

## LYELL AND DAWSON: A CENTENARY

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ONE hundred years ago—in the summer of 1842—the English geologist, Sir Charles Lyell, spent some four weeks of field work in Nova Scotia. He began his investigations about the middle of July, and about the middle of August he left for England, taking with him a large collection of specimens and notes.

In this brief period he had accomplished work of outstanding importance. As Sir William Dawson was to write many years later:

The geology of Nova Scotia is largely indebted to the world-embracing labours of Sir Charles Lyell. Though much had previously been done by others, his personal explorations in 1842 . . . first gave form and shape to some of the more difficult features of the geology of the country, and brought it into relation with that of other parts of the world . . . It is scarcely too much to say that the exploration of a few weeks, and subsequent study of the subject by Sir Charles, with the impulse and guidance given to the labours of others, did as much for Nova Scotia as might have been effected by years of laborious work under less competent heads.

This visit of 1842 is of interest also for the beginning of Sir Charles Lyell's long friendship and collaboration with Sir William Dawson. Though Dawson was only in his twenty-second year in the summer of 1842, Lyell had been recommended to seek him out as one who possessed an exceptional knowledge of the province's geology. Dawson accompanied Lyell during his few weeks of field work, and Lyell found in him the disciple who was to play the leading part in that systematic study of Nova Scotia's geology which he himself was initiating. Indeed, in Dawson's *Acadian Geology* (with its dedication to Lyell) the geological structure of Nova Scotia was to receive its classic treatment.

Lyell had sought out William Dawson at the suggestion of the officials of the General Mining Association, the company then working the principal coal-seam in the Pietou district. He found that Dawson, though delighted to meet him and to learn from him, had already carried out some original researches.

He had formed a museum of his own from specimens he had collected, and a number of these specimens had been brought together to prove that the coal-beds were not all of one type, as was then generally supposed, but could be separated into three distinct groups. These groups were later to become known by many different names, but their distinction from one another, as he had made it out, was to be fully confirmed. Dawson also showed Lyell his collections of birds, insects, and molluses, as well as his considerable herbarium of native plants. All the specimens in these varied collections were related to note books, in which Dawson had recorded his observations and opinions.

Here, in the New World, Lyell had come upon a striking instance of the capacity of the Scot for self-education. Except for an elementary course in "Natural Philosophy" at the Pictou Academy, and a single term at Edinburgh University (from which he had just returned), William Dawson had acquired his scientific knowledge through his private reading and his solitary field work. Nor had he been able to devote his whole time to these studies; for science was to him only a recreation from his regular employment as partner to his father in the Pictou printing firm of James Dawson and Son.

Lyell asked Dawson whether he would care to accompany him on his field work, partly as a student, and partly as a guide. This invitation was readily accepted. They began by examining the geology of the Pictou district, giving particular attention to a bed of upright fossil plants which Dawson had discovered at Dickson's Mills. They then examined the limestone strata on the De Bert River, thirteen miles east of Truro, and the gypsiferous strata in the cliffs of the Shubenacadie Estuary. Dawson had previously visited the Shubenacadie district, and, having learned something of its treacherous tides, he was able to give a timely warning. As Sir Charles Lyell wrote:

On one occasion, as I was seated on the trunk of a fallen tree, on a steep sloping beach about ten feet above the level of the river, I was warned by my companion that, before I had finished my sketch, the tide might float off me and the tree, and carry both down to the Basin of Minas.

Lyell's particular object was to examine the South Joggins coal-cliffs on the southern shore of Cumberland Bay. His interest in these cliffs had been roused the previous summer, when he had just arrived in North America. He had been six hours in Halifax while changing ships for Boston, and he had spent

part of this time in a Halifax museum. Here he had been shown a large fossil tree, filled with sandstone—a specimen of the many to be found in the South Joggins strata. He had written in his journal:

I resolved to examine these before returning to England, as they appeared, by the description given us, to afford the finest examples yet known in the world of petrified trees occurring in their natural or erect position.

Now, in company with Dawson, he examined with the deepest interest the face of the South Joggins cliffs. Here the erosion had disclosed a considerable number of these large-ribbed, pillar-like trees, which, though covered above with many feet of coal deposits, stood out, as in a bas-relief, in their original, upright position. Strewn along the shore were many specimens which had been eaten loose by the action of the weather and had fallen down. In their fall, most of these trees had broken into large disc-like fragments, which Dawson called "fossil-grindstones." These fragments often contained the remains of plants which had been washed into the hollow trunks during the coal-forming period and had become embedded there.

Lyell recognized that the district offered almost unequalled opportunities to investigate the conditions under which coal had accumulated, as well as the beginnings of plant-life, and perhaps even of animal-life. Though his own first-hand study of the South Joggins cliffs was restricted to his brief researches in 1842, supplemented by a few days' field work in 1852, he had seized upon the salient points of the locality, and he was to give valuable direction and encouragement to the more comprehensive investigations by which Dawson uncovered so rich a body of geological facts.

Dawson's association with Sir Charles Lyell during these few weeks in the summer of 1842 formed a turning-point in his life. Previously he had been working in isolation, conscious of his limited opportunities for study, and lacking any authoritative estimate of his accomplishments. His association with Lyell, however, gave him new enthusiasm and new assurance. Lyell had pointed out how Nova Scotia offered problems for geological research of an exceptionally interesting and important kind. He had inspired Dawson with confidence by warmly praising the work he had done, and by personally bringing it to the attention of the scientific world. In his *Travels in North America* (published in 1845), he not only expressed his indebted-

ness to the "active operations" of "Mr. Dawson of Pietou," but he explained how, in forming his own opinions of Nova Scotia's geology, he had often concurred with opinions previously formed by Dawson, and how he had been prepared to accept Dawson's conclusions regarding matters which he himself had not had an opportunity to investigate. Lyell also encouraged Dawson to write descriptions of his researches in a form suitable for publication in scientific periodicals, and under Lyell's patronage Dawson's first papers appeared in the *Quarterly Journal of the Geological Society of London*.

In the years following Lyell's visit, Dawson applied himself with increased energy to studying the geology of the Pietou region in which he lived. But his association with Lyell had broadened his ambition. He now hoped that he might find an opportunity to be the first to study Nova Scotia's geology as a whole. This opportunity came unexpectedly in 1850, when Joseph Howe, who was planning to modernize the Nova Scotia school system, offered him the newly-created position of Superintendent of Education. As superintendent, Dawson would be required to tour the province, gathering facts with regard to existing school conditions, and preparing the public for the intended improvements. Howe pointed out to him that these travels could be made to serve his geological interests. They would take him throughout the province—even to its most remote corners; and since it was proposed to introduce the teaching of agriculture into the schools, the superintendent might quite properly interest himself in all matters relating to soils.

Dawson accepted this offer, and during the three years which he spent as Superintendent of Education he gathered the greater part of the materials for his *Acadian Geology*. He carried his geologist's bag and hammer about with him wherever he went, and late each evening, generally after a day of hard travel and several educational meetings, he would sort out his specimens and write descriptions of the localities from which they had been taken.

In September, 1852, while Dawson was in the midst of these travels, Sir Charles Lyell revisited Nova Scotia, prior to going to Boston to deliver the *Lowell Lectures*. Dawson met him by appointment, and they set out to resume their investigations in the South Joggins district. Lyell hired a private carriage with a pair of horses to take them the sixty odd miles from Halifax to Truro. In describing this journey, he writes of Dawson

"knowing the names of all the plants," and showing him "among other things the great ridges of huge boulders, six feet and upwards in diameter, which the ice heaps up round the numerous lakes of clear water." At one point they got out for a few minutes to examine a group of Indian wigwams, beautifully roofed with birch bark. When they had returned to the carriage, Lyell could not help marvelling that this scene was within eleven days of his "having walked the streets of Liverpool."

After reaching Cumberland Bay, they spent a few days in the South Joggins district. In a letter to his father-in-law, Leonard Horner, Lyell described their explorations:

Dawson and I set to work and measured foot by foot many hundred yards of the cliffs, where forests of erect trees and calamites most abound. It was hard work, as the wind one day was stormy, and we had to look sharp lest the rocking of living trees just ready to fall from the top of the undermined cliff should cause some of the old fossil ones to come down upon us by the run. But I never enjoyed the reading of a marvellous chapter of the big volume more.

One of the primary objects of Lyell's return to the South Joggins district was to search for further evidences of the flora of the coal-forming period. He and Dawson, therefore, spent much of their time on the shore, examining the fossil trees which had fallen down from the cliffs and lay in fragments. While engaged in this work, they were surprised to come upon some pieces of bone. On careful search, other pieces, apparently the limb-bones of a quadruped, were uncovered. They searched further, and at length came upon a jaw-bone with teeth.

This discovery proved to be of exceptional importance. Until the eighteen-forties, the period at which air-breathing animals had first appeared on the earth had not been determined. The earliest evidence that the luxuriant forests of the coal-forming period had contained land-animals, as well as land-plants, had been found only in 1841. In that year the Canadian geologist, Sir William Logan, had reported the discovery of footprints of a reptile in the coal-strata of the Avon Estuary in Nova Scotia. In 1844 the first actual remains of a land-animal of the coal-period had been discovered at Saarbruck by the German geologist, Ernst Von Deeken. The first discovery of such remains in the coal-strata of America had in fact been made by Dawson, though this discovery had gone quite unheralded. He had found, at the Albion Coal-Mine in Pietou County in 1851, a large flattened skull, embedded in a piece of shale.

Uncertain whether it was the remains of a large ganoid fish, or of something higher in the animal scale, he had sent it to the Geological Society of London. But for some two years it had (as he expressed it) "remained as quietly in the Society's collection as in its original bed in the mine." Now, however, he and Lyell had come upon a specimen unique in its relative completeness; for the bones they had discovered comprised portions of the skull, teeth, scales, vertebra, ribs, and limbs. From these remains it was possible to reconstruct in considerable detail the appearance of the animal and its manner of life.

The occasion of this unexpected discovery was memorable in the lives of both men. More than twenty years later, Sir William Dawson was to recall how he and Lyell, forgetful of everything else, had stood on the shore exulting over their find:

I well remember how, after we had disinterred the bones of *Dendroperon* from the interior of a large tree on the Joggins shore, his thoughts ran rapidly over all the strange circumstances of the burial of the animal, its geological age, and its possible relations to reptiles and other animals, and he enlarged enthusiastically on these points, till, suddenly observing the astonishment of a man who accompanied us, he abruptly turned to me and whispered, "The man will think us mad if I run on in this way."

The specimen was subsequently examined in Boston by Jeffries Wyman, Augustus Gould and Louis Agassiz, and in London by Sir Richard Owen. These experts in comparative zoology were unanimous in confirming the opinion of Dawson and Lyell that the remains were those of a reptile of the coal-period. But it turned out that Dawson and Lyell had incidentally made a further important discovery. While examining the fragments, Wyman had come across a small shell, measuring about three-tenths of an inch in length. This was ultimately classified as that of a land-snail of the coal-period, and as, therefore, the oldest known land-shell by a vast interval, the earliest specimen previously discovered having belonged to the Tertiary period. Dawson and Lyell reported their discoveries for the *Quarterly Journal* of the Geological Society of London, in a joint-paper "On the Remains of a Reptile and a Land-shell in an erect Fossil Tree in the Coal Measures of Nova Scotia."

Toward the end of 1853, Dawson resigned as Superintendent of Education. Even from the educational point of view alone, the three years he spent as superintendent had produced notable results. He had collected the first intelligible statistics of the province's schools; he had introduced some unity into the work

of the local commissioners; he had made improvements in text-books, apparatus, buildings, and methods of teaching; and he had succeeded in convincing a large proportion of the people of the necessity of a teachers' college, and of a more equitable and efficient provision for school support. It was largely as a result of Dawson's preparatory work, and his reports, that the Nova Scotia school-system was gradually placed upon an ordered basis.

The scientific results of these same three years were embodied in his *Acadian Geology*, which was first published at Edinburgh in 1855, and expanded through three further editions. Until its publication, Nova Scotia's geology had received only fragmentary treatment. Some pioneer work had been done by two Boston geologists, C. T. Jackson and F. Alger, who published their researches in Silliman's *American Journal of Science* in 1828. In the following year, Haliburton's *Historical and Statistical Account of Nova Scotia* appeared, with a supplement on the province's geology by Richard Brown and Titus Smith, who had carried out explorations, mainly of the eastern counties, for the General Mining Association. Further work (often valuable, but not always authoritative) had been done by the Nova Scotian geologist, Dr. Abraham Gesner. In 1841 Sir William Logan had examined certain of the coal-measures of Nova Scotia, but mainly in relation to his theory that under-clay was almost invariably present beneath seams of coal. Sir Charles Lyell had brought a fresh and stimulating method, which he briefly set forth in his *Travels in North America*, and expounded at greater length in his papers to the publications of the Geological Society of London.

Dawson's *Acadian Geology* surpassed in completeness anything that had appeared before. To the discoveries of his predecessors, Dawson had added a mass of data from his own researches. Moreover, his treatment of Nova Scotia's geology by periods, rather than by regions, enabled him to give a comprehensive picture of the geological structure of the province and the manner of its formation. This method of treatment lent itself both to theoretical and to economic geology. With regard to theoretical geology, it enabled him to describe the successive periods as illustrated in the structure of Nova Scotia, the exceptional breadth and exposure of the Nova Scotia coal-seams yielding data of particular value concerning the mode of coal-accumulation, and the forms of life which existed in the coal-forming period. With regard to economic geology, he was able,

while describing the successive deposits of minerals, to indicate carefully where, in the structure of Nova Scotia, these deposits had been formed. In this way he made known the location of rich accumulations of coal, iron ore, copper, gypsum, shell marl, and other minerals, the presence or extent of which had been only imperfectly recognized. As the result of his researches, the mineral resources of Nova Scotia underwent a rapid development.

The proof of Dawson's painstaking accuracy came in later years, when the province was mapped in detail by the members of the Dominion Geological Survey. It was only in a few particulars that Dawson was found to be in error. Even though the materials in *Acadian Geology* are now available elsewhere, the vigor and clarity of Dawson's style have maintained the standing of his book as the classic study in its field.

In the pages of *Acadian Geology* Dawson paid frequent tribute to Sir Charles Lyell for his part in stimulating and directing the study of geology in Nova Scotia. A more direct expression of his personal indebtedness appeared in the dedication:

To Sir CHARLES LYELL, F.R.S., F.G.S., &c.

My Dear Sir:

To a young naturalist labouring in a comparatively remote and isolated position, no aid can be more valuable than the encouragement and co-operation of those who, from the vantage-ground of a high scientific reputation, and in the great literary centre of the Anglo-Saxon world, are prosecuting similar pursuits. For such benefits, most freely and generously bestowed, I am indebted to you; and I gladly avail myself of the opportunity afforded by the publication of this volume, to express, in dedicating it to you, my grateful sense of your kindness in guiding my humble efforts as a geological observer.

I am

With sincere gratitude and respect,

Yours faithfully

J. W. DAWSON

In 1854, while Dawson had been preparing his *Acadian Geology* for the press, the chair of Natural History at Edinburgh had become vacant through the death of Edward Forbes. Sir Charles had written immediately to Dawson, urging him to become a candidate, and offering him his support and that of other men of influence. Many years later, the English geologist,



Dr. John Bigsby, recalled how Sir Charles Lyell had regarded Dawson as Edward Forbes's successor, in the widest sense of the word. "On the death of Edward Forbes," he wrote, "Sir Charles Lyell remarked to me 'Now, I look chiefly to Dawson . . . for any true progress in the Philosophy of Geology.' "

When Dawson replied to Sir Charles Lyell, gratefully accepting his offer of assistance, Sir Charles solicited the support of Sir Henry de la Beche, the director-general of the British Geological Survey. In a letter to Sir Henry, he set forth Dawson's qualifications as follows:

I know that you appreciate highly, as I do, the printed papers of Mr. Dawson on the Coal Fields of Nova Scotia, and other subjects, in the *Journal of the Geological Society* of London. I have twice had an opportunity, when travelling with him in North America, of estimating his great powers of original observation in the Fields, many of the results of which he has given in his public papers. I can also state that Dr. Hooker is of opinion that the views and occasional speculations on the structure and probable relations of fossil plants, set forth in several of Mr. Dawson's Memoirs on the Carboniferous Strata, display much acuteness, sound judgment, and botanical knowledge. Mineralogy has been a favourite pursuit of Mr. Dawson, and he has made no small progress in Zoology.

That any man should be eminent in all the branches embraced by the Edinburgh Chair, especially one under the age of thirty-five, is of course impossible; but with due reference to Mr. Dawson's age, I consider his attainments as very remarkable, and combining them as he does with zeal and enthusiasm for science and a philosophical mind, he is, I believe, one of the few who would, if elected, prove a worthy successor to our late lamented friend, Professor E. Forbes.

Dawson planned to leave for Scotland that summer in order that he might personally press his candidature, and also attend the meeting of the British Association, which was to be held at Glasgow. He had gone to Halifax and was ready to take passage, when word arrived that, contrary to expectation, the appointment had been hurried through in favour of Dr. George Allman, who was the candidate of the biological party, and more especially favoured by the medical professors. Almost at the very time that this news reached him, however, Dawson received a letter from Montreal, in which he was offered the Principalship of McGill University, a position he had made no effort whatever to solicit. The prospects at McGill were far from encouraging. The university was almost without endowment, and its existence (beyond the medical faculty) was little more

than nominal. "Yet, on this account," as Dawson wrote in later years, "the position had its charms for a young man accustomed to hard work." His transformation of McGill during the thirty-eight years of his Principalship was to establish his reputation among the greatest Canadian educators.

Before taking up his new work at Montreal, Dawson went on to Scotland for the Glasgow meeting. This was his first attendance at the British Association, which, just thirty years later, was to elect him President. "After the meeting," he writes, "I went up to London, and had much pleasant intercourse with Lyell." Indeed, though Sir Charles Lyell had been unsuccessful in his efforts to obtain the Edinburgh professorship for Dawson, he had been, nevertheless, indirectly responsible for the appointment to the Principalship of McGill. On his journey to Nova Scotia in 1852, Lyell had had as a fellow passenger his friend, Sir Edmund Head, then the Lieutenant-Governor of New Brunswick. Lyell had spoken highly to Sir Edmund of Dawson's abilities, and on their arrival in Nova Scotia had introduced Dawson to him. As Lieutenant-Governor of New Brunswick, Sir Edmund had appointed Dawson a member of the commission charged with the reconstitution of the old King's College at Fredericton. In 1854, when he was appointed Governor of the United Canadas, Sir Edmund assumed *ex officio* the position of Visitor to McGill. It happened that the Board of Governors at McGill were then making a determined effort to free the university from the inertia which had paralyzed it since its foundation. Sir Edmund Head was approached, as a man of high university connections, to suggest someone who could provide McGill with vigorous leadership. The governors expected him to suggest a man of mark in one of the British universities. They were (as one of them later admitted) "both startled and disappointed" when he enthusiastically recommended William Dawson, whose name was almost, if not quite, unknown to them. After much discussion, however, it was decided to act upon Sir Edmund's recommendation, and to make Dawson an offer of the appointment. In later years, Dawson used to speak of his introduction to Sir Edmund Head in 1852 as being not the least of the decisive ways in which Lyell had influenced the course of his life.

After he had removed to Montreal, Lyell continued to keep closely in touch with him. As Dawson writes:

He entered with zeal into my work on Devonian plants, and into those investigations of the fossils of the Laurentian limestones

in which, after my removal to Montreal, I was engaged, in connection with Logan, Carpenter, and Hunt.

While Principal of McGill, he took advantage of the long summer vacations to continue his field work in Nova Scotia. These researches, too, were followed by Lyell with the keenest interest. In a letter dated October 27, 1860, he writes enthusiastically of the "grand results" which Dawson had obtained by further investigation of the coal-beds of the South Joggins. When, in 1868, Dawson re-dedicated to Lyell his *Acadian Geology*, in its second and greatly enlarged edition, Lyell wrote at once to express his pleasure; and some four weeks later—on July 31, 1868—he sent a second letter, which began:

My dear Dawson,—I hope that long before this you have got my letter, written in the beginning of this month, in which I spoke of the first part of your *Acadia*, which I have since been reading steadily with increased pleasure and profit . . . It is so full of original observation and sound theoretical views, that it must, I think, make its way, and will certainly be highly prized by the more advanced scientific readers.

In 1875 this friendship of thirty-five years standing came to an end with Sir Charles Lyell's sudden death. Dawson paid tribute to his memory in a valuable paper, first delivered in the autumn of 1875 as his presidential address before the Montreal Natural History Society, and subsequently published. In this paper he expressed his belief that the qualities which had enabled Lyell to contribute so much to the development of geology in North America were the same as those which had won for him his pre-eminent position in the general development of modern geology:

He seemed wholly free from that common failing of men of science which causes them to cling with such tenacity to opinions once formed, even in the face of the strongest evidence. This quality eminently fitted him to be the patron and helper of younger and less eminent men, and was connected with that warm and earnest interest which he ever felt in the progress of knowledge, and with the deference with which he received new facts and suggestions from any quarter.

These qualities, apparent in his connections with American geology, were equally valuable in his relations to science in its general aspects . . . He was thus able to become a guiding mind among his contemporaries in geological theory, and to hold his pre-eminence down to the end of his life, through all the great changes which occurred in the rapid development of the science.

The names of Lyell and Dawson were linked once more, some six years after Lyell's death. In 1881, Dawson received the Lyell Medal, an award which Sir Charles had established by a legacy to the Geological Society of London, with instructions that it be given from time to time to geologists whose work had been outstanding. In this way, Lyell may almost be said posthumously to have recognized the further achievements of his former disciple.

In a very real sense, however, Dawson never ceased to be Lyell's disciple. After 1875, as before, his writings abound in references to Lyell's discoveries and opinions, and in reminiscences of his historic visits to Nova Scotia. This enduring discipleship was the outcome partly of Dawson's gratitude for Lyell's many kindnesses, and partly of his admiration for Lyell's greatness as a scientific worker. One of the last of Dawson's scientific papers bore these words:

DEDICATED TO THE MEMORY OF  
MY FRIEND AND EARLY PATRON AND GUIDE  
SIR CHARLES LYELL  
TO WHOM WE ARE INDEBTED FOR SO MUCH  
OF THE SCIENTIFIC BASIS OF MODERN GEOLOGY