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CHARLES FREDERICK HARTT.¹

By G. F. MATTHEW.²

It is now nearly twelve years since, to the surprise and sorrow of his friends, news came from Brazil of the sudden and untimely death of Prof. Charles Frederick Hartt; cut off in the midst of his noble work of making known to the world the Natural History and resources of the great Empire of Brazil.

He died in middle age with all the enthusiasm of youth upon him, with his life work giving promise of a glorious future. When we think of what he might have accom-

¹ Read before the Natural History Society of New Brunswick, 5th Nov. 1889.

² In the preparation of this paper I have quoted freely and verbatim from a sketch of the life of Professor Hartt written by Mr. G. ~~N.~~ Hay, and from the very excellent sketch prepared by Mr. Richard Rathbun, one of Prof. Hartt's assistants in Brazil. The present sketch is fuller, for his early life and a few incidents that have transpired since his death have been added.

plished, had his life been spared, we cannot repress a feeling of regret at the loss which science has sustained in the death of this talented and devoted man.

Prof. Hartt was the eldest son of the late Jarvis William and Prudence (Brown) Hartt and was born at Fredericton, New Brunswick, August 23, 1840.

His father, Jarvis Hartt, on the completion of his education was appointed Principal of the Baptist Educational Seminary in Fredericton. He was noted for his earnest character and quiet devotion to educational work, and these qualities no doubt helped to mould the character of his son, and implant in him those habits of intense and continuous application which he possessed. And to the fine temperament and high ideals of his mother we may believe that Prof. Hartt was largely indebted for the inspiration which carried him along in the study of Nature. Mrs. Hartt was educated at Cambridge, Mass., and came to Fredericton to take charge of one of the departments of the seminary where her future husband was teaching. Her intellectual training enabled her to appreciate her son's tastes, and in her he found a sympathetic and ready listener, when as school-boy and student he propounded to her his schemes for future study and work. Through her friends he found himself at home in later years in Cambridge, and frequently wrote to her of his plans and prospects.

Hartt's early education was carried on under the direct supervision of his father, who, for a long time was identified with the educational interests of Nova Scotia and New Brunswick. He studied at Horton Academy in Wolfville N.S. where his father was at the time professor, and afterward at Acadia College in the same town. In 1860 he graduated from the college with honor, receiving the degree of Bachelor of Arts, and later that of Master of Arts.

When still a boy, Hartt developed a strong taste for philology, and with the aid of transient people of the village near his home, would make vocabularies of Gaelic and Italian; and it was a day to be remembered by him when

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Mr. Rand, the Micmac missionary, on his round visited Wolfville and taught him something of the Indian dialects.

Hartt's passion for Nature Science was not a late growth, for at the age of ten he showed a decided predilection for Natural History and as he grew up took great delight in assisting Prof. Chipman of Acadia College in preparing and arranging his specimens. With the professor's aid and encouragement he made great progress in acquiring a knowledge of Mineralogy which, owing to the abundance of trap-minerals (zeolites &c.) in the vicinity, was a favourite study of the Professor of Acadia College and his pupils. Fortunately Hartt was not with Prof. Chipman when the latter made the trip by boat to the trap-cliffs of Blomidon, which cost him his life.

Hartt's versatility was shown in his talent for drawing, and for the acquisition of languages, and we are told that he became instructor in drawing in Acadia College when quite a youth. While at college he learned the elements of Portuguese from a shoemaker of the village, and this acquisition no doubt proved useful to him when he visited Brazil; he attained afterward such proficiency in this language that he lectured with great success to cultivated audiences in Rio Janeiro. His skill as a draftsman and his command of language always drew to his lectures interested hearers.

Already, while occupied with his college studies, he entered with zeal into the work of geological investigation. He explored the parts of Nova Scotia in the vicinity of the Annapolis Valley and the Basin of Minas, traversing the country on foot, and making large collections of specimens whenever the opportunity was afforded him. It was his intelligent eye and busy hands that selected in the Gaspareaux Valley the material which enabled Sir Wm. Dawson to establish the genus *Aneamites* on a remarkable fern of the Lower Carboniferous period, which, before that had been confounded with *Cyclopteris*. Many of the specimens of minerals and fossils which Hartt collected in those days, are to be found in the Museum of the Natural History Society at St. John, in the Peter Redpath Museum of McGill Uni-

versity in Montreal and at the Agassiz Museum in Cambridge. While engaged in his college studies, he also made a large collection of insects; and made meteorological observations for the Smithsonian Institution which have received much commendation.

While yet at Acadia College pursuing his studies, Hartt entered into correspondence with the author of this sketch, and before he graduated, we made a visit together to the mineral localities of Minas Basin and the adjacent shore of the Bay of Fundy, where the rich harvest of zeolites and showy varieties of quartz minerals, set free by the frost of winter, still attract numerous summer visitors. This visit was the beginning of a more intimate acquaintance, which was continued when Mr. Hartt moved to St. John.¹

Later in this year (1860) Mr. Jarvis Hartt removed with his family to St. John for the purpose of establishing a Young Ladies High School, which he carried on successfully for many years. For some time his son aided him in conducting the school, but the son's love for his favourite studies was such, that every spare moment which could be snatched from the immediate duties of the school, was given to explorations in the neighborhood of the city, and the gathering of a rich harvest of fossils from the ballast of vessels, arriving from the west coast of Ireland, the Mediterranean and elsewhere.

When Mr. Hartt came to St. John, but little was known to the Scientific World of its geology. Some twenty years previously the late Dr. Abraham Gesner, then employed on the Geological Survey of New Brunswick, had traversed the neighborhood of the city of St. John, and had referred the rocks of that vicinity to the "Grauwacke Formation," with the reservation that certain portions near the city were "imperfect coal measures." He made the latter part of this statement in consequence of the discovery of a fossil tree in the sandstones East of the city. Dr. Jas. Robb of King's College, Fredericton, the successor of Dr. Gesner in the study of the geology of New Brunswick, pronounced the same rocks some years later to be Upper Silurian. It re-

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mained for Mr. Hartt and his *collaborateurs* to amass the materials which, in the hands of the sagacious Principal of McGill University, were to show that these plant-bearing sandstones contained a Devonian flora.

The writer had already found in these beds a sufficient number and variety of species to enable Sir Wm. Dawson to pronounce upon their Devonian age, but the rich harvest of fossils—exquisitely preserved ferns, asterophyllites, and psilophyta were not discovered until Mr. Hartt entered the field. To the collection and observation of these plants he gave the whole of his vacations during the years 1861, '62 and '63; and the result of this work has been of the most enduring value to science. Every bed of the unique section at the "Fern ledges" in Lancaster, West of St. John, was carefully studied, its fossils collected and its remains recorded. Such a work had not been done before in the Maritime provinces of Canada. The thoroughness of the work will be seen from the fact that while Hartt discovered scores of species in these beds, no new species of plants have been added to those which crowned his researches, and remains of only two insects beside those he found.

The discovery of insects of such great antiquity was perhaps the most striking result of these investigations. A few insects mostly related to the cockroaches had previously been found in the Coal Measures in several countries, but Hartt's discovery of insect wings in these older rocks threw a new light upon the history of insect life in the first geological ages. These insects were of five species, and were placed in the hands of Dr. S. H. Scudder of Boston for study. He referred them all to the Neuroptera; in part to new, in part, doubtfully, to old families, and suggested that some of the forms were synthetic types. But their important bearing on the history of insect-life was not then fully reached by that sagacious and experienced student of insects, for he has since referred them all to a great Palæozoic order, now quite extinct, the Palæodictyoptera of Goldenberg, from which he conceives that all the modern orders of insects have arisen.

Plant remains and insects, however, were not the only organisms discovered by Mr. Hartt in these interesting beds, for crustaceans also were found. These were of peculiar types and others found since in the same beds are not less remarkable.

Hartt's restless energy would not allow him to be content with field work alone, so in conjunction with several other young men of kindred tastes, in the city of St. John, he formed the "Steinhammer Club" an association devoted to the study of Geology. Subsequently at the suggestion of Sir Wm. Dawson of Montreal, this club was changed into a public society under the name of the Natural History Society of New Brunswick, whose meetings have been the means of sustaining an interest in the natural sciences in St. John, and in whose publications are recorded much that is of value relating to the Natural History of the Province of New Brunswick.—In this society Mr. Hartt took the warmest interest, attending its meetings, reading papers germane to its object, and devoting much material and time to the enlargement and arrangement of its museum.

Absorbed as he was in geological studies Mr. Hartt could not long remain content with his work in the High School. Accordingly he resolved to seek a larger field for study and work. Prof. Louis Agassiz had then recently come to America, and had already become widely known on this continent, as a successful teacher and instructor in Natural History. To his Zoological museum Mr. Hartt resolved to go in order to complete his studies. He sold his Devonian collections to the Natural History Society of New Brunswick, and proceeded to Cambridge to avail himself of the great stores of material for study in Agassiz Museum, and to obtain instruction from that talented and most attractive teacher of Natural History. Here, with such kindred spirits as Verrill, Morse, Putnam, Hyatt, Scudder and St. John, he devoted himself for several years to the investigation of Nature under the intelligent eye of Agassiz.

The writer of this sketch had meanwhile commenced the study of the older slates at Saint John, whose age hitherto

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had not been determined, but which were supposed to be a downward continuation of the measures which contained the Devonian plants. At first only some badly preserved trilobites were found, which, on account of their long thoraces were supposed to be of Lower Silurian age.¹

Subsequently (1863) much better material of well preserved species of trilobites were found by the author in Portland (St. John) and these, with the collections of the Geological Survey of Southern New Brunswick, were placed in Mr. Hartt's hands for study. Taking advantage of the opportunities which he possessed at Cambridge, he gave these fossils a careful scrutiny, and was able to announce that they were equivalent in age to those of Etagé C. of M. Barrande and, therefore Primordial. After his first brief notice in the report of the Geological Survey of New Brunswick, announcing this discovery, Hartt continued his study of these organisms with the aid of additional material. Upon this material, together with what had been previously obtained, was based his fuller descriptions of the fossils, with many figures, which appeared in Dr. (now Sir Wm.) Dawson's *Acadian Geology* in 1868.

In 1864 Mr. Hartt and the author were invited by Professor L. W. Bailey, to take part with him in the Geological Survey of Southern New Brunswick instituted by the Provincial Government. The results of this survey were published in the following year, and were a very important addition to the knowledge of the geological structure of this part of New Brunswick. The results embodied in this report, formed the basis from which the Geological Survey of Canada in this region, after the confederation of the Canadian provinces, was carried on.

Beside his work on this survey in New Brunswick, Mr. Hartt did independent geological work in Nova Scotia. In 1864 he obtained proof of the pre-carboniferous age of the gold of Nova Scotia. His observations were made at Cor-

¹ At that time the Cambrian had not by common consent, been separated from the Lower Silurian.

bitt Mills, where the well-known auriferous slates are immediately overlaid, unconformably, by conglomerates, grits, and sandstones of Lower Carboniferous age. The lower portion of these rocks contains an abundance of gold, which was undoubtedly extracted from the underlying slates, while the former deposits were in process of formation, and was mixed with the loose gravelly material, which subsequently became consolidated into the conglomerate and sandstone.

We owe to Hartt also, the careful investigation of the relations of the different members of the carboniferous limestone deposits in the neighborhood of Windsor, Stewiacke, &c. in Nova Scotia. He collected and studied the fauna of each separate set of beds with much pains, and in this way was enabled to determine their sequence. The fossils which are marine, are very numerous, and some new species were described by him in the "Acadian Geology." Much interest attaches to the study of this formation at the above localities, where, in the upper beds, occur many forms common to both the Carboniferous and the Permian, and a great likeness is apparent to the upper members of the Carboniferous system in the western United States, called Permo-Carboniferous. Dr. Meek, who examined the fossils, suggested that we might have here what Barrande would call an upper Coal-Measure or even Permo-Carboniferous fauna, 'colonized' far back in the Sub-carboniferous period. Dr. (Sir Wm.) Dawson has enlarged on Hartt's results and shows that the divisions made by him are of more general application than Hartt had known them to be.

As early as this, Hartt developed a constitutional tendency to asthma, which interfered with his field work in the cold and humid climate of this region, and which, after he entered on his professional work in the United States, prevented him from revisiting his native land. This, probably, was one of the causes which induced him to seek occupation in the warmer climate of Brazil.

Upon the organization of the Thayer Expedition to Brazil, by Prof. L. Agassiz, Mr. Hartt was appointed one of its

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two geologists, Mr. Orestes H. St. John being the other. This expedition left New York in April 1865 and returned in July 1866, having been absent a little more than a year. This was the strong and final inducement that called Hartt away from the geology of his own country. Although he was not fortunate in finding a very rich geological territory during his wanderings while connected with the Thayer Expedition, he saw enough to thoroughly interest him in returning again to Brazil, and in finally giving his whole attention to Brazilian studies.

The primary object of the Thayer Expedition was to investigate the distribution of the fresh water fishes of Brazil, but much time was also devoted to its geology. Prof. Agassiz limited himself mostly, in his geological work, to the examination of the superficial deposits at Rio de Janeiro and on the river Amazon, which were studied in connection with the question of glaciers. Hartt was retained near Rio for some time, in making examinations of the many Railroad cuttings around that city. After this work was completed, his field of exploration lay mostly between Rio and Bahia, where he carefully studied the geological and other features of the coast, and of the principal river basins leading to it. Large collections of the fresh water fishes of the rivers, and of the marine animals of the coasts and reefs were made. In consequence of the absence of fossils, no results in systematic geology were obtained, but, nevertheless, Hartt's studies of the geology of this monotonous tract were of great interest.

In the neighborhood of Porto Seguro he explored the coral and sandstone reefs, the latter of which is a prominent feature of the Brazilian coast. He was the first to carefully work out the structure and mode of formation of these sandstone reefs.

After Hartt had returned to the United States from the Thayer Expedition, he felt that he had left unfinished some of the more important investigations he had made in Brazil. He was unable to report as fully as he wished, on many subjects of interest which he had partly studied. So in 1867

he returned to Bahia, to perfect his former work and to continue his observations. He worked out the geology on the line of the Bahia railroad in detail, and collected some fossils from the Cretaceous terrains of that region. He also studied the structure of the Abrolhos islands and reefs which lie off the coast of Bahia. The islands are of stratified deposits, capped with trap, while the reefs, which had never been to any extent examined by a naturalist, are of coral, generally assuming curious tower-like forms, and often growing together to form a large connected expanse.

In addition to throwing new light on the formation of certain kinds of coral reefs, he also discovered a large number of species of corals of which the majority were new, but belonged to West Indian types. The absence of many prominent West Indian genera such as *Madrepora*, *Meandrina*, *Diploria* &c. was noted by him. The Cretaceous region of Sergipe was visited and yielded many fossils, which have been in part described by Prof. Alpheus Hyatt.

In the short interval which elapsed between his first and second trip to Brazil, he was engaged in scientific teaching and lecturing in and near New York city, at the Cooper Institute, Pelham Priory, Adelphi Academy and other places where he attained much success, and made many warm friends who aided him in his second Brazilian expedition. In 1868, soon after returning the second time, he was appointed Professor of Natural History in Vassar College; but he resigned this position in the autumn of the same year to accept the chair of Geology in Cornell University, where he was retained at the head of the department of Geology until the time of his death. In 1869 he was elected General Secretary of the American Association to serve at the meeting of 1870, but before that time he had departed on his third trip to Brazil.

It was in the year 1869 also, that he was married to Miss Lucy Lynde of Buffalo, N. Y., by whom he had two children, a son and a daughter. Both his widow and children are living. His son, now in his twenty-first year, is studying at Williams College, Mass., and his daughter at the

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Buffalo Seminary, Buffalo, N. Y., of which her mother, for several years past, has been the principal.

While at Cornell University, when not occupied with college duties, he was engaged in working up the results of his Brazilian explorations, and in preparing his report as geologist of the Thayer Expedition. This report, however, grew to so great a size, and was so complete in itself, that it was found advisable to publish it separately in 1870 as "The Geology and Physical Geography of Brazil." It forms a large octavo volume of over six hundred pages, and contains in addition to an account of his own researches, a *résumé* of our previous knowledge of the natural history of the country. It is thus not limited to a discussion of the subject indicated by the title, but treats of the topographical and general features of the country, of its flora and fauna, both marine and terrestrial, and of its mining, agricultural, commercial and manufacturing interests. The numerous maps and sketches which illustrate it, were drawn by Professor Hartt himself, and the greater part of them represent regions never before depicted. The volume closes with a valuable appendix on the Botecudo Indians.

In the year 1870, the same in which his book was issued, Professor Hartt organized the largest of his own expeditions from the United States. It was composed, beside himself, of Professor Prentice and eleven students of Cornell University. His object in taking so many young men was to give them thorough practical training, and to stimulate them to undertake original work. He says in his report of this expedition, that he did not expect to make scientists of them all, but hoped that some of them might thus be induced to accept this calling. The means for defraying the expenses of the trip were contributed by several parties, the most prominent of whom was Mr. E. B. Morgan of Aurora, N. Y. whose name has been given to this and the subsequent expedition.

Prof. Hartt determined on this occasion, to change his field of research, and explore the Amazonas. Accordingly he went with his party direct to Pará, and in the neighbor-

hood of this city, spent some time in training his inexperienced assistants. The tributary rivers Tocantins, Zingú and Tapajos, were then examined throughout their lower courses, and many valuable geological facts ascertained. On the Tapajos were discovered highly fossiliferous carboniferous deposits.

At the falls on each of the above named rivers were found series of metamorphic rocks, which, from their position and lithological characters, have been referred to the Silurian system. Passing to the North side of the valley of the Amazonas they minutely investigated the geology of the vicinity of Monte Alegre and the Sierra Ereré. On the plain of Ereré were discovered sandstones and shales, with characteristic Devonian fossils, corresponding more or less with those of the Hamilton and Corniferous groups of New York State. These were the first Devonian fossils found East of the Andes in South America.

One of the party examined the ancient Indian mounds of the island of Marajó at the mouth of the Amazonas, at that time only imperfectly known, and discovered large quantities of richly ornamented pottery, mostly in fragments. These have since been made the subject of considerable study by Prof. Hartt and others. The sea coast was examined at several points, from Pará to Pernambuco, and in the neighborhood of the latter city, the fossiliferous Cretaceous formations of the province of the same name, were studied for the first time. At all the localities visited, they made large collections in geology and zoology, which were sent to the United States, and are now contained in the museum of Cornell University.

Prof. Hartt's researches on the Amazonas did not tend to bring proof of the former existence of glaciers there. The sierra of Ereré was found not to belong to the series of table-topped hills, as Professor Agassiz had been led to suppose, but to consist of inclined strata of very irregular outline. The Devonian fossils of the plain were from a portion of the supposed "drift" material of Agassiz.

Professor Hartt returned to Ithaca, N. Y., January 1872,

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where he remained two years and a half, giving all the time he could spare from his college duties to working up the results of his two Amazonian trips, with the aid of his two assistants, Orville A. Derby and Richard Rathbun. His reports were published as soon as finished, in the journals of several scientific societies. During this time he also gave popular lectures on Brazil in New York, Boston and Syracuse.

But Professor Hartt was unable to continue long in this state of comparative quietude. In bringing together the result of his several trips to South America, with the object of explaining the geology of all Brazil, he saw how meagre were his data for this purpose, notwithstanding all that he and others had recently done toward elucidating the structure of this vast region. He wished to extend his researches and conceived the idea of organizing a survey of the whole Brazilian Empire, which has an area scarcely less than that of the United States. There was only one way of accomplishing such an undertaking; it must be supported by the government. Hartt ventured to bring the matter before some of his Brazilian friends, and his ideas met with such favour that in 1874 he received an unofficial invitation from the Brazilian minister of Agriculture, to submit a proposition for the systematic geological exploration of the Empire. In August of the same year, he accordingly went to Rio de Janeiro for the purpose of formally presenting his plans. Upon arriving at that city he was received with almost as much enthusiasm as was Prof. Agassiz nearly ten years earlier. His thorough acquaintance with the language of the country enabled him to communicate freely with the people, and he soon found himself encircled with friends, who gladly gave their influence in advancing his plans.

A Geological Commission of the Empire of Brazil was organized on the 1st May 1875 with Prof. Hartt as chief, and the following assistants E. F. de Jordão, Engineer, O. A. Derby and Richard Rathbun, Assistant Geologists and F. G. de Freitas, "Particante." Mr. John Branner, now in charge of the geological survey of Arkansas, was soon

added to the staff, and a few other additions and changes were made.

The active work of the Commission began in June 1875, and the coast region North of Rio to Cape San Roque was explored. Here extensive cretaceous deposits were found, with remains of sharks, crocodiles and other reptiles; and large collections of recent marine animals were made along the coast.

In the next year, the work in the maritime provinces North of Rio was continued and abundant remains of reptiles, fishes, and other animals were found. The diamond-bearing gravels near Bahia were also examined for the purpose of discovering the source of these gems. In the province of Sergipe was gathered a rich harvest of cretaceous fossils for the museum at Rio.

In this and the following year (1877) explorations were carried on in the provinces South of Rio, where Carboniferous and Devonian or Silurian deposits were discovered, rich in fossils, and the gold regions of this part of the empire and of Minas Geraes were examined by Mr. J. E. Mills.

While this work was in progress in the South, Mr. Derby was arriving at important results on the Amazonas, where he proved the existence of an immense basin of Palaeozoic rocks with carboniferous deposits occupying an extensive area in the centre, surrounded by Devonian and Silurian beds rich in fossils. Owing to the dense vegetation of the lowlands of the valley of the Amazonas, they were unable to discover whether these Carboniferous rocks held deposits of coal or not. Immense collections of geological, zoological and ethnological specimens were sent to the capital by the various exploring parties, and it was found necessary to set apart a large house to contain them.

In June 1877, prompted by motives of economy, and unacquainted with the amount and value of the work being done by the Commission, the Government gave orders for the temporary suspension of the Commission on the 1st of July. The Emperor, soon after returning to Rio, fresh from the Museums of the Old World and North America,

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carefully inspected the building and work of the Commission. He showed a just appreciation of the value of the new Museum of Geology, both to his own country and to the world at large; he was generous in his words of praise to the talented chief, who had so dearly earned them, and declared that the work should go on.

In the beginning of the following year, an entire change was made in the Ministry of Brazil, and before the several departments had been entirely re-organized, and the appropriations determined upon, Professor Hartt died. There was no one to succeed him, and his large collections were placed in the care of the National Museum at Rio de Janeiro. It is expected that steps will be taken by the Brazilian Government at an early date, toward publishing the many reports which were finished under the direction of Prof. Hartt.

It would appear that before the researches of Professor Hartt, the systematic geology of vast areas of Brazil, was an utter blank. The Carboniferous system was known to exist in the South of Brazil, and some Palæozoic fossils had been found on the Tapajos R. in the North of the Empire; the Cretaceous formation had been recognized on the eastern coast, but it remained for Hartt to exhibit the general geologic structure of extensive areas of the Empire, and to recognize wide spread formations of Upper Silurian, Devonian, Carboniferous and Triassic (?) age. He also divided the vast areas of metamorphic rocks in Central Brazil into Eozoic and Lower Silurian by their lithological aspect and other characters.

Nor did he confine his studies to Geology alone, for in addition to voluminous reports on this subject, he had the following works nearly or quite ready for publication

- I. Brazilian Antiquities,—about 500 pages, 4 to.
- II. Mythology of the Brazilian Indians,—about 300 pages 4 to.
- III. Grammar, Dictionary &c. of the Tupé Language, 400 pages.
- IV. An Album—of about 100 photographs, illustrating the country, people &c. of the Lower Amazonas. With about 100 pages of text.

Prof. Hartt's scientific career may be said to have covered a decade and a half, and one can only wonder at the marvellous industry which crowded what might well be considered the work of an ordinary life-time into this short period. Only those engaged in his enterprises knew the variety and excellence of his scientific work, or could appreciate the skill with which he directed the operations first of his exploring parties in Brazil, and then of the Geological Survey of that vast region. Judging from his brilliant beginning, we may confidently assert that, had he not been cut off in his prime, he would have accomplished a work that would have placed him beside the greatest of the geological investigators of the present century.

None but the hardest constitution could stand the great strain which Hartt laid on his physical powers, and under the exhausting heat of a tropical climate he finally succumbed. Having been on an exploring expedition inland, he came out upon the coast at Rio de Janeiro tired and worn out by physical toil and mental anxiety; the latter due to the difficulties in which the Survey had been placed by changes in the administration of the country. Here he was attacked by that formidable scourge of the lowlands of tropical America—yellow fever. His exhausted system could not withstand the disease. His illness was of scarcely more than two days duration, and he suddenly (and unexpectedly to those who were watching him) passed away in the early morning of Monday 18th of March 1878.

Prof. Hartt was a man of winning manners, affectionate disposition and generous nature, and was greatly esteemed by his scientific associates. He was gifted with an original and inventive mind, and indefatigable industry. The Christian training of his early home, and the stimulating influences of the educational institutions where he spent the first years of his life, no doubt served largely to form his character. His death terminated the Geological Survey of Brazil, as no one was thought worthy of taking the mantle which fell from him. His assistants remained to work up the material which he had gathered; but the leading mind

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which had inaugurated the Survey was gone, and further investigation of the physical structure of Brazil with governmental aid is left to the enterprise of another generation.

Since Professor Hartt's death, two volumes of the Archives of the National Museum of Brazil have been published, which testify to the extent of his labors. The first (No. VI.) contains an account of the Archaeology and Ethnology of the tribes of the Amazonas, based on observations made by Prof. Hartt and his assistants on the shell-heaps, the cemeteries and the artificial mounds of that region, and contains descriptions and figures of the articles found in these repositories of the relics of its pre-historic people. It contains also an essay on the origin of art, and the evolution of ornamentation as exhibited by their pottery &c.; as well as an account of certain tribes of the region and their mythology.

In the remainder of the volume the result of Prof. Hartt's work stands out on many a page, especially in the very interesting memoir by Dr. Ladislaus Netto on the Archaeology of Brazil. The material collected under Prof. Hartt's direction at the island of Marajó and at Maraca, are largely used by Dr. Netto in illustrating his memoir.

The succeeding volume of the Annals of the Museum (No. VII.) is devoted to a description of the Cretaceous Mollusca of Brazil by Dr. C. A. White of the geological survey of the United States. This voluminous memoir, published in Portuguese and English, is also based on the material collected under Prof. Hartt, when in charge of the geological survey of Brazil.

Several years after his death, the remains of this devoted man were removed from Brazil to Buffalo, N. Y., the home of his widow, where they now lie in a cemetery on the shore of Lake Erie.

Since his death, a tablet to his memory has been placed in the library of Acadia College (his "alma mater"). This tablet was set up by his classmates in commemoration of his great services to Science. On the unveiling of the monu-

ment, June 1884, one of their number, Dr. Silas Alward, paid a high tribute to the character and worth of their deceased companion in an oration before the faculty and friends of the college.

The following is a list of the scientific writings of Professor C. F. Hartt as far as known to me:—

1. The Gold of Nova Scotia of Pre-Carboniferous Age. *Canadian Naturalist*, I, No. 6, 459-461, 1864.

2. Observations on the Geology of Southern New Brunswick, made principally during the Summer of 1864, by Prof. L. W. Bailey and Messrs. George F. Mathew and C. F. Hartt; prepared and arranged, with a Geological Map, by L. W. Bailey, A.M. Contains the three following reports by C. F. Hartt:—

(a) Preliminary Notice of a Fauna of the Primordial Period in the vicinity of St. John, N. B., pp. 30-51. (Published also in *Can. Nat.*, VII, 318-320 1865; and in Dawson's "Acadian Geology," 2nd Ed., 1868, 641-643.)

(b) On the Devonian Plant Locality of the "Fern Ledges," Lancaster, New Brunswick, with a detailed Section, and Notes on the Fossils, 131-141. (Includes report of S. H. Scudder on the Devonian insects. An abstract was published in "Acadian Geology," 1868, 513-523.)

(c) List of New Brunswick Fossils, 143-147.

3. The recent Bird-Tracks of the Basin of Minas. *American Naturalist*, I, 169, 176, 234, 243, 1867.

4. On a Sub-division of the Acadian Carboniferous Limestones, with a description of a section across these Rocks at Windsor, N. S. *Can. Nat.*, III, 212-224, 1867. (A summary of the results recorded in this paper are given in "Acadian Geology," 1868, 279-280.)

5. [Descriptions and Notices of the Trilobites and other fossils of the Acadian Group, at St. John, N. B.] "Acadian Geology," 1868, 643-657, with many figures. (Prepared by Dr. Dawson from the MS. notes of Prof. Hartt.)

6. Résumé of a Lecture on the "Growth of the South American Continent," delivered before the Library Association, Ithaca, N. Y., Dec. 4, 1868. *Cornell Era*, Dec. 12, 1868. (Pamphlet reprint contains 8 pages.)

7. A Vacation Trip to Brazil. *Amer. Nat.*, I, 642-651, 1868.

8. A Naturalist in Brazil. *Amer. Nat.*, II, 1-13, with illustrations, 1868.

9. The cruise of the "Abrolhos." *Amer. Nat.*, II, 85-73, with illustrations, 1868.

10. On the Botocudos of Brazil, (abstract). *Proceed. Amer. Ass. Adv. Sci.*, 18th meeting, Salem, 1869, 273-274.

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11. Thayer Expedition.—Scientific Results of a Journey in Brazil, by Louis Agassiz and his Travelling Companions.—Geology and Physical Geography of Brazil, by Charles Fred. Hartt, with illustrations and maps, 8°, pp. 620. Boston, Fields, Osgood & Co., 1870.

12. Discovery of Lower Carboniferous Fossils on the Rio Tapajos, (A letter written near Monte Alegre, Rio Amazonas, Oct. 5, 1870.) Amer. Nat. IV, 694-695, 1871.

13. Devonian Rocks in the Amazonian Valley. Amer. Nat., V, 121-122, 1871.

14. Amazonian Drift. Amer. Jour. Sci. and Arts, I, April 1871, 294-296.

15. Braz. Rock Inscriptions. Amer. Nat., V, 139-147, with 9 plates, 1871.

16. The Ancient Indian Pottery of Marajó, Brazil. Amer. Nat. V, 259-271, with numerous figures, 1871.

17. Recent Explorations in the Valley of the Amazonas, with Map. Jour. Amer. Geogr. Soc., N. Y., III, 1872, 231-252, (read May 16, 1871).

18. [The Origin of the Basin of the Amazonas (abstract).] Proc. Boston Soc. Nat. Hist., XV, 153-154, 1872.

19. On the Tertiary Basin of the Marañon. Amer. Jour. Sci. and Arts, IV, July, 1872, 53-58.

20. On the Occurrence of Face-Urns in Brazil. Amer. Nat. VI, 607-610, with one large figure, 1872.

21. Notes on the Lingoa Geral or Modern Tupi of the Amazonas. Trans. Amer. Philog. Ass., 1872, pp. 20.

22. O Mytho do Curupira. Aurora Brasileira, Ithaca, N. Y., Oct. and Nov. 1873. (Also separate reprint, pp. 12.)

23. Morgan Expeditions 1870-71.—Contributions to the Geology and Physical Geography of the Lower Amazonas. The Eréré-Monte-Alegre District and the Table-Topped Hills. Bull. Buffalo Soc. Nat. Sci., I, No. 4, 201-235, with maps and sketches. 1874.

24. Preliminary Reports of the Morgan Expeditions, 1870-71.—Report of a Reconnoissance of the Lower Tapajos. Bull. Cornell University Society (Science), No. 1, pp. 37, with map, 1874.

25. Evolution in Ornament. Popular Science Monthly, January, 1875, 266-275, with many figures.

26. Morgan Expeditions, 1870-71.—On the Devonian Trilobites and Molusks of Eréré, Province of Pará, Brazil; by Ch. Fred. Hartt, and Richard Rathbun. Ann. Lyc. Nat. Hist., N. Y., XI, 110-127, May, 1875.

27. The Indian Cemetery of the Gruta das Mumias, Southern Minas Geraes, Brazil. Amer. Nat., IX, 205-217 (illustrated), 1875.

28. Amazonian Tortoise Myths. Rio de Janeiro, Wm. Scully, Publisher. 1875, pp. 40.

29. Notes on the Manufacture of Pottery among Savage Races. Published at the office of the "South American Mail," Rio de Janeiro, 1875, pp. 70.

30. Explorações Scientificas.—I. Comissão Geologica do Brazil. Catalogo da Exposição de Obras Publicas do Ministerio da Agricultura, Rio de Janeiro, 1876, 96-106.

31. Nota sobre Algumas Tangas de Barro Cosido dos Antigos Indigenas da Ilha de Marajó. Archivos do Museu Nacional do Rio de Janeiro, I. Trimestre I°, 21-25, Estampas III, IV & V, 1876.

32. Descripção dos Objectos de Pedra de Origem Indigena Conservados ao Museu Nacional. Arch. do Mus. Nac. do Rio de Janeiro, I, Trim. 2° & 3°, 45-53, Estampas VII & VIII, & 2 figuras, 1876.

33. The Geological Survey of Brazil. First Preliminary Report made to the Counselor Thomaz José Coelho de Alveida, Minister and Secretary of State for Agriculture, etc.; by Ch. Fred. Hartt, Chief of the Geological Commission of the Empire of Brazil, Rio de Janeiro, 1876. Translated and abridged by Prof. T. B. Comstock. Amer. Jour. Sc. and Arts, XI, June, 1877, 466-473.

(Posthumous).

34. Contribuições para a ethnologia do valle do Amazonas, par C. F. Hartt. In Archivos do Museu Nacional do Rio de Janeiro, Vol. VI, 1885.

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SUPPLEMENT.

Dr. J. C. Branner, Director of the Geological Survey of Arkansas, has recently written an account of "Prof. Hartt in Brazil." This appeared in the "Cornell Magazine," Ithaca, N. Y., February 1890, and as it gives that author's impression of the life and work of Prof. Hartt, I have made extracts from the article, seeing that it gives an opinion of his character and achievements formed by one who was an intimate associate in his later years.

"Hartt was a man of the broadest sympathies. One of his peculiarities that always impressed me, was the various sides of his character as they appeared to different ones of his most intimate friends. Among his assistants on the Brazilian Survey were men of the most diverse temperaments and tastes, and Hartt always and instinctively approached and dealt with these various characters in the most effective manner. He never acted so out of diplomacy, but out of sympathy; he put himself in accord with the person with whom he had to deal, and the result was that his assistants, and indeed everyone who came in contact with him, felt drawn towards him. With such a man only the most cordial and genial relations were possible. He had a keen appreciation of wit, humor, and of the ridiculous, and as there was much in common between us on this point, he invariably related to me whatever impressed himself as amusing. . . .

Every artist or musician who met Hartt knows of his love for art and music. These tastes were always turned to good account in his scientific work. No one who had really studied those matters so little, could have seized more promptly or more intelligently the ethnologic meaning of the art and music of savages with whom he occasionally came in contact. His love for music gave him and those of us around him a great deal of pleasure. The Brazilians, being naturally very fond of music, had every year some of the best musical talent of Europe at the Imperial Opera House, and frequent attendance at the opera broke for him the strain and worry of official responsibility.

His liking for languages was equally marked, and he never missed an opportunity to learn something of them. . . . In Brazil he became interested in the languages of the native Africans, and never

lost a chance to learn a new word or idiom, or to make use of his knowledge. In such cases as these, the affair was of course but little more than a pastime, but when he came in contact with the native Brazilian races he applied himself to the study of their languages in all seriousness, with the result that he soon came to be one of a very few Tupi scholars, and accumulated much material upon the native Brazilian languages.

Ethnologic studies interested him deeply, and his work led him more and more in that direction. Had he lived, I have no doubt he would eventually have devoted himself entirely to the study of South American ethnology. . . .

Hartt's strong points were enthusiasm and versatility. . . . He loved scientific work for its own sake and with all his heart, and he could scarcely entertain the idea of abandoning it for the administrative duties of chief of the Geological Survey. He tried hard to do both and found it impossible; he became very nervous and suffered greatly from insomnia. On several occasions I have stayed with him all night trying, with but poor success, to divert his mind from the affairs that annoyed him most. At such times he scarcely closed his eyes during the entire night.

It is not difficult to sum up Hartt's influence upon geological work in Brazil, for with very few exceptions all the work of this character which has been done in that country since 1874 is traceable, either directly or indirectly, to the impetus given it by Hartt. For the most part the work has been done by some of Hartt's students and assistants, and as he was not a narrow specialist, but a broad-minded naturalist, his students have also done other than purely geologic work. Hartt's own writings on Brazilian topics number twenty-eight titles, one of which—his "Geology and Physical Geography of Brazil"—is an illustrated book of 620 pages.

Mr. O. A. Derby, Hartt's first assistant on the Brazilian Survey, was, after some delay, appointed assistant director of the National Museum, where he has been able to carry on more or less geologic work ever since the suspension of the Survey in 1877. During the past few years he has been director of a geological survey of the province of Sao Paulo, where he is successfully carrying out in detail for that province the very work that Hartt hoped to accomplish for the empire. Mr. Derby's published papers upon Brazilian geology number at least fourteen titles, and he now has in press the results of the operations carried on under his direction in the province of Sao Paulo. His geologic work is the most thorough that has been done thus far in Brazil, almost all that has been done hitherto partaking more or less of the nature of reconnoissances."

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[One of the latest contributions to geological literature, arising from the explorations of Prof. Hartt in Brazil, is a beautiful memoir on the Trilobites of Ereré and Maecurú, by Dr. John M. Clarke of the State Museum at Albany, N. Y. This work has been published at Rio under the auspices of the National Museum of Brazil, and shows very clearly the value of trilobites as guages of geological history. The brachiopodous shells from the sandstones of the two localities above named, described by Richard Rathburn, synchronized the sandstones of those places with the Middle Devonian of New York, etc. But a study of the trilobites of the two localities compels a modification of this view; for while the trilobites of Ereré have a Middle Devonian aspect, those of Maecurú find their nearest relatives among the lowest Devonian species, or even with the trilobites of the upper part of the Silurian system. Dr. Clarke's essay contains many profound generalizations on the relationship and descent of the species of trilobites of the genera Homalonotus, Phacops and Dalmanites.—G. F. M.]

“Richard Rathburn, now of the Smithsonian Institution, was a member of the Brazilian Survey from 1875 until its work was suspended. He has published nine important papers upon the natural history of Brazil,—results of his work under Hartt. Frank D. Y. Carpenter published two works, one upon methods of geographic work and the other a popular book. Herbert H. Smith has published two books, one of which is the most important popular work that has appeared upon Brazil since that of Mrs. Agassiz. The writer has published twenty-one titles on Brazilian topics. But the publications of these five assistants do not represent the full extent of their work, for, with the exception of Mr. Carpenter, who died in 1883, these men are all active workers, and many of the results of their observations in Brazil still remain to be published.

Other papers, based upon collections made by Hartt and his assistants, have also been written by various authorities. The most important of these is Dr. C. A. White's “Contributions to the Paleontology of Brazil,” published in 1887, and beautifully illustrated. This work describes 315 species of mesozoic fossils collected by the Brazilian Survey. Other contributions are Marsh, Hyatt, Cope, Verrill, S. I. Smith and T. B. Comstock.

But Hartt's good influence has done even more for Brazil in keeping up the tone and character of scientific work than in the results thus

far published. A country situated as Brazil is, far removed from the centres of scientific activity, is often the prey of the grossest forms of scientific charlatanism. Hartt and his assistants naturally came in contact with this class of men, but he so impressed the leading men of the empire with his ability and integrity that charlatanism was never able, in his presence, to make much headway.

That Cornell University has had so long a number of Brazilians among her students is to be attributed either directly or indirectly to Hartt's influence; and whatever helpful, broadening, enlightening aspirations these young men may take with them from Cornell, they should bear in themselves some remembrance — some *saudade* — of Prof. Hartt who laid down his life for science in Brazil."

In conclusion I should express my thanks to those who have aided in obtaining the information upon which the preceding sketch of the life of Prof. Hartt has been based; and my thanks are especially due to his brother, Mr. George Hartt, of New York, who kindly loaned the wood-cut which faces the title-page. The cut was made by Mr. Hartt himself, and is considered a faithful likeness. The autograph is from a letter to Mr. J. B. Hegan, written when Hartt was a student at Cambridge, and when he gave more expression to his signature than he did in later years.

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PRESIDENT'S ANNUAL ADDRESS.

1. INTRODUCTION.—2. ON THE PALEOZOIC INSECTS.—3. ON THE EXISTENCE OF ORGANISMS IN THE PRE-CAMBRIAN ROCKS.—4. RECENT ADDITIONS TO THE MUSEUM AND LIBRARY.

With many societies such as ours it is customary for the outgoing president to address his fellow members on some topic which has formed the subject of his own studies, or to review the progress of science during the preceding year; it is therefore my privilege as the presiding officer of your society to address to you a few farewell words.

Without attempting anything more than the briefest references in either of these directions, I propose to make some remarks to you on two geological discoveries, which, while they are of local interest, also have a wider significance. But I would first call your attention to the more immediate interests of our association.

Our recording secretary has prepared an annual report of the doings of the society, and of its financial standing, which will be submitted to you; and it therefore seems unnecessary for me to review these matters.

But I may say that the society is doing a continuous and useful work in advancing a knowledge of the natural history of the province. It is daily becoming more of a centre of reference for information on such subjects, and I have no doubt that as it becomes better known its usefulness in this respect will increase.

We have had seasons of zeal which have culminated in sending a Hartt to Brazil, and a Chamberlain to Cambridge; and we have had intervening periods in which the interest of the members in the objects of the society seemed to languish.

But this lack of interest was seeming and not real, for during all the years of our existence as an associated body

there has been a steady growth, though of a kind not always obvious to the looker on.

As I recall our position in years that are past, I see a time when a few members—not the less earnest because they were few—were struggling along, without a library worthy of the name, and with collections of objects for study, small in quantity, and so crowded together that you might touch them from the table where we gathered.

Now, as you may observe, the society has the use of a suite of rooms, and much better facilities in all its departments for carrying on its work. The library has been largely added to by the purchase of series of magazines necessary for the students in several departments of natural science, and quite lately we have added, by purchase from the Mechanics' Institute, a number of scientific books of more general interest.

There has also, for several years past, been a steady influx of donations to the museum from friends of the society, so that the members now have within reach books to read and materials to examine and study of much greater value than those available to the first members of the society.

I regret that of late there has been little opportunity for the members to pursue the study of natural history collectively in the field, and would suggest that the practice of holding field meetings should be revived. In such meetings, in some societies known to me, it is the practice to give prizes for collections made and named in the field—a practice which serves to give the younger members a greater interest in the proceedings.

Though we have not met for combined effort and mutual instruction in this way for some time, I observe that several of the members are pursuing individual work which has received commendation abroad. Among such I may name Dr. L. W. Bailey, Prof. W. F. Ganong, and our recording secretary, Mr. W. J. Wilson. Mr. Wilson's discovery of new types of insects and crustaceans in the plant beds of Lancaster is the subject of a paragraph in the proceedings of the Royal Society of Canada,* and is alluded to by Dr. S. H. Scudder,

* See address of the President of Sec. IV., in 1889, p. 11.

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Librarian of Harvard University, in his address to the Cambridge Entomological Club.*

In connection with this subject I would call your attention to the great progress which has been made in the last ten years in our knowledge of fossil insects, and especially those of the Palaeozoic rocks, through the observations of Dr. Scudder, Alex. Brongniart, and a number of German investigators.

You are aware that naturalists divide the modern insects into seven orders. Three of these orders are regarded as belonging to a higher series than the others, as they undergo a more complete metamorphosis, and differ also in other respects. These higher orders we may consider to be represented by bees, the butterflies, and the two-winged flies. The remains of such insects are comparatively modern, for they have not been found in the Palaeozoic rocks, though numbers are known from the Tertiary formations.

In the lower series, containing four orders, the metamorphosis of the individual is incomplete, and these have all been traced back to the Palaeozoic formations. To these lower orders belong the Devonian insects of St. John, and the numerous insects found in the coal measures of Germany, England, Canada, and the United States.

Until recently only two of these lower orders were known in the Palaeozoic rocks, but late discoveries have added the other two, so that now the whole four orders, which may be represented by the dragon-flies, the grasshoppers, the beetles, and the bugs, are found to have had representatives living at some time between the Silurian and Permian ages.

The greatest addition to our knowledge of these old insects has arisen from discoveries made at Mazon Creek, in Illinois, and at Commeny, in France. At the latter place have been found gigantic may-flies and "walking-sticks," besides great numbers of cockroaches and other insects. Six hundred specimens of insects have been found here, and are now being studied by Alexander Brongniart.

* The Work of a Decade upon Fossil Insects, p. 288.

Great numbers of cockroaches have been found also in the American deposits, and Dr. Scudder has for this reason called the carboniferous period, so far as insects are concerned, the age of cockroaches.

On the other hand, no cockroaches have been found among the Devonian insect remains of St. John, for our insects, according to Dr. Scudder, are neuropteroid, or pseudoneuropteroid, only, or, in other words, are related to the dragon-flies and may-flies.

The St. John Devonian insect wings are now no longer the oldest indications of that class of animals known, for at Calvados, in France, there has been found a solitary wing of a cockroach in Silurian sandstone. This wing is not very well preserved, but so far as can be judged from the figures of it given in several publications, it is the wing of some insect similar to a cockroach.

The existence of wood-boring beetles in the carboniferous age had been inferred from the discovery of wood of that period which had been bored by larva, in a way similar to that of modern beetles. The actual wing-cases of beetles, however, have been lately found in the stone coal of Silesia, by Dr. Dathe.

Even the remains of bug-like insects have been recovered from the carboniferous rocks of Missouri, and from the Permian of Bohemia.

Thus we find that the whole four of the lower orders of insects, or at least forms out of which they sprang, were living in Palaeozoic times; and the fact that one of our members has been able to add to the number of these rare and most interesting relics of the early denizens of the air, is creditable to his acute observation, and to the association of which he is a member, for such remains are not easily detected.

I would now ask your attention to another point of local geology which it appears to me fitting to bring first before this society, as the foster-mother of scientific investigation in our community.

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Many years have now elapsed since the discovery of Eozoon (the dawn-animal) and its description by Sir Wm. Dawson,* without any important associated fauna having been found.

It has been stated that the same, or a similar organism, has been found in various countries, as Bavaria, Ireland, and Massachusetts, but apparently Eozoon alone, and no other animal with it, and the animal itself in some of these cases very imperfectly or doubtfully preserved. It is true that Sir William records the occurrence at Côte St. Pierre of minute spherical bodies† in connection with Eozoon, but these he explains to be an open growth of Eozoon at the upper surface of an Eozoonal colony, and not an independent organism.

He also mentions the presence of a crystalline structure, such as is highly characteristic of crinoidal remains, when preserved in limestone. But we are informed that the more dense parts of Eozoon sometimes show this structure, though less distinctly. It is evident, therefore, that we cannot put much reliance on this structure as showing the presence of organisms other than Eozoon. The same remark applies to the observations of Sir William respecting the presence of minute grains simulating the forms of foraminiferous shells.

A more positive evidence of the presence of other creatures than Eozoon in the seas in which this animal lived, may be drawn from the perforations discovered in the limestone of Madoc, Ontario, which Sir William supposes may have been made by worms, having the habit of *Scolithus* (or *Arenicolites*).

Despite these observations, it is evident that very little positive evidence is known of the existence of creatures contemporary with Eozoon.

The nearly entire absence of other animal remains from the rocks containing Eozoon, and the fact that a stout fight has been made by certain English and German chemists in favor of its mineral origin, has caused many to doubt the animal nature of the object which goes under that name.

Among these doubters are many of the leading geologists of America. No better test of opinion on the subject could have

* Can. Nat., 2nd Ser., Vol. II., 1865.

† Called *Archaeospherina*.

been had, than that obtained by the circulation among the American geologists, by Dr. Fraser, as reporter on the Archæan rocks, to the International Congress of Geologists, of the question, "*Is Eozoon Canadense of organic origin*?" The replies to this question will be found in the September number (1888) of the "*American Geologist*," p. 175, where we find that among fourteen geologists consulted, if we leave out the two original investigators of Eozoon, Sir Wm. Dawson and Dr. Hunt, only one, on his own authority, pronounced Eozoon to be organic. This geologist is Mr. C. D. Walcott, of the United States Geological Survey. But probably a number of the others have not had the opportunity of studying Eozoon in the field.

The mode of occurrence of Eozoon in the rocks in which it is found is such that one accustomed to observe the older organisms, resembling the reef-corals, can hardly come to any other conclusion than that Eozoon is of organic origin, and this irrespective of the evidence supplied by the microscope.

The outward appearance of Eozoon is so much like that of some stromatoporoid corals that if the object were found in Ordovician or Silurian rocks its organic nature would scarcely be questioned.

Admitting that Eozoon is of organic origin, it certainly is a remarkable fact that it is the only organism of its kind known; and still more remarkable that it stands almost alone as a solitary animal structure in the great system of rocks to which it pertains.

Remains of other animals have been sought for in these Eozoic rocks, but so far as I know without much success. Discoveries of pre-palæozoic fossils have from time to time been reported but many of these have afterwards been found to pertain to the Cambrian or Ordovician faunas, or are so obscure and indefinite that they are of little value in carrying back the history of life behind the Cambrian forms.

Often also the absence of a definite Cambrian horizon leaves the exact age of such reputed pre-Cambrian animals open to doubt. Such for a long time was the position of the *Olenellus*

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fauna, now found to begin at the base of the Cambrian. Such also is the status of the imperfect fauna discovered in the Catlinite or Indian pipestone beds of Minnesota. Of this it can as yet only be said, that it is older than the upper Cambrian.

For a similar reason a certain amount of doubt attaches to the exact age of the Monian system of rocks of Anglesea, described by Mr. Blake; for on that island the oldest fossiliferous horizon is Ordovician, or post-Cambrian. The Monian system is elaborately described by Mr. Blake, but as yet he has found no fossils in it; and in fact it appears to consist largely of altered sediments, where the fossils, if they ever existed, have been obliterated.

Mr. Walcott has found an obscure discinoid shell, and what he regards as the pleura of a trilobite in pre-Cambrian strata of the Rocky Mountain region, but this, it will be admitted, is but a very imperfect representation of a pre-Cambrian fauna. Anything therefore which goes to prove the existence of living beings prior to the Cambrian age is of considerable importance to the geologist, and to the naturalist as well; it is with pleasure, therefore, that I am able to call your attention to the existence in your neighborhood of remains of organic forms of an antiquity far antedating the Cambrian age.

As we have at Saint John a definite base to the Cambrian system, and since these basal rocks carry the very oldest Cambrian fauna known, we are sure of the greater antiquity of the organic forms to which I refer.

Not only is this antiquity shown by the nature of the fossils, and the entirely different lithological aspect of the series from the Cambrian system, as developed here; but the great denudation which the older system had suffered before the deposition of the Cambrian beds is shown by the occurrence of a conglomerate at the base of Division I. of the Cambrian, which is derived from the limestones of the older system.

Furthermore, between these two systems a third system of rocks — the Coldbrook (or Coldbrook and Coastal) — is inter-

posed, which also has given conglomerates to the Cambrian, and which has a great thickness.

The oldest of these three series of rocks has been described in the reports of the geological survey of Canada as the "Upper series" of the Laurentian area, and in this the fossils I refer to have been found.

At three horizons in this system, remains of animals of low organization occur. The oldest is in the upper part of the quartzites which are found in the lower half of the system. They are Hexactinellid sponges, probably allied to the genus *Cyathospongia*. The frame-work consists of a somewhat irregular set of cross-bar spicules, forming a mesh, in the intervals of which are scattered smaller spicules similarly arranged.

The second horizon of organic forms is in the upper limestones of the "Upper series." The organism found here is of an entirely different character from the sponges. It is one of the calcareous coral-like structures, somewhat like certain forms found in the basal beds of the Cambrian. Its structure has not yet been studied, but it consists of elongated cylindrical objects with bodies from one inch to three inches across, and several inches in length.*

The object consists of a cumulative growth of conical partitions, layer upon layer; building up a cylindrical body that in cross-section looks not unlike a part of a tree trunk; and which bears a general resemblance to *Stromatopora rugosa*. The upper limestones at the base of which these organisms are found have probably suffered greatly from denudation, as we find areas of the rock system to which they belong, which do not appear to have the upper limestones. Good examples of the fossils are known from only one locality.

The third horizon is that of the graphite beds, in which occur great numbers of spicules of sponges arranged in parallel sets, one set crossing another at an acute angle. This type of sponge is apparently Monactinellid. As only straight needle-like spicules, without rays, have been observed in this sponge, it probably was a mass of jelly, or sarcode protected

Archæa* Described further on as *Bozoon Acadiense*.

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and sustained by the spicules which traversed it. A similar sponge was found in the fine black shales of Division I. Band *d*, of the St. John Group, at Musquash.

It seems doubtful if the system of rocks in which these three organisms have been found, is of exactly the same age as that which in the Province of Quebec has been found to contain Eozoon. Sir William Logan, who examined our limestones many years ago, thought them more recent than the Laurentian limestones of the Ottawa Valley. He found them less crystalline than those. There seems no reason, however, why the sponges which are so plentifully distributed in these Acadian limestones of the "Upper Series," should not be found also in that eozoonal limestones and associated deposits of the Ottawa Valley, as they appear to have had a wide range in early Cambrian and pre-Cambrian times.

Lest I should weary you with the details of a subject which probably interests only a limited number, I now pass to another matter, which is of more immediate concern to the members of this society.

Perhaps the most important event to us in the past year is the acquisition of the museum of the Mechanics' Institute, including the Gesner collection.

Learning that the directors of the Institute were about to wind up its affairs, your council thought it advisable to apply to that body for the transfer of the trust of the Gesner museum and the purchase of the remainder of their museum. The directors of the Institute have accepted the offer of your council and the collections they held have now passed into your hands.

The Gesner collection, which forms the bulk of the Institute museum, will add greatly to the material available for the purposes of our society. Its ethnological collections contain many articles from Polynesia, China, the Indies and Australia, of which we had no counter-parts. Objects of this kind are useful for comparison with the rude implements, etc., of the existing Indian tribes of our country, and their predecessors.

The collection of minerals is a good one and contains fine examples of the Nova Scotian zeolites and quartz minerals, and will add many species to those which the society previously possessed. The general collection of fossils and rocks also has many European and United States examples which will serve to extend our series of such objects.

In the Gesner museum is the collection of rocks, minerals and fossils made by Dr. Gesner when employed on the Geological Survey of New Brunswick. These are of historical interest, and with them in hand the reader of Dr. Gesner's reports will be able to understand what he meant by the terms serpentine,* and grauwacke, trap and other obsolete terms of geological literature.

A good and useful piece of work for some member of this Society would be the study of this collection of Dr. Gesner's, to determine what are the modern names for his rocks. It should be remembered that Dr. Gesner's survey was made when geology was in its infancy, and was the first undertaken by a provincial government in Canada; or, so far as I know, in any British colony.

With the collections of this old survey, the society has acquired Dr. Gesner's geological map of New Brunswick, which never was published, but which is necessary to the full understanding of his reports.

In the Natural History part of the museum the society has received a considerable number of native mammals, which, though not all creditable as specimens of the taxidermist's art, are useful to show the wild animals of our country to those who cannot visit them in their native haunts.

Among the birds are a few groups of foreign birds which are a welcome addition to our museum and also some native species, but most of the native birds are duplicates of those already in the society's collection.

There are quite a number of reptiles and fishes, including some foreign species, and several small cases of European and Asiatic insects, some of them much faded, but the cases con-

* "Serpentine" is still used, but not in the sense in which Dr. Gesner employed it.

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tain many peculiar insects, interesting from their large size, or remarkable form.

Among the lower invertebrates, a case of corals and other radiates will add to our means of instruction. A feature of the Mechanics' Institute Museum, which is included in the collections handed over to us, are models of improvements in ship-building and other arts which have flourished, or are still carried on among us.

By the assumption of the charge of this museum, the society has put itself under considerable pecuniary obligation, both for purchase and maintainance. It will be necessary to fit up and heat additional rooms, and further expense will be incurred for attendance, fuel, light, and insurance.

The arrangement of the Gesner collection, made some fifty years ago, is not at all up to modern ideas, and an entire revision and re-cataloguing of the museum is urgently called for. For all these calls, as well as the expense of moving, we hope that means will be provided. The council of the society in the purchase of this museum have been able to preserve to the city a collection which otherwise would have been dispersed, and would have passed into private hands, but we now hope may, for many years to come, be of public utility to the citizens of St. John.

ARTICLE I.

EZOON AND OTHER LOW ORGANISMS IN LAURENTIAN
ROCKS AT ST. JOHN.

BY G. F. MATTHEW, M. A., F. R. S. C.

(Read 7th October, 1890.)

One of the earlier results of the Geological Survey of Canada was the discovery and description of that lowly organism, *Eozoon Canadense*, a creature so obscure in its relations, and so far removed from any modern animal with which it may be compared, that it has formed the theme of controversy for more than a decade.

Outside of the earlier observations and studies on the subject, undertaken by Sir Wm. Logan, Sir Wm. Dawson, and Dr. Hunt, very little has been done by Canadians to add to the range of our knowledge of this interesting organism.

Sir Wm. Dawson has had to maintain almost single-handed, so far as America is concerned, the controversy in favor of the animal nature of *Eozoon*; while the opposition to his views has been strenuous, and has been carried on by several leading scientists both in Europe and America. So strong has been the objection taken to his explanation of the nature of *Eozoon*, that a large majority of the American geologists, whose opinion on this subject was sought, gave their verdict against it.

Any new observations on this subject, therefore, cannot but be of interest to all who give any attention to the historical branch of geology.

The earliest knowledge of the occurrence of *Eozoon* in the neighborhood of St. John was obtained many years ago, when the writer collected and forwarded to Sir Wm. Dawson, pieces

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of the limestone on the south side of Lily Lake containing serpentine. In this limestone Sir William found *Eozoon* in a fragmentary condition.

Sir William, in his work on *Eozoon*, *Life's Dawn on Earth*, p. 235, described the Canadian species as occurring in rounded masses, or thick, encrusted sheets, frequently of large dimensions. The typical structure was said to be stromatopoid, or with concentric calcareous walls, frequently uniting together, etc., etc.

I have lately met with an article by Sir Wm. Dawson, (*Geol. Mag.*, Lond., vol. V. of series III., Feb., 1888), in which he gives new facts on *Eozoon*, and modifies his description of the form of this fossil.

"1. *Form of Eozoon Canadense.*—Hitherto this has been regarded as altogether indefinite, and it is true that the specimens are often in great confluent masses, or sheets, the latter often distorted by the lateral pressure which the limestone has experienced. The form from Tudor, however, figured by Sir W. E. Logan (in *Quart. Jour. Geol. Soc.*, Lond., 1866, p. 253, and described by me, * * * and figured by me in my work, *Life's Dawn on Earth*), gave the idea of a turbinate form, more or less broad. More recently additional specimens, weathered out of the limestone of Côte St. Pierre * * * compared with several less perfect specimens in our collections, have established the fact that the normal shape of young and isolated specimens of *E. Canadense* is a broadly turbinate, funnel shaped or top-shaped form; sometimes with a depression on the upper surface, giving it the appearance of the ordinary cup-shaped Mediterranean sponges. These specimens also show that there is no theca or outer coat either above or below; and that the laminae pass outward without change to the margin of the form, where, however, they tend to coalesce by subdividing and bending together. The laminae are thickest at the base of the inverted cone, and become thinner and closer on ascending, and at the top they become confounded into a general vesicular or acervuline layer. I now feel convinced that broken fragments of this upper surface, scattered over the sea-bottom, form those

layers of *Archæospherinæ* which I at one time regarded as distinct organisms."

"It is to be observed, however, that other forms of Eozoon occur. More especially there are rounded or dome-shaped masses, that seem to have grown on ridges or protuberances, now usually represented by nuclei of pyroxine."

The above remarks may be considered to embody the result of Sir Wm. Dawson's matured studies on the form of *Eozoon Canadense*, and show very clearly its distinctness from the calcareous object I describe below. The broad top-shaped or funnel-shaped form of the Eozoon implies the possession of concave rather than convex partitions (laminae); but hundreds of examples of the Acadian fossil show that the normal shape of its layers is convex.

Some months since the attention of the writer of this communication was called by Mr. Wm. Murdoch, C. E., of St. John, to the appearance of some fragments of crystalline limestone, which were thought to be pieces of petrified wood. The fragments had been broken from ledges, at a locality which from his knowledge of the local geology, the writer knew to be from the upper series of the Laurentian area near St. John, N. B.

These fragments had apparently a concretionary structure, but differed from any concretionary limestone the writer had seen before. The pieces exhibited were not sufficient to show the nature or origin of these apparent concretions, and an early opportunity was embraced of visiting the locality and making observations on the spot. This visit resulted in the discovery of an extensive reef of limestone, in which immense numbers of these peculiar fossils are preserved in a remarkably perfect condition.

The reef began its growth on a bottom of fine sand, now converted into a quartzite rock which forms an important member of the Upper Series. There the objects consist of a multitude of small, short, closely set columns, which grew tier upon tier, with at first more or less of sand between the tiers.

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It may be observed also that these crowded clusters of columns were often cut off over considerable areas, by thin horizontal layers of mineral matter, perhaps indicative of the incursion of sand or other sediment, but the growth was almost immediately renewed by a new set of columns, occupying the fresh surface of mud that covered the old ones.

In the upper part of the reef in which the columns flourished and grew luxuriantly, it is very interesting to observe the apparent effort put forward by some of these columns to overtop their fellows. Those that grew most vigorously would spread and crowd the adjoining ones, so that they were compelled to elevate the centres of their calcareous layers. Thus in these crowded columns the layers became almost funnel-shaped, while in the broad ones that had plenty of room to grow they flattened out to a saucer shape, or in some cases are almost entirely flat. It is these funnel-shaped layers which, when they are cut across, have the appearance of the ends of sticks of wood. They have thus given to unpractised observers the impression that the rock consisted of crowded masses of wood turned to stone.

Sometimes one of these columns was quite crowded out of existence by its more vigorous neighbors. In other instances, we appear to have cases where the columns bifurcated, and formed two to occupy space otherwise vacant on the seabottom. Another feature of these columns which helped to carry out the deception that led those who first saw the rock to suppose that each column was a stick of wood, was that the silicious layers are thinner, and sometimes fail altogether at the centre of the column. As the spaces between the calcareous layers are filled up with mineral matter of a darker hue than the calcareous substance, the columns appear to have a dark centre like the pith of a tree; hence they were thought to be trunks of "hardwood" or exogenous trees.

This reef of calcareous columns was about one hundred and fifty feet deep, but its lateral extent is not known, as it is cut off on one side by a fault, and on the other passes beneath the waters of the St. John River, and thence probably beneath the lower carboniferous sandstones of the Kennebecasis valley.

A peculiarity of the calcareous column is that it is usually surrounded by a casing of more silicious matter. A space of a quarter of an inch, or more, may separate two of the



Problematical fossil from Laurentian limestone at St. John, N. B.
Side view of a portion of a column. Reduced $\frac{1}{2}$ diam.*

columns, the space between being filled up with an irregular and broken calcareous deposit.

The microscopic characters of these columns and their layers have not been studied, but to the naked eye the more silicious layers, when well preserved, are distinctly beaded as if they were the filled up chambers of an organism, in which the chambers were imperfectly separated from each other.

A peculiarity of this object is that of the sudden cessation of growth, either of part, or of the whole of an individual column. In a case of this kind the space thus left vacant, is occupied by the extension over it of the layers of a neighboring column or by the growth of one or more new individuals on the senile surface.

These new columns have in all cases a dome-shaped or hemispherical form, which they retain till they are as large or larger than a finger-end; after which the layers begin to

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flatten. Here we have on a small scale a form of growth similar to the larger dome-shaped masses of *Eozoon Canadense* described by Sir Wm. Dawson.

There is a fossil described by Prof. James Hall (*cryptozoon proliferum*), occurring in the Calciferous rocks at Greenfield, N. Y.,* which at first glance strikingly resembles the Acadian fossil above described, but it differs in the mode of growth, as it occurs in rosettes of various sizes, consisting of concave laminae.

Another organism which occurs in black silicious slate near Lily Lake, consists of black, linear, flat objects that appear to be of the nature of sea-weeds or graptolites, but which have not been found in specimens sufficiently complete to give a satisfactory indication of their relationship.

* See 36th Ann. Rep. N. Y. State, Mus. Appendix.

ARTICLE II.

ON THE OCCURRENCE OF SPONGES IN LAURENTIAN ROCKS
AT ST. JOHN, N. B.

BY G. F. MATTHEW, M.A., F.R.S.C.

(Read 3rd November, 1890.)

A year ago when visiting Drury's cove, an indentation of the Kennebecasis river, in company with members of this society, my attention was attracted by certain smooth surfaces in the layers of the quartzites at that place. These, by their appearance, recalled the shining surfaces of flags of the St. John group over which spicules of hexactinellid sponges are scattered. Fragments of this rock were submitted to the microscope and found to carry solitary spicules, and also fragments of the network of a sponge. The arrangement of the bars in these fragments of sponge skeleton would indicate a species resembling *Cyathospongia*. The following is a description of its character:

CYATHOSPONGIA (?) Eozoica. n. sp.

Skeleton of parallel and some forked spicules, crossed by other spicules at right angles, or nearly so. The spicules are of two sets of different sizes — one larger, forming a fenestral framework to the sponge; the other smaller, producing a minute network in the interspaces of the larger spicules. Spaces between the bars of the framework about one four-hundredth of an inch, the finer spicules are made visible by a one-fourth inch objective.

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As only fragments of the skeleton of this sponge are known, the reference to *Cyathospongia* is conjectural.

In the size of its mesh this sponge may be compared with fragments of hexactinellid sponges found in the basal (Etchimenian) series of the Cambrian rocks of this region. The mesh of the sponge is much smaller than that of *Protospongia fenestrata*, Salter, of the Welsh Cambrian rocks; it is also smaller than *P. minor* of Div. 1d. of the St. John Group.



Fig. 1. *Cyathospongia eozoica*. Mag. 80 diam.

Horizon. In the quartzites of the middle division of the upper series.

The great limestone beds of the upper division are present in force at Drury's cove and vicinity, and contain beds, some of which are bitumenous and others graphitic. On examining these limestones, graphitized layers were found whose surfaces exhibited numerous spicules of sponges. Finding the sponge remains particularly abundant on the graphitic layers, I was induced to examine the surfaces of the graphite, which is found in irregular beds in the upper part of the Laurentian rocks near the Falls of the St. John river. These graphite beds proved to be remarkably rich in sponge remains. So plentiful are the groups of spicules on the layers of the rock, that the individual form of the sponge could not be made out.

HALICHONDRISES GRAPHITIFERUS. n. sp.

I did not detect *Protospongia* or *Cyathospongia* in the graphitic shales, but there are immense numbers of simple spicules; long, acerate, and mostly in parallel sets. The sets of spicules lie across each other at all angles.

So far I have been unable to determine whether this sponge, with bands of parallel acerate spicules, is a monactinellid or hexactinellid sponge, and therefore refer it to Sir Wm. Dawson's provisional genus *Halichondrites*.

Horizon. In graphitic slates in the lower half of the upper division.

Although the spicules observed on the graphitized layers often cross each other at acute angles, I have not observed such

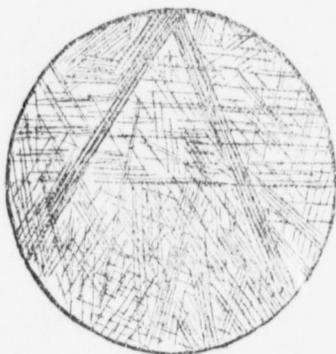


Fig. 2. *Halichondrites graphitiferus*.
Mag. 12 diam.

a constant relation of this kind as to lead to the supposition that any of these sponges belong to *Rhombodictya*; nor is there such a frequent flabellate arrangement of spicules as to suggest *Cyathospongia*. The arrangement of acerate spicules, as seen in *Askonema*, is somewhat akin to that of the species described above, but the Laurentian species shows much wider bands of spicules than *Askonema*.

Besides the bands of parallel acerate spicules, groups of closely crowded spicules occur, that may have been the anchoring bands of some pedicellate sponge.

On the smooth surfaces of other graphitic rocks the same forms of acerate sponge spicules were observed as are seen on those of the St. John mineral. Similar spicules occur also on the surfaces of black shales of Div. 1d of the St. John group at Musquash, N. B.

It may seem a remarkable thing that sponge spicules should be so plentiful in graphite. If unchanged they would certainly be an injurious constituent of a substance applied as a lubricant in the arts. I can only conjecture that the form is there, but not the substance. It is well known that the silica of sponge spicules is in a very unstable condition, and, therefore, very liable to chemical change. The silica of these spicules may have been replaced by some other mineral less harmful to a lubricant than that substance. Veins of quartz traverse the graphitic beds at St. John, in all directions.

SYSTEMATIC POSITION OF THE SPONGES, ETC.

In the northern part of the city of St. John, below the Palæozoic rocks, there is an area occupied by gneisses, mica-

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schists, quartzites, limestones, etc., which have been referred to the Laurentian system. The quartzites and limestones occupy basins in the gneiss and constitute an upper series. Three basins are known, two within the city limits and one to the northward of them, in Kennebecasis Bay. There are three principal sets of strata in these basins, viz.: Near the base schistose beds with limestones; in the middle quartzites and silicious slates; and towards the summit limestones with silicious and graphitic slates. This is the general succession, but further study is required to determine the parallelism of the several members in the different basins. The whole of these Laurentian rocks are separated from the Cambrian by a great mass of intermediate rocks usually denominated Huronian.

We thus have below the Cambrian rocks the following descending succession:

		Thickness.
ARCHÆAN. EOZOIC.	COASTAL SERIES (OR SYSTEM), 1872. — Grits, hydromicaschists, argillites, etc.; resembling the Peibidian rocks of Dr. H. Hicks.	10,000 feet.
	COLDBROOK SERIES (OR SYSTEM), 1865 — Diorites, felsites, petrosilex, etc.; resembling the Arvonian rocks of Dr. Hicks.	15,000 " *
	UPPER SERIES (OR SYSTEM) OF LAURENTIAN, 1872.	
	UPPER DIVISION. Argillites, limestones, graphitic shales. <i>Fossils</i> . In upper part of the upper limestones of the South basin, fragmental <i>Eozoon</i> , observed by Sir J.W. Dawson in specimens sent him. In middle of upper limestones in Middle basin, spicules of sponges. In graphitic shale of South basin spicules of <i>Halicondrites graphitiferus</i> . In lowest limestone of the Middle basin, the reef of columnar fossils described in the preceding article (Article I).	740 "
	MIDDLE DIVISION. Quartzites, siliceous schists, <i>Fossils Cyathospongia (?) eozoica</i> near the top of this division.	450 "
	LOWER DIVISION. Limestones and gneisses. No Fossils known.	200 " †
—		
	LOWER SERIES OF LAURENTIAN. Gneisses, Micaschists, etc.	?

*The above thicknesses are on the authority of Dr. L. W. Bailey. Report Progress Geological Survey Canada, 1879. pp. 10, D. D. and 21, D. D. Dr. R. W. Ells in the same Report, p. 6, D. D. describes these rocks, sixty miles east of St. John, as one system, with a thickness of 14,000 feet.

† Fuller descriptions of these rocks may be found in Rep. Prog. Geol. Surv. of Canada, 1872. pp. 30, 34, etc.

ARTICLE III.

ZOOLOGICAL NOTES.

BY W. F. GANONG.

Report of the Committee on Marine Invertebrate Zoology.]

I. MOLLUSCA.

The numbers refer to the species in the writer's "Preliminary List of the Marine Mollusca of New Brunswick" published in Bulletin No. VI. (1887) of this Society. The typography also follows the rules of that list.

12a. BUCCINUM CINEREUM.—(Say), Gould.

UROSALPINX CINEREA.—St. (F).

This species is undoubtedly to be added to our list, though not actually reported from our coast. Verrill (F) reports it from southern part of the Gulf of St. Lawrence, and Dawson (Rep. on Geology of P. E. I.) from waters of Prince Edward Island. Probably it is not abundant.

[31a. NATICA PUSILLA.—Say.

Reported by Fuller (2nd. Rep. on Nat. Hist. and Geol. of Maine, 1862,) from St. Croix River in vicinity of Dochet, or St. Croix, Island. This is a southern species and its presence in our waters needs confirmation. Possibly was confounded with *L. Grænlandica*.]

35. LUNATIA TRISERIATA.—Say.

Almost beyond question a color variety of *L. heros*. See Verrill, Am. Jour. Sci., iii., III., 1872, p. 282.

43a. ODOSTOMIA SEMINUDA.—(Adams), Gould.

Reported by Rev. H. W. Winkley, in Bull. No. VII., 1888. The present writer has specimens which are undoubtedly

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of this species, taken from the mud of oyster-barrrels which came from the Gulf of St. Lawrence. Though not actually reported from our own coast, it must occur there. Being a southern species its occurrence in the Gulf is of special interest. The specimen of this, as well as of the following (43*b*, 43*c*), are smaller than the southern specimens, if the measurements in Binney's Gould represent the average size.

43*b*. ODOSTOMIA BISUTURALIS.—(Say), Gould.

[See remarks under 43*a*.]

43*c*. BITTIUM GREENII.—(Adams), H. and A. Adams.

CERITHIOPSIS GREENII.—Verrill (F).

[See remarks under 43*a*.]

47. TURRITELLA COSTULATA.—Mighels and Adams.

Synonyms of this species are *Acirsa Eschrichtii*, *Acirsa borealis*,—both reported from Eastport.

53. LITTORINA LITOREA.—(Linn.), Forbes and Hanley.

Bathurst, 1885, *E. S. Morse*. (Bull. Essex Inst. XII., 1880, p. 176). First found on our Bay of Fundy coast at Gardner's Creek, near St. John, 1861 or 1862, by Mr. G. F. Matthew.

58. Omit the three notes which, by an error of the printer, are a repetition of those belonging to Nos. 147, 162 and 167.

77. After "Dalhousie" insert "one specimen."

79. TECTURA ALVEUS.—(Conrad), Stimpson.

"Not found on the southern coast" is found to be a mistake. We find it very abundant on eel-grass at low water at Grand Harbor, Grand Manan, and it probably occurs elsewhere in similar situations.

80. TECTURA TESTUDINALIS.—(Müller), Gould.

The shells of this species are called "Baby-shells" by the fishermen of Grand Manan from the semblance which the *animal* presents to a child covered all but the head, in a cradle. They are also called "cleavers," because they "cleave" to the rocks.

101a. UTRICULUS CANALICULATUS.—(Say), Stimpson.

[See remarks under 43a].

109. PECTEN TENUICOSTATUS.—Mighels and Adams.

Additional localities are given in Bulletin No. VIII, p. 64.

110. CRENELLA GLANDULA.—(Totten), H. and A. Adams.

In tide-pool at the head of the passage between Grand Manan and Ross Island, this species is found living in the greatest profusion, attached by a byssus to a bottom of fine gravel and shells. The tide-pools are left for several hours and become very warm.

113a. MODIOLA PLICATULA.—Lamarck.

Though not actually recorded from our own coast, it must surely occur there. Verrill (F), reports it from the southern part of the Gulf of St. Lawrence, and it occurs upon the north shore of Nova Scotia, about Pictou, etc. It is not improbable that it may be found about the marshes at the head of the Bay of Fundy.

134. CYTHEREA CONVEXA.—Say.

Found by the writer at Oak Bay, Charlotte County, N. B., in 1889. Few dead shells only.

139. ASTARTE LENS.

A. CREBRICOSTATA.—Gould. (Verrill, *Am. Jour. Sci.* iii., III., 1872, pp. 213 and 287).

Two small specimens. Oak Bay, Charlotte Co., N. B.

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141. *TELLINA TENERA*.—Say.

Omit "Off Douglastown," etc. This Douglastown is in Gaspé.

147*a*. *TURTONIA MINUTA*.—(O. Fabr.), St.

TURTONIA NITIDA.—Verrill.

Has not hitherto been reported from our waters. It occurs in considerable numbers about Grand Manan, though we regret to say we have not noticed in what particular habitat.

148*a*. *CUMMINGIA TELLINOIDES*.—Conrad.

[See remarks under 43*a*.]

155. *COCHLODESMA LEANUM*.—(Conrad), Couthouy.

Omit "Near Douglastown," etc., as in No. 141.

165. *ZIRFAEA CRISPATA*.—(Lin.), Adams.

L'Etang Harbor, near Sturgeon Cove, 4 dead valves. *W. F. G.*

168. *XYLOPHAGA DORSALIS*.—(Turton), Forbes and Hanley.

New Brunswick waters. See Bulletin No. VIII, p. 116.

II. ECHINODERMATA.

The numbers refer to the species in the writer's "Echinodermata of New Brunswick," published in Bulletin No. VII (1888) of this Society. The typography also follows the rules of that list.

8. *Asterias vulgaris*, STIMPSON, MS.

ECONOMICS. The only direct value of the species to man consists, as stated, of its very limited use as a fertilizer. Yet the large amount of lime in its skeleton, and the rapidity with which the soft parts decay and allow it to fall to pieces and be more easily scattered, should make it of some value for this purpose where it can be obtained in abundance. In the United States, where they do such damage to oyster-beds that they must be systematically dredged, those thus taken are

used for manure, though I cannot find that they are ever taken specially for this purpose. In England, however, the case is different. In Vol. II. of Sect. V., p. 622, of Fishery Industries of the United States (a splendid publication of the United States Government) is a quotation which states: "Mussels and star-fish (five-fingers) have long been an established manure in the neighborhood of Faversham, Kent, They are procured by dredging. The mussels sell at 16s. sterling per wagon, and the five-fingers at 21s." Forbes (History of British Starfishes, p. 89,) writes: "A gardener told me that he would desire no richer manure than starfishes for his garden." They are said to be esteemed in France as a manure for grape-vines. If they are as valuable as this in Europe, our farmers should given them a trial. We know of places in Charlotte County where a wagon could be filled at a single low tide.

On the other hand, it is said by Mr. Ingersoll (Oyster Industry, U. S. 10th Census, p. 230) that the several attempts at oyster-culture in the region of Passamaquody Bay have failed on account of the rapacity of the hordes of great starfishes in the vicinity. We doubt very much whether oyster culture could be successful there, even if no starfishes were present, the conditions of temperature in summer being unfavorable to it. On our north shore, the starfishes are thought to do very little damage to the oyster-beds. (Bulletin No. VIII., p. 61).

It is not unlikely that the individuals of this species are poisonous, not indeed when taken into the hand, as many persons believe, but when taken internally or into the blood through a break in the skin. Indeed the latter appears to be proven, as is shown by a short article in the Bulletin U. S. Fish Commission, VII., 1887, p. 34. It is entitled, "Fatal injury inflicted by a starfish;" and describes the case of a fisherman whose hand, pierced between two fingers by a spine of a starfish he was removing from his hook, festered and swelled; blood poisoning ensued and the man died. It has been asserted also that starfishes from stagnant water are poisonous. (Zoological Record, XXIII., Mollusca, p. 45.)

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The very bright and conspicuous coloration of many individuals of this and allied species, making them so easily visible to hosts of hungry enemies, offers strong presumptive evidence that they have some means of protection analagous to those of land animals which are conspicuously colored. In the latter case, particularly among the insects and certain reptiles, conspicuous colors are associated with disagreeable or poisonous secretions or juices, and the colors in such cases are of the nature of warning or danger signals. It seems reasonable to suppose that similar disagreeable or poisonous secretions may be associated with the bright colors of our starfishes. *Solaster endeca*, a brightly colored form, is known to be poisonous (see under this species below.) Græffe (Arb. Z. Quest. Wein., iii., pp. 333-344) says that large starfishes have a disagreeable smell, which, he thinks, aids in their protection. Whatever may be the reason, it is certain that fishes very rarely or never eat them, for they are not found in fishes' stomachs. This is not because they contain little nourishment, for the much less nourishing Cake-urchins (*Echinarachnius*), and Ophiurans, (*Ophiopholis*), are often greedily taken. It is a strong confirmation of our view as to the colors of the starfishes, that the forms mentioned, which are eaten, are more or less protectively colored. It must also be taken into account that the color of the sexes are different, which makes the problem more difficult of solution.

Forbes (Hist. British Starfishes) suggests that it may be an acrid or poisonous secretion which enables the starfish to compel bivalves to open their shells. Certainly the valves are not broken, and we apparently know as little as Forbes did of the starfishes' method of procedure, and we must repeat his remark that the question should be investigated.

SIZE. This species in the Bay of Fundy grows to a diameter of, at least, fifteen or sixteen inches. *A. rubens*, which is probably identical with it, is said to attain twenty inches in Europe. The statement in Ingersoll's "Oyster Industry," (p. 227), that near Eastport they occur more than thirty-three inches in diameter, is, of course, an error.

TERATOLOGY. Many monstrosities occur in this species. The most common is that in which six rays are found, and we have every variation from cases in which there are five rays, one of which is bifurcated at tip, down through different degrees of division of the split limb to cases in which there are six perfect rays. This shows one way in which the six-rayed state is brought about. But others are found, it is said (the present writer has noticed none), in which with six, or sometimes even more rays, are found two madreporic plates (or one formed by fusion of two), and two stone canals. Such cases are considered by Giard to be true double monsters, comparable with double fishes and the like. The subject is discussed in *Annals and Mag. Nat. Hist.*, 5th ser., I, 1878, pp. 259-260, translated from *Comptes Rendus* of Nov. 19, 1877, p. 973.

Again, in *Mag. Nat. Hist.*, 2nd ser., IV., 1846, p. 34, J Couch describes an *Asterias glacialis*, now considered to be *A. rubens*, which had eight rays and three madreporic plates. It is not impossible that it may have been a triple monster, the result of fission or budding in a single ovum.

The numerous cases in which there are four, three, two or even but one ray present are not ordinarily monstrosities, but the result of accident, and inspection will usually show that the missing rays are being replaced. A case is on record (*Proc. Nat. Hist. Soc. of Glasgow*, I., p. 41) in which one of the limbs growing to replace a lost one, was bifurcated. Yet cases of four and three rays would be monstrosities when these are the maximum number that the individual has had in its development. Such cases are likely to be confounded with those in which a limb has been recently lost, and are, therefore, likely to escape notice. Yet, such probably do occur in the true starfishes, as they certainly do in the Ophiurans, in which, on account of the inflexibility of the disk, the true number of arms is easily counted. The writer has a fine specimen of *Ophioglypha Sarsii* with four rays, which are placed at exactly equal intervals around the disk. There is a difference also, it may be said in passing, in the method of proceeding to repair a damaged arm, between the true star-

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fishes and Ophiurans. The former throw off the injured member *in toto* from the base, while the latter begin at the first uninjured joint and grow the new arm from its extremity. The writer has specimens of *Ophiopholis aculeata* which illustrate this.

The true anatomical nature of the bifurcating processes referred to above has not yet been worked out. Usually the ambulacral and adambulacral plates are closely involved, but in other cases, the new limbs start from the abactinal surface without reference at first to the actinal surface. A rough classification of the monstrosities the writer has noticed, might be made as follows:

a. MONSTROSITIES, EITHER OF INCREASE OR DIMINUTION OF PARTS, HAVING THEIR ORIGIN BEFORE THE FORMATION OF THE CALCAREOUS SKELETON, *i. e.* IN THE OVUM OR GASTRULA.

I. *Double and triple monsters.* Such, so far as known, are the result of fission, or budding in a single ovum; never the result of the union of two or three ova.

II. *Four or three-rayed forms which are not the result of a loss of a ray or rays, and six-rayed forms which are not the result of fission nor double monsters.* We do not know *positively* of any of these forms in the true starfishes, but the fact that a truly four-rayed Ophiuran (as the *Ophioglypha Sarsii*, referred to above) is found, renders it possible that truly three, four, or six-rayed starfishes may occur, though, as mentioned above, it would be difficult to distinguish them without careful examination. The only explanation for such a case as that of the four-rayed Ophiuran seems to be that the loss of the fifth arm dates from the first appearance of the calcareous plates.

b. MONSTROSITIES, OF INCREASE OF PARTS, WHICH ARE THE RESULT OF BIFURCATION OR BUDDING IN THE SKELETAL SYSTEM.

I. *Six or seven-rayed forms which are the result of the fission to the base of one or two of the ordinary rays.* Occasionally the two rays resulting from the fission from one are not so large as their neighbors. The writer has seen (and possesses), a number of instances of this class, and believes there is a specimen in the society's cabinet.

II. *Forms having bifurcated and laterally branched rays, all of the systems of skeletal plates being involved.* These are the most common monstrosities. The bifurcation may be of any degree from the merest forking at the tip, down to nearly complete division, when it produces the condition of section *b*, I. The branching may take place anywhere along the arm. Instances of this were figured as early as 1733 by Linck (Dr. Stellis Marinis, Pls. XXXIV., XXXV., No. 58) in this or an allied species. A curious modification of this branching is seen in a specimen in the collection of Mr. Van Vleck, of Boston, in which the new arm starting from the under side of the parent near its tip, soon outgrew the latter. As a result the tip of the original ray was forced up so as seemingly (and really, too, for that matter) to project from the upper surface of the new one.

III. *Forms having new arms sprouting from the abactinal or upper surface.* Such cases are not uncommon, and the new ray may grow to a considerable size. Linck's specimen, referred to above, shows this, in addition to the other form of branching. A specimen in the student's collection in the Museum of Comparative Zoology, Cambridge, well illustrates this.

c. MONSTROSITIES WHICH ARE THE RESULT OF FUSION OF PARTS.

I. We have seen but one instance of this, a specimen in the collection of Mr. Van Vleck in which two arms are distinctly united throughout their length, showing two separate ambulacral furrows with a line of adambulacral plates and spines between.

8a. **Asterias Forbesii**, VERRILL.

We are very glad to be able to add this species to our fauna. It was inserted doubtfully in our list of 1888 on the chance that it might be found in the Gulf of St. Lawrence. We are still of opinion that it will be found there; but it has lately been discovered in a quite unexpected quarter. In September, 1888, the present writer found a specimen on Dochet Island, St. Croix River, and later found several

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specimens on the shores of the large island in Oak Bay, a few miles above. During September, 1889, other specimens were found near the latter locality, where it seems to be quite abundant. The specimens were four or five inches in diameter, which is the full average size of the species, and occur at low-water mark, in company with great numbers of the common and generally much larger *Asterias vulgaris*. There is no doubt of the identity of the species; for a specimen from Oak Bay sent to Prof. Verrill, the highest authority on American littoral starfishes, has been pronounced by him "a typical example of *A. Forbesii*."

There are two explanations of the presence of this decidedly southern form in the Bay. One, suggested by Prof. Verrill, is, that it may have been brought with southern oysters and placed there with them. Oysters have been placed in Oak Bay, though I have not been able to learn whether southern or Gulf of St. Lawrence stock was used. In either case, it seems difficult to believe that starfishes could be carried so far out of water and survive. They have no method of retaining water as oysters have. Still the very young may have survived in the wet mud.

The other explanation is that they are a remnant of the southern or Virginian assemblage, of animals which once occupied our entire Acadian coast. Oak Bay is a sheltered locality, not deep, but with clear water. The temperature of its water is high enough in summer to allow of bathing in comfort, which the water of the Bay of Fundy is not; and in this comparatively favorable locality this species may have survived all its southern comrades. No other southern species have been found in Oak Bay, though some search has been made for them.

9. *Asterias littoralis*. (STIMPSON), VERRILL.

A specimen of this species was given to the writer at Grand Manan in August, 1888, by Mr. Simon Cheney, the color of which can be described only by calling it an intense Prussian blue. Others, to whom it was shown, agreed that this was the proper name for its color. It was of the usual size of the species.

13. **Crossaster papposus**, (FABRICIUS), MÜLLER AND TROSCHEL.

Called by fishermen of Grand Manan, "Compass Star."
(J. W. Fewkes).

14. **Solaster endeca**, (GMELIN), FORBES.

ECONOMICS. A case is on record which shows that this species may be very poisonous to animals. In the "Zoologist" for 1881, pp. 214, 215, we are told of a collector who placed a specimen before his study fire to dry. After it had been lying there for two days, two pet cats entered the room and ate it. One of them died within fifteen minutes, and the other in violent convulsions within two hours. The stomachs showed no congestion, which seems to prove that the poison acts on the cerebro-spinal system. It is well for our collectors to know such facts as this.

Specimens of *Solaster* are said to have been found with only six rays. (Proc. Nat. Hist. Soc. Glasgow, I., p. 37).

15. **Hippasteria phrygiana**, (PARELIUS), GRAY.

Two specimen were taken off Duck Island in 1889 by Dr. J. W. Fewkes. In the Museum of the Boston Society of Natural History is a fine specimen from off "Head Harbor, Me.," meaning, doubtless, Head Harbor, Campobello.

18. **Pteraster militaris**, (O. F. MÜLLER), MÜLLER AND TROSCHEL.

The best locality in the Bay of Fundy region for this species appears to be the vicinity of Razor Island, near Eastport. Dr. Fewkes took eight specimens there during last summer.

19. **Strongylocentrotus drobachiensis**, (MÜLLER), A. AGASSIZ.

The common sea-urchin is said to bore holes the size of a six-pence in mussel shells. Mr. C. W. Harding (Fisheries Exhibition Literature, VI., p. 306) says that he has seen three instances of this. It needs confirmation in our waters before we can accept it.

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This species is variable not only in form, but in the length and color of its spines. A very long-spined variety is common off Cheyne Island, Grand Manan, in 20 or 30 fathoms, and white-spined and red-spined forms also occur.

It was stated in our paper on this species in Bulletin No. VII., that it never excavates hollows in the rocks, as some other species are known to do. This is a mistake; for, during last summer, Dr. J. W. Fewkes found them in burrows which they formed in the soft rocks of the Black Ledges, a few miles from Nantucket Island, Grand Manan. He has given a brief description of them in the "American Naturalist" for August, 1889, and a more detailed account, illustrated by cuts made from photographs, appeared in the same journal in the January, 1890, number.

ECONOMICS. We find that this species has been used for food much more extensively than we were aware of when our account of the species was published in the Society's Bulletin in 1888.

It is quite probable that it was an important article of food to the Acadian Indians in the olden times. Such is the opinion of Prof. S. F. Baird, who found sea-urchin spines and shells in great abundance in a shell-heap at Oak Bay. (Proc. U. S. Nat. Mus. IV., 1881, p. 292). Mr. Matthew, in his study of a Bocabec shell-heap found its remains much less abundant, (Bull. this Society No. III., p. 24).

Lescarbot, writing in 1609, appear to have thought it good eating, for he refers to it under the name of Sea-chesnut (*chatagne-de-mer*), and declares it "a fish the most delicious that it is possible to be." Probably, as in France, he ate only the ovaries, if he ate it at all.

It is still eaten by the natives of Alaska and some of the Aleutian Islands; and Mr. H. W. Elliott (Seal Islands of Alaska, U. S. 10th Census, p. 137) describes the eager search made for it by the natives, who greatly esteem it. In Newfoundland, Jukes said in 1842 (Excursions in Newfoundland) it was used as food by many of the French, and Rev. Philip Tocque, in 1878 (Newfoundland, p. 497) wrote: "The

sea-urchin . . . usually called in Newfoundland ox-eggs, . . . are frequently eaten in Newfoundland."

Our sea-urchin's habits, living, as it often does, on decaying fish and other offal, are not pleasant to contemplate from a gastronomical point of view, but it is well to know that it can be safely eaten if necessity demands. The ovaries, easily recognized by their granular appearance and orange color, are the only parts that should be used.

A complete discussion of the economics of our sea-urchin must also include its services to man as a scavenger, removing as it does, considerable quantities of fish-offal and the like. Another indirect use to man is found in its serving as food for fishes, some of which eat considerable numbers of it.

27a. **Molpadia turgida**, VERRILL. *Am. J. Sci.*, iii., XVII., p. 473. *Trochostoma turgidum*, THIEL, *Challenger Zoology*, XIV, 1876, p.

Massachusetts Bay to Gulf of St. Lawrence. Bay of Fundy, VERRILL, *op. cit.* Given from "Gulf of St. Lawrence, WHITEAVES;" though we do not find it referred to in Whiteaves' writings.

29. **Chirodota tigillum**, SELENKA. *Zeitschrift für Wissenschaftliche Zoologie*, [Leipzig] Vol. XVII., 1867, p.

"The twelve short tentacles bear 10-12 plumes. The calcareous wheels having five or six spokes, are entirely smooth, and measure 0.1 mm. in diameter; their rims are very small. The excrescences stand on the intermuscular spaces, always in a row. Animal colorless. The intestine winds in a knot. The calcareous ring is small, of twelve squarish pieces united. Polian vesicles hang to the number of ten or twelve around the ring-canal. Stone canal very small. Eastport, (Maine)."

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III. HYDROZOA.

Physalia Arethusa, TIL. "Portuguese Man-of-War."

An entirely unexpected addition to our fauna. Dr. J. W. Fewkes, of Boston, who spent August and September of 1889 in study at Grand Manan, saw several specimens of this well-known southern jelly-fish "inside the Ripplings" near Grand Manan. He heard also of others seen by the fishermen, which, together with those he himself saw, made ten specimens in all. *Physalia* is common in the Gulf Stream, and is often blown on the south coast of New England, but its occurrence in our icy waters must be very rare. (*American Naturalist*, Vol. XXIII., p. 821).

It has been seen, however, still farther north — on the coast of Newfoundland. Rev. Philip Tocque ("Newfoundland," 1878) tells us: "The Portuguese men-of-war (*Physalia*) are sometimes seen on the coast;" the same writer in another work ("Solitary Thoughts") again mentions its presence in Newfoundland in a way which convinces us that he was not mistaken as to its identity. The Gulf Stream passes over a part of the Grand Bank, bringing these animals quite near Newfoundland, and southeasterly winds might drive them on the coast.

Corymorpha pendula, AG.

This common tubularian hydroid was found by the writer in September, 1889, in a rather remarkable position. At a very low tide, great clusters of the species were found clinging to the woodwork of a weir on Rodger's Island, Oak Bay, Charlotte County. The tide had left some of them four or five feet above the water, and a collapsed and sorry-looking lot they were. They were exceedingly abundant, the posts in places appearing quite red over large patches.

APPENDIX.

REPORT OF THE COUNCIL OF THE NATURAL HISTORY SOCIETY OF NEW BRUNSWICK FOR THE YEAR ENDING JANUARY 20, 1890.

The Council of the Natural History Society desires to lay before the members a summary of the work done during the past year.

MEMBERSHIP.

There has been no material change in the membership.

FINANCE.

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

Balance on hand from last year.....	\$224 53
Receipts from dues.....	94 00
Provincial Grant, \$125; Botsford Estate Inst., \$175,	300 00
Bulletins sold.....	10 00
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	\$628 53
Expenditure for the year.....	\$378 49
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Balance on hand.....\$250 04

The whole of this balance will be required to pay for the Mechanics' Institute Museum and its removal to our rooms.

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

FEB. 5th, 1889.	Geology with experiments —By G. F. Matthew, M. A.
MAR. " "	Economical Mollusca of Acadia. — By W. F. Ganong, M. A.
APR. 2nd, "	Notes on the Watershed between New Brunswick and Quebec. —By Dr. L. W. Bailey.
MAY 7th, "	Plant Life, with experiments. —By G. U. Hay, Ph. B.
NOV. 5th, "	A Sketch of the Life of Prof. Chas. Fred Hartt. — By Geo. F. Matthew, M. A.
DEC. 3rd, "	India Rubber and its Uses in the Arts. —By James A. Estey.
JAN. 7th, 1890.	The Growth of our Knowledge of the Invertebrates of Acadia and Newfoundland. — By W. F. Ganong, M. A.

Besides these, classes in Chemistry, Geology, Zoology and Botany were very successfully carried on during the past winter of 1889, and a somewhat similar course is arranged for the present winter.

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LIBRARY.

The usual additions to the Library have been made in the way of exchanges for our BULLETIN, and a number of valuable scientific works were obtained at the sale of the Mechanics' Institute Library. Much work remains to be done to put the Library in proper order, and it is hoped that during the incoming year some of the improvements suggested in the last report will be made.

MUSEUM.

Much that is valuable has been added from time to time to our collections, but by far the most important addition in late years is that obtained by purchase from the Mechanics' Institute directors. Of the importance of this acquisition the Council will not now speak, as the President will refer to it in his address; but before leaving the subject your Council would state that it will entail considerable expense on the society, and would bespeak the sympathy of the members, as well as the citizens generally, in its endeavor to preserve to the city a collection of so much interest and importance.

BOTANY.

The Botanical Committee report that several species of plants new to the Province have been discovered, chiefly by Mr. Brittain, in the vicinity of Fredericton. The flora of certain sections of the Province has now been pretty thoroughly studied for new and rare species, but many other sections, embracing by far the larger portion of the Province, remains to be examined with minuteness and care.

BULLETIN.

BULLETIN No. VIII. was issued during the summer, and was sent to members and various societies on our exchange list. This BULLETIN contains an article of great value, giving as it does, much valuable information on the economical Mollusca of our Province.

In closing, the Council would take this opportunity of thanking those who have prepared papers for us, and to all others who have aided us in our work. Also to the daily press of the city for inserting preliminary notices of meetings.

Respectfully submitted.

W. J. WILSON, *Secretary to Council.*

DONATIONS TO THE MUSEUM.

DATE.	DONOR'S NAME AND DESCRIPTION OF ARTICLE.
1889.	
Mar.	JOS. ALLISON. — Set of glass shades and stands.
Apr.	G. F. MATTHEW. — Laurentian limestone bleached by intrusive trap, Drury's Cove.
May	G. STEAD. — Slab with large ripple marks, Courtenay Bay. G. F. MATTHEW. — Slab with small worm-burrows (<i>Arenicolites brevis</i>), Cambrian, Courtenay Bay. J. BAXTER, M. D. — Caddis worm, Chatham; sponge, Miramichi Bay; walrus tooth, field at Tabusintac; piece of skin of negro, tanned.
Dec.	W. F. BEST. — Young of Sturgeon (<i>Acipenser</i>); Little brown bat (<i>Vespertilio subulatus</i>). MR. GILMOUR, Quaco. — Samples of raw cotton. PERCY HALL. — Honeycombed vein in clay slate. JAS. A. ESTEY. — India rubber, crude and in various processes of manufacture.
1890.	
Jan.	MARSHALL REED. — Fossil fern (<i>Archæopteris</i>), and two fossil fishes (<i>Pterichthys Canadensis</i> and <i>Phaneropleuron curtum</i> (?) from Devonian rocks near Dalhousie, N. B.

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DATE.	DONOR'S NAME AND DESCRIPTION OF BOOK.
1889.	
Mar.	M. CHAMBERLAIN.—Two Monographs on the Natural History of Alaska.
Apr.	ACADEMY OF NATURAL SCIENCES, Philada.—Proceedings, Part III 1888; (Sept.), Part I; (Dec.) Part II. 1889.
	NATURHISTORISCHEN HOF MUSEUM, Vienna.—Annalen, Band IV. No. 1 and separate part [1888.
	EDUCATION OFFICE, Fredericton.—Annual Report of Schools, G. H. WALLACE, Sussex, N. B.—American Naturalist, 3 vols., 1883-5 [Brunswick.
May	DR. D. HONEYMAN, Halifax—Geological Recreations in New WASHBURN COLLEGE.—Proceedings of, Laboratory of Natural History, Nos. 1-9.
	AUTHOR.—Glaciation of Eastern Canada, by R. Chalmers.
	AUTHOR.—Eozoic and Palaeozoic Rocks of Canada, by Sir J. W. Dawson.
	LINNEAN SOCIETY, New York.—Abstract of Proceedings.
	E. GILPIN, C. E., Halifax—Quarterly Journal of Geological Society, London, May, Sept. Aug., 1889.
	N. Y. MICROSCOPICAL SOCIETY, New York.—Journal, Vol. V. No. 2; (Sept.) No. 3; (Nov.) No. 4.
	E. GILPIN, C. E., Halifax—Report of the Department of Mines, Nova Scotia, for 1888.
	OTTAWA FIELD NATURALISTS' CLUB, Ottawa.—Transactions Vol. II., No. 12, Vol. III., No. 1; (Sept.) No. 2; (Dec.) No. 3.
	FEUILLE DES JEUNES NATURALISTES, Paris.—Catalogue of Library, Part V., Proceedings of, Apr., May; (Sept.), 225 and 226, (Oct.), 227 and 228 (Dec.), 230.
	SOCIETE MALOCOLOGIQUE DE BELGIQUE, Brussels.—(Oct.) Vol. XVII Jan.—June, '89, Vol XVIII. [Report.
	U. S. GEOLOGICAL SURVEY Washington.—Seventh Annual
	G. F. MATTHEW.—American Journal Science, 1883 to 1888.
	U. S. FISH COMMISSIONER, Washington.—Fishery Industry of United States. Sec. III and IV, Sec. V 2 vols. and plates. [vol. II.
	G. F. MATTHEW.—Royal Society of Canada, Proceedings, HENINGWAY'S ARCHEOLOGICAL EXPEDITION.—The Old New World.

DONATIONS TO THE LIBRARY.—(Continued).

DATE.	DONOR'S NAME AND TITLE OF BOOK.
1889.	NATURAL HISTORY SOCIETY, Montreal.—Canadian Record of Science, vol. III, No. 6.
May.	LITERARY AND HISTORICAL SOCIETY, Quebec—No. 19. N. H. WINCHELL, Minneapolis—Geol. and Nat. History Survey of Minnesota.
	CANADIAN INSTITUTE, Toronto.—Proceedings, vol. VI, No. 2; (Dec.) vol. VII. No. 1, Annual Report, 1888.
	R. P. STARR, Esq.—Acadian Geology.
June.	ROYAL UNIVERSITY, Christiania, Norway.—Die Silurischen Etagen 2 and 3. by W. C. Brögger; Silurfossiler, by H. H. Reusch; Forhandling, Scand. Natur, 13, part
	AMERICAN MUSEUM NATURAL HISTORY. New York.—Bulletin, vol. II, No. 2, and Annual Report, 1888-9.
	BELFAST NATURALISTS' FIELD CLUB.—Annual Report, 1887-8 (Nov.) Proceedings. Series II., vol. III., Part I.
	NEW ENGLAND HISTORICAL AND GENEALOGICAL SOCIETY.—Proceedings, Jan., 1889.
Sept.	GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.—Annual Reports, 1874-5, 1875-6, 1882-3-4, and maps, 1885 and maps—Canadian Organic Remains Decades I, II, III. and IV.—Palaeozic Fossils, Vol. II., part I.—Mesozoic Fossils, Vol. I., part I and II.—Fossil plants of Devonian and Silurian—Fossil plants of Lower Carboniferous—Report on Queen Charlotte Island—Chemical contributions—Summary Reports 1886 and 1888 Catalogue of Canadian plants, Part III.—Geological Map of Cape Breton—Geological Map of New Brunswick and Prince Edward Island
	ROYAL SOCIETY OF CANADA.—Proceedings and Transactions. Vols. IV., V. and VI.
	SMITHSONIAN INSTITUTION, Washington.—Report, 1886, Part I.
	COLORADO SCIENTIFIC SOCIETY, Denver.—Proceedings, Vol. III, Part I.
	DR. R. W. SHUFELDT, Washington.—Morphology of <i>Gallus bankiva</i> —On the Muscles of Birds—On the Anatomy of Certain Auks—Variation in the Skeleton of Birds—On Pterylosis of Picidæ—Forms of the Patella in Birds.

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DONATIONS TO THE LIBRARY.—(Continued).

DATE.	DONOR'S NAME AND TITLE OF BOOK.
1889.	GEOLOGICAL SOCIETY, London —Abstract of Proceedings, 1888-1889.
Sept.	SOCIETY OF NATURAL HISTORY, Portland, Me.—Proceedings, 1881, Oct. 3 to May 2nd—1882, Jan. 2nd to Feb. 20th 1889, May 20— Report of Commissioner of Fisheries, Maine, 1871, '72, '73, '74, '75, '77 and '79—N. C. Brown's Catalogue of Birds.
Oct.	VEREIN FUR ERDKUNDE, Leipzig.—Mitteilungen, 1888, 1889. G. F. MATTHEW.—Recent Explorations in Wappinger Valley, by W. B. Dwight.
Nov.	ESSEX INSTITUTE, Salem.—Bulletin, Vol. 21, Nos. 1-3, 4-6, 7-12.
Nov.	GEOL. AND NAT. HIST. SURVEY OF CANADA.—Contributions to Canadian Palæontology, Vol II, Part II.
	U. S. FISH COMMISSION, Washington.—Report for 1886.
	U. S. GEOLOGICAL SURVEY, Washington.—Monographs — Quicksilver Deposits of Pacific Coast; Fossil Fishes and Plants—Bulletins, Nos. 48 to 53. [Hyot.
	THE AUTHOR.—Siege of Fort St. John's, in 1875, by Lucien BOSTON SOCIETY OF NATURAL HISTORY.—Vol. XXIV., Part I and II.
	W. F. GANONG.—List of publications on protozoa.
	E. GILPIN, C. E., Halifax —Law on Mines and Minerals, Nova Scotia.
	THE AUTHOR.—Coal Mining in Nova Scotia, by E. Gilpin.
	THE AUTHOR —Compte-rendu, Société Geologique de Belgique a Spa—Faune palæocène de Copenhagen—Note sur calcaires oolithiques; all by Prof. G. Dewalque.
Dec.	THE AUTHOR.—New Species of Fossil Sponges—On Fossil Plants of McKenzie R.; both by Sir J. W. Dawson.
	GEOL. AND NAT. HIST. SURVEY OF CANADA.—Micropalæontology of the Cambro-silurian Rocks, by E. O. Ulrich.
	NOVA SCOTIA INSTITUTE OF SCIENCE, Halifax.—Proceedings, Vol. VII., Part III.
	UNITED STATES DEPART. AGRICULTURE, Washington.—Bulletin, No. 1. North American Fauna, Nos 1 and 2.
1890.	NATURAL HISTORY MUSEUM, Rio de Janeiro—Archives of the Museum, Vol. I., Parts 1, 2 and 3.
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Press, G. U. Hay, G. E. Fairweather, G. F. Matthew and S. W. Kain.

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SUPPLEMENTARY NOTE TO ARTICLE I.

(23 December, 1890.)

The writer has lately had opportunity to make a preliminary examination of the minute features of the fossil from Green Head, described in the above article, and finds it to be a protozoon, allied more closely to Cryptozoon than Eozoon. The microscopic characters are most easily recognized in the earthy (as distinguished from the calcareous) layers, and consists of minute, branching canals. Under a one-inch objective the smaller canals have the appearance of minute threads, which run sometimes for a distance of two millimetres without branching. The larger canals branch more frequently and are more sinuous. The canals cross and anastomose with each other; they run chiefly at right angles to the axis of the fossil, and appear to branch most in going outward from the centre. More rarely they ascend from the earthy to the calcareous layer, branching upward.

The organization of this protozoon was evidently quite different from Eozoon, where the canals belong to the supplemental or calcareous skeleton; in this species they are rare in the calcareous, but abundant in the earthy layers, and are chiefly horizontal, while in Eozoon they are represented as mostly vertical. I have discovered no trace of the tubulated layer of Eozoon in the Acadian fossil.

Prof. Hall's description of the canals of Cryptozoon is very brief; they are said to run irregularly in all directions, and his fossil may have a closer relation to ours than this brief description would indicate. Still the mode of growth of Cryptozoon is so radically different, that it can hardly be of the same genus. I would propose, therefore, for the Acadian fossil the name of *Archæozoon Acadiense*, with the following macroscopic characters:

Animal growing in closely crowded colonies and forming irregularly cylindrical calcareous columns. The columns are built up of alternating layers of calcareous and earthy (silicate) matter, the calcareous layers being usually thicker towards the outside of the column, and sometimes failing to cover the whole surface. The layers are more or less vaulted, having usually the form of an inverted saucer, though often taking the shape of a bluntly pointed cone; and sometimes they are nearly or quite flat. There is often a space between the columns, which appears to have been filled up by a later, irregular growth.

or dolomite