

field was very limited and the difficulties were great, so that even our friendly Visitor doubted if the time had arrived for such an attempt. The effort was made, however, and though for several years, the candidates were nearly all from the High School of Montreal, the sphere of influence of our examination for Associate in Arts was gradually extended; and now, with the co-operation of the sister university of Bishop's College, and of the Protestant Committee of the Council of Public Instruction, the examinations have become a provincial institution, and the aid and stimulus they have given to secondary education would be difficult to overestimate.

CHAPTER VIII

PUBLICATIONS AND RESEARCHES

My first geological paper, accepted and published by any society abroad, was that on the Lower Carboniferous Formation of Nova Scotia, communicated by Sir Charles Lyell to the Geological Society of London, and published in its *Quarterly Journal* in 1843. It was preceded by short communications in local prints, and by a description of the *Meriones*, or leaping field-mouse, of Nova Scotia, published in *Jameson's Edinburgh Journal* in 1842. These papers were followed by others, too numerous to be mentioned here, in various scientific transactions, proceedings, and periodicals. The whole, as recently catalogued by the Royal Society of London, up to 1884, exceed 150 in number.

My first venture in the publication of an independent book, was the little "Geography and Natural History of Nova Scotia," already mentioned;¹ the second was the "Contribu-

¹ Edinburgh and Pictou, 1848-52; and Halifax, 1852-57.

tions to the Improvement of Agriculture"; the third, and most important in some respects, was "Acadian Geology," the first edition of which was issued in Edinburgh in 1855. In it, I endeavoured to sum up in a popular form all my geological observations in Nova Scotia and the neighbouring provinces, constituting the "Acadia" of the early French explorers; the name, as explained in the book itself, being derived from the Micmac "cadie," and borrowed by the French, though without perhaps quite understanding its meaning.

My next literary effort was in a somewhat different sphere. I had long given some attention to the study of the Hebrew original of the narrative of creation, in the first chapter of Genesis, and to the references to it in succeeding portions of the Hebrew Scriptures; and my studies had convinced me that these documents admitted of a more full and worthy treatment than they ordinarily received from expositors of the Bible. In Pictou, no suitable means of publication were immediately available, but at this time an advertisement of the Burnett Prize for the best essay on this subject, appeared in Scottish journals, and I had my manuscript copied out and entered for competition. It was un-

successful, and was duly returned to me, and was in my possession when I went to Montreal in 1855. Here, I arranged to issue the work under the name, "Archaia, or Studies of the Narrative of Creation in the Hebrew Scriptures." It was published simultaneously in London, and was well received, though the sale was not so rapid as I had hoped for. I have, however, had many testimonies from different parts of the world, as to the good that it has done, in directing attention to this most remarkable part of Divine Revelation, and in clearing up the doubts of students. No second edition was called for; but the work having, after several years, gone out of print, and new discussions having arisen from the growth of the Darwinian theories of evolution, and the higher criticism, it was thought advisable, instead of issuing a second edition, to rewrite the work, and publish it under a new and more distinctive name, as "The Origin of the World,"—which has gone through several editions, and has been widely read on both sides of the Atlantic.¹

When in London in 1870, my friend Mr. S. R. Pattison mentioned to me the wish of Dr. Macauley, the editor of the *Leisure*

¹ Sixth Edition, 1893.

Hour, to secure for that journal a series of articles on the geological history of the earth, free from the taint of agnosticism, which has affected so much of the popular writing on this subject. I undertook this, and endeavoured to give a broader and less local picture of the successive periods of the earth's history, than that usual in English popular works. These articles were afterwards collected into one volume under the title of "The Story of the Earth," and have so far had a larger circulation than any other of my popular writings, having now reached the eleventh edition. Its acceptance in the United States has been proved by the issue of two or three pirated editions, besides the legitimate one, issued by the Messrs. Harpers of New York.

These works led to later enterprises in the same direction, which may be grouped together here. In the winter of 1874-75, I was invited by the late Dr. Adams, president of the Union Theological Seminary of New York, to deliver a series of lectures, and I was asked to repeat these lectures at Princeton. These courses were short, for my only available time for such lectures was in the Christmas vacation; but I en-

joyed much pleasant intercourse with the eminent men connected with these institutions. The lectures were published by the Messrs. Carters, of New York, in a little book entitled, "Nature and the Bible," which I trust has done good service. A somewhat similar course, delivered some years later in Philadelphia, under the auspices of the Crozer Institute, also appeared under the name, "Facts and Fancies in Natural Science." Still later, I prepared for the Religious Tract Society of London a work, "Links in the Chain of Life," in which I endeavoured to trace a number of leading types of animals and plants from their introduction, and to show the remarkable persistence of organic forms through the lapse of geological time, in opposition to misleading statements as to the great instability of species, which have been so current among the leaders of the Darwinian evolution. Another popular effort, for the *Leisure Hour*, was, a series of articles on prehistoric man, based on discoveries at the site of the ancient village of Hochelaga,—where excavations for building purposes were being made about the time of my arrival in Montreal,—which revealed relics of great interest for comparison with

the remains of aboriginal men in other parts of the world. These papers were subsequently reproduced by Messrs. Hodder and Stoughton, of London, with the title of, "Fossil Men and their Modern Representatives."¹ This book is, in my judgment, one of the best I have written.

Some years after my arrival in Montreal, Logan showed me in his museum, certain laminated forms found in the lime rocks of the Laurentian system,—the oldest of the geological formations. No fossils had hitherto been found in these rocks, and it was the general opinion of geologists that, because of their great age and crystalline structure, they could not be expected to contain organic remains. Logan, however, argued that, as the specimens he had obtained, and others procured for him by Mr. Wilson of Perth, and Mr. Lowe, one of his field workers, were definite in form and structure, and similar to the layer-corals (*Stromatopora*) of the Siluro-Cambrian rocks, and that, as the mineral substances composing them were different in different specimens, while the forms were the same, the latter must be

¹ The title was original with me; the valuable "Homme Fossile" of Quatrefages was published later.

organic. As I had, ever since my student life in Edinburgh, been accustomed to study rocks microscopically, he was desirous that I should examine slices of the supposed fossils to ascertain if they showed any minute structures. I was willing to do so in a preliminary way, hoping afterwards to hand them over to Mr. E. Billings, then palæontologist of the Canadian Geological Survey; but in the end, Billings alleged that he was overwhelmed with other work, so it appeared that, unless I could undertake the examination of the slices prepared for Logan by Mr. T. C. Weston, they might be altogether neglected. At first, the specimens seemed to contain no minute organic structure, but at length, in 1864, some carefully selected examples procured from a new locality, showed canals and tubulation, not unlike that found in the shelly covering of the humble marine animals known as foraminifera. These creatures, though vastly abundant in the modern seas, are usually very small, but some fossil ones are of larger size, and it did not seem impossible that their predecessors in the very oldest rocks might have been of still greater dimensions, so that the size of our supposed Laurentian fossils, some of

which were several inches in diameter, might prove to be no objection to their animal origin. Enlarged drawings were prepared by a skilful artist, then in the service of the Survey, who was instructed to represent simply what he could see, without reference to any theory as to its nature; and these drawings were supplemented by micro-photographs.

When the descriptions and drawings were complete, and Dr. Sterry Hunt had worked up, and reported on, the chemical nature and probable origin of the several minerals concerned, Logan wrote a paper, accompanied by maps and sections, on the character and relations of the beds. The generic name, *Eozoon*, was given to the supposed fossil, which was thus to appear as an animal of the early dawn of life, but not necessarily as the first of animals. Although its case seemed to be well made out, it was felt that we would have to deal with a sceptical world, and with a host of scientific specialists, incompetent of appreciating the evidence, except in so far as it related to their own particular pursuits. For this reason, as Logan was about to proceed to England, I advised him to place all our notes and material in the

hands of Dr. W. B. Carpenter, whose admirable figures and descriptions, (and some slices he had kindly furnished me with,) had been our chief means of reference in studying the specimens. He was also, if possible, to consult Professor Rupert Jones, another great authority on foraminifera. On my part, I authorised him to defer entirely to the opinions of these gentlemen as to any criticism of theirs on the microscopic work that had been done, or amendment of the description or name of the supposed fossil, provided they were willing to take the responsibility. It was in this manner that *Eozoon* was finally laid before the Geological Society of London.

As might have been expected, the supposed discovery, although on the whole well received, was greatly misunderstood and misrepresented, even by some who were disposed to accept its reality. It was, too, assailed from various quarters, with as much bitterness as if this old fossil had been a personal enemy, and it soon became evident that not only the general public, but even specialists, whether in minerals, rocks, or fossils, required more detailed information than that as yet furnished. Carpenter and Rupert

Jones attended to this duty in some English periodicals, and I prepared a semi-popular treatise, "The Dawn of Life,"¹ which gave simple explanations and illustrations, and to which Logan contributed a beautiful geological map of those Laurentian districts in which the best specimens had been found. This little work was extensively read, but the publisher not venturing on a second edition, it soon fell out of print. For this reason, and because of new discoveries, indicating the presence of remains of life in formations intervening between the Laurentian and the Cambrian, it has since been necessary to restate the facts in various forms. The evidence has been summarised in one of the Peter Redpath Museum memoirs, also in two chapters of my work, "Salient Points in the Science of the Earth."² In 1896, in connection more particularly with the discoveries of Matthew Walcott and Cayeux, which seemed to bridge over the great gap between the life of the Cambrian and of the Laurentian, I delivered, by invitation of Mr. Augustus Lowell, a course of six lectures in the Lowell Institute, Boston, on the earliest forms of life. These lectures have

¹ Montreal, 1888.

² Hodder & Stoughton, 1893.

been published as a separate work, with the title, "Relics of Primeval Life." In this, the facts representing *Eozoön* are stated in a popular form.

On my removal to Montreal in 1855, whilst I still hoped to continue researches in Nova Scotia in the summer vacations, it seemed desirable to take up some subject of investigation nearer my new home, and my attention was attracted to the superficial clays and sands near Montreal, and elsewhere in the St. Lawrence valley, which had been noticed by Bayfield and Lyell, but not studied in detail. The shells in these were, in many cases, the same as recent species known to me in the Gulf of St. Lawrence, and the deposits in which they occurred were evidently continuations of the boulder formation, and its allied beds, which I had studied in Nova Scotia. No one on the Geological Survey was at the time working at these deposits. Hence arose a series of papers in the *Canadian Naturalist*, afterwards reprinted as "Notes on the Post-pliocene of Canada," (1870). I had previously given my notes on the fossiliferous deposits to Logan for his "Geology of Canada," (1863), though he

could only publish them very imperfectly in that work.

Between 1856 and 1870, I had examined the coast deposits of some parts of New England, and in 1861 spent some time in the White Mountains, especially on Mount Washington. I also made use of a visit to Europe, in 1865, to question the glaciers of Mont Blanc, and the icebergs of Belle Isle strait, as to what they could say on the glacial deposits of Canada. Advantage was taken, too, of my annual visits to the sea-coast to dredge in the lower St. Lawrence, at Murray Bay, Métis, and Gaspé; and in this way, while our collections in McGill college were enriched, I was able to recognise in the colder waters of the Canadian coast, nearly every species found in the Pleistocene clays. Mr. J. F. Whiteaves of the Geological Survey, and the late Mr. J. Gwynn Jeffreys, aided in this work, and the foraminifera and other minute forms were described in the *Canadian Naturalist* by my son, Dr. G. M. Dawson. The results of the whole were finally embodied in "The Ice Age in Canada," published in London and Montreal in 1894, which is my latest, and I trust my last, publication on this subject.

In these same years, I several times re-visited Nova Scotia, and re-examined the Joggins section for remains of land animals, many additional species of which were discovered and communicated to the Geological Society of London. I also printed in the *Canadian Naturalist* a series of more popular papers on the same subject, with illustrative figures from my own drawings. These papers were issued as a separate work in 1863. A little later, I was enabled, by a small grant from the research fund of the Royal Society, to continue and extend my excavations, and to exhume many reptiliferous trees. The material obtained from these is described in a memoir in the transactions of that society for 1882. The story of these discoveries is given in my "Salient Points in the Science of the Earth," and need not be repeated here.

My geological work in Nova Scotia began, as stated in a previous chapter, with the collecting of fossil plants, and these have always been my favourite objects of study; and my collections, deposited in the Peter Redpath Museum, are richer in this than in any other department. In any list of my published papers it will be found that very

many relate to subjects of this kind, and the Carboniferous and Devonian floras of Canada I have especially desired to make my own.

I have mentioned Logan's discoveries of fossil plants in the Devonian of Gaspé, made as early as 1843, the account of which, when he visited Pictou in that year, greatly interested me. Unfortunately, the greater part of his collections of that summer was lost by shipwreck, but when I became domiciled in Montreal he placed in my hands what remained, besides some additional specimens collected in the meantime. This proved so interesting, that I spent two summer vacations with some of my students, in exploring the coasts of Gaspé Bay, discovering several new forms and making large collections. My investigations were then extended to Perry, in Maine, to the Bay of Chaleurs and to St. John, New Brunswick, where very large and interesting collections had been made by Messrs. Matthew, Hart, and others. Professor Hall, of Albany, kindly gave me access to the Devonian plants from his collections, in the State of New York, and Dr. Newberry allowed me to study specimens from Ohio, while several collectors

in different parts of the United States placed numerous specimens in my hands. I was also enabled to examine the collections of Peach from the Devonian of Scotland, and those of the Geological Survey of England obtained in Devonshire.

The result was, to more than double the known flora of that early period, and to show that the Devonian admitted of subdivision into three stages, of lower, middle, and upper, each distinguishable by characteristic fossil plants, as well as by animal remains. Some preliminary notices of these discoveries appeared from time to time in the *Canadian Naturalist*, and in the *Journal of the Geological Society of London*, but they seemed deserving of more full description and illustration. Accordingly, after correspondence with the secretaries of the Royal Society of London, I visited England in 1870, taking with me a large part of my collections, including duplicates of new and important species, for distribution to museums and to societies in Great Britain and on the Continent of Europe. I also had with me all my notes on the specimens and their localities, and a series of excellent drawings prepared under my own directions. The

specimens were exhibited at the annual soirée of the Society, and were made the subject of the Bakerian lecture of the year, as well as of a popular lecture at the Royal Institution; but, to my great disappointment, the council of the Society declined to publish my paper and illustrations, thereby losing the credit of giving to the world the largest contribution made in our time to the flora of the period before the Carboniferous age. At the same time, a work which had cost me a large amount of time, labour, and expense, and which I had looked upon as my *magnum opus*, was not adequately published, and probably never will be. I was enabled, however, through the kindness of the Director of the Geological Survey of Canada, to publish a portion of the material as one of the Palæontological reports of the Survey. The more important results were also introduced into a course of lectures delivered in the Lowell Institute in Boston (1887), and afterwards published as a volume of the International Scientific Series under the title, "The Geological History of Plants." This, in some points, supplements the report above mentioned as having been prepared for the Geological Survey, and in

it, prominence is given to the immense development of the peculiar type of plants known as Rhizocarps, in the Lower Devonian, where this type seems to have had its culmination.

Before leaving this subject, it may be proper to mention that one distinctive object which I have steadily kept in view, is the discrimination of the relative dates of the several floras and sub-floras, in order to make fossil plants, as far as possible, a criterion of geological age. In this I think I have succeeded, to a large extent, in the Devonian and Carboniferous of Canada, and also, to some extent, in the Cretaceous and Tertiary formations of the West. I have spared neither labour nor expense in extracting, as far as possible, from the containing beds, all the parts of each species, so as to restore it in its integrity. Errors have no doubt been inevitable in the study of plants so peculiar, and so different from those of modern times, as are the plants of the Silurian and Devonian,—often, too, fragmentary and poorly preserved. Wherever I have detected such errors in my earlier papers, I have endeavoured to correct them in later publications, though I believe they are not numerous considering the amount of the mate-

rial studied. In connection with the later reports on the Devonian flora above referred to,—and to define more particularly the difference between the plants of the Upper Devonian and those of the lower part of the Carboniferous,—I added a report on the plants of the Lower Carboniferous and Millstone Grit, for comparison with the older flora. This also appears in the publications of the Geological Survey, and is summarised in “The Geological History of Plants.”

Since my engagement in academical work, I have felt that, for the most part, practical investigations of mineral deposits and public surveys were out of my reach. In the summer of 1871, however, I was induced to spend a few weeks in a geological reconnaissance of the province of Prince Edward Island (in which I was interested in connection with new additions to my Acadian Geology), and was assisted by Dr. B. J. Harrington. The report prepared on this occasion was published, and though we could scarcely encourage the hope, entertained by some of the people of the Island, that coal would be found at an accessible depth, we succeeded to some extent in the difficult work of separating the Permian or Permo-Carboniferous beds, from those of

Triassic age, overlying them, and mainly made up of their débris. Since 1871, a local geologist, the late Mr. Bain, has succeeded in finding Permian plants in new localities, and in restricting the area of the Triassic beds, which, nevertheless, are of considerable extent, and have afforded *Dinosaurian reptiles*, and plants of types later than the Permian. I may refer to the latest edition of “Acadian Geology” for further particulars on these points.

Publications arising from travels in Egypt and Palestine, will be noticed under another head. Much desultory work, relating to specimens and facts which have had to be attended to in the midst of other duties, gave rise to papers in different periodical publications, which it would not be profitable to notice otherwise than in a mere list. The same remark applies to the few text-books I have been able to produce, principally for my own classes, and adapted to the wants of Canada. Numerous popular lectures, on scientific and other subjects, have formed a part of my work from the first, until brought to a close by failure of voice and of strength, but I cannot attempt to record them here.

In such a subject as geology, it is difficult to avoid uncertain and disputed questions, and as

to these, people in general, and also specialists, are apt to accept by preference statements which are bold and extreme, rather than those which are more moderate. Experience teaches that such extremes are usually somewhat remote from the actual facts. I have therefore striven, on such points, to follow a quiet middle course, which, however unattractive to the sensation-loving public, is most likely in the end to be correct. I have endeavoured to assume this attitude, not only on many minor questions, but on such general doctrines as uniformity and the cataclysmic question, in relation to the glacial period, on Darwinian evolution, and on the relations of the Bible to Science.

CHAPTER IX

VISITS TO ENGLAND IN 1865 AND 1870

IN 1865 I revisited England with my daughter, (now Mrs. Harrington), and enjoyed for the first time the great pleasure of a short tour on the continent of Europe. On our way to Paris we spent a day at Amiens, to see that ancient city, and the gravels of the Somme, then exciting much attention as affording evidences of prehistoric man. We collected some of the flint "haches" found there, noting their mode of occurrence, and relation to the gravels of manifest post-glacial age, and the absence of any good evidence of the excessive antiquity at that time attributed to them by some writers. This view has since been generally abandoned, though I then stood almost alone in the matter, and even had to differ from my friend Lyell on the subject, which he however took very good-naturedly. We had time also to examine the old historic cathedral, and were witnesses of a grand procession and celebration on the part of the clergy of the diocese, one feature of which