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Résumé de l'article

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WILLIAM E. EAGAN

RÉSUMÉ

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ABSTRACT

This article suggests that Sir William Logan's *Geology of Canada* can be read as a narrative describing the past dynamic changes that shaped the present structure of the earth. The author also suggests, since the foundation of nineteenth century geology was a bio-stratigraphic consensus that combined stratigraphy and the fossil record, that the use of a narrative offered Logan a dynamique method for presenting his central argument.

AFTER TWENTY years working at the heart of Anglo-American geology and, in Morris Zaslow's formulation, reading the rocks of Canada, Sir William Logan published his monumental *Geology of Canada* in 1863.[1] The *Geology* is a classic to be read as carefully as Logan read the rocks; a text whose deciphering can lead to an understanding of geology and the contemporary scientific culture of the North Atlantic world in the 1860s. The *Geology* was a rhetorical argument in narrative form and must be read in the light of the historically informed bio-stratigraphic consensus fundamental to geology's self-understanding.[2] Within that consensus Logan read the rocks as a temporal sequence through stratigraphic unraveling of physical order, supplemented by an understanding of changing fossil content and presented through historical narrative.

The *Geology* is a massive work of more than 900 pages, with over 500 descriptive of the historical, stratigraphic geology of Canada, containing no sustained analysis or little explicitly articulated

theory. The *Geology* is first "a Report of Progress:" a governmental report that must be read as such; a culmination of more than 20 years of work; a report meeting practical and political objectives. (iii, page references to the *Geology* appear in brackets.) The Geological Survey of Canada began in 1843 as a product of a practical, utilitarian science "born of wonder and nurtured by greed," in Carl Berger's felicitous epigram.[3] Logan always sought to achieve practical economic goals and claimed them for his own, emphasizing that his "whole connexion with Geology is of a practical character."[4] The often colorless language of the *Geology*, the listing of economic minerals and chemical analyses, the muted and non-argumentative approach to matters of vociferous controversy, reflect the political purpose of the report.

Yet, carefully read, the *Geology* speaks more clearly to other than political needs. There are many conceivable ways to organize a report on the Geology of Canada: providing detailed geological analyses by geographical section of the province; focusing on types of mineral deposits; inventorying economic minerals and economic geology. Logan chose none of these. Rather, he presented the historical, stratigraphic geology of Canada. The *Geology* is a historical narrative of the development of Canada's rocks from the oldest to the most recent: even the table of contents can be seen essentially as a geological cross-section. Narrative is a rhetorical device, an "order of telling that honours certain proprieties of temporal sequence, interconnectedness, and closure," that is aptly suited to presenting the underlying historical, temporal geological framework of the *Geology*.[5] One can say that "narrative interpretations of the past are not contained *in*, but are rather expressed *by* the narrative as a unified entity," or, that narrative is "a story, sufficiently ordered by the imagination so that the principles of design or purpose may emerge," in the words of A. Bartlett Giamatti.[6] If Giamatti can speak of baseball as narrative, then it may also be possible to speak of geological, or any other, prose in that way.

The *Geology* is, in some ways, a descriptive inventory, but inventory consciously structured in a particular way.[7] Intelligible inventory is impossible without a prior system of categories or taxonomic classification; "relations cannot be conceived without reference to a set of categories that serve as a grid for sorting out experience," in the words of Robert Darnton, for "things do not come sorted and labelled in what we label as 'nature'."[8] The sorting and labelling is done by Logan through narrative, telling a story that carries the ordering.

The *Geology* is the narration of and the classification of the rocks of Canada within a specific temporal system: the bio-stratigraphical historical consensus. That consensus formed in the 1820s as British naturalists crafted an operating approach to geology, pursuing stratigraphic superposition over miles of countryside and collecting bags of fossil creatures to refine their understanding. They crafted an "actualist" program of research seeking "knowledge of the Earth's structure as it lies open to our observation, 'finding' a regular succession and order in the arrangement of the mineral masses constituting the Earth's surface."[9] In the 1830s, Sir Charles Lyell provided philosophical assumptions and theoretical framework for the consensus, while Sir Roderick Murchison and the Reverend Adam Sedgwick's Devonian, Silurian and Cambrian divisions of rocks and geological time established a taxonomy within which Logan and other geologists could work. Across the North Atlantic, the consensus was employed, especially by James Hall and the New York Survey, ordering their rocks, applying local names, creating a North American vocabulary, arraying Potsdam, Hudson River, Chemung and Chazy, etc., and presenting the finished works in historical narratives, gelling by the 1860s into a fruitful approach.

Logan buried a quick sketch of the consensus in his preface, emphasizing stratigraphy, "a preliminary knowledge of the true geological superposition, or the natural order in which these formations have been deposited," and paleontology, the determination of the rock's fossils, as "a fundamental principle of geology that different formations are characterised by different groups of organic remains." (xiv) Logan also outlined the nomenclature to be employed, resorting to "the system of local designation ... as the ... most convenient."(19) Local designation referred back to the original namers, regardless of where they had worked, and he employed "European designations ... as used by the Geological Survey of the United Kingdom" for "the great divisions of the fossiliferous rocks," while "the nomenclature of New York" was "extremely convenient ... for the subordinate groups of fossiliferous strata."(20 & 19) Logan departed from this practice only "when a group has not been recognized among the rocks of New York." (19) The distinctively Canadian "names of the Laurentian and the Huronian systems or series," were Logan's pride, "particularly as they ... have been made by other geologists a standard of comparison both in America and Europe." (21) Nomenclature established the individual's claim to a portion of the categories and rendered

"homage to those whose labors have aided us in understanding our own rocks," in Logan's words. (19 & 20) "Pigeon-holing," according to Robert Darnton, is "an exercise in power," while setting up categories and policing them is "... a serious business."[10] Taxonomic hegemony lay at the center of much of the heated contention of nineteenth century geology.

A brief theoretical introduction was sufficient, for Logan was speaking to an audience familiar with the principles of his geology; an audience who had read Lyell's *Principles*, attended meetings of the Natural History Society of Montreal or thought about the geological arguments in Darwin's *Origin*. A.S. Byatt's "sages and spinster schoolmistresses, frock-coated clergymen and earnest workingmen" engaged in natural history pursuits, are reflected in the wide array of doctors, clergy, farmers and others contributing to the *Geology*.[11] Logan's readers knew the methods of geology and were simply told the story of Canada's rocks, without an explanation of his resort to narrative.

The consensus permitted Logan to retell his reading of the rocks through a narrative of their succession. From the ancient unstratified, non-fossiliferous rocks of his Laurentian System, the *Geology* proceeds through the strata, culminating with a discussion of the Gaspé series. Only when he had narrated the rocks temporally did he append topical discussions of minerals, economic geology, the chemistry and nature of sedimentary and metamorphic rocks, the nature of eruptive rocks, and supplementary materials, including superficial geology.

Follow his story, beginning with the "Laurentian series" which he found "stretching on the north side of the St. Lawrence from Labrador to Lake Huron," occupying "by far the larger portion," a story in which the orderly deposition of strata is complicated by forces of distortion and disruption. (42) Reading "the superposition of the various members of such an ancient series of rocks is a task which has never been accomplished in geology," Logan informed his reader, with the difficulties arising "from the absence of fossils to characterise its different members." (42) Without fossils, the only way to determine the stratigraphy was to "patiently and continuously ... follow the outcrop of each important mass in all its windings as far as it can be traced, until it becomes covered up by superior unconformable strata, is cut off by a great dislocation, or disappears by thinning out." (43) Sequential reconstruction was possible and seeking stratigraphic conformity could be productive. He showed this in his tentative establishment of the boundary

between the Laurentian intrusives and the overlying Silurian rocks by noting that the intrusives have "a date anterior to the deposit of the Silurian series" since none of them break "through this series" and finding "that the Silurian beds in some places overlie eroded portions of the intrusive rocks." (42) So separated and non-contiguous were the individual deposits that Logan informed the reader that "a labor such as this, in a district without roads and the topography of which is yet little known, with a surface much broken by the unequal wear of its rocks, and still covered by forest, must necessarily require much time." (43)

Passing upward through the Huronian, he arrived at the copper-bearing rocks of Lake Superior where his reading conflicted with that of J.D. Whitney of the United States and had been acidly argued in other forums, although it was muted here.[12] With interests in copper resources and personal priority claims of nomenclature, Whitney regarded "the whole series from the summit of the sandstones of Sault Ste. Marie to the base of the Kaministiqua slates as one group equivalent to the Potsdam formation," while Logan wished "to separate the two," based on the "the suspicion of a want of conformity between the Sault Ste. Marie sandstones and the Trappean rocks beneath." (84-5)

The explanatory power of his narrative approach is best caught in his discussions of the Quebec group. Near Quebec City, Logan had identified a series of rocks that were "from an early period of the Survey, a subject of considerable difficulty." (viii) This puzzle had led to several fundamental alterations in his recreation of the succession and a bitter confrontation with James Hall.[13] To lay out his reasoning for his solution, Logan arrayed the twin tools of stratigraphy and paleontology and told the story of the controversy and the rocks, ending with a dramatic narrative of the deposition of those rocks. The controversy was flatly retold in the Preface, noting that the rocks of Point Lévis were first thought older than the Trenton and Hudson River formations of the north Shore. In 1848-49 he proclaimed them younger and maintained that position, with the assistance of James Hall, until "the discovery of the Point Lévis fossils," in 1860, led to the conclusion "that the rocks of the Quebec group must be placed ... about the horizon of the Calciferous and Chazy formations," older than he had thought. (viii) Logan reconciled his stratigraphic and fossil evidence, by claiming that "the attitude of the rocks in question in the vicinity of Quebec is due to a great overlap," resorting to a physical disruption. (viii)

In the body of the *Geology*, he told the geology of the Quebec group as a detective story and as an explanation. In western Canada, "the Hudson River formation is succeeded by the Medina sandstones of the New York geologists." Near Quebec, however, the graptolitic shales which belong to the Utica and Hudson River formations are followed by a series of rocks, which are not met with to the west in the same relations – a mystery outside the framework of the New York Survey. Instead, the Hudson River formation is succeeded by a series which "although from the geographical position apparently superior" to it belonged "in reality to an older group...designated by the name of the Quebec group, which is divided into the Lévis and Sillery formations." (225) He related how these older rocks had been overturned in a great dislocation, traversing "eastern North America, from Alabama to Canada," to appear physically on top of the younger rocks. (234) To illustrate his story, he included a "traverse section from the falls of Montmorenci to the island of Orleans; in which it will be observed, that, without the aid of fossils, the break on the island would never have been suspected from the attitude of the strata." (234) Having placed the Lévis and Sillery formations in their proper chronological place, he could also properly identify a series of "dark grey and black shales, with occasional limestones, which resemble the shales of the Hudson River formation, and, previous to the discoveries at Point Lévis, were supposed to be equivalent to them." (234)

Having unravelled the mystery, he constructed a narrative of the deposition and disruption of the rocks. In the beginning there were the Laurentian and Huronian rocks forming "the coast of the Lower Silurian sea, under comparatively shallow water" representing a slope of "nearly forty-five degrees," where the Potsdam was deposited. (294 and 295) "Shortly after the beginning of the Calciferous period," he went on, "a great continental elevation occurred; and bringing the area at the base of the Quebec group comparatively near to the surface." (294) "The successive coarse deposits of the group indicate a subsequent gradual subsidence," during which "the early shallow-water strata were again submerged" and then "covered over by deposits of the Chazy formation," and "by those of the Trenton and Hudson groups." (294-5) "Ultimately both these, and early shallow-water deposits on the higher terrace, would be covered over by the Birdseye and Black River, the Trenton, the Utica and the Hudson River formations," as the complete stratigraphic sequence was deposited. (296)

Having narrated the order of deposition, accompanying it with an "ideal diagram," he went on to suggest that if "a sufficient lateral pressure were applied to the strata thus accumulated and arranged, there would result a series of parallel folds running in a direction at right angles to that of the force, with prevailing overturn dips towards the line of resistance." He refrained, however, from "enquiring into the origin of the forces which may have produced the corrugations of the earth's crust." (296-7) Given this lateral pressure, "the solid crystalline gneiss in the case before us, offering more resistance than the newer strata, there resulted in a break coinciding with the inclined plane at the junction of these with the gneiss." (297) The accumulated deposits of lower palaeozoic strata would then be "pushed up this slope," and "would then raise and fracture the formations above, and be ultimately made to overlap the portion of these resting on the edge of the higher terrace; after probably thrusting over to an inverted dip, the broken edge of the upper formations." (297) The older formations would then rest on top of the younger, creating a mystery that was only now unraveled to Logan's satisfaction.

The narrative structure served Logan well until he arrived at the most recent surface formations, "the phenomena of Superficial Geology." (v) Palaeozoic rocks lent themselves to narrative presentation, but the unstratified and unfossiliferous "accumulation of loose materials, constituting what is often called diluvium or drift," did not. (886-7) These formations were marked by scratches (striations) on the underlying rocks, the presence of erratic boulders out of their places of origin, and clays, gravels and other unstratified and unconsolidated deposits. These phenomena were not easily accomodated within the consensus which had served him well. In fact, these phenomena had challenged the consensus since Louis Agassiz's theories of great continental glaciers in 1840 had set geologists "off upon a new scent – glacier hunting."[14] The suggestion that these deposits had been accumulated by the presence and movement of massive continent-spanning glaciers seemed absurd to many geologists. Glaciation seemed to challenge the central uniformitarian, actualist ethos at the core of the consensus. Just when catastrophist explanations seemed defeated, glaciers returned to test the steady-state geology of Lyell and his followers, "slicing across categories and spreading static throughout the system," in the words of Robert Darnton. As Darnton had observed, "just when we feel confident that we have found a way through the undifferentiated continuum of the natural world, we may stumble

upon something startling." and in this case, glaciers were one of those things "that slip in between categories, that straddle boundaries, or spill beyond borders threaten our basic sense of order."[15] The topic of glaciation threatened the consensus.

For this superficial geology Logan's tools were limited and narrative was not useful. Logan provided an ordered table of deposits, with a category for marls and peats, one for clays and another for boulder and other drift phenomena, but went out of his way to point out that "the order in which the examples under each are placed must not be understood to imply any differences in the age of these local deposits, which are in many cases equivalents." (887) Elsewhere, tables and lists in a temporal order had supplemented his temporal argument; now he had to find an alternative expression. "Rounded, grooved, and polished surfaces are often found on the older rocks," he said, and given their position and relation to overlying drift the markings must have been "contemporaneous with the transport of the drift over the surface, or anterior to it." (888) Having put the evidence in time, he opined that "these phenomena have by geologists been attributed to various agencies, but the evidences afforded in Canada appear to favor the supposition that they have been caused by the action of glaciers." (888) Turning to "the boulders or erratic blocks, which are found irregularly distributed over the surface of the province," he felt that they "appear to have been left by the washing away of the lighter materials from the formations in which they were once imbedded, and to have been, for the most part, derived from the glacial drift, in which they abound." (893) While calmly opting for a glacial hypothesis, Logan did not provide any narrative description of their action, simply presenting the evidence and transferring to his readers any possible reconstruction. He seems to avoid emeshing himself in the controversy and a narrative involving the movement of seemingly fantastic glaciers would have carried an interpretation that was simply too open to attack. As a result, his narrative lacks a satisfying closure.

The metaphors of reading the rocks and reading the *Geology* can offer a new angle from which to approach the history of the geological enterprise. The *Geology* is far more than a totally objective, detached description of abstract reality. It was constructed, as was the consensus on which it was based, as a powerful way of reading the rocks and then retelling that reading to its audience. It is an argument; rhetorical methods were chosen consciously, or unconsciously, in an attempt to convince the audience of the

validity and power of the argument. Science examines a physical reality, but is presented to the reader through a specific rhetorical framework, in Logan's case a narrative exposition. Trying to persuade with his rhetoric an audience familiar with the substance, theory and form of his approach, Logan chose a widely used narrative structure that was superbly suited to conveying his subject of geological change over time. Geologists always go back to the rocks for the foundation of their understanding, but their exposition must be cast in a way that will persuade and convince their readers. The rocks are there, but they must always be interpreted and that interpretation must be presented to the reader in ways that are intellectually satisfying, logically coherent and in accord with the story current at the time; which William Logan did in his narrative, *The Geology of Canada*.

NOTES

1 Morris Zaslow, *Reading the Rocks: the Story of the Geological Survey of Canada, 1842-1972* (Ottawa:, 1975). Geological Survey of Canada, *Report of Progress from its Commencement to 1863*, (*Geology of Canada*), (Montreal, Dawson Brothers, 1863) and Geological Survey of Canada, *Report of Progress from its Commencement to 1863: Atlas of Maps and Sections* (Montreal: Dawson Brothers, 1865).

2 Cecil J. Schneer has called the consensus "biostratigraphic" in conception and methodology. "Geology, Time and History," *Earth Sciences History 8* (1989), 104.

While I marshall arguments about rhetoric, discourse and narrative, I do not identify with the extreme elements of textual criticism. The historian can strengthen a historical argument through a careful consideration of critical methods. David Birch argues that "your language, your background, biases, ideas, beliefs, politics, education, etc. *determine* your understanding. They are socially determined by the institutions and discursive practices that constitute the social networks you are involved in." Yet is it possible to argue that "as analyst you are not an archaeologist digging out other people's words and ideas; you are a critic actively engaged in understanding your reaction to a text which has been initially created by someone else." Historians dig out other people's meanings and do so with due recognition of both their own and the author's "socially determined" approaches. I reject the position that "much as you might want to talk about that 'someone else' you can only ever talk about your reading, your intertextuality." David Birch, *Language, Literature and Critical Practice: Ways of Analysing Text* (London: Routledge, 1989), 24-5.

3 Carl Berger, *Science, God and Nature in Victorian Canada* (Toronto: University of Toronto Press, 1983), 3.

4 _____, *Report of the Select Committee on the Geological Survey* (Quebec: Lovell and Lamoureux, by order of the Legislative Assembly, 1855), 39.

5 Kenneth C. Dewar, "Where To Begin and How: Narrative Openings in Donald Creighton's Historiography", *Canadian Historical Review* LXXII (September 1991), 351.

6 Dewar, "Where to Begin," 364. A. Bartlett Giamatti, *Take Time for Paradise: Americans and their Games* (New York: Summit Books, 1989), 84.

7 Suzanne Zeller, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto: University of Toronto Press, 1987).

8 Robert Darnton, *The Kiss of Lamourette: Reflections in Cultural History* (New York: W.W. Norton and Co., 1990), 336.

9 Martin J.S. Rudwick, "Uniformity and Progression: Reflections on the Structure of Geological Theory in the Age of Lyell," in Duane H.D. Roller, ed., *Perspectives in the History of Science and Technology* (Norman, Okla.: University of Oklahoma Press, 1971), 222. Rev. William D. Conybeare and William Phillips, *Outlines of the Geology of England and Wales, with an Introductory Compendium of the General Principles of that Science,*

and Comparative views of the Structure of Foreign Countries, (London: William Phillips, George Yard, 1822). Reprint edition, (New York: Arno Press, 1978), ii and iii.

10 Robert Darnton, "Philosophers Trim the Tree of Knowledge," in *The Great Cat Massacre and other Episodes in French Cultural History* (New York: Random House, 1985), 192 and 193.

11 A.S. Byatt, *Possession: A Romance* (New York: Random House, 1990), 270.

12 J.W. Foster and J.D. Whitney, *Report on the Geology of the Lake Superior Land District*, Part II the Iron Region together with the General Geology, Senate Document, Special Session, March 1851, Executive No. 4 and Whitney, "Remarks on the Huronian and Laurentian Systems of the Canada Geological Survey," *American Journal of Science* 2nd XXIII (May 1857), 305-314. William Logan, "On the Age of the Copper-bearing Rocks of Lake Superior and Huron, and various facts relating to the Physical structure of Canada," *AJS* 2nd XIV (September, 1852), 224-229; Logan and T.S. Hunt, *A Sketch of the Geology of Canada serving to explain the geological map* (Paris: Hector Bossange and Son, 1855) in J.C. Tache, *Canada at the Universal Exhibition of 1855* (Toronto: John Lovell, 1856) and *Esquisse Geologique du Canada, pour servir a l'Intelligence de la Carte Geologique et de la collection des mineraux economiques envoyee a l'exposition universalle de Paris, 1855* (Paris: Hector Bossange et fils, 1855); Logan, "On the Division of the Azoic Rocks of Canada into Huronian and Laurentian," *Proceedings of the American Association for the Advancement of Science*, 1857, 44-47.

13 William E. Eagan, "'I would have sworn my life on your interpretation,' James Hall, Sir William Logan and the 'Quebec Group,' " *Earth Sciences History* VI, no. 1 (1987), 47-60.

14 Louis Agassiz, "On Glaciers, and the evidence of their having once existed in Scotland, Ireland, and England," *Proceedings of the Geological Society of London*, III (1840-1841), 327-332 and _____, "The former existence of Glaciers in Scotland," (from *Annals and Magazine of Natural History*, for Jan. 1841.) *AJS* XLI (April-June, 1841), 191.

14 Darnton, *The Kiss of Lamourette*, 336-7.