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CONFERENCE REPORTS

Hutton, Lyell, Logan and their Influence in North America

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The History of Geology Division (HDG) organized a symposium on this topic for the Geological Society of America (GSA) Meeting in Toronto, October 1998. James Hutton died in 1797 and Charles Lyell was born in the same year. That dual anniversary was celebrated by several symposia in 1997: one part of the Geological Society of London's celebration, Special Publication 143 *Lyell: The Present is the Key to the Past,* has already been published. HDG decided nevertheless to organize a Symposium for the Toronto GSA meeting and to couple Hutton and Lyell with William Logan, who was born a year later than Lyell in 1798 (they both died in the same year, 1875). The event, attended by a full house (an audience of more than 200) was made possible by a generous grant from the Canadian Geological Foundation to pay part of the travel expenses of speakers, who were primarily historians, and could not otherwise be expected to attend the meeting.

Besides the symposium itself, a one-day field trip to Niagara Falls visited a geological site studied by many famous geologists, particularly Lyell. Copies of the field guide, *History of Geology Field Trip to Niagara Falls,* by Keith Tinkler (Field Trip Guide 9, 20 p.) are still available from the GSA. Other papers on Lyell and Logan were read at a theme session, and will be discussed below along with the symposium papers.

After a brief introduction, presented by Keith Tinkler, the symposium began with two papers about Hutton (Fig. 1). The first by Hugh Torrens (Keele University, a past president of the British Society for the History of Science, and current President of the International Committee on the History of Geological Sciences (INHIGEO) examined the contradictory view of Hutton held by recent historians: the conventional view is, as inscribed near Hutton's grave, that he was the "Founder of Modern Geology." This view was perhaps first persuasively argued by Geikie (1897, in *The Founders of Geology*). Although we now know much more about Hutton's life than the idealized portrait given by Playfair (1805) — including the facts that he had an illegitimate child, was known to take a dram or two of intoxicating spirits, and wrote a few coarse remarks in letters to his friends (Jones *et al.,* 1995) — we still have very few of his personal archives, because Hutton's executors (as others of his Edinburgh circle) destroyed them as a matter of principle. Even his extensive rock collection went after Hutton's death to Robert Jameson (ironically, the leading and antagonistic British Wernerian) and has not survived.

In understanding Hutton's influence, Torrens argued that we should bear in mind how difficult scientific communication had become in the late 18th century, because of the French revolution and the Napoleonic wars. Continental

Figure 1 James Hutton, 1726-1797. Geological Survey of Canada negative 202367.

scientists generally had no chance to read Hutton in the original during his lifetime and for years after, and were equally wary of any "revolutionary" theory of the Earth. Hutton did travel extensively throughout Britain and had formulated the basics of his theory by the 1760s. He did make detailed field observations as shown by the drawings of his field companion, Clerk of Eldin, and by his published plan views and sections (for examples, see Dean, 1992, listed below). His ideas about unconformities, the intrusive nature of granite, and the pervasive role of subterranean heat were original, in advance of his times, and support the claim for his great historical significance.

Dennis Dean (author of *James Hutton and the Theory of Geology,* Cornell University Press, 1992) then took up the question of Hutton's early influence in North America. There is no question that the main influence in the 18th century was that of Werner, not Hutton, but by the turn of the century Hutton's views gradually became known, even if at second hand. In 1798 and 1803 Hutton's views were discussed in print, and misquoted, based on secondary sources. Hutton never visited America, and the only aspect of American geology that he discussed directly in his publications was the Natural Bridge in Virginia, described earlier by Thomas Jefferson. In 1795 Hutton rejected Jefferson's catastrophist interpretation and proposed an erosional alternative. In 1818, Gilmer gave a Huttonian account of the Bridge. In 1825, the writings of Jeremiah Van Rensselaer give the first clear indication that Hutton was being read in the original (he rejected both Hutton and Werner). The 1828 analysis of the geology of Nova Scotia, by C.T. Jackson and Francis Alger (*cf.* von Bitter, 1978) is a clear example of Hutton's influence. In the next two years, Hutton's views and the Neptunist-Plutonist debate became well known here from the 1829 American edition of Robert Bakewell's *Introduction to Geology* and from Lyell's *Principles.*

Robert H. Dott, Jr. then asked "How significant were Lyell's contributions to North American geology?". Lyell (Fig. 2) paid two visits to North America, and travelled widely under the guidance of local experts. In Dott's view his agenda was: to protect his books (an important source of income for his field expenses), which had begun to appear in pirated American editions; to obtain an expertise that he could display before his home (Geological Society of London) audience; to publish popular, therefore lucrative and influential, accounts of his travels; and to seek new examples to incorporate in future editions of his *Principles* and *Elements.* As a bonus, he also discovered new fossil evidence for his opposition to organic progression, and new field evidence to support the efficacy of floating ice (*cf.* Dionne, 1972, 1974).

Although Lyell was undoubtedly an effective propagandist for his views and books, he learned much from local geologists on his tours. He ultimately published more than 30 communications, based on local authorities and personal observations. By acknowledgment and personal diplomacy, he was able to overcome the suspicions of most American geologists about exploitation, and to make at least one major disciple (J.W. Dawson). With Dawson, he discovered Carboniferous reptiles and non-marine molluscs in Nova Scotia; with Hall he investigated the history of Niagara Falls (*cf.* Tinkler, 1987); and with Roy (*cf.* Legget, 1976, 1988), saw evidence of higher lake levels in the Ontario basin (supporting his views on the importance, albeit limited, of fluvial erosion, and slow elevation of the land). He pointed out the Arctic affinities of marine molluscs interstratified with the drift. In his second travel journal (1849) he made a bold attempt to relate the drift of New England and maritime Canada to river terraces in the southern United States, elevated shorelines, and the extinction of large mammals by alternate vertical uplift, subsidence and marine submergence, and uplift.

The next paper was delivered by Leonard G. Wilson, author of *Charles Lyell – The Years to 1841: The Revolution in Geology* (Yale, 1972). The second volume of his life of Lyell has just appeared, entitled *Lyell in America: The Transatlantic Years, 1841-1853* (Johns Hopkins, 1998) but instead of dwelling on this topic, Wilson described "The influence of the geology of Madeira on Sir Charles Lyell." Lyell was in Madeira and the Canary Islands in the winter of 1853-1854. Besides his general interest in volcanoes, Lyell made this visit because von Buch had described these islands as illustrating his "craters of elevation" theory. Elie de Beaumont believed that lavas were originally horizontal, so that cones with lavas dipping away from the crater must have been uplifted. Darwin's observations in South America had supported von Buch, although Darwin rejected a catastrophic theory of uplift. Lyell found that the island of Madeira had been formed by a long succession of volcanic eruptions on land, from centres in lines running through the middle of the island and along the north and south coasts. Deep valleys cut by streams produced spectacular scenery (illustrated by Wilson, using drawings and sections prepared, perhaps, by Lyell's travelling companion Hastings) and revealed the source of the flows. Few of the volcanoes displayed craters, and vertical dykes showed that the lavas were deposited on slopes as high as 10 degrees, and had not been tilted as von Buch's theory required. Although Lyell was not yet prepared to deny de Beaumont's theory that steeper slopes must be tectonic, what his observations did convince him of was the long history of eruptions required to produce volcanoes, and the efficacy of flood waters in steep streams to erode them.

Suzanne Zeller, author of *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (University of Toronto, 1987) then shifted attention to William Logan. Although Logan (Fig. 3) was educated in Edinburgh at a time when the predominant influence was Wernerian, by the time he became interested in geology in 1831 the climate of opinion had changed. Logan's early work in South Wales was on coal, and he became convinced that coal resulted from forests that accumulated plant materials in place, as re-

Figure 2 Sir Charles Lyell, 1797-1875. Geological Survey of Canada negative 154571.

vealed by the underlying "seat earths," with their included tree-roots (*Stigmaria*). In what is now Canada, developing coal resources was a matter of practical importance, and a survey of New Brunswick was begun by Gessner in 1838, and of Newfoundland by Jukes in 1839. Logan returned to Canada in 1840 and toured extensively, visiting the coalfields of Pennsylvania and meeting Lyell in New York in 1841. Later that same year, the legislature funded a one-year geological survey of "Canada" (Ontario and Quebec), and in 1842 Logan began work in the Gaspésie (after first preparing a detailed section of the coal measures at Joggins Nova Scotia).

By 1845 it was clear that there was no coal in "Canada," and Logan was forced to devise other strategies to continue the Survey: these included the search for other useful minerals (*e.g.*, iron, copper), and exploiting the scientific reputation that he had by then established. His public reputation was further consolidated by the meeting in Montreal of the American Association for the Advancement of Science, and by the success of Canada's contributions to the 1851 Exhibition in London. By 1856 he had succeeded in obtaining permanent status for the Survey. In 1855 Logan exhibited his geological map in Paris, in 1863 the *Geology of Canada* was published, followed the next year by the *Atlas*. Logan's vision, shown by these maps and reports, included much more than just the present Ontario and Quebec, and Robert Bell observed that Logan's maps (including those showing a large hypothesized coal basin in the foothills of the Rockies)

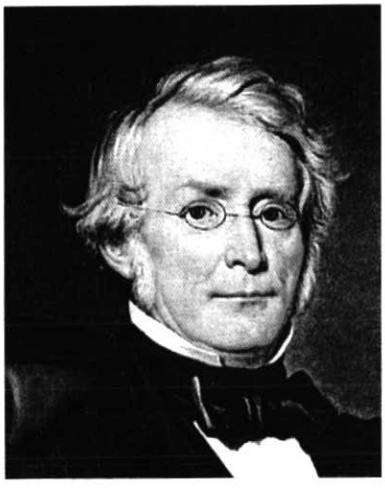

Figure 3 Sir William E. Logan, 1798-1875. Frontispiece from *Reading the Rocks* by M. Zaslow, 1975, Macmillan and Company, 599 p.

helped to establish the vision of a much expanded Canada, a vision realized by Confederation in 1867.

The last paper delivered at the symposium, by Peter von Bitter, displayed the instrumentation that Logan used in the field (he had, of course, to prepare topographic as well as geological maps), and the five geological maps of Canada that resulted from his labours (von Bitter, 1994a,b). Most of his long-distance traverses involved "dialling" along coasts or rivers using pacing and a prismatic compass, with elevations established by mercury barometer. A Rochon's micrometer telescope was used to measure long distances. More rarely, Logan also used a theodolite for triangulation. Dr. von Bitter showed us the five maps that Logan compiled. The best known is the 1865 map on a scale of 1 inch to 125 miles. Less well known is the large wall map of 1869, described in the Transactions of the American Institute of Mining Engineering as "the finest of all our American maps."

As originally planned, the last paper of the symposium was to have been entitled "Shaping a career in geology: William Logan, Charles Lyell, and John William Dawson." Unfortunately, the author, Susan Sheets-Pyenson died before she could present it. Her intentions can be surmised by a reading of her abstract, her article in *GSA Today* (1998), and her book *John William Dawson: Faith, Hope, and Science* (McGill-Queens University, 1996). Instead of her paper, a brief summary of her career was read by the symposium chair, by way of a memorial.

On the next day, several shorter papers were read that supplemented the symposium. William Brice described a meeting between Dawson and Charles Frederic Hartt, a native of New Brunswick who was later to become director of the first geological survey of Brazil. In 1860 Hartt discovered a major source of insect fossils, west of St. John, New Brunswick. Originally thought to be Devonian (later determined to be Pennsylvanian), these were examined by Dawson, and Hartt's description was incorporated, with his consent, in Dawson's celebrated *Acadian Geology*. Laing Ferguson described Lyell's work at Joggins, in two visits, the second (in 1852) accompanied by Dawson. The main discovery, still significant for vertebrate taphonomy today, was of vertebrate remains trapped in hollow, vertical buried tree stumps. Robert Silliman further discussed the importance of Lyell's work and association with Dawson in Nova Scotia. There Lyell made a disciple, and gained valuable evidence for his uniformitarian ideas, both from studies of the coal measures and from observations of recent sedimentation. He also observed the action of floating ice, which Lyell preferred to continental glaciation as an explanation for erratics and glacial striae.

Finally, a significant paper by Hugh Torrens threw important light on a long-standing question about Logan. After working in London for several years as an accountant (and showing no interest in geology) Logan was sent to South Wales in 1831 to become manager of his uncle's Forest Copper Works. Within just a few years he had presented papers on coal to the Geological Society of London, and prepared maps and sections of such high quality that they were used as models by De la Beche for the newly formed Geological Survey of Great Britain. How did he learn his geology and surveying techniques? By examining previously unpublished sources in Swansea (the Royal Institution of South Wales and Library) and Keyworth (British Geological Survey Archives), Torrens has made a persuasive case that the main influence on Logan was the community of "paphyrophobic" (publication-shy) land and mine surveyors ("colliery viewers") operating in that region. An important study of Logan's main business partner in Swansea has also been published (Bayliffe and Harding, 1996) and it demonstrates their myriad business links in both coal and copper, in what was then a world centre for copper production.

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The Eighth International Williston Basin Symposium

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Participants in the Williston Basin Symposium share an interest in this cratonic basin that provides considerable hydrocarbon wealth to Manitoba, Montana, North Dakota and Saskatchewan. The eighth symposium of this title was held 18-21 October 1998 at the Delta Regina Hotel in Regina, Saskatchewan. It attracted 340 registrants despite the lower oil prices that have been in effect for a while. Scientific contributions to the symposium are drawn from staff in oil and gas companies, government geological surveys, and universities. One of the pleasant aspects of this meeting is that there are no concurrent sessions and so registrants get to hear a broad range of talks and have ample time to view posters and exhibits.

The meeting was preceded by field trips to Manitoba and Montana. The Manitoba trip was led by Ruth Bezys (Manitoba Department of Mines and Energy) and Hugh McCabe, formerly of the same organization. The Montana field trip was led by Don Kent (D.M. Kent Consulting). These field trips were pushing the weather envelope for field trips in northern North America in the Fall but both were reported to be excellent. I can personally attest to the excellence of the Montana field trip, which visited the Bearspaw Mountains and the Little Rocky Mountains in northern Montana. The Little Rocky Mountains outcrop area, although relatively small, affords a look at virtually the entire stratigraphy encountered in the subsurface. It is an extemely worthwhile destination for anyone interested in the Williston Basin.

The scientific program featured 29 oral presentations and 31 posters. Much of the interest in the oral session was focussed on the Ordovician Red River play. The papers included an excellent talk by Tom McClellan (Westport Oil and Gas) and Richard Gaber (Swift Energy Co.) on how horizontal drilling has "awoken a sleeping giant" by greatly improving recovery from the Cedar Hills Field, Bowman County, North Dakota. Other talks on the Ordovician dealt with facies recognition and reservoir development in the Red River Formation. A paper by Martin Fowler (Geological Survey of Canada) and others provided details on the Ordovician petroleum system of southeastern Saskatchewan, pointing out the presence of kukersite sources that have given rise to oil discovered in the Yeoman Formation of the Midale area, Saskatchewan. This interest in the Ordovician and the underlying Cambrian was also reflected in the core session, where cores from the Cambrian Newporte and Ordovician Bowman fields of North Dakota and the Ordovician Midale field of southern Saskatchewan were displayed and ably interpreted by Mike Hendricks (Hendricks and Associates), Ward Whiteman (Burlington Resources), and Lyn Canter (Applied Geoscience Inc.), respectively. In addition, cores from the Middle Ordovician Winnipeg Group of North Dakota were displayed by Robert Vinopal (Standard Geological Services).

A second focus of the meeting was on the Devonian of the Williston Basin. In the oral sessions Don Kissling (Jackalope Geological Ltd.) described the intricacies of carbonate-evaporite cycles in the Duperow Formation and their contribution to stratigraphic traps in the northern part of the basin. Brian Pratt provided detailed description of an Upper Devonian patch reef in the Jefferson Formation of the Little Rocky Mountains, Montana. Of particular interest among the Devonian papers was that presented by Vern Stasiuk (Geological Survey of Canada) and others on a new technique for examining hydrocarbon migration in the Upper Devonian Birdbear Formation of southern Saskatchewan. The technique uses fluorescence microspectrometry of hydrocarbon fluid inclusions and entrapped oil globules to evaluate hydrocarbon migration. Different types of oil inclusions have been identified based upon visible light fluorescence properties and their distribution has been mapped, resulting in a better understanding of the distinctive oil types in the region hosted within the Birdbear Formation. The Devonian Bakken Shale was the subject of an oral paper given by Jürgen Schieber (University of Texas at Arlington) who described lag deposits within the Late Devonian Chattanooga Shale as potential sequence boundaries. He presented preliminary results of a similar nature from the Bakken Formation. Two of the core sessions were focussed on the Devonian part of the succession: one by Katherine Bergman (University of Regina) on the Middle Devonian Ratner Formation and one by Don Kent (D.M. Kent Consulting) on stromatoporoid banks in the Birdbear and Duperow formations of southern Saskatchewan.

A luncheon talk on the first day of sessions was given by the Chief Scientist of the Geological Survey of Canada, Dr. Richard Grieve, who spoke eloquently on the relationship of impact