

ARTICLES



J.W. Spencer (1851-1921): his Life in Canada, and his Work on Preglacial River Valleys

Gerard V. Middleton

*School of Geography and Geology
McMaster University*

Hamilton, ON L8S 4K1

*Send correspondence to: 90 St. Margaret's
Rd, Ancaster, ON L9G 2K9*

SUMMARY

J.W. Spencer, born and buried in Dundas, Ontario, was a pioneer Canadian geomorphologist. After attending school in Dundas, he moved to Hamilton where he worked in a pharmacy, and was encouraged by local amateur geologists. He attended McGill University from 1871 to 1874, studied under William Dawson and Bernard Harrington, and graduated in the newly reorganized Applied Sciences program. He spent the summer of 1874 working as Robert Bell's assistant in Manitoba, and the following summer working in the Michigan copper mines as an assistant to a mine engineer, Luther Emerson. He obtained a position as science teacher at Hamilton Collegiate Institute (Fig. 1) in 1876. In 1877 he submitted his thesis on Michigan copper

deposits to the university at Göttingen, Germany and that summer he visited the university, passed his oral examinations and was awarded the Ph.D., becoming the second Canadian to earn a doctorate in geology. In 1880 he became Professor at King's College, Windsor, Nova Scotia. He concentrated his geological studies on the region around his birthplace at the head of Lake Ontario: at first mainly Paleozoic geology and paleontology, but by 1880 he had switched decisively to surficial geology, particularly the preglacial drainage of Lakes Erie and Ontario. In 1880 he travelled extensively in the United States and attended the AAAS meeting in Boston, where he met J.P. Lesley, who encouraged him to continue his studies of preglacial rivers. In 1882 he accepted a position as

Professor and Director of the Museum of Natural History at the University of Missouri.

RÉSUMÉ

J.W. Spencer qui est né et a été inhumé chez lui à Dundas en Ontario a été un géomorphologue canadien qui a fait oeuvre de pionnier. Après avoir été à l'école à Dundas, il a déménagé à Hamilton où il a travaillé dans une pharmacie, et c'est à ce moment que des géologues amateurs l'ont encouragé à aller de l'avant. Il a fréquenté l'Université McGill de 1871 à 1874, où il a reçu les enseignements de William Dawson et de Bernard Harrington, et suivi avec succès la formation du programme nouvellement refondu en sciences appliquées. Durant l'été de

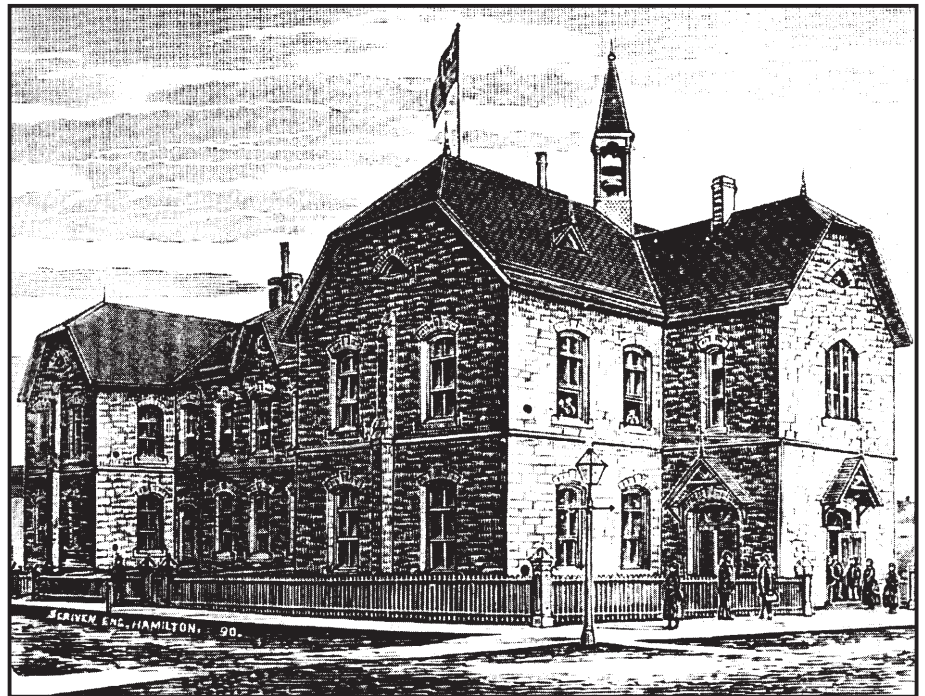


Figure 1. Hamilton Collegiate Institute. It was built in 1866, and replaced in 1948 by the present Federal Building (Vox Lycie Yearbook of 1890, courtesy of Hamilton Public Library Special Collections).

1874, il a été l'assistant de Robert Bell au Manitoba et, l'été suivant, il a travaillé dans les mines de cuivre du Michigan où il a été l'assistant Luther Emerson, ingénieur minier. En 1876, il a obtenu le poste de professeur de science à l'Institut collégial Hamilton (Fig. 1). En 1877, il a soumis sa thèse sur les gisements de cuivre du Michigan à l'université de Göttingen en Allemagne, et durant l'été il s'est rendu à l'université, y a passé ses examens oraux, puis a obtenu son Ph.D., devenant le deuxième Canadien à obtenir un doctorat en géologie. En 1880, il est devenu professeur au King's College, à Windsor en Nouvelle-Écosse. Il a concentré ses recherches géologiques sur la région de son lieu de naissance, à la source du lac Ontario : il s'est d'abord principalement intéressé à la géologie et à la paléontologie du Paléozoïque, mais en 1880 ses intérêts avaient carrément changé pour se porter sur la géologie de la surface, particulièrement le drainage pré-glaciaire des lacs Ontario et Érié. En 1880, il a beaucoup voyagé aux États-Unis, participant au congrès de l'AAAS (association étasunienne pour l'avancement des sciences) à Boston, où il a rencontré J. P. Lesley qui l'a encouragé à continuer ses recherches sur les cours d'eau pré-glaciaires. En 1882, il a accepté un poste de professeur et de directeur au musée d'histoire naturelle de l'Université du Missouri.

SPENCER'S EARLY LIFE AND EDUCATION

Joseph Winthrop Spencer is probably unknown to most Canadian geologists, though the name may be familiar to some who have worked on the Quaternary of the Great Lakes region. His life and work are worth reviewing on several counts: Spencer was a native of Dundas, Ontario, and was one of the early investigators of the Paleozoic geology and paleontology of the region around the head of Lake Ontario. He was the second Canadian to earn a doctorate degree, with a thesis accepted by the university in Göttingen, Germany in 1877 (Middleton, 2003). For most of his life, he worked on proglacial river valleys in Ontario, and

the origin and extent of proglacial precursors of the Great Lakes. In 1907 the Geological Survey of Canada published his book-length study of the origin of Niagara Falls (Spencer, 1907). Spencer taught high school in Hamilton, and was later a Professor at King's College in Windsor, Nova Scotia, but in 1882, at the age of 31, he left Canada for an appointment at the University of Missouri. He also served as State Geologist for Missouri and Georgia, before settling as a consultant geologist in Washington, D.C. Throughout his life he travelled widely, and often visited Canada to carry out further field investigations. In 1919 he returned for good, intending to live in Toronto, but died on October 9, 1921, before he could take possession of his new home.

Spencer was born in Dundas on March 26, 1851, and is buried there, in the family grave. He was the great grandson of Robert Spencer, an United Empire Loyalist and pioneer settler in Stamford township, Upper Canada (now Niagara Falls, Ontario). Spencer's father, Joseph, and his uncle, Benjamin (sons of Adam Spencer, ?1775-1815), moved to Dundas about 1828, and in 1834 his father built the Gore Grist Mills in Dundas, on the creek, known ever since as Spencer's Creek. Joseph, Jr. was his only son, and Joseph Sr. died by falling from the roof of the mill only a few months after his son's birth (Woodhouse, 1965, Part 2, p.5-6). The son, christened Joseph William, grew up in Dundas with his mother and five elder sisters, and was one of the first pupils to attend the new Union School, built in 1857. He became interested in natural history and chemistry, in part because of the setting of his home, near the head of the Dundas valley, and in part because of the influence of his teacher, J. Howard Hunter. Shaw (1924) recorded that "At fifteen Spencer outfitted a little chemical laboratory of his own and was becoming especially interested in the chemical characters of the minerals, rocks, and waters of the region in which he lived. At sixteen he was attempting quantitative analysis and all the while making short field trips, commonly with his teacher, who shared his enthusiasm..."

About this time (1866), Spencer completed his school education, and he and his mother moved to Hamilton, where one of his married sisters (Annie Warren) also lived. Spencer went to work as an assistant at "T. Bickle, Retail and Wholesale Chemist" (see Sources and Notes), and began to associate with a group of Hamilton amateur geologists, at least two of whom (Col. Grant, and D.F.H. Wilkins) were prominent in the Hamilton Association for the Advancement of Literature, Science and Art (Armstrong, 1958). Grant was a well-known fossil collector (Hewitt, 1986); for Wilkins see Sources and Notes.

In 1871 Spencer left for McGill University. He graduated in 1874 from the new program in Applied Science, obtaining a B.A.Sc. "with First Rank in Geology and Mineralogy." His teachers certainly included William Dawson and Bernard Harrington. Shaw (1924) claimed that Sterry Hunt and Elkanah Billings were also among his teachers, but Hunt taught at McGill only until 1868, and left in 1872 to become Professor at MIT (Zaslow, 1975, p.102; Boyle, 1993), and Billings never held an appointment at McGill (Clark, 1971), so if Spencer received instruction from them, it must have been informally. Shaw also claimed that Spencer won a Dufferin medal (the forerunner of the present Governor General's medals) but McGill has no record of this, and Spencer himself never claimed it. Spencer clearly adopted William Dawson as a surrogate father: he was strongly influenced by his views, particularly as regards glaciation (see below), corresponded with him faithfully until 1895, sought his assistance in obtaining teaching positions, and depended on him for advice, and for the loan of books, papers, and surveying equipment.

Following graduation, Spencer worked for the summer of 1874 for the Geological Survey of Canada as assistant to Robert Bell in the new Province of Manitoba (Shaw, 1924). The scientific results from this field season were meagre, but Robert Bell remained a friend for life. If Dawson was Spencer's surrogate father, Bell was his surrogate elder brother: his letters to

Bell were more forthright, and extended from 1874 to about 1910 (luckily for historians, Bell never threw away any papers, not even letters marked "Destroy after Reading"! There is a break in the correspondence between March 1889 and December 1893: perhaps this resulted from their divergent views about glaciation).

Returning to Ontario in the fall, Spencer was unable to find work because of the recession then in progress. In June 1875 he left for Marquette, Michigan, and was hired as assistant to Luther G. Emerson, an engineer working for several of the native copper mines in the Upper Michigan Peninsula (BP, Sept. 12, 1875; see also Lankton, 1991). This work later became the basis of his doctorate degree. By the end of the year he was back in Canada, again searching unsuccessfully for work. 1876 was not a good year for Spencer: his brother in law (Peter Warren, married to Annie) was dying, and his mother and another sister were very ill. Nevertheless, Spencer managed to broaden his geological education that summer. He probably returned to Michigan, and he certainly visited mining and steel production regions in Pennsylvania (BP, Nov. 23, 1876). Returning to Hamilton, he obtained a position as science teacher at Hamilton Collegiate Institute (HCI). His mother died in December.

TEACHING APPOINTMENT IN HAMILTON

In a letter to Bell (BP, Nov. 23, 1876), Spencer complained that he "...received the promise of a Mastership in Upper Canada College at a salary of \$1000, board and lodging, etc..." but when he returned to Hamilton in the fall "...there had been a dispute in the Council and some of the members would not allow my appointment because 'a McGill man must not deprive a Toronto man when the two are even'..." Early in 1877, he wrote again describing his appointment at HCI: "The salary...was the paltry sum of \$600 but raised to \$700 and with the standing of...head of a department. There are fourteen teachers . . . I have four classes in Chemistry, Physiology, Physical Geography, and shortly

Geology, Botany, Zoology and Physics. In the meantime I have a class in Latin and others in History and Geography [it is not clear how that adds up to four!...]I am going to try and make this the best science school in the Province outside of University College." (BP, Jan. 21, 1877).

The headmaster at HCI was George Dickson, and Spencer lodged with him during his first term of teaching. Though Dickson was trained in classical languages, he had a strong interest in geology. Beginning in 1873, he was active on the executive of the Hamilton Association, and was the first chair of the Geological Section established in 1883 (Armstrong, 1958). He was successful in making HCI one of the leading high schools in Ontario, and in 1885 he was appointed Principal of Upper Canada College (Rose, 1888). He lost this position in the reorganization of 1895, but with his wife, he founded St. Margaret's College for women, where he remained President until his death in 1910 (Morgan, 1912). He and Spencer remained friends for many years after Spencer left Hamilton.

While he was at HCI, Spencer certainly knew and taught Chemistry to Andrew Lawson, who was raised in Hamilton, Ontario, and was a star pupil at HCI from December 1878 until June 1880. Lawson worked part-time for the *Hamilton Spectator*, and considered becoming a journalist, or a medical doctor. A summer position as legal journalist in Montreal, and attendance at two courses at McGill soon convinced him that he was not cut out for either profession. In the fall he enrolled at the University of Toronto, and after working as an assistant to Robert Bell in 1882 in the Prairies (Lawson, 1926), he decided to become a geologist. He worked three more field seasons (in the Lake-of-the-Woods region), completed his M.Sc. in 1885, and was hired full-time by the Geological Survey. In 1890, after resigning from the Survey, he accepted a position at the University of California in Berkeley, where he remained for the rest of his long life (Vaughan, 1970). Though there is little evidence that he was influenced by

Spencer, he is known to have presented a paper in 1885 to the Hamilton Association entitled "The physical development of the Niagara escarpment." This address was never published and the manuscript cannot be found in the Hamilton Association papers, or in Lawson's papers at Berkeley.

As a means of obtaining a better appointment, Spencer began to improve his professional credentials. In 1877, with the help of Dawson and Bell, he became a Fellow of the Geological Society of London, and he began to write up his Michigan work as a thesis to be submitted to the University of Göttingen, in Germany. Why Göttingen? The school was perhaps recommended to him by Bernard Harrington, his chemistry instructor at McGill. When Harrington completed his doctorate at Yale in 1871, it was perhaps the leading centre of geological studies in the USA. Clarence King, who later became Director of the U.S. Geological Survey, graduated there in 1863, and so did Arnold Hague, who spent the following three years studying in Germany, where he met another American, S.F. Emmons (Middleton, 2003; see also Geschwind, 1994). Their experiences were certainly transmitted to Harrington's instructors at Yale: none of Spencer's other friends and mentors had any experience of German universities.

Obtaining a doctorate was not then the arduous task that it later became. Even at famous German universities, a doctorate was earned mainly by passing qualifying exams, and by writing and defending a thesis. Spencer wrote to Dawson (DL, Oct. 31, 1879):

"Six months before I went to Germany, the College Authorities accepted my Monograph on the Copper-Bearing Rocks as my thesis. And then, sending my application and sketches of my life in Latin, I was admitted to the examinations for the degree on the 20th of July 1877. The special subjects of the oral were Geology (particularly Paleontology) and Mineralogy, as the leading subjects, with Natural History as secondary."

Spencer wrote his thesis in English and spent less than two months

in Germany (McGill archives, letter to Harrington, May 30, 1877). When the thesis work was published in *Canadian Naturalist* however (Spencer, 1878a), Spencer acknowledges the assistance of Emerson and Bell, but does not mention any of the instructors at Göttingen. After his second visit to Europe (in 1886) he wrote (BP, Sept. 27, 1886):

“When I was in Europe before, I came home without any wish to go back again.” During the three years that he taught at HCI, Spencer was hard at work on the geology of Southern Ontario. He published his first papers, which as well as his thesis included a paper on the taxonomy of the local graptolite fauna (Spencer, 1878b; based largely on specimens collected by Colonel Grant); began to prepare a series of papers on the Paleozoic geology; and most important of all, began to take a keen interest in the local geomorphology and surficial geology. He took a particular interest in the origin of the Dundas valley, where the well records revealed a gorge buried deep beneath the present valley. He wrote to Bell (BP, Apr. 21, 1879):

“...either there must have been a deep gorge scooped out by the close of the Pliocene, or else there is evidence of glacial action, and the Dundas valley, so[?] near to the lake, must have been a sort of fiord.” In March of that year, he wrote to Dawson (DP, Mar. 17, 1879):

“...I am hoping to work up the subject. I have the use of surveying instruments,

and I hope with the fine weather to collect all the facts I can, and get the accurate levels, so as to work up the geology of the head of Lake Ontario.”

Dawson, after reading the list of all Spencer’s activities (which included giving private lessons in geology to the Rev. Samuel Lyle, of Central Presbyterian Church, Hamilton: see Sources and Notes) wrote back:

“I fear...that you are working too hard. Be cautious lest you overtask your brain.”

In a paper, published a few years later (Spencer, 1882, p. 229) Spencer recalled:

“Having procured all the levels that ...were available, it became necessary to connect several places myself by instrumental measurements, which work was accomplished with the aid of Prof. Wilkins...[so that by 1880] the proof that the ancient Grand river flowed down the Dundas valley was completed...”

PROFESSOR AT KING’S COLLEGE, WINDSOR, NOVA SCOTIA

Despite his ambitions for science at the Hamilton Collegiate Institute, Spencer actively sought a better position. Already on August 27, 1878, Spencer had written to Dawson asking for a letter of support for his application for a position in Natural Sciences at the University of Virginia. In 1879, Henry How, a well known mineralogist and Professor at King’s College, in Nova Scotia, died and the college began to look for a replacement (Vroom, 1941,

p. 103-125). King’s was a small Anglican university, located at Windsor N.S. (Fig. 2): it later moved to Halifax and became part of Dalhousie University. Dawson wrote to the Principal, Professor Dart, recommending Spencer, and in October Spencer reported that he sent further testimonials from Dr. Harrington (Director of Applied Science at McGill), Dr. Robert Bell, and Mr. A.R.C. Selwyn (the Director of GSC). Letters had also been sent by Howard Hunter (he had moved from Dundas to become Principal at Brantford high school), and George Dickson. The Rev. James Carmichael, Rector of the Church of the Ascension, in Hamilton, wrote on his behalf to Bishop Binney: he mentioned in his letter that he knew Spencer not only in Hamilton, but also from his years in Montreal. Carmichael had an interest in science, was a keen microscopist, and a member of the Natural History Society of Montreal (see Sources and Notes). The Bishop, as President of the Board of Governors of Kings, would have had much influence in the appointment (McGill archives includes printed copies of all these letters). It is quite likely that Spencer became an Anglican while he was a student in Montreal: his uncles were Methodists, and so was his mother (census of 1871), and Spencer was not baptized in the Anglican Church in Dundas (the baptismal records are held at McMaster University). Spencer’s



Figure 2. View of King’s College, Windsor, Nova Scotia: Main Building (left) and Chapel (courtesy of King’s College archives).

change from his family's Methodism to Anglicanism, however, was not a conversion of convenience: he remained a committed Anglican throughout his life (Shaw, 1924).

Spencer wrote to Dawson (DP, Oct. 31, 1879) :

"I preferred the position from the fact that I would have nothing but Science to teach, and be quite independent of that miserable Central Committee in Toronto. And again, it would be easier to get a still higher position, at some future day, even from a small college. Moreover my work ought to be pleasanter for I could shape my own courses."

He also mentioned that, should a position open up at the University of Toronto, he would be a candidate. This is the first of many references in his letters to his ambition to replace Edward J. Chapman as Professor of Geology in Toronto. After 1885, Spencer was discretely assisted in this ambition by George Dickson, who as Principal of Upper Canada College, was on the Board of the University of Toronto. Chapman had been serving there since 1853, but in fact he did not retire until 1895!

In March 1880 Spencer was apparently already at King's College. He wrote to Dawson (DP, Mar. 4, 1880):

"I have very comfortable class rooms now...I like [President Dart] very much indeed. So also the Prof. of Math. whose room is next to mine and consequently see every day...[the college has] gone to about \$400 expenses for my dept. since I came, but I expect to get no more out of them."

Nevertheless that summer he considered applying for a position to teach Geology, Zoology and Botany at Queen's University in Kingston, Ontario: as we will see, he soon became disillusioned with the Board of Governors at King's, and with President Dart.

He started to prepare his studies at the head of Lake Ontario as a large monograph in three parts. He returned from Nova Scotia to carry out an ambitious series of field studies, and wrote to Bell (BP, Nov. 18, 1880):

"I had a good expedition up the Assemetquagan River, Quebec [a tributary of the Matapedia River in Gaspesie],

visited my friends ...at Brampton Falls, Montreal, Ottawa, Kingston, Toronto, Brantford, three or four smaller places, Detroit, Cleveland, Albany, and Boston, where the AAAS meeting was held for nine days. I met lots of eminent people, made a number of nice friends, and have lots of invitations to the States, even as far south as Georgia for Christmas..."

At the AAAS meeting in Boston, he met J.P. Lesley, the Director of the Pennsylvania Geological Survey, and a prominent geologist with a special interest in fluvial geomorphology (Chorley et al., 1964, p. 346-354). Lesley encouraged Spencer's interest in buried river valleys, and was perhaps more influential than any other person in determining Spencer's future research.

On February 3, 1881, he wrote to Lesley:

"My paper on the Preglacial drainage is nearly ready..."

And he wrote to Bell (BP, Feb. 19, 1881):

"When you see the proofs you will be astonished. The work was carefully done with levels by the railways and myself. It is the best thing I ever did."

On March 1, 1881, he wrote again to Lesley:

"At last, I have finished a manuscript for you...After having printed this, I will supplement it next year...and I will try and make the two papers contain my whole study of the Preglacial Drainage. I think I have a clue to the outlet of Lake Ontario, but of course it is more theoretical at present than based on my own observations. But next summer I will try and work out the truth."

"Since seeing you, new life has been infused into my work. Living in this isolated region, one is very apt to get in a state of lethargy, when he never or rarely meets scientific men, and all reading is rather dry, after one's college duties are over for the day...[at Boston] I think that you impressed in me more enthusiasm than all others, and so, if for nothing else, my visit to Philadelphia [during the Christmas vacation of 1880] amply rewarded me for the long journey."

The paper that Spencer referred to was his "Discovery of the Preglacial outlet of the Basin of Lake Erie..." which was published in the *Proceedings of the American Philosophical Society* (Spencer, 1881; see his illustration

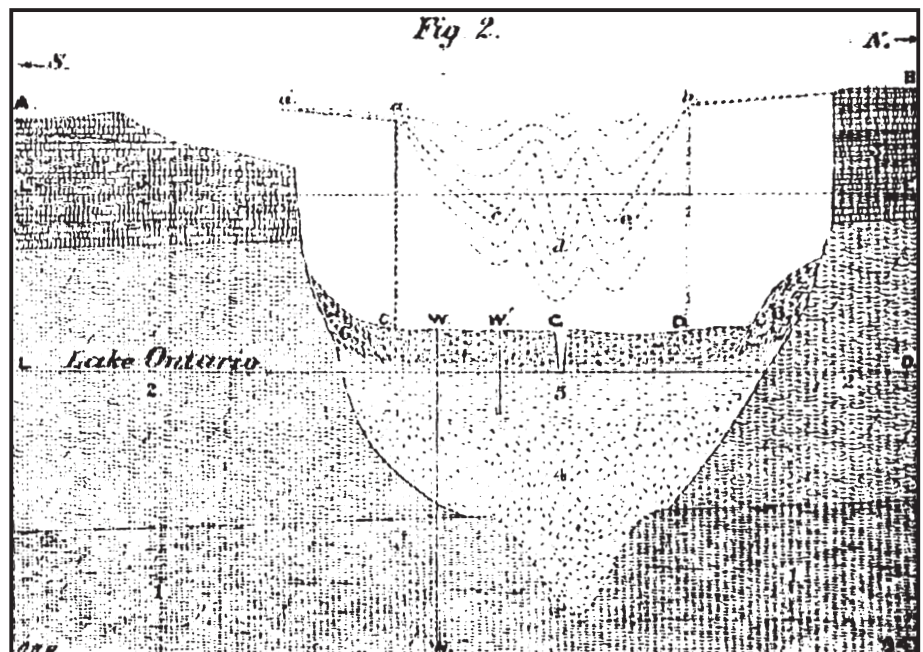


Figure 3. Cross-section of the Dundas buried canyon (from Spencer, 1881). Different ornaments distinguish the Silurian dolomites from Silurian (Medina) and Ordovician (Queenston) shaly beds; and the modern and proglacial alluvium (above the level of Lake Ontario), from the till filling the gorge (below). Dotted lines show profiles across the modern Dundas valley farther west.

reproduced herein as Fig. 3), and republished by Lesley in his *Second Geological Survey of Pennsylvania* (see Shaw, 1924, for reference).

From this time on, Spencer set aside most of his other interests and concentrated on the geologically recent [i.e., post-Pliocene] history of the Great Lakes. The summer of 1881 was spent in an even more extensive field season in southern Ontario and upper New York State, and ended at another AAAS meeting, that year in Cincinnati, Ohio. In June he wrote to Bell (BP, June 12, 1881):

“I would like to devote my whole time for a year or two to Fluvial Geology of America. It is a magnificent new field of enquiry.”

Though he did eventually carry out his program of fieldwork, many years were to pass before Spencer developed his mature thoughts on this subject (for a short summary of his later views on the modern Great Lake basins, see Spencer, 1890, from which an illustration is

provided here as Fig. 4).

However, King’s College was in the early stages of a major upheaval, which has been well documented recently in articles by Roper (e.g., 1999). Spencer was only marginally involved, but felt that he had been misled and betrayed by President Dart.

Even though he had been promoted to Vice-President, he reported to Dawson in the spring of 1882 (DP, April 5, 1882):

“I have long been intending to go to the States, if I cannot do better here...I have friends...trying to give me a position at Georgia State University.”

The Georgia appointment came several years later, but by September 1882 he had left Canada for an appointment at the State University, in Columbia, Missouri (at a salary of \$2000, substantially larger than anything that King’s could offer). The position had been offered first to William Dawson himself, but he declined it and suggested Spencer.

PRESENT STATUS OF RESEARCH INTO THE PREGLACIAL CHANNELS

Though his letters indicate that he was prepared at first to consider a glacial origin for the Great Lake basins, Spencer soon came to believe that the basins were largely fluvial in origin, formed by a preglacial river system. He was ambivalent about whether or not they were ever filled by ice sheets during the Ice Age. He would admit they were somewhat modified by glacial abrasion and deposition, but he thought that ice sheets, if they existed, would have been quite thin and incapable of eroding the basins themselves. He mostly ascribed glacial striae to the action of floating ice, and even attributed many moraines to accumulations from stranded icebergs (in these ideas he was strongly influenced by William Dawson: cf. Brookes, 2002). Later he became strongly opposed to the theory that proglacial lakes were formed by the agency of huge glacial dams.

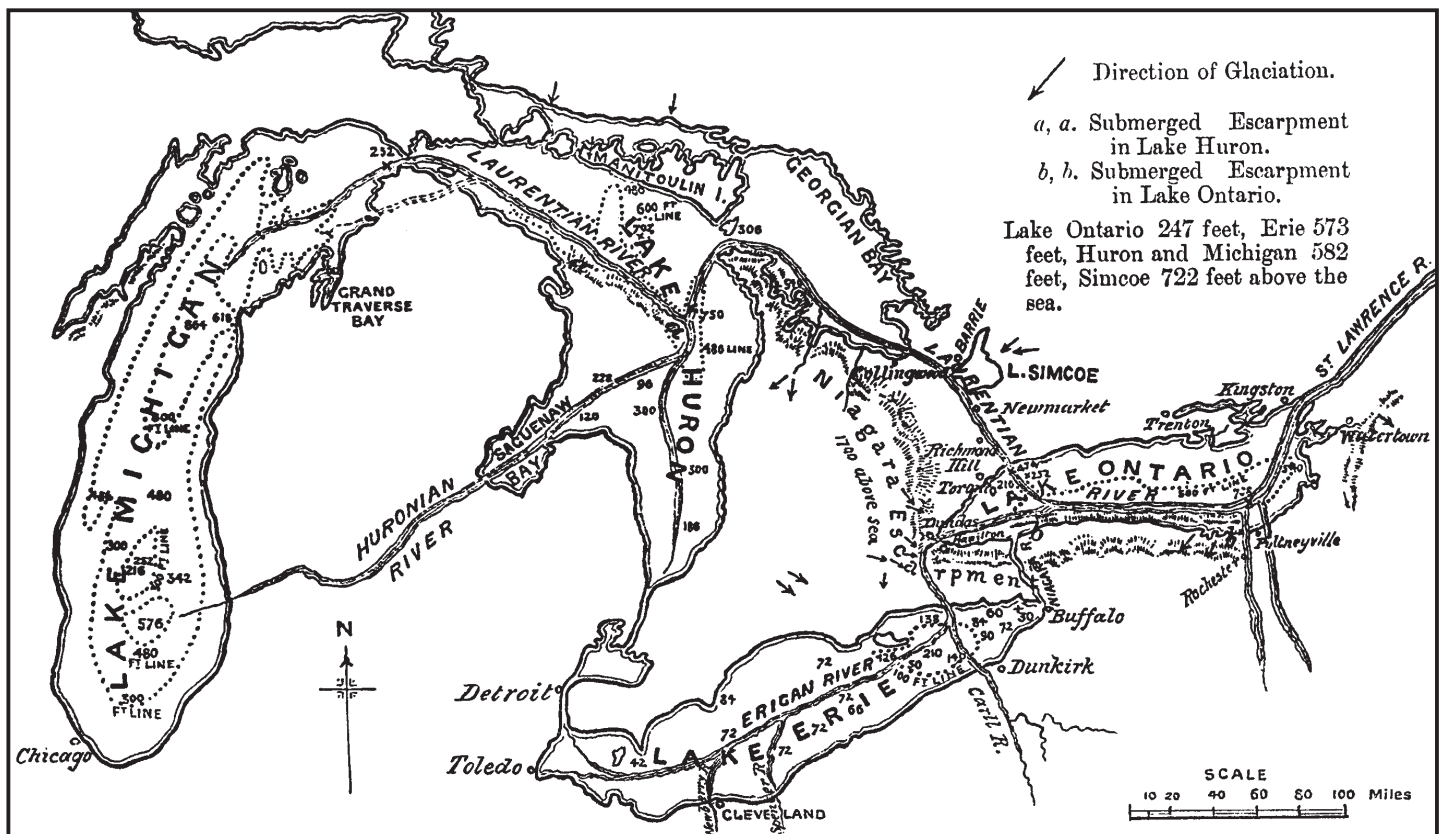


Figure 4. Map of the preglacial drainage in the Great Lakes, from Spencer (1890). Later, Spencer found evidence that the Eriean River crossed the Niagara peninsula east of Hamilton, rather than flowing north up the Grand River to the Dundas valley (see Spencer, 1907, and map reproduced in Tinkler, 1994). In this later view, the Dundas River was a tributary to the Eriean, not part of the main system.

Spencer's view that glaciers, particularly ice sheets, were incapable of major erosion was not unusual in the nineteenth century. It was shared by Charles Lyell, J.P. Lesley, T.G. Bonney, and many other noted geologists, even after the publication of Ramsay's book (1863), which is often cited as establishing the power of glacial erosion (for documentation see the review in Totten and White, 1985; and Chapter 2 of Tesmer, 1989). Indeed, exactly how effective ice sheets are as erosive agents was somewhat controversial even recently: for example, Chapman and Putnam (1984, p. 6) wrote:

"The amount of erosion accomplished by the great Pleistocene glaciers is not subject to accurate measurement...Most active erosion of the bedrock occurred on the brows of the escarpments and along the lowland routes taken by the principal streams of ice. The basins of Lakes Ontario, Huron and Superior extend to below sea level; as such scooping-out could not have been the work of a river, it is attributed to the glaciers, although this is the subject of some debate."

Spencer pioneered in the discovery of field evidence for preglacial river valleys. These included the channel at the head of Lake Ontario (Dundas) and another crossing the Niagara peninsula south of St. Catharines. His view, based on his studies of bedrock topography, was that before the glacial period (widely believed at that time to be quite short), the Lake Erie and Ontario basins were river valleys, and that the river, which he called the Erigan River, originally flowed *north* up the Grand River valley, then east through the Dundas buried gorge to the Ontario basin, with an exit near the present exit at the east end of Lake Ontario. Later investigations allowed him to extend and modify his scheme somewhat.

Buried channels exist, and remain incompletely explained (for a summary of work carried out in the United States not long after Spencer, see Bork, 2003; for later work, Flint, 1971, p. 232-239). Spencer's overall scheme of drainage has been reproduced frequently, more recently (with sceptical comments) by Tinkler (1994). Later work has revealed a much longer, more complex history of glaciation than was

known in the nineteenth century, so channels buried in drift may be interglacial rather than preglacial. Nevertheless, Spencer's reconstruction of an ancient Great Lake river system, though regarded as speculative, was fairly generally accepted. After his work, little progress was made in Canada for many years. Recently, Greenhouse and Monier-Williams (1986) showed, using geophysical methods, that the Dundas valley ends abruptly (perhaps at a waterfall) near Copetown (a few miles west of Dundas). Flint and Lolcama (1986) confirmed the existence of Spencer's Erigan channel (south of St. Catharines). The larger role of the Erigan River remains unclear. Some American workers (e.g., Hansen, 1987) have suggested that the buried Teays channels in Ohio, Indiana and Illinois, whose status as a major preglacial drainage system also remains controversial, may have originally flowed northeast into the Erigan system.

ACKNOWLEDGMENTS

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SOURCES AND NOTES

Much of this article is based on archival (unpublished) sources. These include

letters to William Dawson in the McGill archives (cited as DP, followed by the date of the letter), to Robert Bell in the National Archives (BP), and to J.P. Lesley in the American Philosophical Library in Philadelphia (LP). In quoting from the letters, I have standardized the spelling, capitalization, and punctuation. There is also an archive of Spencer's papers (SP) at the University of Manitoba, but unfortunately it includes almost no letters. The Canadian census of 1881 (available at <http://www.familysearch.com>), early Hamilton directories, and copies of Spencer's family's wills, have also been useful. A good bibliography of Spencer's publications is given by Shaw (1924), and the Bibliography of North American Geology gives an even more complete list. The only other obituary was a brief note by Holm (1921). Throughout his life, Spencer contributed to numerous Who's Who publications: the most informative entries are in the second edition (1910) of American Men of Science (Spencer was a "starred" geologist – meaning that the editors considered him to be among the top 100 geologist in America at that time); and in the first (1898) and second (1912) editions of Canadian Men and Women of the Time, edited by H.J. Morgan.

Throughout his life Spencer always signed his letters and papers "J.W. Spencer." He was christened Joseph William, but some time before his marriage (in 1896) he apparently decided to use the name "Winthrop," because he believed he was descended from the family that included the first Governors of Massachusetts and Connecticut. He never used three initials in his signature, though some reference works (see above) used all three first names. His marriage certificate is the first document which used Winthrop as well as William. His gravestone is engraved "J. Winthrop Spencer, Geologist," and the date of birth is given erroneously as 1850 (the same date is found in the first edition of Canadian Men and Women of the Time, but is corrected in the second edition). The medal later established by his wife as a memorial at the University of Manitoba is entitled the "Winthrop Spencer Gold Medal," awarded "for

outstanding achievement in geological research by a student or graduate of the [university].” Recipients have included such well-known geologists as Thomas Oliver, Andrew Baillie, Peter Laznicka, and William Last.

For Tristram Bickle and his son John Wesley Bickle see Anonymous (1981) and Katz (1975, p.196).

James Carmichael (1835-1908) served as Rector of the Church of the Ascension, Hamilton, from 1878 to 1881. Before that he was an assistant at St. George's in Montreal. He became Bishop of Montreal in 1906 (K.M., 1991).

Samuel Lyle (1841-1919) emigrated to Canada in 1877, and the next year was appointed pastor of Central Presbyterian Church in Hamilton. He became one of the leading Presbyterian clergymen in Canada. He admired German philosophy and scholarship, and was a spokesman for liberal Protestantism. He was active in the Hamilton Association and twice served as its President – which probably explains his interest in geology (Hanlon, 1991).

David Francis Henry Wilkins (b.1846) was a school teacher. When Spencer first met him he was teaching music in Hamilton. He attended McGill at about the same time as Spencer, and graduated in Applied Science a year after Spencer (McGill archives). He published five papers on geology, three in the *Canadian Naturalist*, two in the *Journal and Proceedings of the Hamilton Association*. In 1881 he was teaching in Chatham (census), and in 1890, when he published his last papers he was headmaster of Beamsville highschool (east of Hamilton).

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