bellona.)

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

Melitæa phæton, Drury.

(Euphydryas phæton.)

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

Melitæa harrisii, Scud.

(Cinclidia harrisii.)

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

Phyciodes tharos, Drury.

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

Grapta interrogationis, Fabr.

(Polygonia interrogationis.)

Forms umbrosa, Lint. morpheus, Fabr.

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

Grapta comma, Harris.

(Polygonia comma.)

Forms dryas, Edw. harrisii, Edw.

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

Grapta faunus, Edw.

(Polygonia faunus.)

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

Grapta progne, Cram.

(Polygonia progne.)

Common throughout the Province, flying from May to October.

Grapta gracilis, Grote and Rob.

(Polygonia gracilis.)

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

Grapta j-album, Boisd, Lec.

(Eugonia j-album.)

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

Vanessa antiopa, Linn.

(Euvanessa antiopa.)

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

Vanessa milberti, Godt.

(Aglais milberti.)

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

Pyrameis atalanta, Linn.

(Vanessa atalanta.)

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

Pyrameis cardui, Linn.

(Vanessa cardui.)

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

Pyrameis huntera, Fabr.

(Vanessa huntera.)

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

Limenitis arthemis, Drury.

(Basilarchia arthemis.)

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

Limenitis disippus, Godt.

(Basilarchia archippus.)

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

Sub-family SATYRINÆ.

Neonympha canthus, Boisd Lec.

(Satyrodes eurydice, Linn.)

Neonympha boisduvallii, Harris.

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

Satyrus nephele, Kirby.

(Cercyonis nephele.)

Erebia nephele.

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

Satyrus alope, Fabr.

(Cercyonis alope.)

Hipparchia alope.

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

Satyrus alope nephele, Scud.

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

Family LYCÆNIDÆ.

Sub-family LYCÆNINÆ.

Thecla augustus, Kirby.

(Incisalia augustus.)

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

Chrysophanus epixanthe, Boisd Lec.

(Epidemia epixanthe.)

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

Chrysophanus hypophlæas, Boisd.

Chrysophanus americana, D'Urban.

(Heodes hypophlaeas.)

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

Lycæna pseudargiolus, Boisd Lec.

(Cyaniris pseudargiolus.)

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

Family PAPILIONIDAE.

Sub-family PIERINÆ.

Pieris napi, Esper.

(PIERIS OLERACEA, Harris.)

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

Pieris rapæ, Linn.

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

Colias philodice, Godt.

(EURYMUS PHILODICE.)

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

Colias interior, Scud.

(EURYMUS INTERIOR.)

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

Sub-family PAPILIONINÆ.

Papilio turnus, Linn.

(JASONIADES GLAUCUS, Scud.)

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

Papilio cresphontes, Cram.

PAPILIO THOAS, Boisd.

(HERACLIDES CRESPHONTES.)

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

Papilio brevicauda, Saunders.

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

Papilio asterias, Fabr.

(Papilio polyxenes.)

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

Family HESPERIDÆ.

Carterocephalus mandan, Edw.

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

Pamphila zabulon, Boisd-Lec.

(Atrytone zabulon.)

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

Pamphila leonardus, Harris.

(Anthomaster leonardus.)

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

Pamphila peckius, Kirby.

(Polites peckius.)

Pamphila wamsutta, Harris.

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

Pamphila mystic, Scud.

(Thymelicus mystic.)

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

Pamphila cernes, Boisd-Lec.

(Limochores taumas, Fabr.)

Pamphila ahaton, Harris.

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

Nisionades brizo, Boisd-Lec.

(Thanos brizo.)

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

Nisionades icelus, Lint.

(Thanaos icelus.)

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

ARTICLE V.

NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong, Ph. D.

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

(Read October 4th, 1898.)

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

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

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

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

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

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

(Read November 1st, 1898.)

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

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

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

(Read November 1st, 1898.)

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

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

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

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

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

[Read December 6th, 1898.]

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

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

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

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

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

[Read December 6th, 1898.]

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

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

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

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

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

A. Present provincial and world distribution of the species.

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

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

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

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

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

(Primary Divisions in part after Warming.)

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

SECTION 2. Groups in adaptation to external physical conditions.

I. *Xerophytes* (*Desert-Plants*)—Typical forms entirely wanting in our Flora; represented only by xerophytic characters in species living where transpiration normally exceeds supply, either because water drains off quickly or for other reasons is available in but small quantity.
- A. Rocky hills, etc.
- B. Sea-cliffs.
- C. Sand-dunes.
- D. Dry Barrens. [See also some features in L.]

II. *Halophytes* (*Strand Plants*)—But a few herbaceous species in our Flora; some inland colonies.
- E. Gravel and Sand Beaches.
- F. Salt Marshes. [See also T.]

III. *Hydrophytes* (*Water-plants*)—Very well developed in our Flora.
- G. Plankton.
- H. Algae, { *a* Marine. *b* Fresh water.
- I. Immersed Phanerogams.
- J. Stream and Lake margin.
- K. Fresh water marshes.
- L. Sphagnum Bogs, { *a* Flat *b* Raised

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

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

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

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

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

[Read January 3rd, 1899.]

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

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

20.—Upon Biological Opportunity in New Brunswick.

[Read January 3rd, 1899.]

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

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

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

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

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

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

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

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

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

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

Plants.

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

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

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

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

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

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

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

Animals.

Mammalia. List by Chamberlain in Bulletins III and X.

Birds. List by Chamberlain in Bulletin I.

Reptilia. No published list.

Amphibia. List by Cox in Bulletin XVI.

Fishes. List by Cox in Bulletin XIII.

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

Crustacea. No published lists.

Worms. No published lists.

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

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

Coelenterata. No published lists.

Protozoa. No published lists.

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

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

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

(Read February 7th, 1899.)

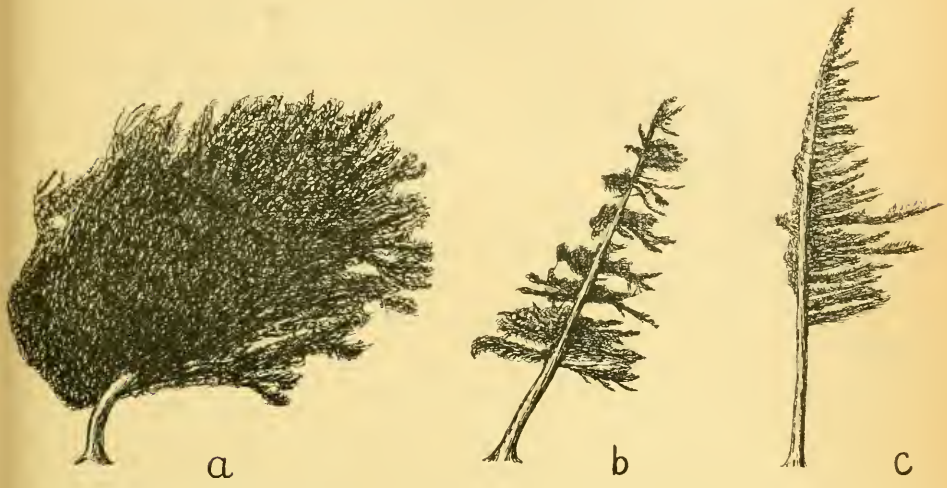
Pearls of considerable, and often great, value are occasionally found in the freshwater clams or mussels occurring abundantly in the brooks and rivers of North America, and there are periodical revivals of interest in the search for them. The latest Bulletin of the United States Fish Commission (Vol.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

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

(Read February 7th, 1899.)

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

The cause producing these effects is perfectly obvious and agreed upon by all residents, *i. e.*, the great prevalence, particularly in summer, of southwest winds. The Bay of Fundy acts as a sort of funnel

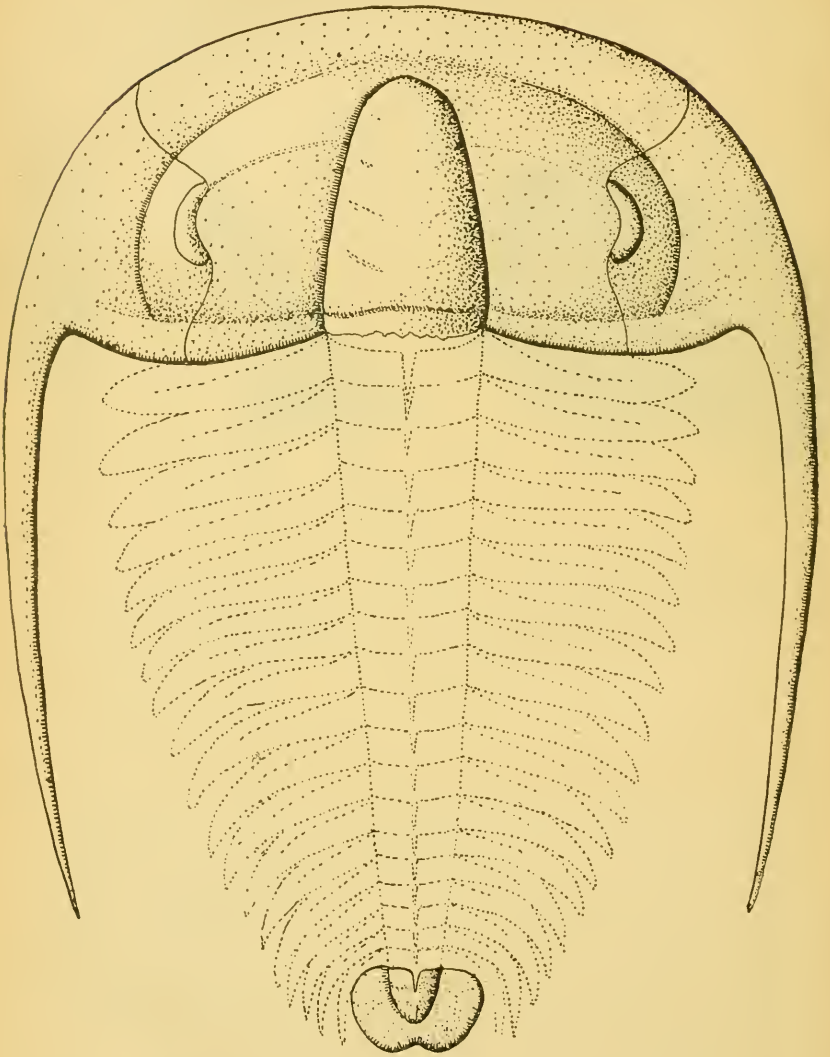


converging at the Isthmus. It would be of great interest to compare the aggregate prevalence of southwesterly winds and their velocity for a summer on the Isthmus with the corresponding facts for other parts of the province, but the data are not available, for there is no station for wind measurement in this district.

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

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

PLATE III.



METADOXIDES MAGNIFICUS, n. sp.

Restored—Reduced $\frac{2}{3}$.

ARTICLE V.

A NEW CAMBRIAN TRILOBITE.

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

(Read February 7th, 1899.)

ERRATA.

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

we proceed to describe under the name

Metadoxides magnificus, n. sp.,

a species of the Lower Cambrian beds in Newfoundland.

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

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

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

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METADOXIDES MAGNIFICUS, n. sp.

Restored—Reduced $\frac{2}{3}$.

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

(Read February 7th, 1899.)

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

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

Regarding the forms with conical glabella as a separate genus—

METADOXIDES, Bornemann,

we proceed to describe under the name

METADOXIDES MAGNIFICUS, n. sp.,

a species of the Lower Cambrian beds in Newfoundland.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

POSTSCRIPT.

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

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

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

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

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

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

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

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

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

*Versteinerungen des cambrischen Schichtensystem der Insel Sardinien, p. 405, Halle, 1891.

ARTICLE VII.

ON ARTESIAN AND FISSURE WELLS IN NEW BRUNSWICK.

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

Read March 7th, 1899.

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

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

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

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

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

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

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

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

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

* Sandstones that are easily cut with the chisel.

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

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

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

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

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

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

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

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

Explanation of the Tabular List of Wells.

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

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

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

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

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

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

"Temperature," was taken with the Fahrenheit thermometer.

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

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

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

ARTESIAN WELLS

Bored in New Brunswick, referred to in this Article

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

FISSURE AND DEEP WELLS

Bored in New Brunswick, referred to in this Article.

No.	Location.	Date.	Depth.	Bore.	Pressure.	Flow.	Temperature.	Water Veins.	Height.	Kind of rock penetrated.
14	Albert Co., Albert	'98	345	.6				345	Near sea level.	Grey sandstone, gypsum, red sandstone.
15	Sussex, Geo. D. Slipp	'95	998	.5	—24			200 and below.	About 65 ft abv sea level.	60 ft. of clay to the rock, then 893 brown sandstone, 35 very soft sandstone, 10 hard sandstone.
16	Chatham, Pulp Mill		1400					100 & 1000		Grey sandstone, etc.
17	Campbelltown, "Hotel Dieu"	'90	100							100 ft. in solid rock.
18	Milltown, Cotton Mill	'84	200						Near sea level.	[Pyritous slates?] sulphurous water.
19	Kings Co., Hatfield's Point	'57	282	.6	—25	ample		24, 80	do.	75 ft. sand, 10 clay, 297 hard rock.
20	Brookville. W. Wheeler		130	.5½	—15	100		60, 130	do.	60 ft. limestone, 3 ft. quartzite, 67 ft. "whinn."
21	Simonds, Alms House	'97	760	.4	—13	15	Jan. 45°	404	About 30 ft abv sea level.	758 ft. black slate, 2 ft. quartzite.
22	(470 ft. W.)	'97	550	.4	—2½	2000	Dec. 43°	28, 40, 406	About 10 ft abv sea level.	Slates and flagstones.
23	Union Street, St. John, S. Jones,	'96	585	.4		1000	Feb. 45°	382	+58 feet.	52 ft. clay, 9 gravel, 317 black slate, 68 sandstone.
24	Portland Rolling Mill	'80	275	.3		ample	Feb. 46½°		15 ft. above sea level.	Slates and hard sandstone.
25	Carleton, Lunatic Asylum	'98	515	.3	—140	1000			+124 feet.	Slate and limestone.
26	Fairville, Pleasant Point		640	.4		small		at intervals	Sea level.	Granite.
27	Mt. Pleasant Av., Convent Sch.	'94	521	.4		40		245	+219 feet.	Limestone, etc.
28	Adelaide Road, Ropewalk	'88	278	.3	0	ample			+60 feet.	Limestone, etc.

Additional Notes.

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

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

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

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

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

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

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

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

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

Analyses.

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

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

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

(Signed) Alfred E. McIntyre.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

APPENDIX.

THE PRESIDENT'S ADDRESS.

A WILDERNESS JOURNEY — WITH SUGGESTIONS.

By G. U. Hay.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

REPORT OF THE BOTANICAL COMMITTEE.

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

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

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

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

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

G. U. HAY,
Chairman Committee on Botany.

REPORT ON ZOOLOGY.

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

Insects.

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

Wm. McIntosh.

Batrachians.

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

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

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

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

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

CHAS. F. B. ROWE.

BIRDS.

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

SECTION A.

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

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

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

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

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

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

A. GORDON LEAVITT.

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

METEOROLOGICAL ABSTRACT FOR 1898.

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

D. L. HUTCHINSON, Director.

	BAROMETER.			TEMPERATURE.			Cloudiness : 0—Clear. 10—wholly clouded.	Precipitation Rain and Melted Snow.	WIND DIRECTION AND VELOCITY.																		Thunder Storms.
									N.		N. E.		E.		S. E.		S.		S. W.		W.		N. W.				
	Mean.	High st.	Lowest.	Mean.	Maximum.	Minimum.			Hours.	Miles.	Hours.	Miles.	Hours.	Mile s.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Calms.	Total Miles.	
January	29.96	30.68	28.94	16	42 9	− 14.6	5	5.11	177	1271	74	796	26	243	24	344	33	590	40	599	59	665	174	2736	137	7,244	1
February	30.09	30.70	29 02	26 7	41,8	− 2.6	7	3 59	71	465	147	1881	38	364	35	407	63	831	64	755	37	248	124	1337	93	6,288	0
March	30.20	30.95	29.44	33.6	52 7	16.5	5	2.38	70	602	46	415	13	53	37	263	186	1426	123	1239	13	114	44	2432	112	6,544	0
April	29.90	30.41	29 33	38 2	61.5	21 5	7	5.47	50	434	251	2818	24	205	51	366	33	133	62	601	30	225	154	2277	85	7,059	0
May	29.98	30.41	29 61	48.9	68.3	29.2	6	1.27	42	349	145	1216	22	126	113	765	131	758	123	1179	4	26	55	729	109	5,148	0
June	29.94	30.13	29.37	56 4	73.5	41	7	2.38	15	79	130	1019	22	99	94	558	186	1019	80	870	8	32	111	1715	71	5,391	0
July	30 04	30.52	29.62	64.4	78.5	18	6	1.26	29	230	49	369	18	66	121	634	232	1399	112	971	6	27	62	474	115	4,170	1
August	29.96	30.28	29.66	62 5	77	49 5	7	3.26	18	97	49	294	66	396	103	132	220	1141	74	878	10	112	68	605	136	3,955	1
September	30.02	30.43	29,50	55.8	81.2	32.5	4	4.04	14	17	51	333	21	105	80	400	95	472	112	1219	44	515	158	2247	145	5,368	1
October	30.10	30.62	29.41	47.1	73	29.5	6	7.50	39	392	125	958	23	102	73	950	41	267	166	2432	12	98	159	2182	106	7,371	0
November	29.96	30.53	28,98	38.2	56.5	19,3	8	4.19	134	1675	167	2657	33	332	18	211	34	600	91	1378	30	383	141	1558	69	8,824	0
December	29 95	30.67	29.19	23.9	44.2	− 8.7	7	1.21	37	322	115	1069	29	252	26	561	9	144	110	1414	111	1428	276	3904	31	9,094	0

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

MAGNETIC DISTURBANCES.

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

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

EARTHQUAKE SHOCK, AUGUST 14, 1898.

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

S. W. KAIN.

THIRTY-SEVENTH ANNUAL REPORT OF THE COUNCIL

OF THE

NATURAL HISTORY SOCIETY

OF

NEW BRUNSWICK.

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

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

Membership.

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

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

Finances.

The Treasurer makes the following statement :

Receipts.

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

Receipts carried forward	$696 56

Expenditure.

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

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

Library.

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

Publications.

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

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

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

Museum.

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

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

Lectures and Essays.

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

1898.

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

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

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

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

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

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

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

1898.

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

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

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

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

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

1899.

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

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

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

Elementary Series.

1898.

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

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

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

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

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

The Associates' Afternoon Series.

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

General.

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

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

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

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

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

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

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

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

PERCY G. HALL,

Secretary to Council.

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

FREDERICTON NATURAL HISTORY SOCIETY.

(Instituted February 2nd, 1895.)

The officers for the current year are :

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

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

1898.

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

1899.

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

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

JOHN BRITTAIN,
Secretary.

KINGS COUNTY NATURAL HISTORY SOCIETY.

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

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

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

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

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

1897.

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

1898.

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

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

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

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

WM. N. BIGGAR,
Secretary.

THE NATURAL HISTORY AND ANTIQUARIAN SOCIETY OF PRINCE EDWARD ISLAND.

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

The following are the officers:

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

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

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

1889.

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

1890.

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

1891.

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

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

DONATIONS TO THE LIBRARY, 1898.

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

DONATIONS TO THE LIBRARY—*Continued.*

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

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

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

Manual of Entomology, by Comstock.

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Date.	Donor's Name and Description of Article.
March	United States National Museum. 17 Fossil Plants of the Richmond (Va.) coal field, ("Rhœtic"); 40 Fossil Plants of the Potomac formation.
	Mr. Alfred Morrisey. Japanese Bird Skins.
	Mr. Geo. E. Fairweather. Two St. John papers of the year 1789.
April	Mr. Jas. Patterson. Number of Marine Forms preserved in alcohol.
	Dr. R. J. Kirkland, Grand Rapids, Mich. 250 Fresh Water and Land Shells.
May	Prof. Jas. Fowler, Kingston, Ont. Number of mounted plants.
June	E. T. P. Shewen, C. E. Specimens of polished marble from Bras D'Or, C. B.
	Mr. A. H. Hanington. Cocoon of the Emperor Moth.
October	Mrs. Jas. Warner. Collection of Shells, Egg cases of Conch Shell, Spawn of Ray, from Gulf of Mexico.
	Miss Agnes L. Warner. Collection of New Brunswick plants.
	Mr. W. Frank Hatheway. Stone Gouge, from Random Sound, Newfoundland.
	Mr. Samuel Lyons. Stone Gouge, from Westfield Beach.

DONATIONS TO THE MUSEUM.—*Continued.*

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

DONATIONS TO THE FUNDS, 1898.

James Manchester, Esq. (for Exhibition Prizes)	$100 00
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No. XVIII.

(Volume IV. Part III.)

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ARTICLE I.

PRELIMINARY NOTICE OF THE ETCHEMINIAN FAUNA OF NEWFOUNDLAND.

By Geo. F. Matthew, D. Sc., LL.D.

Read February 7, 1899.

For comparison with the known forms of the Etcheminian terrane in New Brunswick and as a guide to other species which may be discovered in it, the author describes here briefly, and figures the species which have been found in the Etcheminian rocks of Newfoundland.

BRACHIOPODA.

Obolella c. f. chromatica, Billings. Pl. I., fig. 1.

See *O. chromatica*, Bill., Palæoz. Foss., vol. i., p. 7, fig. 7, *a.* to *d.*

A small Obolella, resembling the above species, was met with. The surface is granulated, but shows undulations of growth and faint obscure radiating lines.

Kutorgina granulata, n. sp. Pl. I., fig. 2, *a.* to *d.*

Another little shell, but with a straight hinge line, occurs. The surface is minutely granulated; concentric striæ and faint radial lines are visible. *Size*—Length, 4 mm; width, 6 mm; depth of ventral valve, $1\frac{1}{2}$ mm.

This species is smaller than *K. cingulata* and differs in ornamentation. It is about the size of *K. pannula*, but has not the diagonal cancellation of that species.

GASTEROPODA.

Scenella c. f. reticulata, Billings.

c. f. *Scenella reticulata*, Bill. Palæoz. Foss., vol. ii., pt. i., p. 77, (no figure).

Some shells were observed which appear to be of this species of Billings. The ornamentation is of sharp thread-like radiating ridges, which, without break, cross over fine striæ of growth. *Size* of the aperture, 7x9 mm.

Scenella c. f. retusa, Ford.

Scenella c. f. *retusa*, Ford. Am. Jour. Sci., 3 ser., vol. v., p. 213 figs. 2 *and b* (page 214).

Another species occurs, smaller than *S. reticulata*, and distinguished by its ornamentation. The radiating ridges are broader than in this species and both radiating and concentric ridges are obscured by a more distinct granulation of the surface.

RANDOMIA, n. gen.

This genus does not differ in form from Palæacmæa, but it is characterized by strong radiating ridges, which cross the concentric ridges and prominent undulations of growth, that mark the shell. Mr. E. O Ulrich says that the species of Palæacmæa have only concentric lines

Randomia Auroræ, n. sp. Pl. I., figs. 3 *a* to *c*.

This is one of the most characteristic species of the Etcheminian ; and a species, probably the same, occurs in the St. John Basin of Eopalæozoic rocks. The surface is marked by very fine, sharply raised lines, radiating from the apex toward the margin ; about six are found in the space of one millimetre. *Size* – Opening of the shell 20x25 mm.; height 11 mm.

The very prominent ridges, straighter dorsal line, and fine radiating striæ distinguish this species from *Stenotheca (?) rugosa* and *S. (?) paupera*, Bill.

Parmophorella (?) paupera, Bill. sp.

Stenotheca paupera, Bill. Pal. Foss., vol. ii., pt. i., p. 77 (no figure).

A few examples occur which agree with this species. The shells are compressed laterally, indicating that it had a narrow, oval aperture.

PLATYCERAS TRANSVERSUM, n. sp. Pl. I. figs. 4 *a* and *b*.

This is one of a group of three species of small gasteropods, occasionally met with at Smith Sound. They are found buried in the calcareous mud of the upper limestone, and also within the tubes of Hyolithes, etc., where they probably concealed themselves after the death of the animals which formed those tubes.

The surface of all those species is minutely granular, and in none does the curve make a complete whorl, but the umbo projects too far to allow the shell to be classed with Palæacmæa or Parmophorella. *P. transversum* is considerably larger than the other two, and is distinguished by its fine, closely set growth lines.

PLATYCERAS RADIATUM, n. sp. Pl. I., figs. 5 *a* and *b*.

This is proportionately a longer species with more projecting umbo. It is distinguished by about a dozen fine, narrow, sharp ribs on the dorsum, radiating from the umbo.

This differs from any described Cambrian or Ordovician species. It approaches the genus Heliconopsis, Ulrich and Scofield; but its strongly curved back and projecting umbo separate it.

PLATYCERAS CYMBULA, n. sp. Pl. I., figs. 6 *a* and *b*.

Distinguished from the preceding by its smooth surface, and from the first by its sub-carinate dorsum, and less concave slopes in the anterior region.

LAMELLIBRANCHIATA.

MODIOLOPSIS THECOIDES, n. sp. Pl. I., figs. 7, *a* to *c*.

Only the right valve is known; it is remarkable for its long, narrow shape and ear-like anterior end. When this is concealed, the shell is easily mistaken for a Hyolithes, the form of the posterior end and the sculpture of the surface, being like the dorsal side of a tube of that genus. The shell is about 9 mm. long and 4 mm. wide.

ANNELIDA.

UROTHECA, n. gen.

This genus based on chitinous tubes from the Etcheminian and Cambrian is described in an article to be communicated to the Royal Society of Canada, May 1899.

UROTHECA PERVETUS, n. sp. Pl. I., fig. 8.

Only the distal end of this tube is known, and that pressed flat in the stone so that the form of the orifice is not seen. *Size*—Length of the part preserved 35 mm., width 3½ mm. ; rate of tapering, 1 in 17 mm.

HELENIA GRANULATA, n. sp. Pl. II., figs. 7, *a* to *e*.

Small, much flattened, curved tubes, the curve not in one plane, but the tube somewhat twisted. The tubes enlarge towards the aperture so that in 10 mm. of the length the width is doubled. Width of the orifice 2½ mm. Surface minutely granulated.

The form and curve of the fragments of these tubes cause them to resemble those of the genal and pleural spines of trilobites, but we have found nothing resembling the cheeks or head of trilobites in the bed where these fragments are found.

HYOLITHELLUS MICANS, Billings, (pars). Pl. II., figs. 1., *a* to *d*.

These appear to be much smaller than the limit of size assigned by Mr. Billings for his species. But I surmise that objects similar to these have been included under his name. *Size*—The longest are 20 mm. with a width of 1 mm. The surface, though shining, is not quite smooth, but is minutely granulated. These objects appear to be clustered in the shale, as though they were gregarious, or were attachments of larger organisms.

HYOLITHELLUS (?) FLEXUOSUS, n. sp. Pl. I., fig. 9.

A small slender tube of which the proximal end is very slender, straight and hyaline. This enlarges somewhat abruptly into a terete, opaque tube, which is curved in one or more planes. Rate of taper of the known part 1 in 20 mm.

This species differs from *Hyolithes lævigatus*, Linrs., (Torellella, Holm.) in its circular form and calcareous substance.

The slender, cylindrical, hyaline tube in which this species begins was possibly membranaceous ; if chitinous it was extremely thin.

COLEOIDES TYPICALIS, Walc. Pl. II., fig. 2.

Objects which appear to agree in all respects with this species are common with Hyolithellus, from which some can hardly be distinguished ; they have a length of 10 mm. and a width of 1½ mm.

ORTHOTHECA PUGIO, n. sp. Pl. II., fig. 4 *a* to *d*.

An elongated, thick shelled species having the tube somewhat flattened on the dorsal side, and arched longitudinally toward the ventral side. The known part of the tube is about 27 mm. long, with an orifice of 6 mm. The whole length would be about 40 mm. if the shell preserved its taper and were not decollated.

This species is like *Hyolithes communis*, Bill, but has no "dorsal lip." From *O. DeGeeri*, of the Swedish Cambrian, it differs in its rounded dorsal side and granulated surface. *O. Johnstrupi*, of the same country, has a more slender form and different sculpturing.

ORTHOTHECA SICA, n. sp. Pl. II., figs. 5, *a* to *e*.

This species which is of about the same size as *O. pugio*, may be distinguished by its smoother surface, more triangular section and more distinct surface striæ.

MUTATION. Pl. II., figs. 6, *a* and *b*.

This in place of a gradually rounded ventral side shows a flattening of the middle quarter of that side. In this it approaches *H. quadricostatus* Shaler and Fœrste, of the Attleboro fauna, but is a true Orthotheca, while the latter by its form is a Hyolithes.

ORTHOTHECA STILETTO. Pl. II, figs. 3, *a* and *b*.

A small, slender, straight species, with a very tenuous tube. It has a concave dorsal side, and a rounded, convex ventral side. Rate of tapering about 1 in 8. The dorsal side has fine, closely set striæ of growth just visible with a strong lens.

This species is near *O. affinis*, Holm, of the Paradoxides beds of Sweden, but is not half the diameter and has a more elongate form.

ORTHOTHECA BAYONET, n. sp. Pl. III. fig 1 *a* to *f*.

Tube very thin and with concave slopes on three sides, two of which are ventral. The dorsal side is concave in the middle and convex towards the angles. Each ventral slope is convex toward the middle of the ventral side and concave toward the dorsal edge. Longitudinally the tube curves toward the ventral side, especially toward the apex.

Sculpture.—The outer surface is finely granulated, and traversed by fine transverse striæ.

This tube was very fragile and is found in fragments, of which the largest indicates an aperture of 8 mm. Taper of the tube 1 in 5.

This species differs from *Hyolithes Americanus* in the absence of a lip, and in having the lateral angles more acute than the median angle of the ventral side. It differs from all Orthothecæ described by Walcott (under Hyolithes) in its angular form. It differs from all those described by Holm in the acuteness of the lateral angles, and by the concave form of the ventral slopes near those angles.

This form of Orthotheca seems not to have survived the Etcheminian time, as no similar one is found in the Cambrian.

HYOLITHES EXCELLENS, Bill. Pl. III., figs. 3, *a* to *i*.

This is the leading species of the Etcheminian fauna of Smith Sound. It is a true Hyolithes of advanced type, in which a part of the ventral surface has passed over to the dorsal side. It thus belongs to the "*Magnidorsati*" section of G. Holm, which this author considers the higher section of Hyolithes, sens. strict. In *H. excellens* the proximal part of the tube has a more triangular section than the distal, and this is seen to be due to the two sides of the tube here possessing their original integrity of form, and no portion of the ventral has passed over to the dorsal side. Hence this species at first was among the Equidorsati, but in growing to maturity became a Magnidorsatus.

HYOLITHES RUGOSUS, n. sp. Pl. III. figs. 4, *a* and *b*.

A small, slender species, having the dorsal side flatly rounded, and gently curved towards the ventral side longitudinally.

The ventral side is marked by prominent transverse ribs, which are closely set on the lower part of the tube, but in the upper fifth are more distant. Surface minutely granulated. Length 11 mm.; width about $3\frac{1}{2}$ mm.

Mr. Walcott has described an object similar to this, but smaller, as *Hyolithellus micans*, var. *rugosa*; it differs in having a longitudinal striation between the ridges of growth, where this species has only a granular surface.

CRUSTACEA.

APTYCHOPSIS TERRANOVICUS. Pl. III., fig. 5

Each valve of this little crustacean has an oval lenticular form with the widest part one-third from the anterior end. The hinge has

a strong fold which is more than two-thirds of the whole length of the shield. The lower and posterior border has a distinct marginal fold. The front border is angulated, but no rostral piece is known.

mut. ARCUATA. Pl. III., fig. 6.

This form is somewhat smaller, is rounded in front, and the shape is more elongate.

The surface in these little shells is granulated and there are traces of concentric grooving. The largest is about $3\frac{1}{2}$x2 mm., the mutation about 3x$1\frac{1}{2}$ mm

SUMMARY.

The peculiarities of this fauna as distinguished from the Cambrian are the following :

1. Great preponderance of the tube worms (*Hyolithidæ*, etc).
2. Absence or rarity of trilobites.
3. Minuteness of the Gasteropods except Capulidæ.
4. Minuteness of the Brachiopods.
5. Minuteness of the Crustaceans.

The two special types of the Etcheminian fauna are, among the Hyolithidæ *Orthotheca bayonet*, and among the Gasteropoda *Randomia Aurorœ*. The minuteness of the Lamellibanchs is not peculiar to the Etcheminian as the Cambrian species are not much larger.

DESCRIPTION OF THE PLATES.

PLATE I.

FIG. 1. *Obolella* c. f. *chromatica*, Bill. Ventral valve, mag. $\frac{3}{1}$. See p. 189.

FIG. 2. *Kutorgina granulata*, n. sp. *a* Ventral valve ; —*b* Dorsal valve ; both mag. $\frac{3}{1}$; —*c* Dorsal (?) mould of, —— *d* Ventral, hinge seen from behind. Both mag. $\frac{5}{1}$. See p. 189.

FIG. 3. *Randomia Aurorœ*, n. gen. et sp. *a* Side view, restored from two examples ; —*b* Same seen from above ; —*c* Smaller entire shell. All natural size. See p. 190.

FIG. 4. *Platyceras transversum*, n. sp. *a* Side view ; —*b* Same seen from above. Mag. $\frac{3}{1}$. See page p. 191.

FIG. 5. *Platyceras radiatum*, n. sp. *a* Side view ; —*b* Seen from above. Mag. $\frac{4}{1}$. See p. 191.

FIG. 6. *Platyceras cymbula*, n. sp. *a* Side view; —*b* Seen from above. Mag. $\frac{4}{1}$. See p. 191.

FIG. 7. *Modiolopsis thecoides*, n. sp. *a* Interior of the right valve ;— *b* Section near the hinge ; —*c* Section near the posterior end. All mag. $\frac{4}{1}$. See p. 191.

FIG. 8. *Urotheca pervetus*, n. sp. Distal part of the tube. Nat. size. See p. 192.

FIG 9. *Hyolithellus flexuosus*, n. sp. Proximal end of the tube. Mag. $\frac{6}{1}$ See p. 192.

PLATE II.

Fig. 1. *Hyolithellus micans*, Bill. *a* A group of paired tubes ; —*b* Another group ; —*c* A third group, all mag. $\frac{2}{1}$;—*d* Groups of the tubes in association with Orthotheca bayonet. Nat. size. See p. 192.

Fig. 2. *Coleoides typicalis*, Walcott. Part of a tube. Mag. $\frac{1}{1}^{0}$. See p. 192.

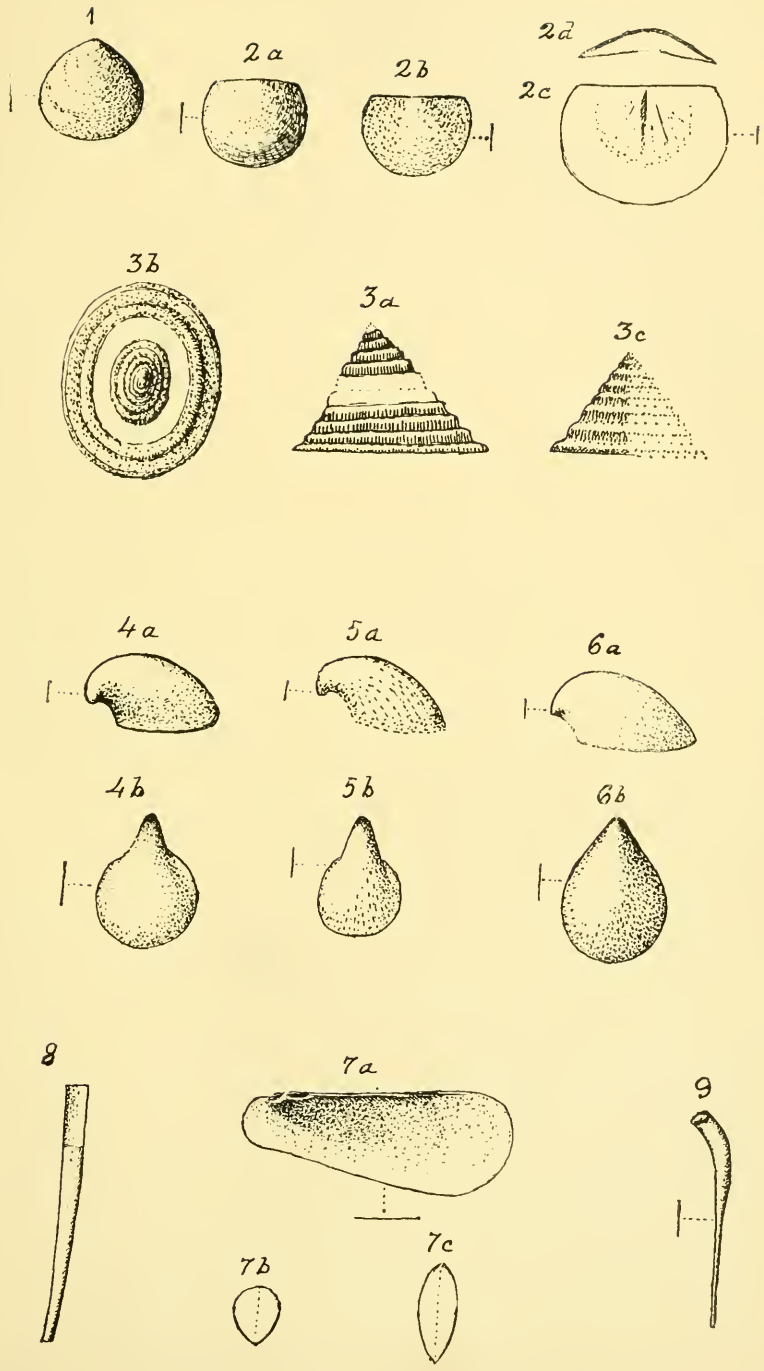
Fig. 3. *Orthotheca stiletto*, n. sp. *a* The tube ; —*b* Section at the aperture, both mag. $\frac{4}{1}$. See p. 193.

Fig. 4. *Orthotheca pugio*, n. sp. *a* A tube decollated ; —*b* Form of aperture ;—*c* Section at the decollation; —*d* A smaller example, side view; —*e* An operculum,possibly of this species. All mag, $\frac{2}{1}$. See p. 193.

Fig. 5. *Orthotheca sica*, n. sp. *a* Decollated tube, ventral side ; —*b* Form aperture ; —*c* Another tube with more rounded angles ;—*d* Form of the aperture. All mag. $\frac{2}{1}$; —*e* An operculum, possibly of this species. Mag. $\frac{2}{1}$. See p. 193.

Fig. 6 *Orthotheca sica*, quadricostate mutation ; *a* Ventral view of the tube ; —*b* Section at the aperture. Both mag. $\frac{2}{1}$. See p. 193.

Fig. 7. *Helenia granulata*, n. sp ; *a* Side view of the tube ; —*b* Front view of another tube. Both mag. $\frac{2}{1}$; —*c* Section of the second tube. Mag. $\frac{4}{1}$; —*d* Large end of a tube, mag. $\frac{2}{1}$; —*e* Section, mag. $\frac{4}{1}$. See p. 192.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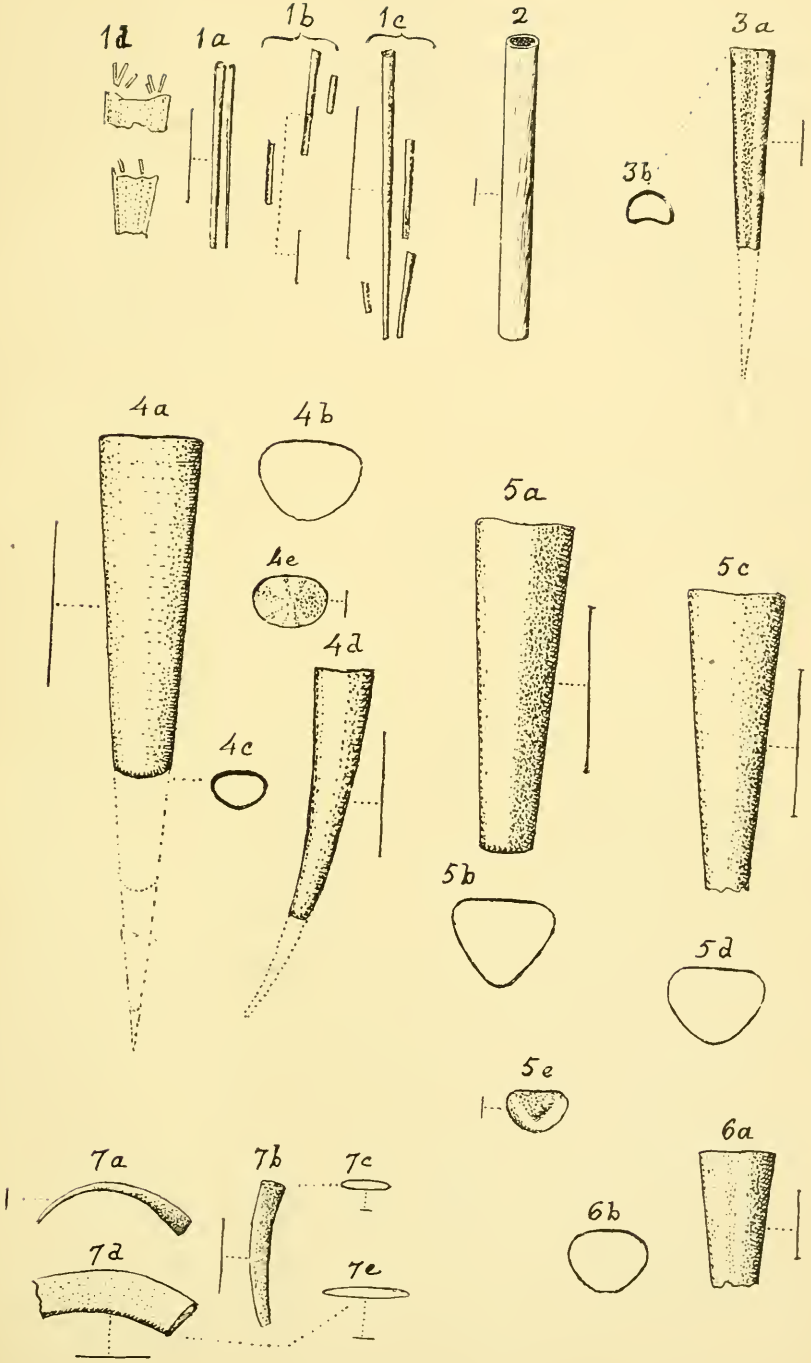
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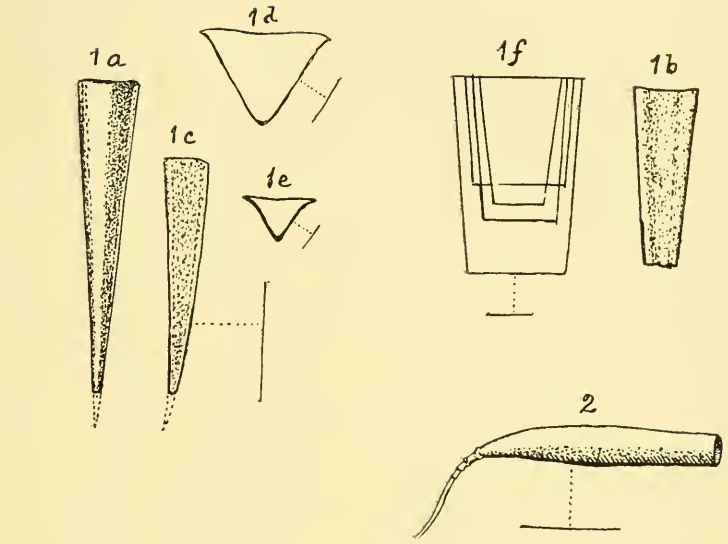
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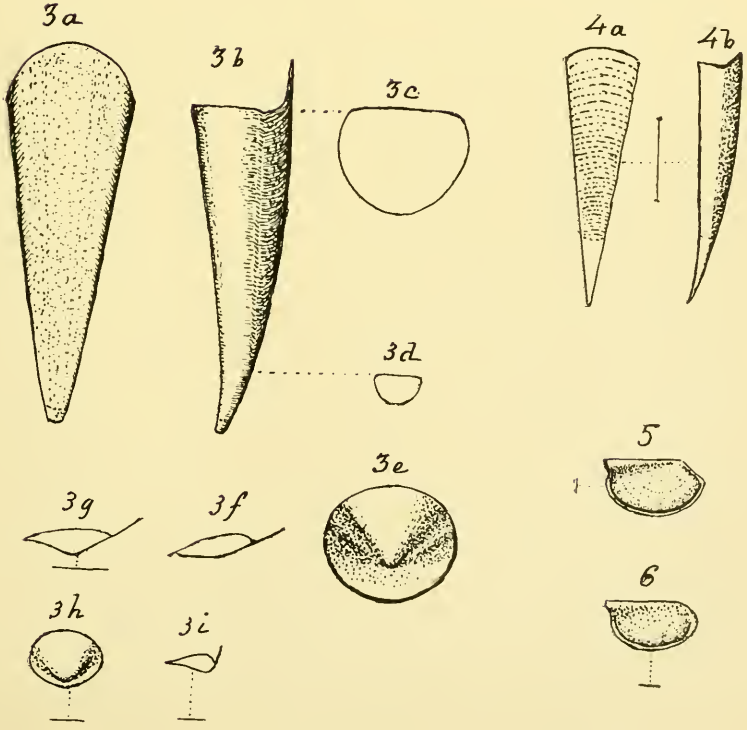
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Plate III.

Fig. 1. *Orthotheca bayonet*, n. sp. *a* The tube, ventral side; —*b* A tube showing the dorsal side; both nat. size; —*c* Side view of a small example, mag. $\frac{2}{1}$; —*d* Form of the aperture of the tube; —*e* Section toward the small end, both mag. $\frac{2}{1}$; —*f* Outline of the distal end of several tubes, to show the taper; mag. $\frac{2}{1}$. See p. 193.

Fig. 2. *Urotheca.* A small species of the Mt. Stephen fauna, figured, to show the larval tube of the young worm; mag. $\frac{3}{1}$. See p. 191.

Fig. 3. *Hyolithes excellens*, Bill. *a* Dorsal side of the tube; —*b* Side view;—*c* Form of the aperture;—*d* Section near the small end; —*e* Operculum of this species; —*f* Outline of side view; all nat. size; —*g* Side view of a young opercule; —*h* A still smaller opercule, probably of this species; —*i* Side view of same, the three mag. $\frac{2}{1}$. See p. 194.

Fig. 4. *Hyolithes rugosus*, n. sp. *a* Dorsal side of tube; — *b* Side view of tube; both mag. $\frac{2}{1}$. See p. 194.

Fig. 5. *Aptychopsis terranovicus*, n. sp. Side view of right valve; mag. $\frac{4}{1}$. See p. 194.

Fig. 6. *Aptychopsis terranovicus*, mut. *arcuata.* Side view of right valve; mag. $\frac{4}{1}$. See p. 195.

P. S.— In the above article is described briefly the Etcheminian Fauna in the locality where it shows to best advantage. Those who wish to know the stratigraphical relations of the rocks which contain it, are referred to the Annals of the New York Academy of Science, Vol. XII., No. 2, pp. 41–56.

ARTICLE II.

PRELIMINARY NOTICE OF THE ETCHEMINIAN FAUNA OF CAPE BRETON.

By G. F. Matthew, LL.D., D.Sc., F.R.S.C.

(Communicated by permission of the Director of the Geological Survey of Canada, 3rd of October, 1899.)

The following brief notice of the new fauna recovered from the Etcheminian rocks of Cape Breton is presented for the information of those who are working in the oldest fossiliferous deposits; and is collateral to a similar notice of the Etcheminian fauna of Newfoundland presented to the Society in the early part of this year.

The physical conditions and history of the Etcheminian deposits in Cape Breton are very closely parallel to those in New Brunswick. In both regions there was volcanic action in districts adjoining the areas where the sediments of this age accumulated; or there were exposed areas of volcanic deposits (ashes, etc.,) from which much of the sediment was derived. This is a more noticeable condition in the Lower Etcheminian of Cape Breton, than in that of New Brunswick; but the Upper Etcheminian of both regions had a very similar physical history.

Appended to this notice (See Plate IV.) are two sections of the Cape Breton Cambrian and Etcheminian, from which the relations of the two terranes in that region will be seen, and from which it appears that the Cambrian of that island rests sometimes on the Etcheminian, and at others directly upon the older felsites and syenites which form prominent ridges of land on that island.

As regards the Cambrian it is to be noted that these sections show *no Lower Cambrian* nor have the faunas of this part of the system (Paradoxides and Protolenus) been recognized in Cape Breton. The fauna which is found in the lowest sandstones and shales above the basal conglomerate of the Cambrian, appears to be Upper Cambrian; certainly all the faunas above the latter pertain to the upper horizons.

It is therefore more reasonable to expect a discordance of strata in this region between the Cambrian and the Etcheminian than in the region of New Brunswick where the Lower Cambrian is present.

The conditions for the preservation of fossils seem to have favored more the region of Cape Breton, for there we have a fuller fauna than in New Brunswick.

Though fossils are also more abundant in the Etcheminian of Newfoundland than in the last named province, that fauna is quite dis-similar from the one in Cape Breton. This latter fauna has a facies similar to that of the Protolenus Zone in New Brunswick, if we eliminate the trilobites from the latter. In fact every genus in this new fauna has its counterpart in the Protolenus Zone ; but when it comes to a comparison of species, we cannot find one that is common to the two faunas. Hence we must believe there is a greater difference in age than at first sight appears.

It is to be remarked however, that if the sequence of similar physical events were contemporary in the two regions, the most characteristic part of the known fauna of the Etcheminian in New Brunswick lies below the fossiliferous zones in Cape Breton from which came the fossils described in the following pages. Hence this fauna might be expected to show a closer relation to that of the Protolenus beds than any other Etcheminian fauna, described, especially if we regard also the similar physical conditions which environed the two faunas.

DESCRIPTION OF THE FOSSILS.

Lingulella Gregwa, n. sp. Pl. I., figs. 1*a* to *f*.

This species has a long acuminate beak to the ventral valve like *Lingulepis pinniformis* of a later fauna, but the dorsal valve is quite different ; its central group of scars is advanced far to the front, as in Obolus, and in connection with this feature a flattened band traverses the centre of this valve ; this flattened area is narrower than that of *Mickwitzia monilifera* and *Obolus major*, and it is a smaller species than the latter.

Sculpture.—The surface of the valves of this species has a dull appearance, and under the lens the ornamentation is resolved into irregular concentric beaded ridges.

Size.—Length of ventral 12 mm., width 9 mm. The dorsal valve is 3 mm. shorter than the ventral.

This species is like *Lingulella acutangulus* Roem. of the Upper Cambrian of Texas, but is larger and differs in the more acuminate apex of the ventral valve, etc.

LINGULELLA TUMIDA, n. sp. Pl. I., figs. 2*a* to *c*.

A small round, thick-shelled species, of which only the ventral valve is known. It resembles an Obolella in form, but has a corneous test, and a pedicle groove.

Sculpture.—The surface of the shell is marked by rounded concentric ridges, some of which show a beaded crest.

Size.—Length 6 mm., width 5 mm.

Lingulella Martinensis, of the Protolenus Zone, is something like this in form, but is much larger. *Lingulella Ella*, H. & W., of the Middle Cambrian of the West, is like this in size and outline, but the surface markings are finer.

We now come to two species whose reference to the genus Lingulella is doubtful, because we have not recognized the pedicle groove, and because especially as regards the second, the form, etc., is suggestive of Lingula rather than Lingulella.

LEPTOBOLUS (?) COLLICIA, n sp. Pl. I., figs. 3*a* to *e*.

A small oval species somewhat pointed in front. Margins flattened, especially in the posterior half. Remarkable for the peculiar spoutlike flexure at the front of the dorsal valve, acquired in the later stages of growth. A corresponding pair of grooves appears in the anterior part of the ventral valve. This peculiarity of form simulates the sinus of the articulate Brachiopoda.

Sculpture.—This consists of fine concentric ridges, visible only with the aid of a lens. These sometimes anastomose.

Size.– Length 10 mm., width 6 mm.

LEPTOBOLUS ATAVUS, n. sp. Pl. II., figs. 1*a* to *f*.

Shell calcareo-corneous. Ventral valve somewhat pointed behind. Hinge area very small and obscure, not more than a tenth of the length of the valve. Margins of the valves arched downward all around, except at the apex of the ventral valve. The median depression of the dorsal valve indicates that the central group of muscles are set far forward in that valve, as they are also in the ventral valve.

Sculpture.—Somewhat obscure fine concentric striæ, visible with a lens, are present on all parts of the valves. A very fine granulation also can be seen. The outer layer of the shell, which carries the ornamentation, is calcareous.

Size.—Length 5 mm., width, $3\frac{1}{2}$ mm.

This species is of about the same size and geological age as *Lingulella ferruginea*, Salter; but if Davidson's figure is correct that species had a hinge area twice as long as this. It may be further observed that Davidson has included in this species forms from much higher zones of the Cambrian (Dolgelly group, etc.), but the characters are so vague that any small oval species might be referred to *L. ferruginea*. We are subject to the dilemma of choosing between two or several species which by form and size represent *L. ferruginea*, but which by other characters are found to be distinct from each other; hence, if one is *L. ferruginea*, the others are not.

Lingulella Granvillensis, Walcott, of the New York Cambrian, is of about the same size as this, and approaches it in form, but the moulding of the interior of the dorsal valve differs.

Palæobolus, n. sub-gen.

Distinguished from Obolus proper by the close approximation of the vascular trunks, as shown by their impression on the ventral valve, and by the forward direction of its branches. The callus of the visceral cavity of this valve is correspondingly narrow (therefore the muscle scars are also approximated). Yet the valve is round as in Obolus.

In default of more exact criterea, we have adopted here and elsewhere the following characters for distinguishing Obolus from Lingulella,— roundness of outline, short cardinal area and depressed beaks, advanced position of muscle scars in the valves, and strong arch of the vascular trunks in the ventral as well as the dorsal valve. There is, however, a more important distinction, which, in consequence of imperfect preservation of the valves, can seldom be observed, that is, the position of the secondary muscles of the central group in the ventral valve, as compared with the great muscle of that group. In Obolus they are *lateral*, but in Lingulella *anterior* to the great muscle. This shows a radical difference of structure between the two genera. It will be observed that the relation of these muscles is as yet unknown in Palæobolus.

PALÆOBOLUS BRETONENSIS. Pl. II., figs. 2*a* to *i*.

Oblately orbicular. Valves evenly rounded from the centre, except that the borders are flattened at the sides and front. Both dorsal and ventral valves somewhat pointed at the umbo, which is depressed in both valves. *Interior of the ventral.*—This has a broad hinge area and a triangular pedicle groove. The visceral cavity has two pairs of diverging ridges, which mark the advance of the lateral muscles during the growth of the shell. Between the outer and the inner pair originate the vascular trunks, which in going forward throw off branches at an acute angle. *Interior of the dorsal valve.*—This valve has a broad, transversely striated hinge area. The visceral cavity is traversed by two pairs of diverging ridges, more widely divergent than those of the ventral valve; there is also a strong median septum along the middle of the valve. The central group of muscle scars are about a fifth from the front of the valve.

Sculpture.—The whole outer surface, except close to the umbo, is ornamented with sharp concentric ridges which occasionally anastomose; these ridges have fine, faintly marked, radiating striæ on their posterior slopes, and are obscurely crenulated along their crests.

Size.—Length 15 mm., width 17 mm. Dorsal valve somewhat shorter than the ventral.

The Obolus nearest this in age is *O.* (?) *major*, of the Upper Etcheminian in New Brunswick; that species, however, is larger, and does not have the concentric ridges, on the only example of it which is known. None of the European Oboli have the sharp ridges which mark the surface of this species, and they all belong higher in the geological scale. *Obolus* (*Mickwitzia*) *monilifera*, Linrs., has a flattened dorsal valve, and thus differs from this species.

ACROTHELE AVIA, n sp. Pl. III., figs. 1*a* to *h*.

Calcareo-corneous. A rather large species with oblately oval valves, thick, horny, shell substance within, and a thin, calcareous crust without.

Outwardly the ventral valve differs little in shape from the ordinary types of Acrothele of the Protolenus and Paradoxides beds; internally, however, it is characterized by a single in place of the paired pits in front of the foraminal opening, and by strong vascular trunks and branches.

The dorsal valve has radiating ridges on the lateral slopes—a character unique to the species. The interior of this valve has, at the umbo, the usual " nail-like process," as Prof. Hartt called it, viz., the median ridge, on each side of which are impressions of the umbonal and lateral muscles. The group of central muscles are somewhat in front of the middle of the valve. Faint impressions of vascular, and of radiating ridges, are also visible.

Sculpture.—The surface of the valves is marked by fine, irregular, concentric rounded ridges, that frequently anastomose. These ridges are more regular in their course on that part of the shell which is near the margins.

Size.—Length 9 mm., width 10 mm. or more.

ACROTRETA PROAVIA, n. sp. Pl. III. figs. 2*a* to *f*.

Shell substance calcareo-corneous. Ventral valve obliquely conical, with a prolonged beak. Cardinal area narrow ; a tubercle below the foramen, which opens behind the beak. The beak of this valve has a heavy overhang beyond the aperture (nearly half its width). The dorsal valve is orbicular, convex, but somewhat flattened towards the front, the interior has two strong muscular pits near the hinge line, spreading vascular impressions, and a broad low median septum.

Sculpture.—A strong lens reveals a series of concentric striæ on the surface of the shell, of which there are about twenty in the space of a millimetre. A still stronger magnification brings to view a granular ornamentation ; occasional rows of coarser granules are seen to be parallel to the concentric striæ.

Size.—Length of ventral valve 2 mm., width 1½ mm. The dorsal valve is 1½ mm. long.

This species differs from all others in its overhanging apex. From having this form the ventral valves are found lying prostrate on the layers and when their dark shining inner layers are exposed look very like the conical teeth of fossil fishes.

They also are not unlike a long conical Lingulella, and may show us a step by which the genus Acrotreta was differentiated from some such form as Lingulella.

Bradoria* n. gen.

In the Protolenus Fauna are two species of Ostracods, which for want of other known relationship were referred to the genus Primitia. It would appear, however, that in this genus the sulcus which extends from, or near the hinge, downward, should be subcentral. In these two species it is not so, and the depression such as it is, is at or near the anterior end of the hinge line—moreover one of these species (and probably both) is marked by a prominent tubercle, which, from the smoothness of its summit, is supposed to be an organ of vision. It would appear now that these species are representatives of an ancient group of Ostracods which has several specimens in the underlying Etcheminian beds. Though having the general form of Primitia, Primitiella and Aparchites, they do not have the median pit or sulcus of the first, the shallow median depression of the second, or the perfectly smooth valve of the third. Their most marked character is the prominence or tubercle just at the front end of the hinge line. Some of the species have close behind this tubercle a short vertical furrow, scarcely extending clear of the tubercle; or the furrow may pass around the tubercle. In the five species referred here, the marginal furrow is obscure, or invisible along the lower margin.

The known species are nearly of the same size (about $2\frac{1}{2}$ to 4 mm. long) and the surface of the valves is distinctly pitted, tuberculated, or wrinkled.

The following new species come under this genus *B. scrutator*, *B. vigilans*, *B. rugulosus*. It includes also *Primitia oculata* and probably *P. aurora* of the Protolenus Fauna.

Bradoria scrutator, n. sp. Pl. IV., figs. 1*a* to *c*.

Valves ovate, with straightened hinge-line, which is more than half of the length of the valve. Furrow short, immediately behind the ocular tubercle. Hinge bordered by a narrow, sharp ridge. Ocular tubercle nearly marginal, and just in front of the hinge. Marginal furrow obscure, extending around the lower margin of the valve.

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* Named from the Bras d'Or, a salt-water lake occupying the interior of Cape Breton.

Sculpture.—The whole surface is covered with closely set conspicuous pits that are finer toward the hinge-line, where they have a linear arrangement.

Size.—Length 3 mm., width 2 mm.

This species is a little larger than *B. oculata* of the Protolenus Zone, from which it is easily distinguished by the surface ornamentation ; the sculpturing is more like that of *Isochilina ventricosa* of the same zone, but that species is much larger.

BRADORIA VIGILANS, n. sp. Pl. IV., figs. 2*a* to *c*.

Outline of the valves ovate with a straightened hinge line, which is about half of the length of the valve. Ocular tubercle at the front of the hinge line, and surrounded by a shallow groove. The margin is gradually rounded at the front, and below, and project somewhat behind, hence it is nearly straight to the hinge.

Sculpture.—Surface marked by closely set granulations, that become finer toward the hinge line and ocular tubercle, and graduate into a series of sub-parallel anastomosing ridges at the posterior quarter of the valve.

Size.—Length $3\frac{1}{2}$ mm., width $2\frac{1}{4}$ mm.

Distinguished from *Aparchites conchiformis* of the Protolenus Zone by its smaller size and prominent tubercle ; and from *A. secunda* by the tubercle and the coarser ornamentation, etc.

BRADORIA RUGULOSA, n. sp. Pl. III., figs. 3*a* to *d*.

A sub-orbicular species, with outline straightened along the hinge line. Ocular tubercle somewhat prominent and situated a little below the anterior end of the cardinal line, which is about half of the length of the shell. There is a faint furrow behind the tubercle nearly parallel to the hinge line, and a shallow pit just in front of the tubercle. A narrow, obscure marginal rim appears at the posterior margin of the valve.

Sculpture.—The lower slopes and posterior half of the valve are covered with fine anastomosing ridges, concentric to the upper side of the valve ; toward the top and front of the valve these ridges become obscure and the surface of the valve is granulated.

Size.—Length $2\frac{1}{2}$ mm., width nearly as great.

This little species is easily distinguished from the others by its circular outline and rugulose surface, which simulates that of certain trilobites.

SCHMIDTELLA (?) PERVETUS, n. sp. Pl. IV. figs. 3*a* to *c*.

Only the right (?) valve known. It is moderately arched and without furrows, and its greatest fulness is in the upper half. The hinge margin, which is more than half of the length of the valve is formed by an infolding of the edge, without a furrow. No marginal fold was observed.

Sculpture.—The surface is covered with minute pits closely placed the raised spaces between the pits become so prominent on the lower part of the valve that the surface seems tuberculated ; towards the lower and the posterior (?) edges, these tubercles are arranged in rows so that there the valve seems covered with obscure ridges, parallel to the margin : at the opposite side of the valve, toward the hinge, the pits become very fine, and the surface of the valve has a shining appearance.

Size.—Length, 3 mm. Width, $2\frac{1}{2}$ mm.

This species differs from *S. cambrica* of the Protolenus Zone in the less protuberent centre of the valve, and the narrower and straighter infolded border of the hinge line. The marginal fold also is more distinct in *S. cambrica* which does not have the concentric marginal ridges of this species.

SCHMIDTELLA, ACUTA, n. sp. Pl IV., figs. 4 *a. c.*

Valve tumid. Hinge line somewhat more than half of the length of the valve marked by a narrow fold and furrow that extends most of its length. Valve about as wide as long, somewhat acutely pointed at the lower margin. A narrow marginal fold extends along one side of the valve to the pointed end. Greatest protuberance of the valve in the upper half, and towards the hinge the arching of the valve turns suddenly in towards the cardinal line.

Sculpture.—The surface is smooth, somewhat shining, and covered with minute pits or granulations, uniformely distributed.

Size.—Length, $2\frac{1}{4}$ mm. Width, 2 mm.

This species, by its smooth surface and pointed form recalls the genus Beyrichona of the Protolenus Fauna, but it has not the flattened area near the hinge that marks that genus, and is more flattened in lower part of the valve.

From *S. pervetus* this species is distinguished by its finer ornamentation and pointed lower margin ; and from *S. cambrica* by its

smoother surface and narrow fold at the cardinal line. No Silurian Schmidtella has the pointed valve of this species.

DESCRIPTION OF THE PLATES.

Plate I.

Fig 1. *Lingulella Gregwa*, n. sp. —*a* Ventral valve ; *b* interior of same ; —*c* Section of same ; —*d* Dorsal valve ; —*e* mould of interior of same ; *f* Section of same. All mag. $\frac{3}{1}$. See p. 199.

Fig. 2. *Lingulella tumida*, n. sp. *a* Ventral valve ; *b* mould of interior of same ; —*c* Longitudinal section of same. All mag. $\frac{4}{1}$. See p. 200.

Fig. 3. *Leptobolus (?) collicia*, n. sp. *a* Ventral valve ; *b* Dorsal valve; —*c* Interior of a broken ventral valve. All mag. $\frac{4}{1}$; —*d* Another ventral, showing the callus of the visceral cavity, mag. $\frac{3}{1}$; — *e* Section of the two valves, mag. $\frac{4}{1}$. See page 200.

Plate II.

Fig. 1. *Leptobolus atavus*, n. sp. —*a* Ventral valve ; —*b* Mould of the interior ; —*c* Longitudinal section of same ; —*d* Dorsal valve ; —*e* Mould of the interior. All mag. $\frac{6}{1}$. —*f* Portion of the outer surface of the shell. Mag. $\frac{40}{1}$. See p. 200.

Fig. 2. *Obolus (Palæobolus) Bretonensis*, n. subgen. et sp.; —*a* Ventral valve ; —*b* Interior of same ; —*c* Longitudinal section ; —*d* Dorsal valve ; *e* Interior of same ; —*f* Longitudinal section. All mag. $\frac{2}{1}$; —*g* Portion of outer surface of the shell, mag. $\frac{5}{1}$; —*h* smaller portion, mag $\frac{10}{1}$; —*i* Section of the two valves, mag $\frac{2}{1}$. See p. 202.

Plate III.

Fig. 1. *Acrothele avia*, n. sp. *a* Portion of a ventral valve ; *b* Longitudinal section of same. Both mag. $\frac{6}{1}$; —*c* Interior of a ventral valve ; —*d* Dorsal valve ; —*e* Longitudinal section of same ; —*f* Interior of a dorsal valve. The four mag. $\frac{3}{1}$ —*g* Enlargement of the outer surface of the

middle of a dorsal valve; —*h* Enlargement of the surface of the lateral slope of the valve. The two mag. $\frac{10}{1}$. See p. 202.

Fig. 2. *Acrotreta proavia*, n. sp. *a* Ventral valve, upper side; —*b* same, lower side; —*c* same, side view; —*d* Dorsal valve; —*e* Mould of a dorsal valve; —*f* Side view of a dorsal valve. All mag. $\frac{10}{1}$. See p. 203.

Fig. 3. *Bradoria rugulosa*, n. gen. et. sp. *a* Side view of right valve; —*b* Outline from the front; —*c* Outline from the cardinal side; all mag. $\frac{6}{1}$; —*d* Outer surface of the valve; mag. $\frac{10}{1}$. See p. 205.

Plate IV.

Fig. 1. *Bradoria scrutator*, n. sp. *a* Side view of the left valve; —*b* Vertical section; —*c* Transverse section. All mag. $\frac{6}{1}$. See p. 204.

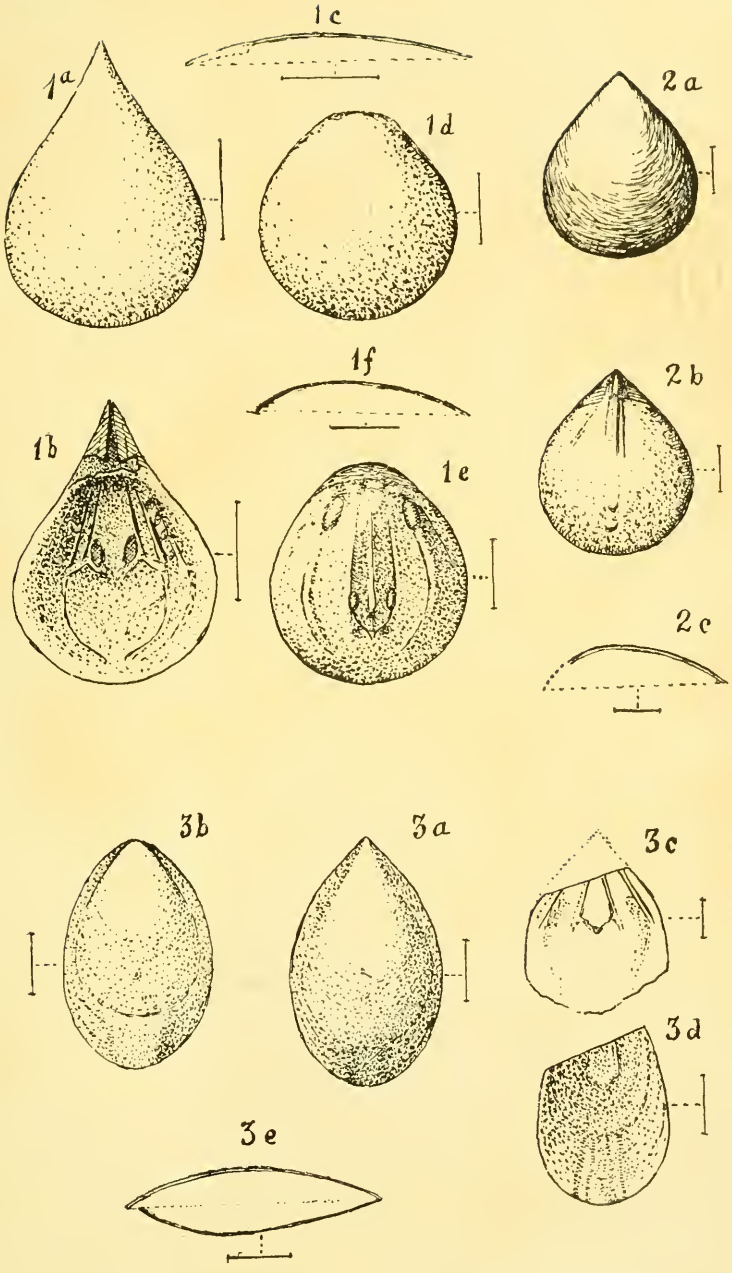
Fig. 2. *Bradoria vigilans*, n. sp. *a* Side view of the right valve; —*b* Outline, front view; —*c* Outline, cardinal view. All mag. $\frac{6}{1}$. See p. 205.

Fig. 3. *Schmidtella pervetus*, n. sp. *a* Side view of (the right?) valve; —*b* vertical section; —*c* transverse section. All mag. $\frac{6}{1}$. See p. 206.

Fig. 4. *Schmidtella acuta*, n. sp. *a* Side view of (right?) valve; —*b* Vertical section; —*c* Transverse section. All mag. $\frac{8}{1}$. See p. 206.

ERRATA TO THE PRECEDING ARTICLE.

Page.	Line.	
193	21	For "Stiletto, read stilletto.
194	5	For "lip," read projecting lip.
195	15	For "trilobites," read Trilobites.
195	16	For "Capulidæ," read Patellidæ.
195	21	For "Lamellibanchs," read Lamellibranchs.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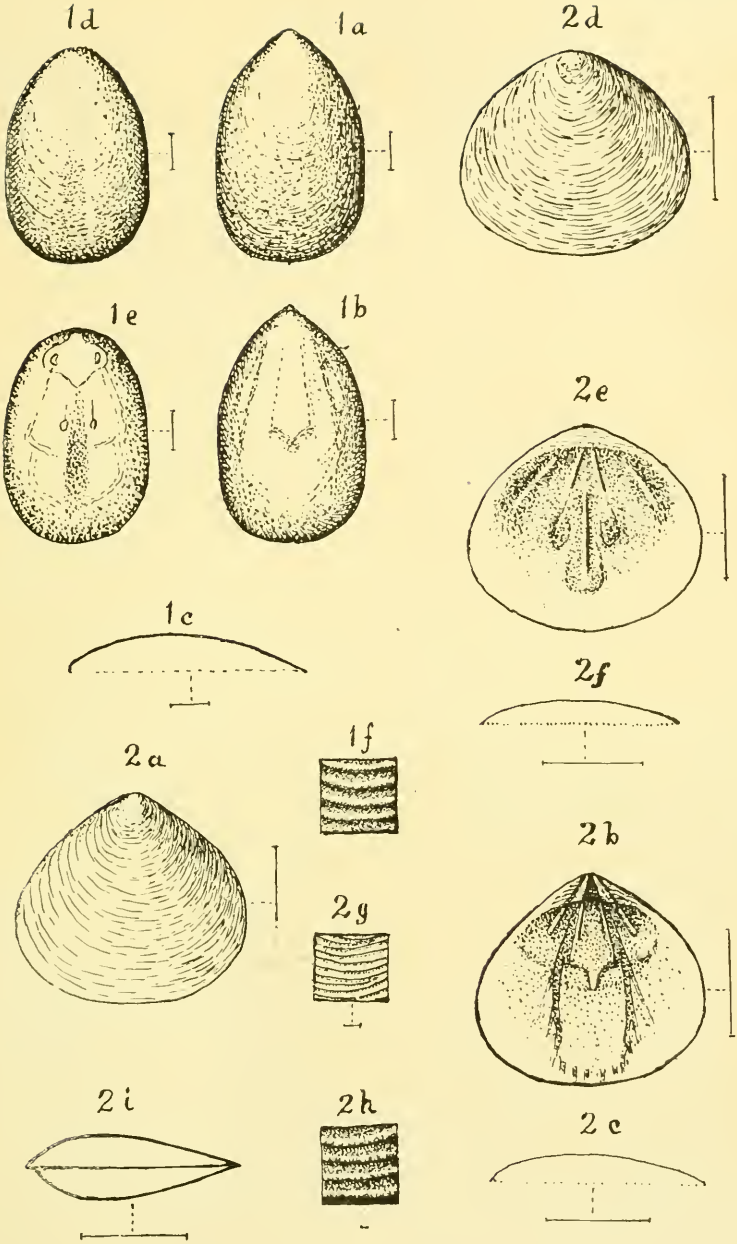
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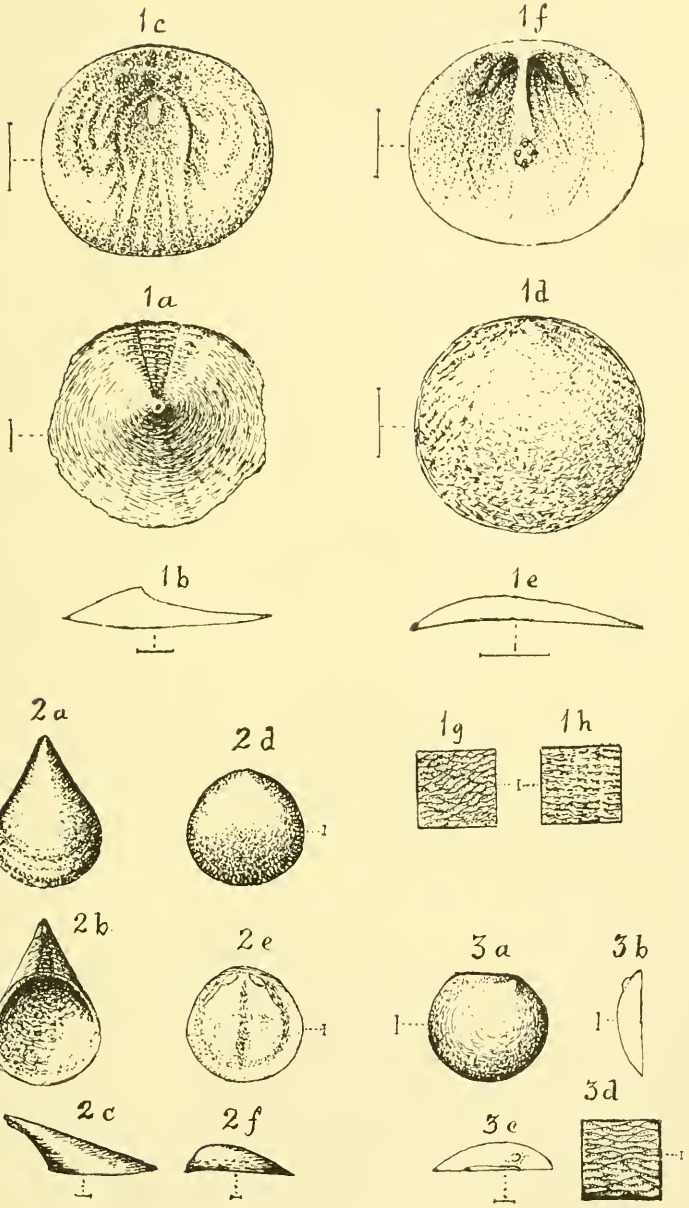
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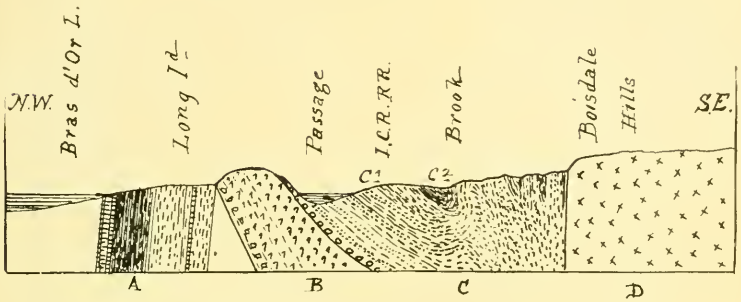
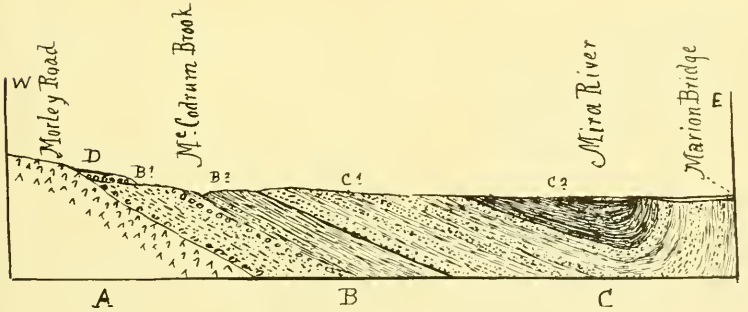
SECTIONS OF THE CAMBRIAN AND ETCHEMINIAN IN CAPE BRETON

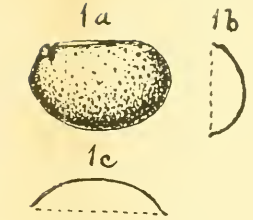
Showing their relation to each other and the underlying Prepalæozic rocks.

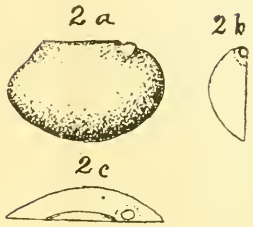


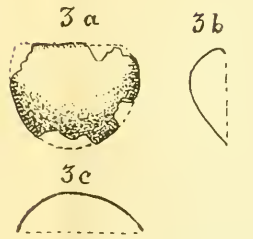
No. 1.—Section at Long Island, Bras d'Or Lake, Cape Breton.—A, Laurentian limestone, schist, etc.—B, Volcanic eruptive (felsites etc.)—C, Cambrian.—D, Prepalæozoic Syenite.—C¹ Olenus Zone.—C² Peltura Zone.

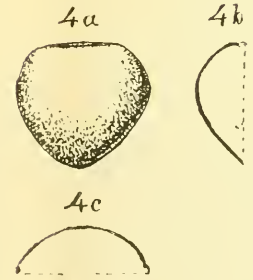


No. 2.—Section from Morley Road to Marion Bridge, Mira R. Cape Breton.—A, Volcanic eruptive (felsite).—B, Etcheminian terrane.—C, Cambrian.—D, Lower Carboniferous—B¹ Lower Etcheminian.—B,² Upper Etcheminian.—C,¹ Olenus Zone.—C,² Peltura Zone.









ARTICLE III.

THE NOCTUIDÆ OF NEW BRUNSWICK.

INTRODUCTORY LIST.

By William McIntosh.

Read November 7th, 1899.

The following list of New Brunswick Moths, with the exception of the Jacquet River and Chatham records, is the result of the past three years collecting in the vicinity of St. John.

In the preparation of this list I am much indebted to Dr. James Fletcher, Ottawa, Dr. R. Ottolengue, New York, Mr. Albert F. Winn, Montreal, and Dr. Herman Strecker, Reading, Pa., who have determined my specimens and given me valuable assistance in my entomological work.

I am under obligation to Mr. Winn, not only for identifying a number of specimens, but also for a very interesting list (in MS.) of Moths taken at Jacquet River in July and August, 1886. All the Jacquet River records are taken from Mr. Winn's list.

The Chatham records are from Mr. J. D. B. F. Mackenzie's List of the Moths of Miramichi (Proceedings of the Natural History Society of Miramichi).

Thanks are due also to Mr. Philip J. R. McIntosh, who kindly placed his collection in my hands for examination.

Family THYATIRIDÆ.

Thyatira scripta, Gosse.

Common at light during June and July.

Pseudothyatira cymatophoroides, Gn.

Two specimens taken at light July 10th and 22nd (1897). Also at Jacquet River.

Pseudothyatira cymatophoroides var expultrix, Grt.

A few specimens taken every year from July 16th to August 2nd. Also at Jacquet River.

Leptina doubledayi, Gn.

One specimen taken June 13th (1898).

FAMILY NOCTUIDÆ.

Demas flavicornis, Smith.

Three specimens, June 26th and 28th.

Raphia frater, Grt.

Two specimens, July 20th and 28th (1898).

Acronycta morula, G. & R.

Chatham.

Acronycta innotata, Gn.

Quite numerous during June and July. Also taken at Jacquet River.

Acronycta populi, Riley.

One or two specimens taken at light.

Acronycta vulpina, Grt.

One taken at light.

Acronycta americana, Harr.

Several specimens taken at light in July. Also reported from Jacquet River and Chatham.

Acronycta dactylina, Grt.

A few specimens taken each year ; but not at any time abundant.

Acronycta impressa, Wlk.

Two specimens taken during the present year.

Acronycta superans, Gn.

Jacquet River.

Acronycta dissecta, G. & R.

Jacquet River.

Harrisimemna trisignata, Wlk.

One perfect specimen at light August 2nd (1899).

Microcœlia fragilis, Gn.

Two taken July 20th (1899).

Chytonix palliatricula, Gn.

One specimen captured at light July 18th (1899).

Rhynchagrotis chardinyi, Bdv.

Several taken during the present year. Also at Jacquet River.

Rhynchagrotis minimalis, Grt.

One specimen (1898).

Rynchagrotis placida, Grt.

One at light in July.

Rhynchagrotis alternata, Grt.

This species is usually abundant on Willow blossom in April and May.

Adelphagrotis prasina, Fabr.

Very common at light during July. Also taken at Jacquet River.

Platagrotis pressa, Grt.

Taken in limited numbers in July. Also at Jacquet River.

Eueretagrotis perattenta, Grt.

One specimen taken at light in July.

Pachnobia salicarum, Wlk.

This species is quite numerous on Willow blossom in April and May.

Agrotis ypsilon, Rott.

This Moth is exceedingly common, dozens being taken at light in a single evening. Also taken at Jacquet River.

Peridroma occulta, Linn.

This species, is quite numerous at light on old walls, fences, etc. Reported from Jacquet River.

Peridroma astricta, Morr.

One or two specimens taken in July.

Peridroma saucia, Hbn.

A few specimens taken during the past season—August.

Noctua baja, Fabr.

Abundant at light in August. This species varies considerably; some specimens are ashy gray, while others are pale reddish brown. Also taken at Jacquet River.

Noctua normaniana, Grt.

Several at light July and August.

Noctua c-nigrum, Linn.

This is one of the most common Moths in this locality—July to October. Also reported from Jacquet River.

Noctua jucunda, Wlk.

One at light in July.

Dr. Strecker, referring to the specimen sent for identification, says: "A very decidedly marked example; I never saw one so richly colored or distinctly marked; but I do not doubt it is this species."

Noctua phyllophora, Grt.

Three specimens taken during the present year.

Noctua rubifera, Grt.

One taken late in July.

Noctua fennica, Tauseh.

Twelve or fourteen specimens taken during the past three years.

Noctua plecta, Linn.

A limited number taken in June, July, and early in August. Also at Jacquet River.

Noctua collaris, G. & R.

Two specimens taken at light—July.

Noctua haruspica, Grt.

Abundant at light in July. Also taken at Chatham.

Noctua clandestina, Harr

Jacquet River.

Feltia subgothica, Haw.

Not uncommon at light during August. Also taken at Jacquet River and Chatham.

Feltia herilis, Grt.

A few specimens yearly; not so abundant as the preceding species.

Feltia venerabilis, Wlk.

Several at light during the present year. Also at Jacquet River and Chatham.

Porosagrotis mimallonis, Grt.

One taken August 13th.

Carneades quadridentata, G. & R.

Two specimens taken, August 26th (1899.)

Mr. Strecker informs me that heretofore he has only seen this from the West.

Carneades fumalis, Grt.

One at light.

Carneades pitychrous, Grt.

Chatham.

Carneades messoria, Harr.

Jacquet River.

Carneades lutulenta, Smith.

Very numerous at light for about a week in August (1898–99).

Carneades mollis, Wlk.

A few specimens of this beautiful Moth taken at Willow blossom in May. Also a number of what appears to be a darker form taken at light.

Carneades decolor, Morr.

One at light.

Carneades tessellata, Harr.

Quite numerous at light early in July.

Carneades ochrogaster, Gn.

Very abundant at light in August. Three forms of this variable insect is common here.

Carneades redimicula, Morr.

A few specimens taken at light during the first week in August.

Mamestra nimbosa, Gn.

This beautiful Moth is taken in limited numbers at light in August. Also at Chatham.

Mamestra imbrifera, Gn.

Two at light.

Mamestra purpurissata, Grt.

Several taken at light in August.

Mamestra detracta, Wlk.

Two taken July 20th (1899).

Mamestra radix, Wlk.

Two taken at light near Gagetown.

Mamestra canadensis, Smith.

In Prof. J. H. Smith's Catalogue of Noctuidæ, New Brunswick is the only locality given for this Moth. We have no local record of its capture.

Mamestra subjuncta, G. & R.

Four specimens taken July 12th, 15th and 27th.

Mamestra grandis, Bdv.

One taken early in October (1899).

Mamestra trifolii, Rott.

One taken at light July 10th (1897).

Mamestra picta, Harr.

A few taken at light during the present year—July.

Mamestra lubens, Grt.

Three taken in 1897 ; and one at light July 18th of the present year.

Mamestra assimilis, Morr.

One taken by Philip McIntosh July 18th (1899).

Mamestra latex, Gn.

Chatham.

Mamestra adjuncta, Bdv.

A few specimens at light in June and July.

Mamestra legitima, Grt.

Two specimens taken at light early in July.

Mamestra lilacina, Harv.

One taken by Philip McIntosh July 2nd (1899).

Mamestra renigera, Steph.

A few specimens taken every year. Also reported from Jacquet River and Chatham.

Mamestra olivacea, Morr.

During July and August this species is very common at light. Also taken at Chatham.

Mamestra lorea, Gn.

Jacquet River.

Hadena passer, Gn.

A few taken at light during the latter part of July.

Hadena remissa, Hbn.

Two or three specimens taken each year from the 8th to 20th of July.

Hadena vultuosa, Grt.

Two taken July 22nd (1898) and August 1st (1899).

Hadena finitima, Gn.

One at light July 1st (1899).

Hadena dubitans, Wlk.—(Sputatrix, Grt.)

Common at light under logs and in crevices during August. A very light form of this species is abundant here.

Hadena impulsa, Gn.

Two taken July 6th and 11th (1898-99).

Hadena devastatrix, Brace.

This species is quite common during July, August, and the first part of September. Also reported from Jacquet River and Chatham.

Hadena arctica, Bdv.

This beautiful insect is so common in July and August that it is a nuisance at light; also taken at bloom resting on fences, etc. Reported from Jacquet River.

Hadena verbascoides, Gn.

A few taken at light in July.

Hadena bridghami, G. & R.

Taken in limited numbers late in July and early in September.

Hadena minuscula, Morr.

One specimen taken August 14th (1899).

Hadena modica, Gn.

A few taken at light early in August.

Hyppa xylinoides, Gn.

Not uncommon at light in July. Also at Chatham.

Trigonophora periculosa, Gn.

Three specimens taken in August (1898–99). Also at Jacquet River.

Trigonophora periculosa (var. v-brunneum), Grt.

Jacquet River.

Brotolomia iris, Gn.

Very abundant during the last of June and early in July.

Euplexia lucipara, Linn.

Two specimens at light July 15th and 26th (1899).

Nephelodes minians, Gn.

Common at light, in crevices, etc.—July and August.

Tricholita signata, Wlk.

Three or four specimens taken in August.

Helotropha reniformis, Grt.

One taken on bloom August 17th (1898).

Hydrœcia velata, Wlk.

Extremely common from July 25th to September 20th.

Hydrœcia nictitans, Linn.

Very abundant at light ; flying during the same season as Velata. Also at Jacquet River.

Hydrœcia nictitans (var. erythrostigma), Haw.

Taken at light during the entire month of August, but not so abundant as the preceding species.

Hydrœcia medialis, Smith.

One taken September 2nd (1898).

Hydroecia cerussata, Grt.

Several taken every year, but not at any time abundant.

Leucania pallens, Linn.

A few specimens taken yearly in July. Also at Jacquet River.

Leucania extincta, Gn.

Several taken in the middle of July (1899).

Leucania insueta, Gn.

Two taken in July (1899). Also at Jacquet River.

Leucania commoides, Gn.

Several at light during July and August. Also at Chatham.

Leucania unipuncta, Haw.

This species is taken every year, but does not appear to be very numerous.

Leucania pseudargyria, Gn.

Jacquet River.

Caradrina multifera, Wlk.

Jacquet River.

Amphipyra tragopoginis, Linn.

Abundant at light from the 12th to 30th of August.

Orthodes puerilis, Grt.

Two specimens taken in July (1899).

Crocigrapha normani, Grt.

One taken May 20th (1899).

Tæniocampa furfurata, Grt.

Several specimens taken in July (1899).

Tæniocampa alia, Gn.

Not uncommon at Willow blossom in May.

Cosmia paleacea, Esp.

Several taken at light early in September.

Pyrrhia umbra, Hbn.

Very abundant for about a week during the latter part of June.

Orthosia conradi, Grt. (?)

Jacquet River.

Xanthia flavago, Fabr.

Two specimens taken in 1897.

Cirrœdia pampina, Gn.

Chatham.

Scoliopteryx libatrix, Linn.

One taken by Philip McIntosh. Also reported from Chatham.

Scopelosoma devia, Grt.

One taken by Philip McIntosh May 15th, 1898.

Xylina disposita, Morr.

Several taken in May (1898).

Xylina ferrealis, Grt.

Two specimens taken in May (1898).

Xylina bethunei, G. & R.

One taken by Philip McIntosh May 1st (1899).

Xylina laticinera, Grt.

Three specimens taken in May 1898.

Xylina thaxteri, Grt.

One May 10th (1898).

Colocampa nupera, Lint.

Three or four specimens taken during the past three years.

Cucullia convexipennis, G. & R.

Taken in limited numbers in August.

Cucullia asteroides, Gn.

A few taken in June.

Cucullia intermedia, Speyer.

Common at light June and July. Also reported from Jacquet River and Chatham.

Aletia argillacea, Hbn.

Abundant at light in September and the earlier part of October. On the 11th of October, 1897, this species appeared in immense numbers.

Abrostola urentis, Gn.

A few taken in July. Apparently rare.

Deva purpurigera. Wlk.

Two specimens taken by Philip McIntosh.

Plusia ærea, Hbn.

Three taken in July 1898.

Plusia aeroides, Grt.

Much more abundant than the preceding species. Also taken at Jacquet River.

Plusia balluca, Geyer.

Only two or three specimens taken each year.

Plusia contexta, Grt.

Jacquet River.

Plusia putnami, Grt.

Not common ; taken at light in July and August.

Plusia mappa, G. & R.

Taken in limited numbers in July.

Plusia bimaculata, Steph.

A very common species ; taken in July August and September. Also at Jacquet River and Chatham.

Plusia precationis, Gn.

Abundant from June to October. During the present year this species was common on blossom until November 5th.

Plusia flagellum, Wlk.

(Syn. monodon-insolita.)

A few specimens taken each year in June and July.

Plusia brassicæ, Riley.

Only one or two taken at bloom in August.

Plusia mortuorum, Gn.

Very common at light and bloom in July and August. (Dr. Ottolengui states that this species is "erroneously called u-aureum in American collections.") Also taken at Jacquet River.

Plusia retangulum, Kirby.

Dr. Ottolengui informs me that this species, known as mortuorum in American collections, is really Kirby's retangulum. This Moth is exceedingly common at light and on bloom, July, August, and early in September. Also taken at Jacquet River.

Plusia octo-scripta, Grt.

Common at light and bloom, July, August, and early in September.

Plusia falcifera, Kirby.

Seven or eight specimens taken from July 30th to September 7th.

Plusia selecta, Wlk.

(Syn. viridisignata, Grt.)

Four taken in August.

Plusia epigæa, Grt.

Not uncommon at light and bloom in July and August.

Plusia ampla, Wlk.

Only three or four specimens taken during the past three years—August 4th to 11th.

Plusia simplex, Gn.

A few taken at light and bloom. Also at Jacquet River and Chatham.

Calpe Canadensis, Bethune.

One specimen taken on bloom July 15th (1899).

Heliothis armiger, Hbn.

One taken September 15th (1899).

Alaria florida, Gn.

Two taken in August (1897).

Metathorasa monetifera, Gn.

Two specimens taken in July (1897-98).

Erastria apicosa, Haw.

Jacquet River.

Drasteria erechtea, Cram.

Abundant from June to October. Also at Jacquet River.

Drasteria erichto, Gn.

Several taken with erechtea in June.

Euparthenos nubilis, Hbn.

Known to occur in this locality, but not taken by the writer.

Catocala cerogama, Gn.

One taken in August (1899).

Catocala ultronia, Hbn.

Several taken every year—August and September. Also at Chatham.

Catocala ilia, Cram.

Two specimens taken September 12th and 16th (1898).

Catocala parta, Gn.

Several are known to have been taken in this locality some years ago.

Catocala unijuga, Wlk.

A few specimens taken during the latter part of August Also at Jacquet River.

Catocala concumbens.

Not uncommon ; taken at light and sugar in August and September.

Catocala relicta, Wlk.

This beautiful insect is not uncommon in this locality. August and September.

Catocala antinympha, Hbn.

Chatham.

Catocala cœlebs, Grt.

One specimen taken by Philip McIntosh.

Parallelia bistriaris, Hbn.

One taken July 16th (1898).

Homoptera lunata (var. edusa), Drury.

One specimen taken resting on a wall June 4th (1897).

Ypsia undularis (var. æruginosa), Gn.

A pair taken resting on trees.

Epizenxis æmula, Hbn.

A few specimens taken late in August (1899).

Hypena scabra, Fabr.

Chatham.

FAMILY BREPHIDÆ.

Brephos infans, Mœschl.

In April this interesting Moth was quite numerous in groves of small birch trees near the city; but only two specimens were taken.

ARTICLE IV.

THE BUTTERFLIES OF NEW BRUNSWICK.

By William McIntosh.

(Read November 7th, 1899).

In Bulletin No. XVII, pages 114–121, I gave a list of the butterflies of this province as far as known to me. During the past season a number of additional species have been captured near St. John; these will be found in the following supplementary list. Mr. Albert F. Winn, of Montreal, also sent me some very interesting notes on butterflies taken at Jacquet River, New Brunswick, in 1886. Among Mr. Winn's captures are two species not recorded in my former list; these are also noted below:

Phyciodes nycteis, Double-Hew.

(Charidryas nycteis).

One specimen taken at Welsford, July 1st.

Thecla titus, Fabr.

(Mopsus, Hubn. Strymon titus).

Two specimens captured in the Nerepis valley in July.

Feniseca tarquinius, Fabr.

Three specimens of this curious little butterfly were taken during the past summer, July 16th and 31st.

Lycæna couperii, Grote.

Taken at Jacquet River by Mr. Winn. "Was quite common during early July ; one stray specimen August 8th."

Pamphila manitoba, Scud.

(Erynnis manitoba).

"A few taken towards the end of August" by Mr. Winn at Jacquet River.

Pamphila metacomet, Harris.

(Euphyes metacomet).

Not uncommon at Welsford and Westfield in July and early in August.

Eudamus pylades, Scud.

(Thorybes pylades).

This species was quite abundant at Welsford, Nerepis and Quispamsis during the past summer.

NOTES.

Melitæa phaëton.— On July 1st I had the pleasure of taking a number of perfect specimens of this beautiful butterfly.

Melitæa harrisii.— Over forty of this species were taken in about two hours on July 1st. Worn specimens were plentiful in the same locality July 15th. On August 1st (my next visit) they had entirely disappeared.

Mr. Winn, speaking of this species, says: "One specimen, taken end of July, flying before 5 A. M.

Grapta gracilis.— Mr. Winn refers to this species as follows: "I can confirm occurrence in New Brunswick, having taken a few specimens during the latter part of August.

Two specimens were taken by the writer July 15th (1899).

Pieris napi.—Mr. Philip McIntosh found this species quite abundant on the Belleisle in July. The following is quoted from Mr. Winn's notes: "Pieris oleracea (napi.) Was then (1886) abundant at Jacquet River, but doubtless has decreased proportionately as Pieris rapæ increased, as it has done elsewhere."

Colias interior.— This species still continues to be our most common yellow. Colias philodice not being abundant until late in the season.

ARTICLE V.

NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong, Ph.D.

23.—The Forestry Problem in New Brunswick.

(Read March 7th; revised December, 1899.)

The greatest natural source of wealth of New Brunswick lies in her forests. These are steadily deteriorating. The public is uninformed and hence indifferent as to their fate. These three facts constitute a forestry problem of the gravest character, and one vastly important to the future of this province.

Probably there is no other part of the earth's surface that originally bore a nobler forest on a land so richly watered. Some of the most valued timber trees of the northern temperate zone grew in New Brunswick, and completely clothed her hills and valleys from her farthest inland waters all around to the sea. Every part of the province is penetrated by streams which, while swift, are never torrents; and these by the melting of the abundant snows of winter are made passable for the lumber which thus may be carried cheaply into the many large rivers, and down these to fine harbors at their mouths. Immense tracts in the province are admirably adapted for tree growing, and are useless for any other known purpose. Thus has Nature provided in New Brunswick the conditions for a great industry, and thus does she point out our most profitable occupation for the future, when lumbering must be based upon forestry, which consists not in the hunting of trees but in their cultivation.

In the meantime, however, New Brunswick forests are being irretrievably damaged. I do not now refer to defects in forest regulations, systems of cutting, stumpage, etc., for I know nothing about this subject. I have inferred, however, from the numerous newspaper writings of the late Edward Jack, who knew these matters so practi-

cally and thoroughly, that our general system of forest management is far from provident. But there is one deadly enemy of our forests whose worst visitations can never be entirely recovered from, and that is the great forest fires. It is not only the timber they destroy that makes these fires so bad, for in a generation or two it may be partially restored, but it is the permanent injury they do to much of our soil whereby its capacity to produce trees for the future is permanently lessened or even practically destroyed. Where naturally the soil is thin, as it is over the rocky hills underlying much of our forest land, the roots and other organic matter binding it together is utterly burnt out by the great fires, and the rain washes the earth off into the streams, leaving behind but the naked rocks, hostile to vegetation. Most of that soil was placed there originally by the ice of the glacial period, and has ever since been held in position by its continuous covering of vegetation; once removed it can be restored only with the most extreme slowness. An awful example of this practically permanent destruction is to be found in an area many miles square on the upper Lepreau river; the still standing rampikes and great stumps show how fine a forest once clothed this land, which now is but a stony desert that not for generations, and perhaps never, can again bear trees. Here is a tract of country that might to-day be yielding a revenue to the province and supporting a considerable village at the mouth of the river, but it lies waste and useless because a fire twenty years ago was not stopped in time. This is an extreme case, but large areas in the province have suffered in but little less degree. The prevention of forest fires is the first problem of forestry in any country, and it has to be solved not only by stringent laws upon railroads, lumbermen, hunters and settlers, but also by a ranger service, a corps of men whose business it is to watch for fires in the dangerous season, and to extinguish them at their beginning. The ranger service may well be combined with that of fish and game wardens, and even with some phases of lumber surveying.

But in addition to loss of timber and permanent injury to the soil, there are yet other losses suffered through the deforesting of a country.* Aside from the still unsettled question as to the effect of forests upon

* The reader who wishes further information upon these subjects will do well to turn to the publications of the Division of Forestry of the U. S. Department of Agriculture, including their recent "Primer of Forestry" and articles in the Year Books of the Department, and also to the reports of the Maine Forestry Board.

the amount and regularity of annual rainfall (both of which, as many students think, are increased by the presence of forests, to the great advantage of the farmer) it is everywhere known that the removal of forests leads to great fluctuations in the water level of rivers, periods of extreme low water alternating with destructive floods. This not only interferes with navigation upon the smaller rivers, but greatly lessens the value of their waterpowers, a subject certain to become of great practical importance in the near future, since, as the leading authorities agree, the improvements in the conduction of power by electricity are sure to make natural sources of power again of value. Destruction of forests, too, destroys their game-producing power, and the fish-producing power of their streams, and hence removes their attraction to wealthy sportsmen whom New Brunswick is doing her best to attract. Yet other losses, sentimental as well as economical, which a people may suffer with loss of their forests, will occur to all.

Deforesting may, of course, occur in other ways, and lead to the same losses, though these are far less in degree than fires entail. Land cleared for cultivation, though partially kept intact by the farmer's crops, suffers slow deterioration, but this loss is unavoidable and slight in proportion to the gain. Especially reckless lumbering sometimes lays an area well nigh waste, allowing of similar deterioration, particularly since such places are very liable to fires. At the present day the forests are threatened by a new danger—the rapacity of pulp-mills, which take lumber even as small as five inches diameter, and hence practically clear the land where they operate, leaving little to grow into timber for the future. No pulp-mill should be allowed to operate in New Brunswick in a way to deforest any piece of land, for a speedy profit of this kind will be dearly paid for in the future. The only wise method in forestry management is to keep a forest intact, and this can be done only by a system of rotation in cutting, by which the larger trees alone are removed, the smaller being left to grow. The prevention of forest fires, and a wise system of cutting, would make the annual lumber crop as certain and as continuous as the agricultural crop. This would give permanence to settlements in the lumber districts and increase the prosperity and contentment of our people. What would it not mean to Charlotte county to-day if her lumber had not been recklessly cut away and her best lands badly burnt over?

It will be a long time yet before tree-planting will pay in New Brunswick, though some day it will. There is one situation, however, in which I think a certain amount of cultivation would pay in the near future. In St. John and Charlotte counties, and in lesser degree in other parts of the province, are many abandoned farms growing up in trees. Left to themselves these trees are oftener than not of worthless sorts, and grow so densely as greatly to injure one another in the struggle that ensues. If pine and the best spruce were established on these lands, and kept thinned out, they would in time yield ample returns, returns that no individual can afford to wait for, though a government, with its borrowing capacity, can. Care should be taken in future, too, not to grant for settlement land that is better suited for trees than for agriculture.

Under so purely democratic a government as that of New Brunswick, no legislature can afford to take steps not backed by public opinion. Any movement entailing much present expense for a distant return would undoubtedly be condemned by the people. If, however, the great importance of this subject to the future of the province were generally understood, the people could be trusted to respond in its favor as they have for education and other great interests. It is, however, the duty of the government to take the first step, which should be towards the acquisition and dissemination of knowledge upon the subject of forestry in all its aspects and in its relation to allied interests, such as game preservation, fishing licenses, water-powers, location of settlements, etc.; and, following this, should come the formulation of a broad plan for the economic management of these great public interests. The experience of other countries shows that such wide-reaching investigation must be made independent of the exigencies of local politics, which can be done only by placing the whole subject in the hands of a commission, unpaid except for expenses, composed of the most public-spirited and able citizens. Surely New Brunswick is not so poor that she cannot command this service from her sons.

24.— Cost of a Topographical Survey of New Brunswick.

(Read April 4th, 1899).

In a former note upon this subject (No 14), I pointed out that a survey of New Brunswick upon the plan and scale of that of Massachusetts would cost at least $351,000, and probably much more,

perhaps $500,000.* Mr. Henry Gannett, Geographer of the United States Geological Survey, and the leading American authority upon this subject, in acknowledging the receipt of a copy of the afore-mentioned note, writes me as follows: "Referring to what you say concerning a survey of the province, let me suggest that a scale of about two miles to an inch is sufficiently large for present requirements. This is the scale which we are using in this country for the greater part of our territory and find it, on the whole, most satisfactory."

"The expense of a survey for this scale, including all the operations incident to the production of the manuscript maps amounts on an average, to about $5.00 to a square mile, which for the area of New Brunswick, will be about $140,000, which is not a prohibitive price to pay."

A very complete, and of course authoritative, account of the methods of conducting topographical surveys and of constructing topographical maps is given by Mr. Gannett, in his "Aims and Methods of Cartography" recently published by the Geological Survey of Maryland (Special Publication, Volume II., Part IIIa, 1898), and this work is invaluable to all interested in this subject.

A topographical survey of New Brunswick must in time be undertaken, and so great will be its scientific and economic benefits that this Society should use its utmost influence to have it begun as soon as possible.

25.—What is the Highest Land in New Brunswick?

(Read April 4th; re-written December, 1899.)

In former notes of this series (Nos. 5 and 19), it was pointed out that two hills compete for the honor of being the highest in New Brunswick, namely: Big Bald Mountain on the South Branch of Nepisiguit, and another unnamed mountain three miles south of Mount Sagamook near Nictor Lake. The latter of these two, I shall, for reasons to be given in a later note (No. 30) call Mount Carleton.*

The height of Big Bald was measured in 1880 by Mr. Ells, and

* I find that I was probably mistaken in my supposition (Note 19) that this mountain was the one to which the name Bald originally and properly belonged. It is Sagamook which is called Bald by the guides and others, and on the early plans. Mount Carleton appears hitherto to have been entirely unnamed.

found to be 2,500 feet, as given in his Geological report. The geological map marks it, however, as 2,700 feet; but as Mr. Ells is the only one who has measured it, the greater height upon the map appeared to be an error. Mr. Chalmers, however, has recently written me as follows: "So as to settle the question of the height of Big Bald Mountain, South Branch Nepisiguit, as far as it is possible to do so with the aneroid, Mr. Ells and I have gone carefully over his notes and barometric readings again. He has two sets of readings, one taken while going up river from Bathurst Harbour, the other taken when returning. Observations were made regularly every day, and at the camping grounds morning and evening several times. Working out the figures both ways we find the results to be very close, *and the mean elevation of Big Bald Mountain to be 2,715 feet above sea level.*" This gives a definite basis for the height of 2,700 feet com monly assigned to that mountain.

Some new facts as to the height of its rival, Mount Carleton, are here to be presented. In August last, I climbed and measured it. I made it by direct measurement with aneroid 112 feet higher than Mount Sagamook, and this I made by a mean of two measurements, 1,633 feet above Nictor Lake. Nictor Lake I made by a mean of fourteen measurements, all corrected from simultaneous readings at Fredericton, (see later Note 31) 837 feet above sea level. This would make Carleton 2,582 feet above the sea level. I have reason to think, however, that this result is considerably too low. I have found that my barometer moves slightly sluggishly, and moreover other good measurements of Nictor Lake and Sagamook Mountain have given considerably higher results. Thus Mr. Chalmers gives the height of Nictor Lake as 878 feet, and Sagamook as 1659 higher. On this basis Carleton would be 2649 feet. There is, however, another set of measurements of lake and mountain which cannot be disregarded, the more especially since they were made with mercurial barometers, which are much more reliable than aneroids. In 1839 a series of such measurements, checked by comparison with a fixed station at Grand Falls, was carried across the province by way of Nictor Lake, by a Mr. Wightman, employed by the British government in connection with the elucidation of the highlands of the boundary disputes, and the results are given in full in the Blue-book, "The North American Boundary," 1840. All of his measurements however, while relatively accurate, are absolutely

too low, and we must apply to them a correction of fully 100 feet.* As the mean of many careful observations he made the surface of Nictor Lake 777 feet above the sea, *i. e.*, with the correction 877 feet. He made Bald Mountain (or Sagamook) 2496 feet, *i. e.*, 2596 with the correction. If to this we add the 112 feet which Carleton surpasses Sagamook or Bald, we have as the height of Carleton 2708 feet, which is very close to the 2715 of Big Bald.

If one were to take Hind's correction of 123 feet for Wightman's results, instead of the 100 here adopted, it would make Carleton 2731 feet, thus surpassing Big Bald considerably. I by no means think, however, that reliance can be placed upon these latter figures, but they at least should make us cautious in forming a judgment as to which is the higher mountain. Big Bald and Carleton must be very near the same height, with the probability in favor of Big Bald. The relative heights could be best settled by a comparison of careful theodolite measurements made from the summit of each upon the summit of the other.

26.—On a Division of New Brunswick into Physiographic Districts.

(Read May 2nd, 1899.)

Whoever attempts a systematic description of any class of facts or phenomena, or treatment of phases of local history, for the whole of New Brunswick, must feel the need for some natural and recognized

* Wightman's figures are too low, because it was assumed that the levels along the St. John, from Fredericton to Grand Falls, made in 1826 by Foulis, were correct, whereas they are inexplicably erroneous and low. Hind (Geological Report, 1865, 31) has shown that this is the case, and arguing from levels taken by Graham in connection with the survey of the north line in 1842, and from those on the Royal Road, he reasons that Foulis' figures are about 123 feet too low. Other measurements by Wightman himself show a discrepancy between head of tide above Fredericton and high tide on Bay Chaleur of 77 feet, which is explained by the report as due to high tide level at Fredericton being 80 feet above high tide level at St. John. This we now know is erroneous, for Duff has shown (this Bulletin, XV. 69) that mean tide at Fredericton is only about 14 feet above mean tide at St John, and hence high tide level is about the same at both places. But I think Hind puts the correction for Wightman's error too high, for I think Graham's figure of 419 feet for the river above the fall is too high. It is higher than the Royal Road levels. Graham, moreover, gives the monument at source of the St. Croix as 538 feet above mean tide at Calais ; later measurements of the surface of Grand Lake (from which there is continuous deadwater to the monument) based I believe on railroad levels, given on the geological map, make it only 499 feet. Probably we would be safe in giving a correction of 100 feet to Wightman's figures, though if we wished to be extra conservative we might restrict it to the correction supplied by Wightman himself in his difference of 77 feet above high tide in Bay Chaleur, plus 3 feet to reduce the latter to mean tide, that is, in all 80 feet.

division of the province into districts. In a work now nearing completion I have had to make such a division, and thus have given some study to the subject, with the following results. For a detailed natural division the counties, with their artificial boundaries, are not available; and the geology, with its correlated topography, is too irregular and complicated. We do find, however, a convenient and fairly natural division in the river systems, which for historical purposes is especially suitable, since they have powerfully influenced the distribution of settlements. But if we attempt to separate these systems by lines drawn along their watersheds (as is done on the accompanying map, fig. 1), we see at once that in a general way there is a correspondence between counties and river systems. This is, of course, no mere accidental coincidence, but is the result of a true causal relation, for the principle that has determined the setting off of our counties has been that of grouping them around the river basins and running their boundaries along the watersheds.* It will obviously be convenient in making our natural divisions to pay as much attention as possible to the familiar county divisions, and hence the boundaries of the latter may well be used to settle doubtful points in the natural divisions. There are two cases in which it is profitable to use the county divisions to determine details of the natural divisions —first, in the points of separation of the systems along the sea coast (for here the county lines have been very wisely chosen), and second, in the secondary division of the large St. John system. The geology also, in doubtful cases, may be called to aid. Taking into account all of these factors, the river system districts of New Brunswick would appear to be as follows, and as traced on the accompanying map. Natural divisions should obviously be known by indigenous names, for which, happily, convenient Indian names are available.

I. *The Passamaquoddy (or Charlotte) District.* Includes the basins of all rivers from the Cobscook to Point Lepreau.

II. *The Woolastook (or St. John) District.* Includes the entire St. John System and the smaller rivers from Point Lepreau to Martins Head.

* That river systems and counties do not correspond yet more closely is due to three causes:—First, county lines are, for convenience of running and marking, best made straight, while watersheds are crooked; second, the geography of the province was imperfectly known when some of the lines were established by law, and hence they do not run as it was supposed they would; third, some of our rivers run so far across the province and head so near the basins of others, it is practically more convenient to allow their heads to fall into other counties. Such is the case with the St. Croix and Magaguadavic, Washademoak and Salmon River, Miramichi, and Restigouche.

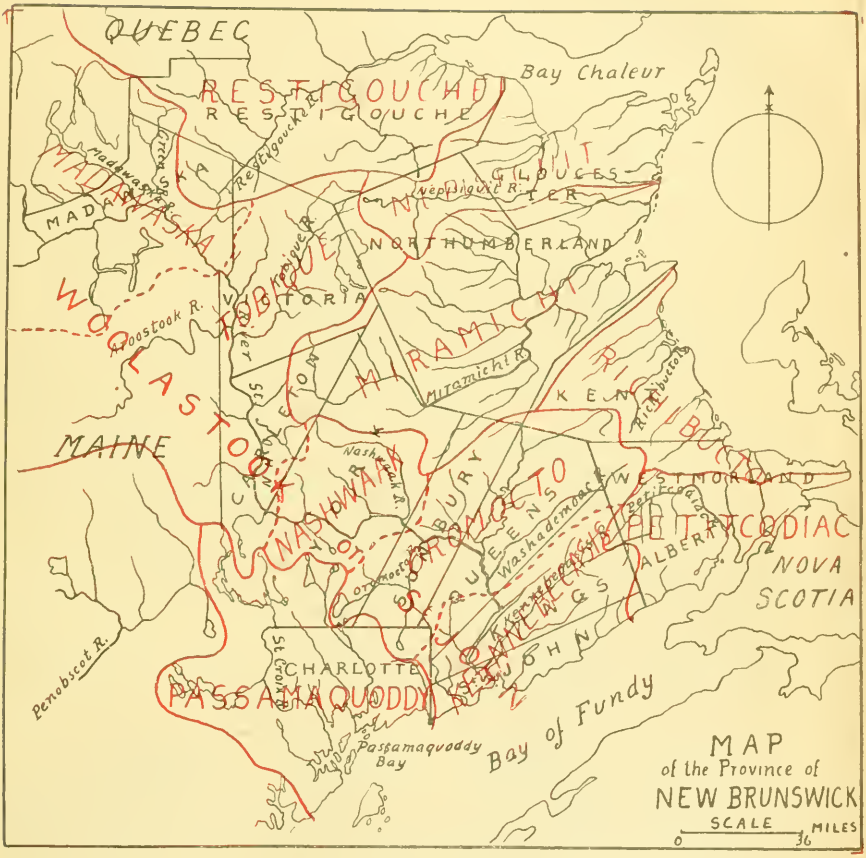

QUEBEC
Bay Chaleur
RESTIGOUCHE
RESTIGOUCHE
Restigouche R.
Madawaska R.
MADAWASKA
MADAWASKA
GLOUCESTER
Nepisiguit R.
NORTHUMBERLAND
Kenique R.
VICTORIA
WOOLASTOOK
Aroostook R.
River St. John
MIRAMICHI
Miramichi R.
KENT
Richibucto R.
RICHIBUCTO
MAINE
Nashwaak R.
NASHWAAK
SUNBURY
QUEENS
WESTMORLAND
Petitcodiac R.
PETITCODIAC
Washademoac R.
Oromocto R.
OROMOCTO
ALBERT
NOVA SCOTIA
Kennebecasis R.
KENNEBECASIS
JOHN
Penobscot R.
St. Croix R.
CHARLOTTE
PASSAMAQUODDY
Passamaquoddy Bay
Bay of Fundy
MAP
of the Province of
NEW BRUNSWICK
SCALE
0
36
MILES

Fig. 1.

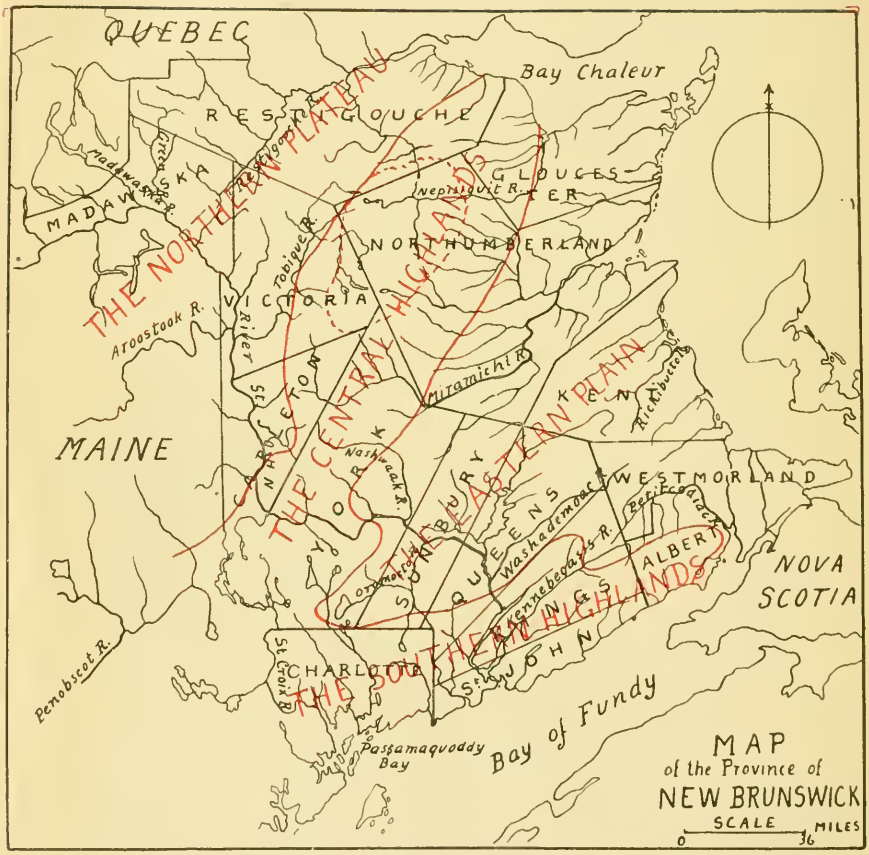

QUEBEC
Bay Chaleur
RESTIGOUCHE
GLOUCESTER
MADAWASKA
NORTHUMBERLAND
VICTORIA
KENT
MAINE
WESTMORLAND
QUEENS
SUNBURY
YORK
CARLETON
ALBERT
NOVA SCOTIA
CHARLOTTA
ST JOHN
Bay of Fundy
Passamaquoddy Bay
Penobscot R.
St Croix R.
Madawaska R.
Aroostook R.
Tobique R.
Nepisiguit R.
Miramichi R.
Richibucto R.
Petitcodiac R.
Washademoak R.
Nashwaak R.
Canaan R.
Kennebecasis R.
THE NORTHERN PLATEAU
THE CENTRAL HIGHLANDS
THE SOUTHEASTERN PLAIN
THE SOUTHERN HIGHLANDS
MAP
of the Province of
NEW BRUNSWICK
SCALE
0
16
MILES

Fig. 2.

Since however it is far too great to be treated as a unit, it may be subdivided as follows :

A. *The Madawaska Sub-district.* Includes all north of a line separating Grand River and Little River, crossing the St. John at Grand Falls, and separating the Fish River and Aroostook system.

B. *The Tobique (or Carleton-Victoria) Sub-district.* Includes all north of a line separating Becaguimec from Nacawicac and Nashwaak, and Eel River from Sheogomoc, crossing the St. John on the edge of the granite at Middle Southampton.

C. *The Nashwaak (or York Sub-district.* Includes all north of a line between the Little River and Nashwaak systems and between the Oromocto and Longs Creek, crossing the St. John with the County line.

D. *The Oromocto (or Queens-Sunbury) Sub-district.* Includes all north of a line between Belleisle and Washademoak and between Nerepis and Oromocto, crossing the St. John with the County line.

E. *The Kennebecasis (or St. John-Kings) Sub-district.* Includes all south of the preceeding to the Bay of Fundy.

III. *The Petitcodiac (or Westmorland-Albert) District.* Includes the basins of all rivers falling into the Bay of Fundy and Baie Verte from Martins Head to Cape Tormentine. The County line might seem a more logical division between this and the Woolastook district, but Martins Head is so much more natural that it would seem better to adopt it as the division point.

IV. *The Richibucto (or Kent) District* Includes the basins of all the rivers from Cape Tormentine to Point Escuminac.

V. *The Miramichi (or Northumberland District).* Includes the basins of all rivers from Point Escuminac to Barreau Point (between the Tabusintac and Tracadie.)

VI. *The Nepisiguit (or Gloucester) District.* Includes the basins of all rivers from Barreau Point to Belledune Point, including Miscou and Shippegan.

VII. *The Restigouche District.* Includes all north and west of Belledune Point. Belledune Point gives a more natural division than Little Belledune Point, near which the County line starts.

The above division of the province by river basins will probably be found most useful for purposes of detailed description of provincial phenomena, and of local history, etc.; but a more strictly natural one, taking account of the geology and accompanying topography, will be needed for some purposes. Unfortunately, as stated above, our geology appears too complicated to admit of a very detailed division of the province upon this basis. A general natural division is, however, possible, as shown on figure 2. Although the geological boundaries

are fairly distinct, the accompanying topography is not, and, hence, sharp lines are impossible, and the boundaries shown on the map are only approximate. The divisions may be named as follows :

I. *The Northern Plateau*, including the great Upper Silurian Area of the Northwestern part of the Province, with Lower Carboniferous outliers on its margin in places, forming mostly a great peneplain 800 to 1000 feet above the sea.

II. *The Central Highlands*, of Archaean Felsites and of Granite, bordered by Cambro-Silurian Slates, consisting of irregular ridges, forming the axis of the Province, and culminating in the high hills, 2000-2700 feet above the sea, between the headwaters of the Tobique, Nepisiguit and Miramichi.

III. *The Eastern Plain*, of Carboniferous bordered by Lower Carboniferous sandstones. This is a peneplain, is highest in its western part and slopes off to the eastward where it is low and level.

IV. *The Southern Highlands*, also of ridges of Archaean Felsites and of Granites intermixed with Silurian and Devonian rocks reaching heights up to 1400 feet, and merging in Charlotte with the Central Highlands. This may perhaps better be called *The Southern Ridges*.

27.— On a marked Browsing-effect observed near St. Stephen.

(Read May 2nd, 1899).

Five miles below St. Stephen, on the peninsula between the St. Croix and Oak Bay, is a high granite hill, called locally Dickie's Mountain. It is notable for the supurb view it commands, and is recorded in the Society's Bulletin as the best mapped hill in New Brunswick (Bulletin No. XVII, page 123). The top is largely bare rock, but bears here and there small spruces, many of which attract attention through their unusual form, for they are hour-glass shaped, or at times like two cones, with the base of one resting upon the apex of the other (see the third in the accompanying Figure 3). The lower cone is the most symmetrical, extremely dense, and always approximately of the same height, as the axe introduced into the three figures will show. The upper cone may be absent altogether, or developed in various degrees, and is always loose in structure, and quite like any other spruce. One is at first inclined to ascribe the appearance to clipping by man, or to some growth conditions peculiar to the locality, but it is no doubt a marked kind of browsing effect. The place is a sheep pasture, and these animals probably bite off the young terminal

buds in spring, forcing the plants to branch profusely, as a hedge does when clipped. This is confirmed by the broken appearance of the tips of the branches. The sheep browse as high as they can reach, but finally the main terminal bud gets beyond them and thenceforth develops

FIG. 3. Browsing effect upon spruces.

normally. Three stages in the development of the upper cone are shown in the three accompanying figures which are traced from photographs, and therefore are accurate. No doubt this effect is common enough, though I have seen it in but two or three other places, and never so perfectly as here.

28.—AN OPTICAL ILLUSION ON THE PEAT BOGS OF CHARLOTTE COUNTY.

(Read June 6, 1899)

In a paper on "Raised Peat-bogs in New Brunswick," published two years ago (Trans. Royal Society Canada, new series, III, sec. iv, 150) I pointed out what seemed to be a rising and sinking of the surface of the Lepreau bog to an extent of several inches, under the influence of weather conditions which I could not determine. The only rule about the movement seemed to be this, that it rose in bright and fell in dark

weather. In a letter dated July 1st, 1898, Dr. C. Weber, of Bremen, Germany, a distinguished authority on Peat-bogs, gives me an entirely different, and doubtless correct, explanation of the phenomenon which he illustrates by the accompanying figure (Fig. 4). He shows that it

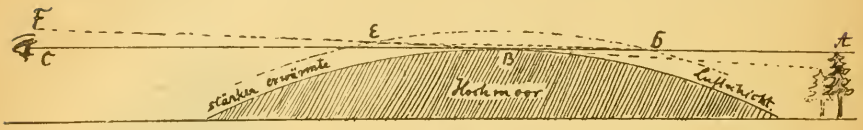


FIG. 4. Diagram of rays over a raised peat bog in dark and bright weather. Hochmoor = raised bog: B = its highest part. Stärker erwärmte Luftschicht = more strongly warmed layer of air.

is an optical illusion, caused as follows: if in dull weather, the eye of an observer standing near the margin of the bog (*i. e.*, C. in Fig. 4), be at such a height that the top of some object on the opposite margin is just visible, (*i. e.*, A) the ray from one to the other will be straight. If now, the sun appears, the layer of air in contact with the bog will become more strongly warmed than the layers above it, and hence it will become rarified and less refractive. When the ray from the object reaches this layer, it passes into a less dense medium and hence bends from the perpendicular, *i. e.*, away from the surface of the bog (*i. e.* from *b* to E). In issuing from this layer, it re-enters the denser layer, and hence it will be bent towards the perpendicular, and therefore still farther upward from the surface (*i. e.*, from E to F). Consequently the ray will pass over the head of the observer (to F), who, finding it necessary to rise vertically some inches to again see the object, naturally thinks the bog itself has risen.

29.—On the Physiography of the Nictor Lake Region.

(Read December 5th, 1899).

At the eastern head of the Tobique River, in the north of the New Brunswick Highlands, lies Nictor, fairest of New Brunswick lakes. It is absolutely wild, unvisited save by an occasional sportsman or naturalist, and may be reached only by a several-days' canoe journey. It is unsurveyed, wrongly mapped, and scientifically little known. For these reasons, the following observations, made during two visits

to the lake in 1898 and 1899, will doubtless be acceptable; and because of the great interest of the place, I shall try to make my account monographic.

History. The lake makes its first appearance in historical records upon Franquelin's fine map of Acadia, of 1686, (Fig. 5, A). He does not name the lake, though he marks the portage to Nepisiguit (Oniguen is the Maliseet *Oonegun*—a portage), and he names the Little Tobique, *Nipisigooichich*, or Little Nepisiguit, probably its

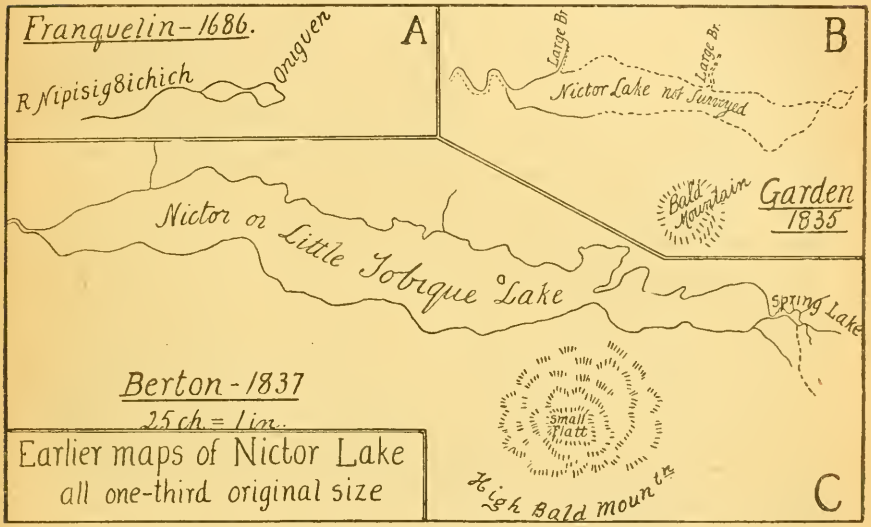


Fig. 5. Early Maps of Nictor Lake.

Micmac name. How remarkably this map influenced all others of this region for over a century, I have elsewhere traced.* The lake next appears, though very imperfectly, upon the fine engraved Baillie and Kendall map of 1832; but it was first sketched by a surveyor in 1835, when Garden made the MS. map shown herewith (Fig. 5, B). In 1837 Deputy Berton made the MS. sketch shown in Fig. 5, C, which is the original of every published map of the lake down to the present day. In August, 1899, I made a survey of the lake, the first

* Trans. Royal Soc. Canada, new ser., III., ii., 364, where the New Brunswick part of the map may be found.

ever made, resulting in the accompanying map (Fig. 6). I used a fair prismatic compass, and a simple home-made apparatus on the stade principle for measuring distances; the general shape must be nearly accurate, though its proportions may be somewhat in error.*

The lake must have witnessed events of no small interest, but these are unwritten and lost. It was one of the most ancient and frequented highways across the province, and has seen the passing of warriors, hunters, missionary priests, traders, grand seigniors, governors and scholars. It was probably somewhere in this vicinity that the good Father Bernardin perished on his way from the Nepisiguit to the St. John, in 1621, as related by LeClercq. The first mention of it in print that I have found is in Wightman's report on barometric measurements, made in 1839, contained in a British boundary Blue-book of 1840. Governor Head was here in 1849, as Gordon tells us, but he left us no account of his travels. Governor Gordon came in 1863, and has left us in his "Wilderness Journeys" a most interesting account of his impressions, as well as the first printed description of the lake. He admired it as possessing "more beauty of scenery than any other locality I have seen in the province, except, perhaps, the Bay of Chaleurs," meaning, of course, the head of the Bay, above Dalhousie. He gave to Bald Mountain the name Sagamook—(mount of chiefs)—which it still bears. Later in the same year Professor L. W. Bailey visited the lake, and has given us our first scientific notes upon it, particularly its geology.† Since then Messrs. Hind, Ells, Chalmers, and Hay, have briefly visited it with results contained in well-known reports.‡ There are references to Nictor Lake in various reports, guide books, sporting books, etc., but I believe the above-mentioned include all real sources of information. Nearly every writer, from Gordon to the present, speaks of the beauty of the lake.

Place-Nomenclature. On the map (Fig. 6) are two sets of names, one in Roman letters, including those already more or less in use (for a list of which I am indebted to Mr. George Armstrong, of Perth Centre), and another set in italics which now appear for the first time. The latter I have myself given, for reasons and upon a principle fully set

* I was accompanied and aided by my brother, Mr. Arthur Ganong. The preceding summer I was with Mr. G. U. Hay, who has described our trip in this Bulletin (XVII. 153).

† In his "Report on the Mines and Minerals of New Brunswick," (1864), and also in his "Notes on the Geology and Botany of New Brunswick," (Can. Nat., 1864).

‡ Geological Reports: this Bulletin IV, 104.

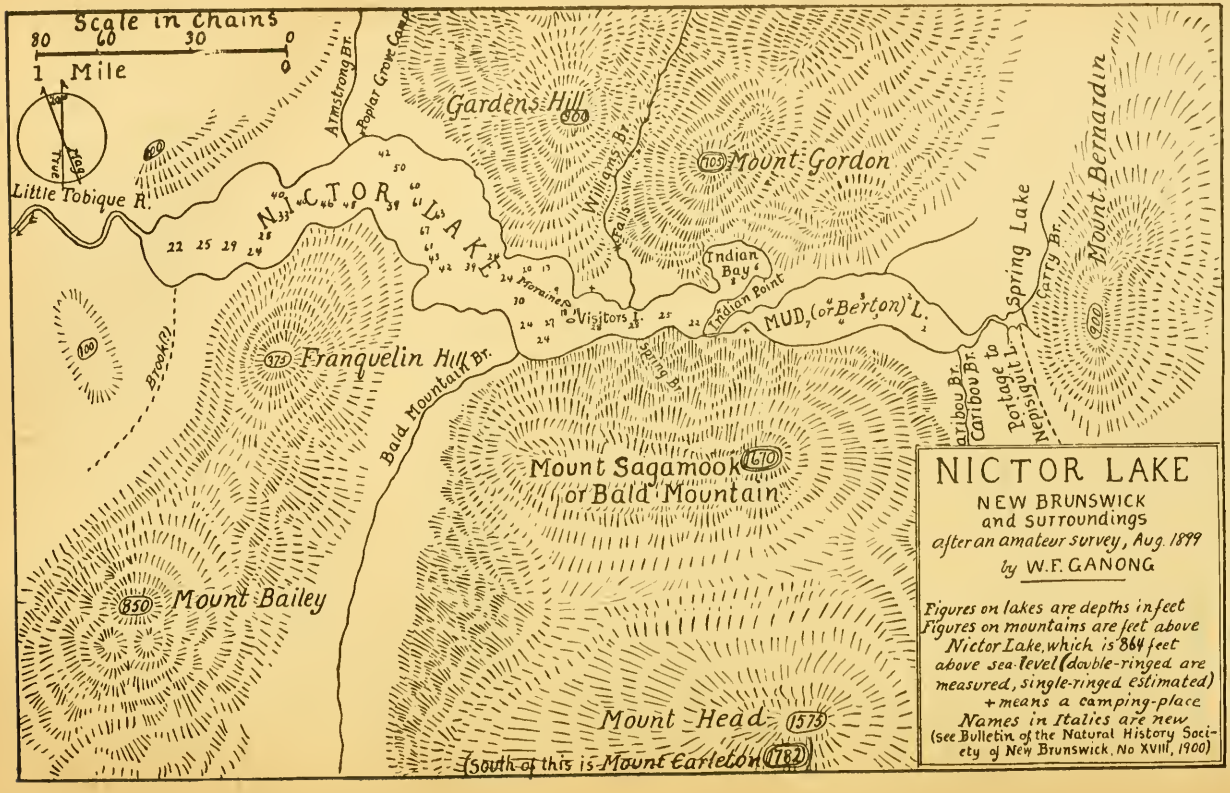


Fig. 6. Map of Nictor Lake.

forth in the next note of this series (No. 30). Most of them are sufficiently explained by the facts given in the preceding section, *i. e.*, they commemorate those who have been in some way closely connected with the history of the lake. Moraine Island describes its formation as a glacial moraine. Nictor is a corruption of the Maliseet Nictau,

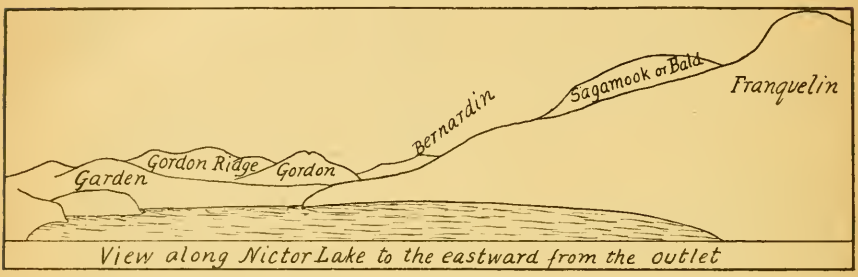


Fig. 7.

meaning Forks, and applied by the Indians to the main forks of Tobique. It was extended to the Little Tobique, and then to the Lake.

Description. The most striking and charming feature of Nictor consists in the splendid forested hills among which it winds. In the beauty of its hill scenery no other lake of the province can compare with it. The hills are highest towards the east (their heights are upon the map), and as one enters from the Little Tobique he sees the fine range

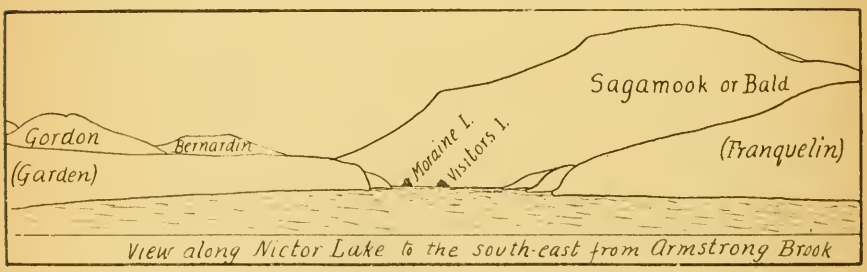


Fig. 8.

crudely shown in Figure 7. This figure will be sufficient to admit of their identification, but gives no conception of their real grandeur. In some respects they show yet better from farther up the lake (Figure 8), and here the stately form of Sagamook shows to best advantage. Best of all, however, are the views from the little island under Saga-

mook, from which all the prominent hills about the lake are visible. The view to the east is the finest (Figure 9), but to the west it is little inferior (Figure 10). Above all and over all, however, towers grand Sagamook. Rising steeply over sixteen hundred feet directly from the lake, higher than any other New Brunswick hill rises from the water, clothed with living forest, except for a few bold bosses near

Fig. 9.

its summit, shrouded often in mists, it is easily the finest, even though not the highest, of New Brunswick hills. Happy is he who, from the ideal camping place upon the island, can watch day after day these beautiful hills in their varying lights and colors, and can know they are his own.

Next in charm to the hills is the virgin forest which clothes them. This is everywhere entirely unbroken, except for the few naked spots

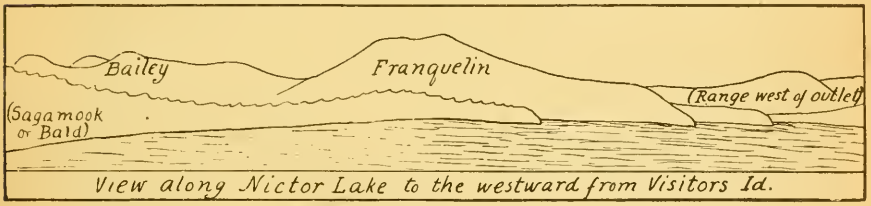


Fig. 10.

near the summit of Sagamook. There is no trace of fire, nor of the lumberman. Probably in no accessible part of the province is there a finer forest, or one more nearly primeval than this. It is of the mixed growth of our common provincial species, and it is a fine sight to see the splendid spruce in sombre green towering above the level of the brighter green hard woods. This forest owes its preservation to the expensiveness of driving lumber down the crooked Little

Tobique. But the shadow of the deadly pulp-mill already looms over it, and its glory will soon depart.

This forest is extremely rich in game, especially moose and deer. The lakes contain many trout and other fish, though in this respect they are inferior to the Nepisiguit lakes.

Physiography. The lake is 864 feet, more rather than less, above mean sea level. Its maximum depth is 67 feet, surprisingly little for a hill lake.* This depth diminishes to only 28 feet directly under Sagamook, and lessens eastward so that Mud or Berton Lake, separa ted from Nictor only by a morainic ridge and connected with it by a short brook falling from one to two feet, is but a few feet deep, though it is made thus shallow by deposits of organic mud similar to that found in so many of our "mud lakes."† The shores of Nictor are usually bold and rocky, but in places the shores are of loose morainic materials, and but rarely of gravel or sand. There are but two islands, one of them narrow and low, apparently a moraine, and the other of highly tilted slate rising abruptly from the bottom. The latter bears a few trees and bushes, and forms the most charming camping-ground that I know of in New Brunswick. Four large brooks flow into the lakes, of which two, Bald Mountain and Caribou, flow in broad deep valleys, which are doubtless the courses of ancient rivers. Williams' Brook is new, and has upon it, not far from the mouth, an irregular fall of some eight feet, whose murmur can be heard from afar on still days, and the mist from which in certain weathers hangs like smoke over the slope of Gordon. A striking place is Spring Lake, practically an immense spring with a summer temperature of but 41° or 42°. The lakes empty by the Little Tobique, a very winding stream of much, though rather monotonous, beauty, but perfectly ideal for the amateur canoeman.

Origin of the Lake. I believe the lake occupies an ancient valley of erosion choked by glacial drift. As I shall show in a later note, the entire upper valley of the Nepisiguit is very ancient, and it could not have emptied by its present course. It probably therefore ran into Nictor Lake by way of the portage valley now followed by Caribou Brook. The valley of the Little Tobique, though perhaps post-glacial

* The deepest known lake in New Brunswick is Clear Lake, Lepreau, 78 feet (this Bulletin, XIV, 48).

† This Bulletin, XVII, 126.

in spots, is certainly pre-glacial as a whole. By its extension back the lake was doubtless robbed from Mamozekel waters, into which it once probably flowed along the low valley now occupied by Bald Mountain Brook.

The geology, as traced in general by Bailey, Ells, and Chalmers, is shown upon the geological map. All the large hills about the lake and its entire eastern end are of Pre-cambrian felsites, but Silurian rocks appear at the western end. One very remarkable fact about the geology of the lake, first referred to by Bailey, is the presence of the little island of slate, Visitor's Island, completely surrounded by felsites. It may represent the remanant of a tongue of Silurian rocks extending along the bed of the lake to this point, which would give a great age to this valley. The island slopes down so steeply and abruptly on the north side as to suggest a fault running along the axis of the lake. Were it not for its relatively enormous size, 100 feet long by 50 wide, one would be tempted to view it as simply an enormous boulder. But this is but one of the very many attractive problems awaiting solution in this region.

Natural History. No study whatever has yet been made of the zoology of the region, and but little of the botany.

The Neighboring Highlands. To the north of the lake the mountain ranges appear irregular, and I have not tried to work out their particular arrangement. On the southern side, however, they are as follows: Sagamook is not an isolated mountain, but is the northernmost of three parallel ridges forming together a great island or plateau of felsite (see map, Fig. 6, and also the map accompanying the next note, Fig. 13). This plateau has Nictor Lake on the north, the deep valley of Caribou Brook and the portage on the east, Bald Mountain Brook valley on the west, and a valley between Nepisiguit Lakes and the Mamozekel on the south. Sagamook is separated from the next ridge, Mount Head, by a valley not over 300 feet deep, while a somewhat deeper valley lies between Head and Mount Carleton. The appearance of Head and Carleton from Sagamook is shown by Fig. 11. Mount Carleton is over 100 feet higher than Sagamook, and is easily recognized by its bold, bare, saw-like top. Still farther to the southward one can see the summit of Mount Winslow, not a part of this plateau (Fig. 12). On the westward of the valley of Bald Mountain Brook runs a fine range of hills south-west. It begins at Nictor Lake

with Franquelin; next is Bailey, and then follows a series of six or more crests, which are to be named for the geologists who have investigated the structure of the province, and which, therefore, may well be called the Geologists' Range. But on these matters future communications will be made to the Society.

The impression of this plateau which one gains by viewing it from either Nictor or Nepisiguit lakes is extremely misleading. Thus

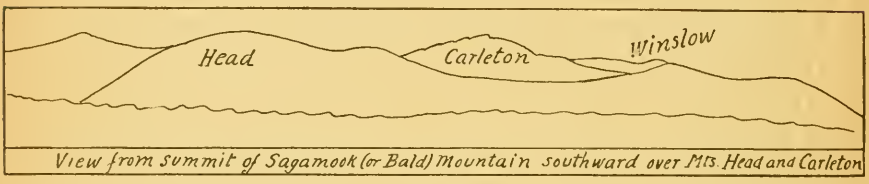


Fig. 11.

the summit of Mount Carleton is not visible at all from Nictor Lake nor from the Upper Nepisiguit Lake, though it is from the Lower Nepisiguit Lakes. Again, the summit of Sagamook is not visible from the Upper Nepisiguit Lake, but only from the lower lakes. It is only by visiting the summits of these mountains and comparing the different views thus obtained, that one can gain a correct knowledge of their relationships.

A great charm of these mountains is the view from their summits. That from Sagamook is particularly grand. From the naked bosses

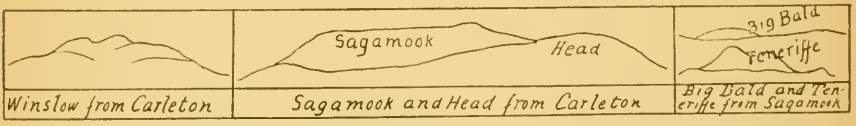


Fig. 12.

at the west end one can look away over the rolling Silurian plateau to the mountains of Quebec and Maine, while from the highest point of the mountain, a bare place near the eastern end of the ridge, one can see far off to the north and east, and the fine range of mountains through which runs the Nepisiguit, and the great mass from which rises Big Bald on the South Branch. But even these views are sur-

passed by those from the summit of Mount Carleton,* for here from one spot the eye may range without hindrance in every direction, and there cannot be a grander outlook over a more rugged country anywhere in this province. Everywhere lie the splendid hills with innumerable crests, as if the sea, with its rollers and breakers were suddenly stilled to stone. They stretch away vast, silent, patient, as unvexed by the little affairs of man as by the shadows of the summer clouds floating above them. They are nearly all forested and unburnt, a great contrast with most other parts of the province. As one stands upon the summit of one of these rarely-visited hills on a fair summer's day, and looks upon these unspoiled hills and forests, the very rugged foundations of his native land, he cannot but feel an exaltation which is one of the best joys of life.

Nictor Lake, therefore, lies to-day not only by nature the most charming place in the interior of New Brunswick, but as yet entirely unspoiled. But the doom of the summer hotel even now threatens its shores, and the pulp-mill its forests. But why should not the people of New Brunswick prevent its despoiling, and set aside the lake and its shores as a provincial park, to be kept wild and beautiful for their enjoyment forever? It can be sacrificed for a small present profit, or saved for a large one in the future. But there is another reason for the preservation of the lake region. In the very near future New Brunswick must turn her attention to systematic forestry, or else lose her chief source of wealth, and resort to direct taxation of her citizens. The first step towards such forestry must be the setting aside of certain areas to be managed on good principles, as a nucleus for forestry extension, and for instruction in forestry management. Nowhere in the province in an equally accessible place is there so fine a forest as here, or one which it would be easier to manage on correct principles. Various states of the United States are making reservations about the heads of their principal rivers for the purpose of preserving forest and game and water supply, as well as for wild parks. Let us be warned in time and set aside here a forest and game preserve and wild park for the future instruction and enjoyment of our people.

* Mount Carleton is most easily reached from Nictor by taking a compass line to it from the highest point of Sagamook.

30.—Proposals for a Nomenclature of unnamed New Brunswick Hills and Mountains.

(Read December 5th, 1899).

It is a fact that the great majority of New Brunswick hills and mountains, including some of the very finest, are to-day quite nameless. In the settled districts, it is true, they are mostly named, but most of New Brunswick is unsettled. This seems the more remarkable when it is recalled that practically all of our streams and lakes, even to small brooks and ponds, and in the wildest parts of the province, are named. But for this the reason is plain. Our watercourses have a relation to our interests through their use for lumbering, hunting and fishing; hence they must often be spoken of, and names for them arise. But our mountains only exceptionally affect our interests in these or other ways, hence are rarely spoken of, and names do not arise for them. Such is the condition at present, but it will not always be so. As the province becomes settled, as hunters and tourists visit it more, as a provincial literature arises, as forestry becomes systematized, as maps become more accurate and detailed, as scientific explorations become more extended and minute, a need for names for our mountains will be felt, and they will gradually come into use. Unless, however, some broad and consistent plan for the giving of such names be adopted, those which will arise will be often of the most trivial, inappropriate and inconvenient sort. One has only to instance the very numerous and confusing Bald Mountains.* Is it not possible to inaugurate some plan which will provide for our mountains a convenient, appropriate and pleasing nomenclature? Certainly such a matter is eminently one for consideration by this Society.

If now, we pass to details, three questions arise: first, what kind of names should be given; second, what shall determine the adoption of proposed names; third, how may they be introduced into general circulation? We may most conveniently consider these questions in reverse order.

How may names, deliberately given, be introduced into general circulation? Guides, lumbermen, and most others who are much in

* Attention was first called to incongruities and inconveniences in our place-nomenclature by Professor Bailey (Mines and Minerals of N. B., 1864, pp. 8, 9).

the woods, make no use of maps, but adopt names only as they hear them, or as they arise naturally from the fixation of descriptive phrases, the method by which nearly all place-names arise among uneducated people. Yet such people, as I have often observed, have great respect for maps, and for their "correct," *i. e.*, printed names; and undoubtedly they would adopt them when brought to their attention, for otherwise unnamed places, provided only they are pronounceable and familiar enough in form to be easily remembered. But surveyors, tourists, hunters, scientists, and the better class of guides, do use maps, and unhesitatingly adopt their names. The number of such visitors to our mountains is increasing, and if the new names are on the maps used by them, they will be adopted; the guides will then hear them and pass them to others, and so on, until in time they will become widespread and fixed. The great practical point, then, is to secure their insertion upon all new maps, not only upon geological and other scientific maps, but upon all those issued by the Provincial and Dominion governments. If the Society approves of this plan, and will use its influence to urge the adoption of these names in all official publications, setting the example in its own publications, it will go far to secure this desirable end.

We next consider what shall determine the names to be adopted. I would suggest that such names be adopted and approved by the Society as are given upon the same principles as are recognized among scientific men for the naming of new species of animals or plants; that is, the first name applied to a previously unnamed place shall be accepted when published with such a description and illustration as will enable any other person to recognize it. The illustration should be a drawing, or better a photograph, or a survey (not a sketch) map accurately locating the place.

We ask, finally, what kind of names may best be given? Here we are much aided by taking account of the known qualities of the best place-names. The best names are, first, *melodious*, that is, they have a well-balanced succession of a few pleasing easily-pronounced sounds; second, they are dignified, that is, are free from incongruous associations, and have sounds consistent with the character of the place; third, they are individual or unique, that is, are applied to but a single place, and not met with elsewhere. Few names can realize all of these qualities, but they put before us an ideal to be striven for.

As to the actual words chosen, they may be drawn from any one of several classes. First, there are descriptive names; but these are good only when they describe some striking and easily-recognizable quality of the place, and are such as are not likely to be in use or to be adopted elsewhere. Our mountains, however, are not unlike enough to one another to make many such names available. Then there are Indian names, especially when these are familiarized into an easily pronounced form. Unfortunately, however, our Indians appear rarely to have had native names for mountains, and this, of course, for much the same reason that their white successors have none. Again, names may be drawn from those of persons or events prominent in the early history of the province. In these we have a great store of pleasing, easily-pronounced, already more or less familiar, words; and, as to their appropriateness, it is surely fitting that the names of those who have laid the foundations of the province should be lastingly commemorated in her eternal foundation hills. Most of our new names will probably be drawn from this source. Of course such names will be applied, as nearly as possible, to places associated with the person or event commemorated. It is a fact, too, that more honor would be done a person by naming for him a smaller mountain in an accessible and much visited place, than a larger one in a place inaccessible. There should be, too, some proportion between the importance of the place and the prominence of the person commemorated; the greater hills should be named only for those of provincial prominence, while the smaller may well be devoted to the names of those whose importance is only local.

With the convictions here expressed, and following the principles here recommended, I have ventured to apply names to the more prominent mountains about Nictor Lake and along the upper Nepisiguit. This region includes some of the highest, and perhaps scenically the finest, of New Brunswick mountains, and is withal fairly accessible.

About Nictor Lake is a particularly fine series of hills, described and figured in the preceding note (No. 29). The map accompanying that paper, as well as the one with this, show all new names in italics.

Mount Bernardin is named for the Recollet Missionary, who, about 1621, perished of cold and hunger somewhere in this vicinity while on his way from the mouth of the Nepisiguit to the St. John. *Franquelin* is for the great French cartographer, who was the first, in

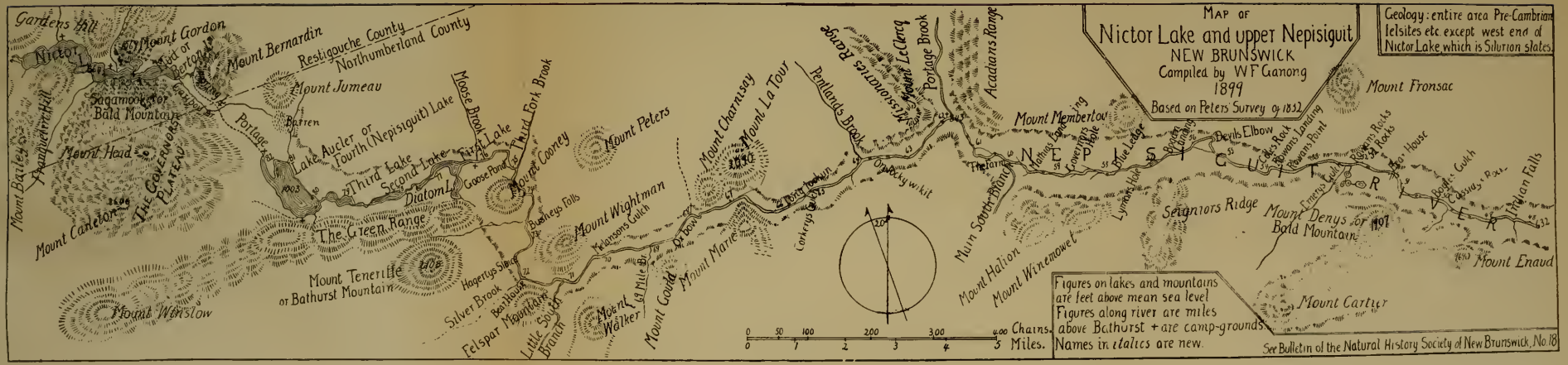


FIG. 13

The height of Sagamook is 2534 feet above the sea; Carleton is 2646 feet; Gordon is 1569 feet; LaTour is 2090 feet.

1686, to place Nictor Lake upon a map. *Garden* is for the surveyor who, in 1835, was the first to sketch a modern map of the lake, and to apply the name Nictor to it. *Berton* (lake, not mountain), is for the other surveyor who, in 1837, made the sketch map which has been the original of all published maps of the lake even to the present day. *Head* is for a governor of the province who was here in 1849 and named Mount Teneriffe. *Gordon* is for another governor, whose charming book, "Wilderness Journeys," published first in 1864, gives the first published description of the lake. It was he who named Mount Sagamook. *Bailey* is for the naturalist, Professor in the University of New Brunswick, who gave us, in 1864, the first scientific account of the geology and botany of this region. *Carleton*, applied to what is much the highest mountain in this part of the province, and possibly in the entire province, is named for Thomas Carleton, governor of New Brunswick from its foundation in 1784 until his death in 1817. Mounts Carleton, Head and Sagamook form a plateau, which, since its peaks are named for two governors, and by another, may well be called *The Governors' Plateau.* In Nictor Lake lies a little island named from its mode of formation, *Moraine Island.* South of Carleton lies another high and conspicuous mountain named *Winslow*, in honor of Edward Winslow, who was so closely associated with the foundation of the Province of New Brunswick, and who is as yet uncommemorated in any place-name.

As one stands upon the western end of Sagamook, he can see running off to the southwest a fine range of very prominent hills, with several rounded summits. This range begins with Mount Bailey and terminates near Bald Head, south of the Tobique. Since Bailey is one of the range, the other summits may well be named for the other geologists who have worked in this province, *Gesner*, *Robb*, *Hartt*, *Matthew*, *Dawson*, *Ells*, *Chalmers*, and the range may well be called the *Geologists' Range.* No maps or figures are here presented, for I hope soon to give it further study.

We pass next to Nepisiguit waters, of which a map is given herewith (Fig. 13), and we may well commemorate in its numerous grand hills those who have been prominent in the history of the river and the region of the North Shore about its mouth. We come first to a large lake. It first appears on the excellent map of 1685 by the Recollet missionary, Jumeau, as *L. aucler*, and the name is restored.

From no part of this lake can the summits of Sagamook or Carleton be seen, nor, of course, can the lake be seen from their summits, but they can be seen with great distinctness from near the summit of Teneriffe (Figs. 14, 15). In addition to those already mentioned, one sees a low rounded hill, which shows more distinctly from the lower end of the lake, named for *Jumeau*, the lake's first cartographer. To

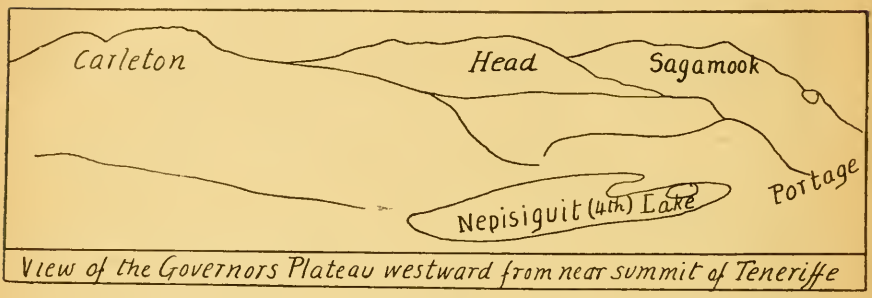


Fig. 14.

the northward stands up a splendid very high rounded dome, falling outside the limits of the map, but shown in Fig. 15, easily seen from Sagamook and from other directions, which is named *Mount Villebon* in honor of the most prominent of the French governors of what is now New Brunswick when it was a part of Acadia.

Below Aucler are three other shallow lakes, from the eastermost of which an arm, forming another lake, runs to the southward. This is

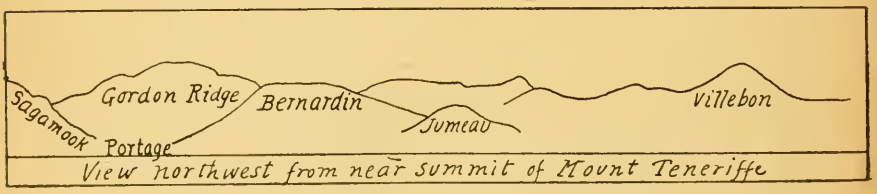


Fig. 15.

remarkable for its great deposit of diatomaceous earth, described in an earlier note (No. 17), whence it may be well called *Diatom Lake.* South of these lakes and parallel with them runs a splendid ridge, known appropriately to the lumbermen as the Green Range. It is, I think, continuous with Mount Winslow, but I am not sure of this.

South of it stands Mount Teneriffe, from which a fair view may be obtained to the westward (Figs. 14, 15), and a particularly grand one to the eastward (Fig. 16). From here two mountains falling outside the limits of the map show up with particular distinctness, the round dome of Big Bald on the south branch of Nepisiguit, and to the left of it a pointed mountain with three bare spots near its summit. The latter is named *DesBarres* for the man, afterwards governor of Cape Breton, who first thoroughly surveyed our coasts, and who mapped, in 1780, the interior of New Brunswick far better than any other cartographer until well into this century. This is, I think, the mountain shown on the geological map at the forks of the south branch of Nepisiguit (just west of the large N).

We begin now to descend the river. As in other rivers of the province the lumbermen have a nomenclature of their own for the

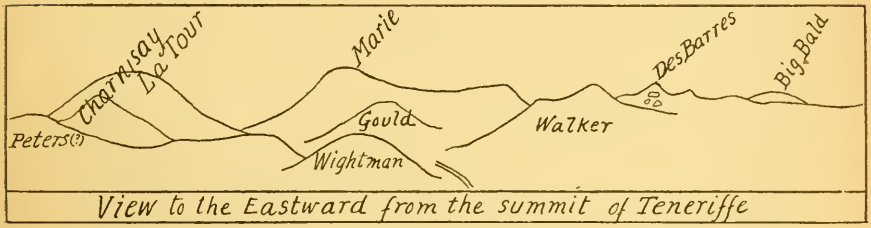


FIG. 16.

rapids, rocks, points, etc., along the river, and these names (for much help in compiling which I am indebted to Mr. P. J. Burns, M.P.P., of Bathurst,) are given on the map. As to the mountains, the first we meet is the symmetrical hill around which the river flows, which may well be named *Mount Cooney*, in honor of the author of the "History of Northern New Brunswick and Gaspé," (1832), in which is found the first, and, on the whole, an accurate description of the river. Northeast of this is a prominent symmetrical mountain, which is named *Mount Peters*, for the surveyor whose accurate map of the river, made in 1832, is the basis for all subsequent maps. From the forks of the Little South Branch three fine mountains may be seen at once, one of which was named Felspar Mount by Professor Bailey in 1863, and on the slope of which he describes a remarkable chasm. That to the east of it is named *Mount Walker* in honor of Commodore Walker, who was the first English settler at the mouth of the river,

where in 1768–1776 he had a large trading establishment described by Cooney. The rounded mountain just north of the river here is named *Mount Wightman*, for the surveyor of Fredericton who, in 1839, carried a line of barometric measurements through this region for the British government, as described in a Boundary Blue Book for 1840. Farther down on the south bank is a distinct, though not a high hill, which should be named *Mount Goold* (on the map, by mistake, Gould), for Arthur Goold, who at one time owned the site of Bathurst and attempted to make a settlement there. Lower still, on the north bank, towers up a splendid symmetrical rounded mountain, prominent in the landscape from both up and down river (see Figures 16, 18), showing from the west a marked red color; this is named *Mount LaTour* for the Sieur de LaTour, so well known in our provincial history. Just west of it is another of similar character, but not so large, and more deeply stained with red, and this is named for *Charnisay*, his rival. Directly south of LaTour, across the river, is a splendid wooded ridge, as high as or higher than LaTour itself, and as prominent, but of softer and more pleasing character, which is named *Mount Marie*, for our Provincial heroine, the wife of LaTour.

From Mount LaTour to Portage Brook the hills are high,* but none stand out distinctly until the brook is reached. Portage Brook occupies a deep and broad valley, with splendid hill ranges along both sides, and these are named the *Missionaries' Range* and the *Acadians' Range* to commemorate two peoples prominent in the history of the North Shore. One of the hills in the Missionaries Range, the prominent one as seen from below the brook, in the angle between brook and river, is named for *LeClercq*, who, in 1691, published a most valuable book containing much information about the lower part of the river. It will be well in the future to apply the names of other missionaries to other summits of this range, and likewise to apply the names of prominent Acadians to the summits in the Acadian range.

Just below the South Branch, on the south side, are two prominent rounded hills (Figure 17) which may be named *Mount Halion* and *Mount Winemowet* for two Micmac chiefs mentioned by Cooney.

* From the river alone one is apt to be misled as to the character of these hills along the river. They appear like long ridges, and one imagines deep valleys and other ridges behind them. In fact they are often but the edges of a great plateau, into which the river has cut a deep valley. It is only to more or less isolated mountains and ridges that names are applied in this paper.

Lower, on the north bank stands out a very prominent mountain (Fig. 17), which is named *Mount Membertou* in honor of the grand old Micmac sachem, friend of the French, and one of those who saw Cartier on the North Shore in 1534. Descending the river one presently sees a bare reddish summit appearing over a wooded ridge, the first glimpse of Fronsac (Fig. 17), and later there comes into view

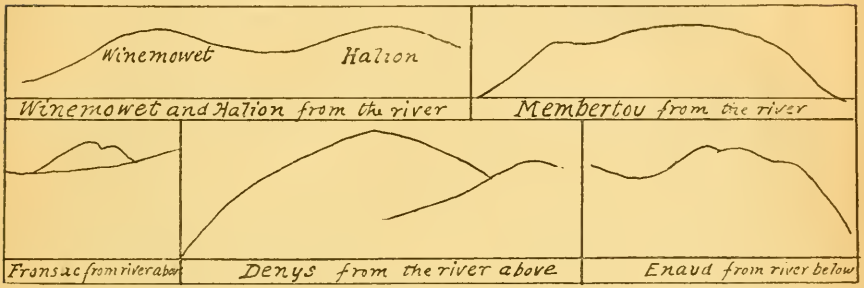


FIG. 17.

the symmetrical mountain locally called Bald Mountain (Fig. 17), but much better to be known as *Mount Denys* in honor of the first settler at the mouth of the river, and the author of one of the most important early works on Acadia, published in Paris in 1672. North of it lies *Mount Fronsac* (Fig. 18), somewhat higher than Denys itself, but otherwise less distinctive, named for the Sieur de Fronsac, Denys' son, who lived and had a fort at Miramichi. Southwest of Denys there

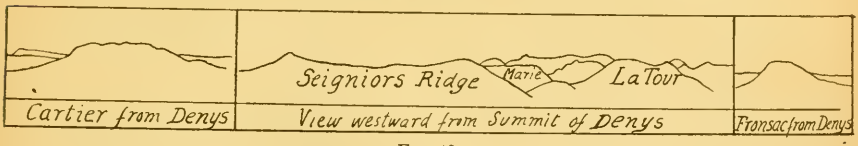


FIG. 18.

towers up a bare mountain visible from many points (Fig. 18), the highest and most conspicuous in this vicinity (sometimes, I believe, called Little Bald Mountain), which may well be named *Mount Cartier* in honor of the first explorer and map-maker of our North Shore. To the westward rises a high and prominent ridge, which is named the *Seigniors Ridge* for the French Seigniors who once possessed much of New Brunswick, and played some small part in her history. To the eastward is a lower mountain, which shows more prominently from

the river below (Fig 17), and this is named *Mount Enaud* (also spelled Enault) for one of the most prominent of the early settlers at the mouth of the river, mentioned by Cooney.

Below Indian Falls no more prominent mountains appear. The country becomes a flat plateau, sloping evenly and gradually eastward.

31.— On Heights determined with Aneroid in 1899.

(Read December 5th, 1899).

In the course of a canoe trip up the Tobique and down the Nepisiguit in August last, I made many measurements with a good aneroid. These were all taken contemporaneously with the readings made at Fredericton by Dr. Harrison for the meteorological service, and I wish to express my thanks to him both for adjusting my aneroid and also for a long series of readings used in computing results. I have since found that my aneroid tends to read a trifle low, especially on the greater heights; hence the following figures are to be taken as below, rather than above, the truth. Those marked with a star (*) have never before been measured. The heights are all above mean sea level at St. John. The position of all of the places, except the last in the list, may be seen upon the map accompanying Note 30.

Forks of Tobique (or Nictau). Mean of two measurements, 576 feet. Wightman gives (with an added correction explained earlier in Note 25) 575 feet for four miles below Nictau.

Surface of Nictor Lake. Mean of fourteen measurements, 837 feet. Chalmers made it 878, and Wightman (corrected) 877. Mean of the three, 864.

Sagamook (or Bald) Mountain. Mean of two measurements, 1633 feet above the lake. Chalmers gives 1659, and Wightman 1719. Mean of the three, 1670 above the lake, and 2534 above the sea.

*Mount Carleton. By direct measurement 112 feet higher than Sagamook, and hence 1782 above Nictor Lake, and 2646 above the sea.

*Mount Gordon, on Nictor Lake. 705 feet above Nictor Lake, and 1569 above the sea.

*Bank of Caribou Brook, half way across the Nictor-Nepisiguit Portage, 984 feet.

Surface of Nepisiguit Lake. Mean of five measurements, 1011 feet. Chalmers gives 996; mean of the two, 1003. Mr. Chalmers statement that this is the highest lake in New Brunswick, was of course made before the heights of the lakes on the south branch of Tobique, which are much higher, were measured. By direct measurement I made it 145 feet above Nictor Lake, *i. e.*, 864 + 145 = 1009.

*Mount Teneriffe. By direct measurement, 1105 feet above Nepisiguit Lake, and hence 2108 feet above the sea. Mr. Chalmers is in error in stating that this is about as high as Sagamook. Even as seen from Sagamook it is much lower.

*Mount LaTour. By direct measurement, 1150 feet above the river. As this falls 160 feet between the lake and Portage Brook, and the fall is considerably greater below than above it, the river is here probably 940 feet above the sea, and hence LaTour is 2090 feet above the sea.

*Mouth of Portage Brook, river level. Mean of five observations, 843 feet.

*River at camping place near the "bear house" at foot of Mount Cartier or Bald Mountain. Mean of four observations, 715 feet.

Mount Denys, or Bald Mountain, above Indian Falls. By direct measurement, above the river at the camping place, 1175 feet. In 1898 I made it 1170 feet; mean, 1172. This agrees well with the height of 1183 feet on the survey map of 1832 by Peters. Mean of these two, 1138, which, added to the river level, gives 1893 feet above the sea. Chalmers, following Ells, gives 1922; mean, 1907. There are higher mountains in the near neighborhood.

Mount Enaud, or Bald Face Mountain, is given on the Peters map as 998 feet high, that is, of course, above the river, and hence about 1690 feet above the sea.

*Lower end Indian Falls. Mean of three measurements, 632 feet.

*Mouth of Nine-mile Brook. Mean of two measurements, 429 feet.

APPENDIX.

THE FREDERICTON NATURAL HISTORY SOCIETY.

(Instituted February 2nd, 1895).

The Society continues to hold its meetings in the High School Building through the kindness of the School Board. The attendance has been generally good, and much interest shown in the discussion of the subjects dealt with in the papers read before the Society.

During the year addresses were given, or papers read, as follows:

1899.

Feb. 20. Insect Life, by Mr. Wm. McIntosh.
Mar. 20. Electricity, by H. H. Hagerman, M.A.
April 17. A Talk on Insects, by Mr. G. W. Bailey.
May 15. The Eye, by Dr. Bailey.
Oct. 16. Our Summer's Work, by Dr. Bailey and Mr. W. T. L. Reed.
Nov. 20. How the Brain Works, by Mr. John Brittain.

At the May meeting Mr. W. H. Moore presented the Society with a number of alcoholic specimens of Reptilia and Amphibia; Mr. Drury Allen donated a collection of birds' eggs, and Mr. H. H. Hagerman, a crayfish and a cat-fish.

The officers of the Society for the year ending in February, 1900, are:

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

JOHN BRITTAIN,
Secretary.

KINGS COUNTY NATURAL HISTORY SOCIETY.

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

The officers for the year ending October 2nd, 1899, are as follows:

R. P. Steeves, A.M. ..... *President.*
Miss L. Wetmore... ..... *Vice-President.*
W. N. Biggar.. ..... *Secretary-Treasurer.*

During the year nine meetings were held, eight regular and one special. The following papers have been read before the Society:

1898.
Nov. 5. Snakes, by Miss Annie White.

1899.
Mar. 4. The Deer Family, by Miss Annie White.
Fur-bearing Animals, by W. A. Alward, A.B.
April 8. Insects Injurious to House Plants, by W. E. Goold.
Unity of Living Things, by Robert King, A.B.
Return of Birds, by Miss L. Wetmore.
May 5. Moths and their Preventatives, by Miss Edith Darling.
A Spring Ramble, by Miss L. Wetmore.
The Nuthatches, by Miss L. Wetmore.

The result of the work of collecting for the museum has been the addition of forty-four specimens to the scientific collections.

For the better keeping and exhibiting of the specimens, the Society has procured this year the following: one large cabinet for minerals, etc., one glass case for birds, and two cases for insects.

Eight new members were added to the roll during the year.

The thanks of the Society are due the Natural History Society of New Brunswick for Bulletins, etc., received., and also to Mr. G. U. Hay for assistance rendered.

W. N. BIGGAR,
Secretary.

THE NATURAL HISTORY AND ANTIQUARIAN SOCIETY OF PRINCE EDWARD ISLAND.

(Instituted March 28th, 1889; re-organized January 10th, 1899).

During 1899 eleven public meetings have been held, and on each occasion the attendance has been good.

The dates of the meetings and the subjects of the papers and lectures were as follows:

1899.

Jan. 10. Re-organization.

24. Business meeting, followed by an impromptu address upon "Some of our Fungi," by Mr. John MacSwain.

Feb. 7. Rust of Wheat, by John MacSwain.

21. Geological Reminiscences of Prince Edward Island, by Thos. May.

Mar. 7. Floriculture, by James Tait.

21. An Abnormal Vegetable Growth in the Human Throat, by L. W. Watson, M.A.

Apr. 4. Some Geological Evidences of the Nebular Hypothesis, by John Newson.

18. Some Effects of Solar Radiation upon Organic Life, by W. J. Bulman, B.S., etc.

May 2. Some Notes on Man Primeval, by Charles Palmer, Q.C.

16. The Colored Races of P. E. Island, by J. T. Mellish, M.A.

Nov. 27. *(a)* Notes on Fungi Collected by Miss Pippy, 1899, by John MacSwain

(b) Note on a Piece of Petrified Wood found in the heart of a living Tree, by J. M. Duncan.

(c) Explanation of an Abnormal Potato Growth (exhibited by Mr. W. Doull), Lawrence Watson.

Dec. 11. An Introduction to the Study of Mineralogy, by Rev. T. H. Hunt, M.A., B.D.

The annual "outing" was held on the 24th of June, when the Society and many guests, having visited on the way the Micmac encampment at Rocky Point, walked to the ruins of "Ringwood," where Hon. F. St. Croix Brecken delivered a short address upon the Life and Times of Col. Cumberland. The ruins of Fort La Joie were next visited, where Messrs. Brecken and Newson delivered very inter-

esting addresses upon the history of the place. The position of many historic sites was pointed out by Mr. Newson as the party, after luncheon at the President's summer residence, proceeded on its way to Holland Cove. Here the listeners enjoyed the reading by Mr. Brecken of a paper upon Captain Holland and his work, embodying much matter of rare historical value.

During the year a delegation from the Executive Committee interviewed the Provincial Government, praying for a grant of money (such as is annually given our sister societies in the other provinces), and the use of rooms for the Society and for museum accommodation. The delegation was most kindly received, and the accommodation asked for was promised as soon as any suitable rooms at the disposal of the government should become available.

Application was made to the Geological Survey for a collection of mineralogical specimens which has been promised so soon as our Society shall have a suitable place in which to store and exhibit the grant.

We have received the publications of a few sister societies, and it is much to be desired that we may soon be in financial position to publish such bulletins as will enable us to secure a number of similar "exchanges," the educational value of which cannot be over-estimated.

In conclusion, it is gratifying to recognize on every hand, many evidences that the Society enjoys the confidence, interest and good-will of the community at large, that it is conceded that material advance has been made in the educational work of the Society, and that the prospects of rapid growth and constantly-increasing usefulness are of the very brightest character.

LAWRENCE W. WATSON,
Secretary-Treasurer.

Charlottetown, P. E. I.

THE ST. JOHN OBSERVATORY.

In addition to the annual meteorological abstract, a brief description of the instruments and work of the St. John Observatory may be of interest.

The Observatory is the chief station in New Brunswick under the Canadian Meteorological Service of the Department of Marine and Fisheries.

Observations of pressure, temperature, hygrometric conditions of the air, amount and character of precipitation, clouds, velocity and direction of the wind and general conditions of the weather are made at intervals of four hours, commencing at 3.44 A.M. local time. In addition to the meteorological work, astronomical observations are made for determination of time.

The Director's office, instrument and clock room is situated in the north wing of the Customs building, the thermometer shed and rain gauge on the ground adjoining the observer's residence, the anemometer and wind vane are mounted on the time ball tower.

The standard barometer by H. J. Green, New York, is constructed on Fortin's principle, the level of the mercury in the cistern being adjusted previous to each reading; secondary to this is a smaller barometer of the same construction, and a Richard's barograph (self-recording barometer). The thermometers are all by Negretti & Zambra of London, have been tested at the Kew Observatory in London, and are exposed in the Canadian pattern shed and screen which faces north, the bulbs of the principal thermometers being four feet above the soil. The highest and lowest temperatures are registered by mercurial maximum and spirit minimum self-registering thermometers which are read and re-set at the midnight observation, the temperature of the air at time of observation from the ordinary mercurial thermometer, and the hygrometric observations from a pair of thermometers, one of which has its bulb covered by a thin muslin wrapping, kept moistened by water or covered by a thin coating of ice during freezing weather.

The anemometer is of the Robinson pattern, and with the wind vane records electrically the direction and velocity of the wind upon the register. The register has three essential parts,—the cylinder, the clock and the electro magnets. A specially ruled sheet is placed upon the cylinder and revolved by means of clock work; the direction of the wind is printed upon the sheet every five minutes, and a mark is made at right angles to the direction of the revolution of the cylinder for each mile of wind, and the number of marks within a given space shows the rate per hour at which the wind is blowing. The sheet placed on the cylinder holds the record for twenty-four hours.

The rain gauge has a circular receiving surface equal to ten square inches. No snow gauge is used, but it is assumed that ten inches of snow equals one inch of rain.

The astronomical equipment is intended specially for the determination of correct time. The transit room is situated on the western side of the building, and the transit telescope is mounted on a substantial brick pier, capped with stone. It is of modern construction by Troughton & Simms, London, has an object glass of two and a half inches diameter, two setting circles attached to the tube, micrometer eye pieces and electric illumination. Observations of stars on the meridian are made with this instrument for the correction of clock errors and rates.

The standard sidereal clock by Victor Kullberg, London, was received at the Observatory in September, 1899. It has a zinc and steel compensated pendulum, similar to the standard sidereal clock of the Royal Observatory, Greenwich, a central steel rod being surrounded to about the middle of its length by a tube of zinc, and then incased by an outer tube of steel. The latter carries the lead bob, which is cylindrical in shape (weighing forty pounds) and suspended at the middle of its height, thus eliminating the temperature changes in the bob itself. This clock is of the best construction, and is fitted with break circuit attachment for operating chronograph. The movement and pendulum are mounted on a solid iron bracket, which is firmly bolted to heavy masonry; the iron base and bracket also carries the case of solid teak. To prevent sudden changes of temperature from affecting the clock, it is enclosed in a closet which is thickly padded with felt.

The transmitting clock, which was formerly used as a standard sidereal, was made by Emanuel, of London. It has lately been fitted with electric contacts for automatically transmitting time by the electric telegraph. It has a mercurial compensated pendulum, and is enclosed in a similar closet to the one described for the sidereal standard. There is also another mean time clock, with mercurial pendulum and a box chronometer, in the observatory.

The time ball on the northern tower of the Customs building is dropped by an electric key on the table which contains the electric telegraph instruments.

D. L. HUTCHINSON,
Director.

METEOROLOGICAL ABSTRACT FOR 1899.

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

D. L. HUTCHINSON, *Director*.

	BAROMETER.			TEMPERATURE.			Cloudiness: 0 = clear; 10 = wholly clouded.	Precipitation: Rain and melted snow.	WIND DIRECTION AND VELOCITY.																		Thunder Storms.
									N.		N.E.		E.		S.E.		S.		S.W.		W.		N.W.				
	Mean.	Highest.	Lowest.	Mean.	Maximum.	Minimum.			Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours.	Miles.	Hours Calm.	Total Miles.	
January	30.30	30.75	29.03	19.9	46	−12.7	5	4.35	28	312	91	1096	17	194	44	843	21	358	128	1954	55	814	339	5724	21	11,295	0
February	29.88	30.51	29.13	18.7	43.7	−7	6	3.14	24	199	103	1376	29	299	24	331	13	78	55	771	76	1170	329	5852	19	10,079	0
March	29.95	30.62	28.76	27.2	45.5	2.8	7	5.48	41	361	194	1924	25	196	79	1247	36	356	124	2313	29	484	187	3314	29	10,195	1
April	30.01	30.33	29.48	39.01	61.7	22.5	6	0.94	67	880	132	1408	28	313	61	514	122	801	78	1041	28	224	154	2015	50	7,196	0
May	30.03	30.31	29.61	48.3	79.2	30.5	6	3.51	29	423	213	2652	22	139	63	337	160	1124	96	1007	6	74	84	1177	71	6,933	0
June	29.97	30.36	29.66	54.5	80.2	44 8	7	2.65	42	346	103	1035	16	84	67	352	187	1363	129	1561	14	127	114	1435	48	6,303	1
July	29.95	30.30	29.60	59.1	78.5	46.2	7	7.47	20	103	24	159	12	88	144	949	218	1280	135	1468	35	306	68	786	88	5,139	4
August	30.02	30.40	29.74	62.5	79	47.7	6	2.17	20	137	66	449	33	309	84	546	163	900	120	1080	9	53	147	1546	102	5,020	1
September	30.06	30.49	29.57	55.4	70.2	34	4	3.05	24	157	60	484	43	344	122	961	101	740	187	2219	20	223	148	2254	15	7,382	1
October	30.20	30.54	29.65	47.7	70	29	6	2.49	78	641	97	852	22	126	44	382	61	347	149	2026	18	154	216	2778	29	7.306	0
November	30.02	30 56	29.42	34.7	59.7	16.2	6	3.37	107	1192	91	988	1	1	31	464	14	229	108	1151	74	491	277	3648	17	8,164	0
December	30.04	30.83	29.31	27.7	51.8	−2.5	6	5.45	113	1083	110	1052	46	416	48	1133	21	290	127	2389	55	811	216	3130	8	10,304	0

Barometer readings have been reduced to sea level and 32° Fahrenheit. The minus sign when used indicates temperatures
The maximum temperature, 80.2, was registered on the 9th of June; the minimum, − 12.7, on the 2nd January.
recipitation for year was 44.07 inches.

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