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BULLETIN No. IX.

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I am ever your very truly
Chas. F. Halle

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. ~~F.~~ 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

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 Gaspeaux 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-

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 german 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

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 thoraxes 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

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

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 Botocudo 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,

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 Palæozoic 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,

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

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 Archæology 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 Archæology 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, Juny 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. 30-31. (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.

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 Maraçon. *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 Tupí 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 Reconnaissance 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 no 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 Almeida, 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.

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. . . .

Hart'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 Hart'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 Hart. For the most part the work has been done by some of Hart'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. Hart'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, Hart'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 Hart 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."

[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.