

SIR JOHN WILLIAM DAWSON: A PROFILE OF A NOVA SCOTIAN SCIENTIST

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This is a summary of the life and work of Sir John William Dawson (1820-1899), a Nova Scotian who made major contributions to geology, education and the development of science in Canada. His early life and educational work in Nova Scotia, his years as Principal of McGill, his success in developing science, at the community, national, and international level, his prolific written output, and highlights of his geological work are described.

Key words: Darwin; Education; Eozoon; Fossils; McGill; Pictou; Royal Society of Canada; Science and Religion

INTRODUCTION

Much has been written about John William Dawson (known as William Dawson). This paper draws extensively on Sheet-Pyenson's detailed biography (Sheets-Pyenson 1996), and on his autobiography, published posthumously (Dawson 1901), as well as other valuable sources (Adams 1899, Ami 1900, Clark 1971, Collard 1942, Eakins & Sinnamon Eakins 1990, Hook 1990, MacIntosh 1930, O'Brien 1971, Pighetti 1980, Sheets-Pyenson 1998, Vaillancourt 1973, Wood 1991). The first 35 years of his life, based largely in his birthplace of Pictou, established the scientific, educational and administrative skills later brought to his remarkable career in Montreal as Principal of McGill and as a vigorous proponent of science in Canada. The formative years in his native province also established his religious convictions, which were to strongly influence his career. His contributions in geology and paleontology spanned both eras.

NOVA SCOTIA (1820-1855)

Growing up in Pictou

The son of Scottish immigrants, James and Margaret (Rankine) Dawson, William was born in Nova Scotia on 13 October, 1820. When a recession in 1823-24 destroyed his business and placed him in serious debt, James started a printing and publishing business, and vowed to pay his creditors in full. This commitment, shared by the entire family, was to have an impact on William's early career.

The Dawsons were devout Christians, and their strong Presbyterianism was a major influence in the home.

William received his schooling at Pictou Academy (1833-1839), where he received a grounding in the scientific and literary basics. Established in 1816 by Thomas McCulloch (Whitelaw 1985), the Academy enjoyed excellent resources, including a well-stocked library, scientific equipment, and McCulloch's own impressive natural history museum.

As a child William was not encouraged to make friendships, and he had a lonely and introspective childhood. The death in 1837 of his only sibling, James, four years younger, had a traumatic impact on William and his parents, and later served to strengthen his sense of duty to his parents (Dawson 1901). His after-school time was spent reading, gardening, fishing and exploring the countryside. Sparked by an innate scientific curiosity and keen interest in the natural history of his environment, he eagerly studied birds, plants, insects, shells, rocks, minerals, and fossils. Thomas McCulloch encouraged his young student in these endeavours. As a teenager Dawson roamed the nearby coalbeds and shale formations, looking for fossils. In summer vacations he went further afield to explore the Joggins area and other locations, employing textbooks such as "Principles of Geology" and "Elements of Geology" by eminent British geologist Charles Lyell (Lyell 1830, 1838) to improve his appreciation of the rocks, minerals and fossils he observed. He quickly accumulated a significant collection, which he developed through specimen exchanges with others. These early surveys left him with not only a great enthusiasm for geology, but also a local reputation as an authority on the subject. At the age of 16, William spoke to the Pictou Literary and Scientific Society (Dunlop 1973) "On the Structure and History of the Earth" - clearly a harbinger of things to come.

Getting Started in Geology

As an 18 year old, William Dawson's first interest was geology, but he had a more immediate role to play in helping maintain his father's business. The family decided, however, that he should attend the University of Edinburgh, where between 1840 and 1841 he studied under John Hutton Balfour (botany), Edward Forbes (paleobotany), William Gregory (chemistry) and Robert Jameson (mineralogy and physical geography). Economic circumstances at home forced him to curtail his studies and return to Pictou in 1841, where his time continued to be divided between the family business and natural history. The forced break in his training was to be fortuitous. In the summer of 1841 in Nova Scotia, Dawson met both Charles Lyell and William Logan, who had just been appointed as Director of the

Geological Survey of Canada. Dawson told Lyell of his own studies and explained his conclusion that Nova Scotia's coal beds belonged to three distinct stratigraphic units. When Lyell returned to Nova Scotia in 1842, he naturally recontacted his "local authority" and together they explored the Pictou coalfields and other geological sites in the province. The unique combination of Lyell's expertise and experience and Dawson's detailed local knowledge not only led to scientific discoveries, but also established a strong and lifelong mentor/protégé relationship between the two men (Collard 1942). Lyell encouraged Dawson's continuing field work in Nova Scotia, and also facilitated publication of his findings. Articles published by the Geological Society of London, starting in 1843, were Dawson's first research publications (Dawson 1843).

Despite this early scientific success, Dawson enrolled in divinity classes in 1844, and considered becoming a minister, a logical calling at the time for a graduate of Pictou Academy, and one for which he had earlier prepared by studying Hebrew. However, the continuing demands of the business and his own expanding geological interests served to make this career path implausible.

Dawson returned to Edinburgh University in 1846 to get additional training in practical chemistry, and to learn microscopic techniques. When he returned to Pictou in 1847 his new skills started to open doors. In 1848 he was contracted by the General Mining Association of London (GMA) to do an evaluation of coal mining in Cape Breton. He also performed assays and evaluations of coal, copper, and iron deposits for the province, as well as fieldwork as a consultant for a number of small mining companies and entrepreneurs (Sheets-Pyenson 1996, Wood 1991).

When he set sail for Halifax in 1847, Dawson did not travel alone. Earlier that year he had married Margaret Mercer, daughter of an Edinburgh lace merchant. The need to maintain a Pictou base to meet his ever present family responsibilities meant that the couple took up residence in the Dawson family home. In the next few years Dawson coordinated his partnership in his father's business, survey work, geological research, some teaching (and preaching), and also completed his first book "A Handbook of the Geology and Natural History of the Province of Nova Scotia", published by James Dawson, and soon used as a standard textbook in Nova Scotian schools (Dawson 1848). He taught natural history courses at Pictou Academy (1848), and gave a course of lectures at Dalhousie College in Halifax (1850). The latter, open to both students and interested members of the public, represented an early attempt at "university extension" (Dawson 1901, Pighetti 1980). While in Halifax he gave a presentation to the Halifax Mechanics' Institute, a precursor organization to what we now recognize as the Nova

Scotian Institute of Science, on the composition of soils, and also performed a number of assays for the Institute's museum.

Nova Scotia's first Superintendent of Education (1850-1853)

The young Dawson impressed George Young, Chair of the Province's education committee, and Joseph Howe, the Provincial Secretary. Anxious to reform the educational system in Nova Scotia, the two men persuaded Dawson to fill the new position of Superintendent of Education. Lyell had warned Dawson to avoid educational work, unless it also guaranteed time for research. Although reluctant to assume the Superintendent role, he did so when Howe pointed out that the position would require travel throughout the province, and that since one planned initiative was the teaching of agriculture in the schools, he would have an excellent excuse to study soil composition. Once in the position, Dawson applied to it his characteristic and remarkable level of commitment and vigour (Hook 1990, Sheets-Pyenson 1996, Vaillancourt 1973, Wood 1991).

In 1850 there was a serious shortage of teachers, and schools typically had poor facilities and supplies. Less than half of Nova Scotian children attended school, and many from poorer families were excluded. As a prelude to his work, which he insisted be based in Pictou, he visited a number of public schools in Canada and the eastern US to examine issues such as teacher training, curricula and funding.

Dawson recommended a humanitarian approach to childhood education as promoted by Scottish Free Church reformer David Stow, as well as a uniform school system, free to all, without class distinction, and under centralized government control. Also high on his list was the need for systematic teacher training.

At the time Dawson attended Pictou Academy, there were two Presbyterian factions – the Secessionists (led by Thomas McCulloch) and the Church of Scotland - each of which fought to control the town's higher education. Frustration over their squabbling led to McCulloch's departure in 1838 to take up the position of Principal of Dalhousie College (Whitelaw, 1985). Having witnessed McCulloch's efforts in Pictou beset by political and religious infighting, Dawson was determined that provincial schools should be non-denominational, and strongly opposed separate schools. While advocating respect for religion in general, he decreed that denominational religious instruction should not be part of the school curriculum.

Recognizing also that acceptance of a 30 year old Superintendent would be difficult for some, he decided "to proceed on the principle that what was well might be left as it was" (Dawson 1901). He gained further community support by holding local meetings to identify and discuss the special needs and issues of each district. He was also

required to spend considerable time in Halifax, explaining plans and progress to members of the legislature. His workload was phenomenal. In his first two years he travelled to more than 500 schools, held 56 public meetings, gave 113 lectures, and organized 8 teachers' institutes (Wood 1991). In his autobiography he describes difficult journeys to less accessible parts of the province, such as Brier Island and Advocate Bay (Dawson 1901).

In addition to teachers' institutes, he encouraged formation of teachers' associations, and published a "Journal of Education", distributed to teachers throughout the province. He set out to supply the schools with basic texts on arithmetic, geography, reading, and other subjects, and by the end of 1852 had already distributed 12,541 books and 893 maps (Wood 1991). He also ensured that chemistry, history, agricultural chemistry, and natural history were part of the school curriculum. In his relatively short tenure, Dawson oversaw a number of other improvements, including better teaching methods, recognition of the need for systematic teacher training, better school buildings, school libraries, increased attendance, organized school administration, reliable provincial school statistics, and most importantly, increased public awareness of the value of education.

Central to his educational reform were the creation of a provincial Normal School (teachers' training institute), and provision of free schooling based on compulsory county assessment. He shrewdly used his talent for building consensus to draw broad public support for these ideas. However, his educational model required a major readjustment in public thinking, with its introduction of state authority in an area which had traditionally been under the control of church and family. His proposed School Bill fell victim to political partisanship, and it was not until 1863 that legislation was passed implementing a free school system and compulsory assessment. Looking back at his role as Superintendent, Dawson described it as "that of the pioneer" (Dawson 1901), while Vaillancourt (1973) has described it as that of "educational missionary". Dawson's efforts laid the foundation for a common school system, which better prepared Nova Scotia for the coming period of industrialization (Sheets-Pyenson 1996, Vaillancourt 1973, Wood 1991).

The Superintendent position required him to travel throughout Nova Scotia, and he took advantage of the opportunity to continue his personal geological survey of the province. Some of his most significant scientific discoveries were in fact made while he was most preoccupied with his duties as Superintendent. The superhuman energy and effort which Dawson brought to his "two careers" proved to be unsustainable, and in 1852 he became seriously ill.

He agreed to remain as Superintendent for an additional year, on condition that his duties would be largely administrative. In 1853 Alexander Forrester succeeded him as Superintendent; Forrester was also named as first Principal of the Normal School, opened in Truro in 1855. Dawson viewed the opening of the Normal School as the most important development arising from his own tenure (Sheets-Pyenson 1996).

In accord with the plan to teach agriculture in the schools, Dawson prepared his “Scientific Contributions to Agriculture” (Dawson 1853), and followed this with “Practical Hints to the Farmers of Nova Scotia” (Dawson 1854). The two works were later revised and combined into a single text “First Lessons in Scientific Agriculture for Schools and Private Instruction”, later used at McGill Normal School (Dawson 1864).

Major Fossil Finds

In 1852 Charles Lyell returned to Nova Scotia, and he and Dawson explored the interiors of petrified tree trunks discovered in the cliffs at Joggins, a site added to the list of UNESCO World Natural Heritage Sites in 2008. It was during this excursion that the two were to make revolutionary fossil finds, including *Dendroperon acadianum* (the earliest reptilian remains then known in North America) and fragments of a shell, belonging to the oldest land snail (*Pupa vetusta*) then known (Dawson & Lyell 1853). These and other similar findings were of major significance to paleontologists, Lyell asserting that they opened a new chapter in North American geology. The dramatic new discoveries and subsequent field work by Dawson represented some of his most important scientific work (Dawson 1863a, 1863b). In 1854 Dawson was awarded his Fellowship in the Geological Society of London. Falcon-Lang and Calder (2005) have described Dawson’s work on the coal measures of Nova Scotia as that of “a very modern paleobotanist”, as evidenced by his emphasis on field work, skills in microscopic analysis and multidisciplinary approach, linking fossil plant descriptions to geological context. His differentiation of the provincial coalbeds made him “a scientist well ahead of his time” (Falcon-Lang & Calder 2005).

It is astonishing to reflect upon the immense productivity of William Dawson during the early and mid 1850s. He was able to fulfill all the diverse responsibilities of his Superintendent position, conduct and publish geological research, and at the same time write books, including what was perhaps his most significant book: “Acadian Geology” (Dawson 1855). Dedicated to Lyell, this provided a comprehensive description of the geology of Nova Scotia, New Brunswick and Prince Edward Island. The major section of its more than 400 pages comprised five chapters on Carbonifer-

ous systems, and an appendix contained a fossil listing. (Revised and expanded editions were published later (Dawson 1868, 1878, 1891)). "Acadian Geology" firmly established Dawson's reputation as one of the leading geologists of the day.

When his mother died in 1854, Dawson was released from the family ties he felt so keenly, and which had kept him in Pictou. Encouraged by Lyell, he applied in 1854/55 for the position of Chair of Natural History at Edinburgh. Despite numerous testimonials Dawson's bid was unsuccessful.

During Lyell's 1852 visit, he had introduced Dawson to Sir Edmund Head, then Lieutenant Governor of New Brunswick, an introduction which led to Dawson's invitation to join the Ryerson Commission looking at King's College in Fredericton. When Head later became Governor General of Canada, he also became a Visitor at McGill College. McGill was in desperate need of new leadership, and Head convinced its Board of Governors that Dawson was the man to provide this, meeting all the criteria (that the new Principal be a layman, religious, capable, modern and young) for the position. Waiting in Halifax to travel to Glasgow for a British Association meeting, Dawson not only received news that he did not get the Edinburgh appointment, but also received an unexpected offer to become Principal of McGill.

At the age of 35, Dawson had already established his scientific reputation, had just published a comprehensive treatise on the geology of Eastern Canada, and had amassed considerable practical experience in education, administration, publishing, business and politics, all of which would find good use in Quebec. Although initially reluctant to take a position which would clearly limit his research, he was ready for a change, and in 1855 he left for Montreal with his wife and three young children.

MONTREAL (1855-1899)

Building a University: 38 Years at McGill

When Dawson arrived at McGill he found a few dilapidated buildings, limited equipment, and an institution in precarious financial condition. With three Faculties (Law, Medicine and Arts), there was a total, mostly part-time, teaching staff of 16, and about 80 students. Five years earlier he had thrown his energy and talents at reforming the educational system in Nova Scotia, and he now put body, mind and spirit into working with the Board of Governors to revitalize the university. He again took upon himself an exceptional workload, assuming all of the administrative and other functions of the Principal position as well as lecturing 20 hours per week in

chemistry, geology, paleontology, zoology and agriculture. He established a library, and actually served as librarian. He also set up a small museum, which quickly became overcrowded, with much of the working collection accommodated in his home. Examples of Dawson's personal commitment were his purchase of trees and plants to beautify the campus, and the way in which he and wife Margaret opened the doors of their home to students, faculty and visitors; the students referred to such invites as "Tea and Fossils".

In the absence of government support, the fortunes of the university were very dependent on the support of the community – in this case that of Montreal's wealthy anglophone business class. Many of these commercial leaders were of Scottish Presbyterian background. Although Dawson recognized that his total abstinence from alcohol "was not, I fancy, understood or appreciated in Montreal", his heritage and Presbyterianism clearly worked in his favour as he energetically applied himself to soliciting their financial support. Not only did he persuade individuals to provide support to the university, he also took advantage of, and even provoked, competition between the donors. His focus on applied sciences was of particular appeal to many of the benefactors. It is estimated that during his term as Principal he raised a total of more than \$6 million in private donations (Sheets-Pyenson 1996).

The support of Montreal's business leaders, such as William Molson, Peter Redpath, and W. C. Macdonald, came in various forms, including new buildings and facilities, endowed Chairs, and acquisition of specimens for the museum. Redpath funded the Peter Redpath Museum of Natural History and the Redpath Library. Sir William Logan led a fundraising effort to establish an endowed Chair in geology, and in 1883 Dawson himself was appointed as the first holder of this (Logan) Chair. As new facilities appeared, civic pride in the University grew, and enrolment increased rapidly.

McGill University represented a small, largely Protestant and English-speaking entity within a French-speaking society dominated by the Roman Catholic Church. Dawson was concerned at the low level of scientific instruction in French schools, and greatly feared the Jesuit influence on education, especially following Confederation. Despite being opposed in principle to the concept of separate schools, he considered that Quebec's system was unavoidable, and worked to maintain Protestant education in the province. He was a member of the Protestant Board of School Commissioners in Montreal, and also served for ten years on the Protestant Section of the Council of Public Instruction in Quebec.

Following his success with the Normal School in Nova Scotia, one of his first steps as Principal was to help establish the McGill Normal School (1856). He was unexpectedly called upon to assume

yet more responsibilities as Principal and science teacher at the new Normal School, roles he performed for thirteen years. These additional duties halved the summertime available for research. In 1868, after more than a decade of strenuous administrative and teaching duties at McGill University and Normal School, and with the encouragement of Lyell and Logan, he made an unsuccessful bid for the Principal position at Edinburgh. One positive outcome of this was his release from his duties at the Normal School. Despite all the demands on his time, he was able to prepare a number of university textbooks on geology and zoology (Dawson 1870a, 1871b, 1880a).

At age 70 Dawson was still lecturing up to 14 hours per week. When ill health forced him to retire in 1893, student enrolment was approaching 1000, and there were more than 100 faculty, and more than a dozen buildings on campus. Under his stewardship, McGill had grown from its impoverished state of 1855 to become one of North America's most respected universities.

Higher Education for Women

Dawson was an advocate for higher education of women, and in 1871 he worked with Mrs (John) Molson and several of her friends to establish the Montreal Ladies Educational Association. This operated for 14 years, with Dawson himself teaching its natural history classes. He enjoyed teaching "earnest and attentive young women" (Dawson 1901). At the Association's first session he gave an insightful lecture on the benefits to society of higher education for women; the text is reproduced in his autobiography (Dawson 1901). The Protestant School Board established the Montreal High School for Girls as a feeder school for the University. McGill allowed the School's graduates to be examined for an Associate in Arts, and in 1877 a class of ten passed the examination. In 1884 Sir Donald Alexander Smith provided the funds necessary to admit women to the first two years of the Arts program, in what was referred to as the Donald Special Course. Smith soon doubled his endowment to allow for extension to the third and fourth year classes, and by the 1887-88 session there were 26 regular and 82 part-time students enrolled; a total of eight women graduated that year.

The Peter Redpath Museum

At the time the new Principal was expanding his own collection, Montreal was the headquarters of the Geological Survey of Canada, which housed the national geological collection. Following Confederation, however, the Geological Survey announced its intention to move to Ottawa. Although Dawson fought hard against the intended move, it finally took place in 1881. He set out to create an even

better collection at McGill, and Peter Redpath gave \$140,000 to build a new museum, which he wished to be “the best of its kind in Canada”. The Peter Redpath Museum was announced in 1880 in celebration of Dawson’s first 25 years as Principal.

Building Science in Montreal and Canada

In addition to his role as Principal, Dawson set out to stimulate community interest in science, and to position Montreal and Canada on the international scientific map.

The Natural History Society of Montreal (NHSM)

Founded in 1827, and the organization behind the original creation of the Geological Survey of Canada, the NHSM was struggling in 1855. Dawson joined immediately, within the year was elected President, and went on to occupy this position no fewer than 20 times, eventually being elected honorary president for life in 1890. The Society quickly received the full “Dawson treatment”. Subcommittees were formed to streamline activities, and the membership was categorized by discipline (botany, geology, zoology and antiquities). In 1857 the Society took over publication of the “Canadian Naturalist and Geologist”, and later (1888) its successor publication the “Canadian Record of Science”. Publication of its own journal, and its exchange with those of other similar societies, were essential functions of a serious scientific organization at the time (Gibson 1982). Not surprisingly, geology took a central place in both the NHSM and its publications, and Dawson encouraged young Canadian geologists to publish their findings in the journal. He himself contributed more than 170 articles to the Canadian Naturalist and the Canadian Record of Science.

Dawson persuaded the McGill Board to provide a building and other support for the Society, succeeded in obtaining a government operating grant, and encouraged the city’s citizens to become actively involved in the exploration of their environment. In just a few years the Society had become revitalized, and it continued to flourish well into the next decade. The Society’s annual “conversaciones” and field trips became popular civic events. During the 1870s and 1880s the fortunes of the Society appear to have been in synchrony with the time and energy Dawson brought to this end. By the late 1880s attendance at meetings was low, the membership was aging, and very little material was being received for publication. (The Society disbanded in 1925). Following his retirement, Dawson himself no longer regularly attended meetings, although he did read a paper to the Society as late as 1897. Justifiably, the NHSM memorialized him as “the mainstay of the Society for upwards of 40 years” (Sheets-Pyenson 1996).

International Scientific Societies

At Dawson's invitation, the American Association for the Advancement of Science (AAAS) held a meeting in Montreal in 1857. This meeting, hosted by the NHSM, was the first for AAAS to be held outside the U.S., and was attended by scientific leaders from Canada, the U.S. and Britain. Registration was the second largest in the Association's history at that time. In 1881 Dawson was elected President of the AAAS, and a year later the organization met for a second time in Montreal, with the NHSM again acting as host. At the age of 62 (despite the involvement of six special committees) Dawson appears to have "micro-managed" the entire event. This second meeting, with a registration of over 900, was timed to coincide with the grand opening of the Redpath Museum. In 1882 the British Association (BAAS) also announced its intention to hold its annual meeting in Montreal – the first time that this organization had ever met outside Britain. The meeting was very successful, with as many as 2000 at some early sessions; more than 900 British members made the overseas trip, thanks to a generous travel subsidy from the Dominion government. At the opening session of the event, the Governor General formally announced Dawson's knighthood. In 1886 Dawson was elected to preside at the BAAS meeting in Birmingham, England, an event he considered as the greatest honour of his life (Dawson 1901).

Dawson in 1888 also had a vision of a new association of geologists from throughout the British Empire, but this initiative did not come to fruition. With some reluctance, he joined the new Geological Society of America (GSA) in 1889. The GSA met jointly with the AAAS in Toronto in 1890, and Dawson served as GSA President in 1893.

The Royal Society of Canada

The Marquis of Lorne (then Governor General) discussed with Dawson the need for a national scientific organization in Canada; the Governor General himself favoured a broadly based learned society. At meetings held in Dawson's home and later at Government House in Ottawa, a constitution for the Royal Society of Canada (RSC) was drafted. At the inaugural meeting in Ottawa in May, 1882, Dawson was acclaimed as first President of the Society. During his presidential address, he reflected on the enormous progress of Canadian science in the previous four decades, but made pleas for government funding of research and for greater uniformity in education across the country. He commented on the importance of national meetings, especially for those in remote areas, and of a recognized Society journal, which would publish good articles from any source, and thus help younger scientists establish their reputations. Dawson stressed that the Society "must be exclusive

in its membership, but inclusive in that it offers benefits to all” (Dawson 1883a).

Fittingly, in 1891, the NHSM invited the RSC to hold its annual meeting in Montreal – the first such meeting to be held outside Ottawa. The 1982 Centenary Medal of the RSC depicts the Marquis of Lorne, William Dawson and Pierre-Joseph-Olivier Chauveau, who succeeded Dawson as President. In 1985, the RSC established the Sir John William Dawson Medal, for important contributions of knowledge in multiple domains.

Geology: Contributions and Controversies

William Dawson’s primary expertise was paleontology, and particularly paleobotany. He brought two significant qualities to this lifelong interest – a passionate belief in the value of field work, and the application of microscopic techniques. The latter permitted his identification of 125 new species of Paleozoic plants. He published more than 100 papers on paleobotany, as well as about 50 and 30 on invertebrate and vertebrate paleontology, respectively. In 1859 he described *Psilophyton*, the earliest land plant then known, which he discovered in Devonian strata on the Gaspé peninsula (Dawson 1859). This paper, and his descriptions of Devonian and Upper Silurian formations of Canada, published by the Geological Survey (Dawson 1871a, 1882a), are considered key contributions. His studies resulted in a doubling of known Devonian flora.

He produced a series of articles and a book on amphibian and reptilian species (“Air Breathers of the Coal Period”) (Dawson 1863a, b). Many of these discoveries are described in his later book “Some Salient Points in the Science of the Earth” (Dawson 1893a), and his last major paper on this topic was published in 1894 (Dawson 1894a). Despite his strong lifelong opposition to Darwin’s theory of natural selection in evolution (see below), Dawson’s studies of fossil reptiles and amphibians were to provide important scientific information on vertebrate evolution.

He began a study for the Geological Survey of Cretaceous and Tertiary fossil plants from Western Canada; this yielded several papers, most of which were published in the *Transactions* of the newly created RSC (e.g., Dawson 1883b). He gave an account of his extensive geological studies across Canada in a series of lectures delivered to Boston’s Lowell Institute in 1887, and later published as “Geological History of Plants” (Dawson 1888a). This volume, issued as part of a significant international series, was used as a textbook for decades after.

Summers provided him with the only opportunity for extended field work. He returned several times to Nova Scotia and explored other sites in the Maritimes and the eastern U.S. He built a sum-

mer home at Little Métis, Quebec, a location which allowed him to collect fossil specimens from Pleistocene and Paleozoic deposits in that area.

William Dawson's half-century of research covered many parts of Canada and virtually all aspects of geology. The subjects of his groundbreaking paleobotany work spanned from the earliest land plants to the Holocene (Falcon-Lang & Calder 2005). He accumulated a huge quantity of new geological information, which resulted not only in the production of an average of ten scientific papers a year, but also his best remembered "Acadian Geology", which laid a framework for subsequent geological work in Nova Scotia, and the later "Geological History of Plants".

Eozoon

Dawson's name is often most closely associated with "*Eozoon*", and the controversy surrounding it. In 1858 an unusual specimen was collected by the GSC in the Laurentians, in some of the world's oldest pre-Cambrian rocks. The samples were characterized by alternating concentric rings of siliceous and calcareous material, and had a fossil-like appearance. Asked by William Logan in 1864 to examine the material, Dawson concluded that the specimen represented organic remains of a giant foraminifer which he named *Eozoon canadense* (see Dawson 1874). Since metamorphic rocks had long been supposed to be free of fossils, this exciting report caught international attention. Other experts agreed that the specimen was of animal origin, and Dawson was convinced that this discovery was of immense geological significance. Controversy erupted in 1866 when two Irish mineralogists claimed that the specimen was inorganic (King & Rowney 1866). Similar samples were collected in Europe and the controversy deepened. Dawson's book "Dawn of Life", published in 1875 and dedicated to William Logan, emphasized the importance of *Eozoon* (Dawson 1875a). Evidence mounted that the specimen was mineral in nature, especially from work by Karl Möbius, a recognized expert on foraminifers (Möbius 1876, 1879). In 1894 *Eozoon*-like specimens were collected from limestone ejections near Mount Vesuvius. These strongly supported the theory that *Eozoon* had been produced by metamorphism of limestone under extreme conditions of heat and pressure. Eventually Dawson alone defended the organic nature of the specimen. His last book "Relics of Life" still included a discussion of *Eozoon* (Dawson 1897), and he was preparing a paper on the topic at the time of his death. A full account of the *Eozoon* story is given in O'Brien (1970, 1971).

Theory of Glaciation

Geographic considerations led Dawson to extensive field work on glacial deposits and fossils in the Montreal area, Maine, the Gaspé peninsula and the Lower St. Lawrence River. He published detailed descriptions of Ice Age fossil flora and fauna in his “Notes on the Post-Pliocene Geology of Canada” (Dawson 1872a), and his later “Canadian Ice Age” (Dawson 1893b). Dawson rejected the hypothesis first raised by Louis Agassiz in 1840 that the Earth had been sculpted by land glaciers, and subscribed to the theory that this was due to the action of giant floating icebergs. Dawson promoted his glaciation position in several articles for the Canadian Naturalist in the late 1850s, and at meetings of the NHSM and the BAAS. New evidence mounted in support of the land glacier hypothesis, including work at the Geological Survey of Ohio (Newberry 1869). While Lyell was very impressed by the second expanded edition of “Acadian Geology” (Dawson 1868), he was critical of the views on glaciation it contained. Throughout the 1880s, however, Dawson held fast to his position (O’Brien 1971).

Bakerian Lecture to the Royal Society

Dawson delivered the 1870 Bakerian Lecture to the Royal Society of London on “Precarboniferous Flora of Northeastern America”. Traditionally, the actual presentation had been followed by its publication in the Society’s *Philosophical Transactions*. Dawson was very anxious to publish in full his work on Devonian plants, which he described as his *magnum opus*. When the Society declined to publish Dawson’s material, choosing to issue only an abstract (Dawson 1870b), he was bitterly disappointed at what he perceived as a personal rejection (Dawson 1901). The material was later published by the GSC (Dawson 1871a, 1882a), and the most important findings were also included in “Geological History of Plants” (Dawson 1888a). Sheets-Pyenson has explained the rejection in the context of the communication difficulties faced by colonial scientists at that time, as well as the economic changes being imposed on long-established societies (Sheet-Pyenson 1991).

Science and Religion

Following this setback by the Royal Society of London, Dawson appears to have lost some of his enthusiasm for scientific studies. In the 1870s and 1880s his speeches and books and prolific writing for literary and religious periodicals reflected a gradually increasing focus on religion. Dawson’s basic belief was that God’s will was revealed both in nature (the Work) and in Scripture (the Word). Exploring nature was akin to reading the Bible, and it was the responsibility of the scientist to relate observations to the teach-

ings of the Scripture. His lifelong objective was to synthesize the two theologies (natural and revealed). O'Brien has provided a full discussion of how the two theologies approach broke down after Darwin's "Origin of Species" and how this led Dawson inevitably to controversy (O'Brien 1971).

Evolution

In 1859 Charles Darwin published his "Origin of Species" (Darwin 1859), presenting his theory of evolution through natural selection. With unquestioning belief in the existence of God, creation and revelation, Dawson rejected Darwin's new hypothesis, citing false methodology and poor reasoning (Dawson 1860a). He insisted that Darwin and his supporters had no evidence, and argued that paleontology did not support evolution through natural selection. Although Darwin's ideas were initially also treated with scepticism by others, they gradually won acceptance by the scientific community in the latter half of the 19th century. Dawson's vigorous anti-Darwinian stance was, however, to continue for the rest of his life. His opposition to Darwinian evolution began to isolate him from the scientific community, and many were critical of his increasingly evangelical approach. Even lifelong mentor Lyell cautioned him, pleading with him to consider phenomena which could now be explained by Darwin's theory. Dawson argued that its acceptance would "rob me of all I value most in this life and that which is to come" (Sheets-Pyenson 1996). Dawson's obituary included in the address by the President of the Nova Scotian Institute of Science (McKay 1903) describes him as "a most uncompromising opponent" of the theory of evolution. Ironically, it was Charles Darwin who co-sponsored William Dawson's Fellowship in the Royal Society in 1862.

Popular Writings

Although he had written most of it in 1855, it was not until 1860 that Dawson published "Archaia", or "Studies of the Cosmogony and Natural History of the Hebrew Scriptures" (Dawson 1860b), in which he combined his scientific expertise and detailed knowledge of Scripture in his first major attempt to reconcile science and Scripture.

In the early 1870s Dawson produced a series of articles on the geological history of the Earth ("free from the taint of agnosticism") for the Religious Tract Society's "Leisure Hour" (UK), and for the similar "Princeton Review". His 1872 book "Story of the Earth and Man" was a compendium of his Leisure Hour articles, and proved to be very popular (Dawson 1872b). As Dawson became increasingly recognized as a strong defender of Christianity, he received invitations from theological and church groups to present public lectures on science and the Bible in Canada and the US. A popu-

lar book "Nature and the Bible" (Dawson 1875b) was based on a Christmas lecture series given to New York's Union Theological Seminary. Dawson followed this with a revised version of "Archaia" entitled "Origin of the World, According to Revelation and Science" (Dawson 1877), which sold 1500 copies in the first year, and went through six editions by 1893. His editors encouraged him to popularize his books by using less scientific language. His prodigious written output continued with "The Chain of Life in Geological Time" (Dawson 1880b), "Facts and Fancies in Modern Science" (Dawson 1882b) and "The Meeting Place of Geology and History" (Dawson 1894b). As late as 1896 a course of lectures at the Lowell Institute was presented in book form as "Relics of Primeval Life" (Dawson 1897). Overall, he devoted more than 100 articles and a dozen popular books to promote his views on science and religion, gaining him wide public recognition.

Dawson's combination of science and religious beliefs was very appealing to some, and in 1878 he was offered, but declined, the Chair of Paleontology and Geology at Princeton, a move strongly supported by the Princeton Theological Seminary. Princeton was closely affiliated with the U.S. Presbyterian Church, and Dawson's established geological reputation and anti-Darwinian stance made him an ideal candidate.

Anthropology

In 1860, during some excavations in Montreal, workers uncovered bones and other artefacts of an Aboriginal settlement, and Dawson himself coordinated a controlled recovery at the site. He speculated that the remains were from the early 16th century, and represented the original Indian village of Hochelaga (Dawson 1860c). He wrote several articles for *Leisure Hour* on prehistoric man, which were combined in the release of his "Fossil Men and their Modern Representatives" (Dawson 1880c), a book of which he was especially proud. Dawson took a leave of absence from McGill from fall 1882 until spring 1884, to tour the Middle East, a project subsidized by a gift of \$5000 from his Montreal friends and colleagues. The trip was to result in several geological and anthropological publications, as well as two books - "Egypt and Syria" (Dawson 1885), and "Modern Science in Bible Lands" (Dawson 1888b). Trigger has described Dawson's approach to anthropology in the context of his deep religious beliefs and opposition to biological and cultural evolution (Trigger 1966).

DAWSON THE MAN



William Dawson was a paradoxical character. Clearly a competent scientist technically, with good practical skills and powers of observation and deduction, his approach was qualified by his unbending adherence to his religious beliefs. While possessing ample powers of persuasion, as demonstrated in his dealings with school commissioners in Nova Scotia, wealthy business people in Montreal or with leaders of international scientific organizations, he nevertheless showed an uncompromising approach to particular issues. In 1875 Dawson eulogized Charles Lyell as “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” (Dawson 1901, p55) - a characteristic that he found hard to emulate. Despite his autobiographical claim “to have striven – to follow a quiet middle course”, the evidence suggests that he may have enjoyed the controversy raised by his uncompromising views.

Sir John William Dawson died on 19th November, 1899 in Montreal, and is interred in that city’s Mount Royal Cemetery.

His many accomplishments as a scientist, teacher, administrator, and organizer were recognized during his lifetime. He was awarded his fellowship in the Royal Society of London as early as 1862. The 1880s in particular saw a stream of recognition, including the award of the Lyell Medal for outstanding achievement in geology, being the first appointee to the Logan Chair of Geology, being the only person ever to serve as President of both the AAAS and the BAAS, an honorary LLD from his alma mater (1884), his knighthood, and serving as the first President of the RSC. The mineral dawsonite and Montreal’s current Dawson College commemorate his name.

One section of the Redpath Library at McGill is also named in his honour – the Dawson Zoology Library.

Family

In 1849 William and Margaret Dawson's second son, George Mercer, was born less than one month after the tragic death of their first child, James, in infancy. Although childhood illness left George with severe physical handicaps, he performed exceptionally as a student at The Royal School of Mines in London. He joined the Geological Survey of Canada in 1875, and became its Director in 1895. He was a brilliant field geologist and a pioneer in Canadian anthropology. References to "Little Doc", some of his explorations, and the impact of "Elder" Dawson's views can be found in Robertson's recent biography of J.B. Tyrrell (Robertson 2007). The life and work of George Mercer Dawson are described in his memoirs "Beneath My Feet" (Jenkins & Dawson 2007). William and Margaret Dawson had four other children (Anna, William, Eva and Rankine). Anna (b 1851) worked as her father's secretary and also prepared illustrations for his presentations and publications. The younger William (b 1854) was an engineer who became the Director of the Dominion Survey of Tides and Currents (Sheets-Pyenson 1996).

Friends, Mentors and Promoters

Dawson forged lasting relationships with a small number of professional colleagues, including Lyell, Logan, John Jeremiah Bigsby (British paleobotanist), James Hall (New York paleontologist) and Daniel Wilson (who came from Edinburgh in 1853 and was appointed President of the University of Toronto in 1887). Like Lyell, Bigsby had a paternalistic relationship with Dawson. Bigsby was even more dogmatic in his opposition to Darwin, and it was he who was responsible for recruiting Dawson as a contributor to *Leisure Hour*. Dawson and James Hall met in 1856 and continued to exchange geological specimens for the next four decades. His relationship with Daniel Wilson commenced with their interest in anthropology, and evolved with shared problems as University heads, and as co-workers on creation of the RSC.

In his recent book, "The Outliers", Gladwell speculates that native talent and ability alone were often not sufficient to have assured the success of many eminently successful people (Gladwell 2008). William Dawson possessed the essential intellect and scientific skills, but clearly also benefited from advantages accruing from family, friends, and mentors. These include James Dawson who, despite economic hardship, ensured that his son received advanced schooling, including training overseas; Thomas McCulloch, who as headmaster encouraged his early geological pursuits; Charles Lyell

who provided collaboration, mentorship and advice; George Young and Joseph Howe, who recognized his abilities and placed a young man in an important educational reform role; and Edmund Head, who recognized his potential as an educational leader and played a major part in securing his appointment as McGill Principal. Connections and encouragement notwithstanding, Dawson's energy, commitment and vision certainly contributed to his success and many accomplishments.

CONCLUSION

As a scientist William Dawson made enormous contributions to the growth of geology and paleontology. As an educator he initiated important policies and reforms in the school system in his native province, and also provided outstanding leadership to develop McGill as a leading North American university. Although his intransigent positions on some issues and scientific topics, especially evolution, caused some loss of reputation, this is far outweighed by his many positive accomplishments. He was the foremost Canadian scientist and educator of his day, and there is no doubt that his life's work contributed significantly to laying a solid foundation for Canadian geological science in the 20th century. Writing of his former headmaster Thomas McCulloch, Dawson described him as "a man of independent character, confident in himself and in his power of leading others, astute in guiding and regulating affairs, and a keen and incisive controversialist" (Dawson 1901, p 25). In 1899 these words would have been a fitting epitaph for Sir John William Dawson himself, save for some acknowledgment of his pioneering geological contributions.

REFERENCES

- Adams FD** (1899) Memoir of Sir J. William Dawson. *Bulletin of the Geological Society of America* 11:550-557.
- Ami HM** (1900) A Brief Biographical Sketch of Sir John William Dawson. *American Geologist* 26:1-48.
- Clark TH** (1971) John William Dawson. In: Gillespie, CC (ed), Dictionary of Scientific Biography, CC Gillespie (ed), Charles Scribner's Sons, New York Vol. III p. 607-609.
- Collard EA** (1942) Lyell and Dawson: A Centenary. *Dalhousie Review* 22:133-144.
- Darwin C** (1859) *On the Origin of Species by Means of Natural Selection*. Harvard Univ Press, Cambridge MA.
- Dawson JW** (1843) On the Lower Carboniferous Formation of Nova Scotia. *Proceedings of the Geological Society of London* 4:272-281.

- Dawson JW** (1848) *A Handbook of the Geography and Natural History of the Province of Nova Scotia*. James Dawson, Pictou, NS.
- Dawson JW** (1853) *Scientific Contributions towards the Improvement of Agriculture in Nova Scotia*. J Dawson, Pictou, NS.
- Dawson JW** (1854) *Practical Hints to the Farmers of Nova Scotia*. R. Nugent, Halifax.
- Dawson JW** (1855) *Acadian Geology: an Account of the Geological Structure and Mineral Resources of Nova Scotia, and the Neighbouring Provinces of British America*. Oliver and Boyd, Edinburgh; Simpkin, Marshall and Co, London; J. Dawson & Son, Pictou, NS.
- Dawson JW** (1859) On Fossil Plants from the Devonian Rocks of Canada. *Quarterly Journal of the Geological Society of London* 15:477-488 .
- Dawson JW** (1860a) Review of 'Darwin on the Origin of Species by Means of Natural Selection'. *Canadian Naturalist & Geologist* 5:100-120.
- Dawson JW** (1860b) *Archaia: or, Studies of the Cosmogony and Natural History of the Hebrew Scriptures*. B Dawson & Son, Montreal; Sampson Low, Son & Co, London.
- Dawson JW** (1860c) Notes on Aboriginal Antiquities recently discovered in the Island of Montreal. *Canadian Naturalist & Geologist* (6): 430-449.
- Dawson JW** (1863a) Air Breathers of the Coal Periods in Nova Scotia. *Canadian Naturalist & Geologist* 8:1-12, 81-88, 159-160, 161-175, 268-295.
- Dawson JW** (1863b) Air Breathers Of the Coal Period. Dawson Bros., Montreal.
- Dawson JW** (1864) *First Lessons in Scientific Agriculture for Schools and Private Instruction*. Lovell J, Montreal; Miller A, Toronto.
- Dawson JW** (1868) *Acadian Geology: The Geological Structure, Organic Remains, and Mineral Resources of Nova Scotia, New Brunswick and Prince Edward Island*, 2nd ed. Macmillan, London; Oliver & Boyd, Edinburgh; A & W Mackinlay, Halifax; Dawson Bros, Montreal.
- Dawson JW** (1870a) *Handbook of Zoology, with Examples from Canadian Species, Recent and Fossil. Invertebrata, Part I* Dawson Bros, Montreal.
- Dawson JW** (1870b) On the Pre-Carboniferous Flora of Northeastern America, with special reference to that of the Erian (Devonian) period. *Proceedings of the Royal Society of London* 18:333-335.
- Dawson JW** (1871a) The Fossil Plants of the Devonian and Upper Silurian Formations of Canada, Part 1 (p. 1-92) Report to Geological Survey of Canada.
- Dawson JW** (1871b) *Handbook of Geology for the Use of Canadian Students*, Montreal.
- Dawson JW** (1872a) Notes on the Post-Pliocene Geology of Canada. *Canadian Naturalist*, New series VI.
- Dawson JW** (1872b) *The Story of the Earth and Man*. Copp Clark & Co., Toronto; Harper & Bros., New York.
- Dawson JW** (1874) *Eozoon canadense*. *Nature* 10:1-103.
- Dawson JW** (1875a) *The Dawn of Life: being the History of the Oldest Known Fossil Remains, and their relations to geological time and to the development of the animal kingdom*. Hodder & Stoughton, London; Dawson Bros, Montreal.
- Dawson JW** (1875b) *Nature and the Bible*. WB Ketchum, New York.

- Dawson JW** (1877) *The Origin of the World, according to Revelation and Science*. Dawson Bros, Montreal.
- Dawson JW** (1878) *Acadian Geology* 3rd ed. Macmillan, London; van Nostrand, New York; A&W MacKinley, Halifax.
- Dawson JW** (1880a) *Lecture Notes on Geology and Outline of the Geology of Canada*. Dawson Bros, Montreal.
- Dawson JW** (1880b) *The Chain of Life in Geologic Time*. Religious Tract Society, London.
- Dawson JW** (1880c) *Fossil Men and Their Modern Representatives*. Dawson Bros., Montreal.
- Dawson JW** (1882a) *The Fossil Plants of the Devonian and Upper Silurian Formations of Canada, Part 2 (p 93-142)* Report to Geological Survey of Canada.
- Dawson JW** (1882b) *Facts and Fancies in Modern Science*. American Baptist Publication Society, Philadelphia.
- Dawson JW** (1883a) *Presidential address to RSC 1882. Royal Society of Canada Proceedings & Transactions* 1:6-11.
- Dawson JW** (1883b) *On the Cretaceous and Tertiary Flora of British Columbia and the Northwest Territory. Transactions of the Royal Society of Canada* Sec 4, 1:1.
- Dawson JW** (1885) *Egypt and Syria: Their Physical Features in Relation to Bible History*. Religious Tract Society London, Oxford.
- Dawson JW** (1888a) *The Geological History of Plants*. International Scientific Series no. 61 Appleton & Co, New York.
- Dawson JW** (1888b) *Modern Science in Bible Lands*. Dawson Bros, Montreal; Hodder & Stoughton, London.
- Dawson JW** (1891) *Acadian Geology* 4th ed. Macmillan, London.
- Dawson JW** (1893a) *Some Salient Points in the Science of the Earth*. Drysdale Co, Montreal; Hodder & Stoughton, London.
- Dawson JW** (1893b) *The Canadian Ice Age: Being Notes on the Pleistocene Geology of Canada with Especial Reference to the Life of the Period and its Climatal Conditions*. WV Dawson, Montreal.
- Dawson JW** (1894a) *Synopsis of air-breathing animals of the Paleozoic in Canada, up to 1894. Transactions of the Royal society of Canada* Sec IV:71-88.
- Dawson JW** (1894b) *The Meeting Place of Geology and History*. Drysdale Co, Montreal; Fleming H Revell Co, New York, Toronto, Chicago.
- Dawson JW** (1897) *Relics of Primeval Life*. Fleming H Revell Co, Chicago, London, Toronto.
- Dawson JW** (1901) *Fifty Years of Work in Canada. Scientific and Educational: Being Autobiographical Notes by Sir John William Dawson*. R Dawson (ed), Ballantyne, Hanson & Co, Edinburgh & London.
- Dawson JW, Lyell C** (1853) *On the Remains of a Reptile (Dendrerpeton acadianum Wyman and Owen) and of a Land Shell Discovered in the Interior of an Erect Fossil Tree in the Coal Measures of Nova Scotia. Quarterly Journal of the Geological Society of London* 9:58-63.
- Dunlop AC** (1973) *The Pictou Literature and Scientific Society. N.S. Historical Quarterly* 3:99-116.

- Eakins PR, Sinnamon-Eakins J** (1990) Biographical Note on William Dawson. *Dictionary of Canadian Biography* 12:230-237 University of Toronto Press.
- Falcon-Lang HJ, Calder JH** (2005) Sir William Dawson (1820-1899): a very modern palaeobotanist. *Atlantic Geology* 41:2, 103-114.
- Gibson SS** (1982) Scientific societies and exchange: a facet of the history of scientific communication. *Journal of Library History Philosophy and Comparative Librarianship* 17:144-163.
- Gladwell M** (2008) *Outliers: The Story of Success*. Little Brown & Co., Boston, MA.
- Hook EL** (1990) Sir William Dawson and Henry Marshall Tory. The Achievements and Ideological Attitudes of Two Great Canadian Educators. M.A. Thesis, Carleton University, Ottawa.
- Jenkins P with Dawson GM** (2007) *Beneath My Feet: Memoirs of George Mercer Dawson*. McLelland & Stewart, Toronto.
- Lyll C** (1830) *Principles of Geology*, John Murray, London.
- Lyll C** (1838) *Elements of Geology*, John Murray, London.
- King W, Rowney, TR** (1866) On the So-called Eozoonal Rock. *Quarterly Journal of the Geological Society of London* 22:185-218.
- MacIntosh FC** (1930) Some Nova Scotia Scientists. *Dalhousie Review* 10:199-213.
- McKay A** (1903) President's address, Nova Scotian Institute of Science. *Proceedings & Transactions of the Nova Scotian Institute of Science* (1899-1902), Vol X, p xxxvi.
- Mobius, KA** (1876) Professor Mobius on the Eozoon Question. *Nature* 20:272-275, 297-301.
- Mobius KA** (1879) Principal J.W Dawson's Criticism of my Memoir on the Structure of Eozoon canadense compared with that of Foraminifera. *American Journal of Science*, ser 3, 18:177-185.
- Newberry JS** (1869) Report of Geological Survey of Ohio for 1869, pp 28-33, Columbus, 1871.
- O'Brien** (1970) *Eozoon canadense*, the Dawn Animal of Canada. *Isis* 61:206-223.
- O'Brien CF** (1971) Sir William Dawson: A Life in Science and Religion. *Memoirs of the American Philosophical Society*, Philadelphia.
- Pighetti C** (1980) William Dawson and Scientific Education. *Dalhousie Review* 60:622-623.
- Robertson H** (2007) *Measuring Mother Earth*. McClelland and Stewart, Toronto.
- Sheets-Pyenson S** (1991) Pearls Before Swine: Sir William Dawson's Bakerian Lecture of 1870. *Notes and Records. Royal Society of London*, 45:177-191.
- Sheets-Pyenson S** (1996) John William Dawson. Faith, Hope and Science. McGill-Queen's University Press.
- Sheets-Pyenson S** (1998) John William Dawson: Geologist and Educator. *GSA Today* Sept:14-15.
- Trigger BG** (1966) Sir John William Dawson: A Faithful Anthropologist. *Anthropologica* 8:351-359.

- Vaillancourt JP** (1973) John William Dawson: Educational Missionary in Nova Scotia. M.A. Thesis, Dalhousie University.
- Whitelaw M** (1985) Thomas McCulloch: His Life and Times. Nova Scotia Museum, Halifax.
- Wood BA** (1991) God, Science and Schooling: John William Dawson's Pictou Years 1820-1855. Nova Scotia Teachers' College, Truro. NS.